Department of Energy

Portsmouth/Paducah Project Office
1017 Majestic Drive, Suite 200
Lexington, Kentucky 40513
(859) 219-4000

JUL 14 2017

Mr. Brian Begley
Federal Facility Agreement Manager
Division of Waste Management
Kentucky Department for Environmental Protection
300 Sower Boulevard, 2nd Floor
Frankfort, Kentucky 40601

PPPO-02-4253804-17B

Ms. Julie Corkran
Federal Facility Agreement Manager
U.S. Environmental Protection Agency, Region 4
61 Forsyth Street
Atlanta, Georgia 30303

Dear Mr. Begley and Ms. Corkran:

FEASIBILITY STUDY FOR SOLID WASTE MANAGEMENT UNITS 2, 3, 7, AND 30 OF THE BURIAL GROUNDS OPERABLE UNIT AT THE PADUCAH GASEOUS DIFFUSION PLANT, PADUCAH, KENTUCKY, DOE/LX/07-1274&D2/R1

References:

1. Letter from T. Duncan to B. Begley and J. Corkran, "Signed Memorandum of Agreement for Resolution of Dispute for the Feasibility Study for Solid Waste Management Units 2, 3, 7, and 30 of the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, DOE/LX/07-1274&D2," (PPPO-02-4229276-17), dated May 26, 2017
2. Letter from A. Webb to J. Woodard, "Feasibility Study for Solid Waste Management Units 2, 3, 7 and 30 of the Burial Grounds Operable Unit (DOE/LX/07-1274&D2); Proposed Plan for the Burial Grounds Operable Unit Source Areas for Solid Waste Management Units 5 and 6 (DOE/LX/07-1275&D2); Remedial Investigation/Feasibility Study Report for CERCLA Waste Disposal Alternatives Evaluation and Subsequent Documents (DOE/LX/07-0244&D2), Paducah Gaseous Diffusion Plant, Paducah, McCracken County, Kentucky, KY8-890-008-982," dated March 20, 2015
3. Letter from A. Webb to J. Woodard, "Conditional Concurrence to the Feasibility Study for the Solid Waste Management Units 2, 3, 7, and 30 of the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant (DOE/LX/07-1274&D2), Paducah Gaseous Diffusion Plant, Paducah, McCracken County, Kentucky, KY8-890-890-982," dated February 2, 2015
4. Letter from A. Webb to J. Woodard, "Feasibility Study for Solid Waste Management Units 2, 3, 7 and 30 of the Burial Grounds Operable Unit (DOE/LX/07-1274&D2); Proposed Plan for the Burial Grounds Operable Unit Source Areas for Solid Waste Management Units 5 and 6 (DOE/LX/07-1275&D2); Remedial Investigation/Feasibility

Study Report for CERCLA Waste Disposal Alternatives Evaluation and Subsequent Documents (DOE/LX/07-0244&D2), Paducah Gaseous Diffusion Plant, Paducah, McCracken County, Kentucky, KY8-890-008-982," dated January 22, 2015

5. Letter from J. Richards to J. Woodard, "Letter of Conditional Concurrence for the Feasibility Study for the Solid Waste Management Units 2, 3, 7, and 30 of the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant (DOE/LX/07-1274&D2)," dated December 19, 2014
6. Letter from A. Webb to J. Woodard, "Conditional Concurrence to the Feasibility Study for the Solid Waste Management Units 2, 3, 7, and 30 of the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant (DOE/LX/07-1274&D2), Paducah Gaseous Diffusion Plant, McCracken County, Kentucky, KY8-890-982-008," dated November 12, 2014

Please find enclosed for your approval the certified *Feasibility Study for Solid Waste Management Units 2, 3, 7, and 30 of the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-1274&D2/R1 (FS). This version of the document addresses conditions received from the Kentucky Department for Environmental Protection (KDEP) and the U.S. Environmental Protection Agency (EPA) in the referenced letters. Responses to undisputed conditions are documented in the enclosed Condition Response Summary; resolutions to disputed conditions are also included in the Condition Response Summary and references the Memorandum of Agreement. Revisions to the document that are not related to conditions are listed in the enclosed file titled, "Other Changes." To assist with your review, a redlined version of the document is enclosed.

It is the U.S. Department of Energy's (DOE's) belief that this version of the document reflects the resolution of all EPA and KDEP conditions. In the event that EPA and/or KDEP determines that the conditions have not been satisfied, DOE reserves its right to dispute in accordance with Section XXV.A of the Federal Facility Agreement (FFA).

DOE appreciates the FFA parties' efforts to resolve the conditions and looks forward to receiving approval of the FS.

If additional information is required, please contact April Ladd at (270) 441-6843.

Sincerely,

Tracey Duncan
Federal Facility Agreement Manager
Portsmouth/Paducah Project Office

Enclosures:

1. Certification Page
2. *Feasibility Study for Solid Waste Management Units 2, 3, 7, and 30 of the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-1274&D2/R1—Clean
3. *Feasibility Study for Solid Waste Management Units 2, 3, 7, and 30 of the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-1274&D2/R1—Redline
4. Condition Response Summary
5. Other Changes

e-copy w/enclosures:
april.webb@ky.gov, KDEP/Frankfort
brian.begley@ky.gov, KDEP/Frankfort
bruce.ford@ffspaducah.com, FFS/Kevil
bwhatton@tva.gov, TVA/PAD
christopher.jung@ky.gov, KDEP/Frankfort
corkran.julie@epa.gov, EPA/Atlanta
craig.jones@ffspaducah.com, FFS/Kevil
edward.johnstone@ffspaducah.com, FFS/Kevil
edward.winner@ky.gov, KDEP/Frankfort
ffscorrespondence@ffspaducah.com, FFS/Kevil
gaye.brewer@ky.gov, KDEP/PAD
hjlawrence@tva.gov, TVA/PAD
jana.white@ffspaducah.com, FFS/Kevil
jennifer.woodard@lex.doe.gov, PPPO/PAD
karen.walker@ffspaducah.com, FFS/Kevil
kim.knerr@lex.doe.gov, PPPO/PAD
leo.williamson@ky.gov, KDEP/Frankfort
mike.guffey@ky.gov, KDEP/Frankfort
mmcrae@techlawinc.com, EPA/Atlanta
myrna.redfield@ffspaducah.com, FFS/Kevil
nathan.garner@ky.gov, KYRHB/Frankfort
pad.rmc@swiftstaley.com, SSI/Kevil
richards.jon@epa.gov, EPA/Atlanta
rkdehart@tva.gov, TVA/PAD
stephaniec.brock@ky.gov, KYRHB/Frankfort
tracey.duncan@lex.doe.gov, PPPO/PAD

CERTIFICATION

Document Identification: ***Feasibility Study for Solid Waste Management Units 2, 3, 7, and 30 of the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,*** **DOE/LX/07-1274&D2/R1, dated July 2017**

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

Fluor Federal Services, Inc.

Myrna E. Redfield, Director
Environmental Management

7/14/17
Date Signed

I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations.

U.S. Department of Energy

Jennifer Woodard
Jennifer Woodard, Paducah Site Lead
Portsmouth/Paducah Project Office

7/14/17
Date Signed

DOE/LX/07-1274&D2/R1
Primary Document

Feasibility Study for Solid Waste Management Units 2, 3, 7, and 30 of the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

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DOE/LX/07-1274&D2/R1
Primary Document

Feasibility Study for Solid Waste Management Units 2, 3, 7, and 30 of the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky

Date Issued—July 2017

U.S. DEPARTMENT OF ENERGY
Office of Environmental Management

Prepared by
FLUOR FEDERAL SERVICES, INC.,
Paducah Deactivation Project
managing the
Deactivation Project at the
Paducah Gaseous Diffusion Plant
under Task Order DE-DT0007774

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PREFACE

This *Feasibility Study for Solid Waste Management Units 2, 3, 7, and 30 of the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-1274&D2/R1, (FS) was prepared to evaluate remedial alternatives to support remedy selection under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) at the U.S. Department of Energy's Paducah Gaseous Diffusion Plant. This document follows *Feasibility Study for the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0130&D2 (DOE 2010a). As a result of review and discussion by the Federal Facility Agreement (FFA) parties, the D2 version of the feasibility study was separated into smaller documents focused on fewer solid waste management units (SWMUs). This document presents only information about SWMUs 2, 3, 7, and 30. Information for the rest of the Burial Grounds Operable Unit (BGOU) landfills and burial grounds is presented in separate documents. This work was prepared in accordance with the requirements of the *Federal Facility Agreement for the Paducah Gaseous Diffusion Plant* (EPA 1998a). In accordance with Section IV of the FFA, this integrated technical document was developed to satisfy applicable requirements of CERCLA (42 USC § 9601 *et seq.* 1980) and the Resource Conservation and Recovery Act (42 USC § 6901 *et seq.* 1976). As such, the phases of the investigation process are referenced by CERCLA terminology within this document to reduce the potential for confusion.

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CONTENTS

TABLES

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FIGURES

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ACRONYMS

ARAR	applicable or relevant and appropriate requirement
AT123D	Analytical Transient 1-,2-,3-Dimensional
BGOU	Burial Grounds Operable Unit
bgs	below ground surface
BHHRA	baseline human health risk assessment
CAMU	corrective action management unit
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
cis-1,2-DCE	*cis*-1,2-dichloroethene
COC	contaminant of concern
COE	U.S. Army Corps of Engineers
COPC	chemical of potential concern
CSM	conceptual site model
DNAPL	dense nonaqueous-phase liquid
DOE	U.S. Department of Energy
DPE	dual-phase extraction
E/PP	excavation/penetration permit
ELCR	excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
ERH	electrical resistance heating
EW	extraction well
FFA	Federal Facility Agreement
FR	*Federal Register*
FS	feasibility study
GAC	granular-activated carbon
GIS	geographic information system
GRA	general response action
HASP	health and safety plan
HDPE	high-density polyethylene
HEAST	Health Effects Assessment Summary Table
HI	hazard index
HU	hydrogeologic unit
IC	institutional control
IRIS	Integrated Risk Information System
ISCO	*in situ* chemical oxidation
KAR	*Kentucky Administrative Regulations*
KDEP	Kentucky Department for Environmental Protection
KOW	Kentucky Ordnance Works
KPDES	Kentucky Pollutant Discharge Elimination System
KY	Commonwealth of Kentucky
LCD	Lower Continental Deposits
LDA	large diameter auger
LLTW	low-level threat waste
LLW	low-level waste
LUC	Land Use Control
LUCIP	land use control implementation plan
MCL	maximum contaminant level
MIP	membrane interface probe

MLLW	medium low-level waste
MNA	monitoring natural attenuation
MW	monitoring well
N/A	not applicable
NAL	no action level
NAPL	nonaqueous-phase liquid
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act of 1969
NFA	no further action
NNSS	Nevada National Security Site
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
NRCS	Natural Resources Conservation Service
NSDD	North-South Diversion Ditch
O&M	operation and maintenance
OMB	Office of Management and Budget
OREIS	Oak Ridge Environmental Information System
ORP	oxidation reduction potential
OSWDF	on-site waste disposal facility
OSWER	Office of Solid Waste and Emergency Response
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PGDP	Paducah Gaseous Diffusion Plant
POC	pathway of concern
POE	point of exposure
PPE	personal protective equipment
PRB	permeable reactive barrier
PRG	preliminary remediation goal
P&T	pump-and-treat
PTW	principal threat waste
RAO	remedial action objective
RAWP	remedial action work plan
RCRA	Resource Conservation and Recovery Act
RD	remedial design
RDSI	remedial design site investigation
RDWP	remedial design work plan
RfD	reference dose
RG	remediation goal
RGA	Regional Gravel Aquifer
RGO	remedial goal option
RI	remedial investigation
RME	reasonable maximum exposure
ROD	record of decision
RPO	representative process option
SADA	Spatial Analysis and Decision Assistance
SAR	SWMU assessment report
SERA	screening ecological risk assessment
SESOIL	Seasonal Soil Compartment Model
SI	site investigation
SMP	Site Management Plan

SPH	six-phase heating
SVE	soil vapor extraction
SVOC	semivolatile organic compound
SWMU	solid waste management unit
T&E	threatened and endangered
TBC	to be considered
Tc-99	technetium-99
TCE	trichloroethene
TCH	thermal conduction heating
TSCA	Toxic Substances Control Act
UCD	Upper Continental Deposits
UCRS	Upper Continental Recharge System
UE	unrestricted exposure
USC	*United States Code*
USFWS	U.S. Fish and Wildlife Service
UTL	upper tolerance limit
UU	unlimited use
VOC	volatile organic compound
WAC	waste acceptance criteria
WAG	waste area grouping
WDF	waste disposal facility
WKWMA	West Kentucky Wildlife Management Area
XRF	X-ray fluoroscopy
ZVI	zero-valent iron

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EXECUTIVE SUMMARY

This *Feasibility Study for Solid Waste Management Units 2, 3, 7, and 30 of the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-1274&D2/R1, (FS) was prepared to evaluate remedial alternatives to address risks associated with Solid Waste Management Units (SWMUs) 2, 3, 7, and 30 at the Burial Grounds Operable Unit (BGOU) in support of remedy selection under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) at the Paducah Gaseous Diffusion Plant (PGDP). This document was prepared in accordance with the requirements of the *Federal Facility Agreement for the Paducah Gaseous Diffusion Plant* (FFA) (EPA 1998a).

Under a work plan approved by U.S. Environmental Protection Agency (EPA) and the Commonwealth of Kentucky (KY) (DOE 2006), the U.S. Department of Energy (DOE) conducted a Remedial Investigation (RI), which was the continuation of earlier investigative activities, to evaluate source areas of contamination associated with PGDP's landfills and burial grounds. Results of the RI were reported in the *Remedial Investigation Report for the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0030&D2/R1 (DOE 2010b). A baseline human health risk assessment (BHHRA) also was conducted that evaluated the range of risks to human health under a range of exposure scenarios associated with current and future land use, some of which are unlikely or hypothetical. A screening ecological risk assessment (SERA) also evaluated impacts to the environment.

Following approval of the RI, an FS was prepared, with the latest version being *Feasibility Study for the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0130&D2, submitted in December 2010 (DOE 2010a). As a result of review, discussion, and agreement by the FFA parties, the D2 version of the FS has been subdivided into focused groupings. This document presents an FS for SWMUs 2, 3, 7, and 30 that develops and evaluates remedial alternatives to address risks from and uncertainties about these SWMUs. Information for the rest of the BGOU landfills and burial grounds is presented in separate documents.

The RI identified risks to human health and the environment from potential exposure to contaminants of concern (COCs) remaining in wastes and surface and subsurface soils at SWMUs 2, 3, 7, and 30 under some current and future use scenarios. Between the RI/Baseline Risk Assessment and FS, new information was evaluated and certain decisions were made (see Chapter 1). Additional information was evaluated, including information from the BGOU FS scoping meetings held in June and July 2009, Soils Operable Unit (OUs) RI sampling information, and seep observations and conclusions. This new information was used for refinement of COCs for soils data, identification of target COCs, and principal threat waste (PTW) determinations. Thus, remedial alternatives have been developed to reduce the potential for exposure to surface soil, subsurface soil, and buried wastes, using control, containment, treatment, and/or removal response actions. Alternatives developed to address buried waste will generally be effective at addressing contaminated soils. In addition, the RI identified the potential for impacts to groundwater from COCs. This FS addresses these constituents by developing and evaluating alternatives that include processes to contain, treat, or remove COCs. Finally, alternatives that allow wastes or contaminated soils to be left in place incorporate Land Use Controls (LUCs) and monitoring to control exposure to COCs, and five-year reviews will be used to ensure that the remedy remains protective.

SCOPE OF THE BGOU

The BGOU at PGDP is one of five media-specific, sitewide OUs associated with pre-shutdown efforts to evaluate and implement remedial actions. A final Comprehensive Site OU evaluation will be conducted following plant shutdown and completion of pre- and post-shutdown actions to ensure long-term protectiveness of human health and the environment. The five media-specific, strategic cleanup initiatives that have been agreed upon by the DOE, EPA, and KY, as documented in the current *Site Management Plan* (SMP) (DOE 2015), are as follows:

- Groundwater OU Strategic Initiative
- Burial Grounds OU Strategic Initiative
- Surface Water OU Strategic Initiative
- Soils OU Strategic Initiative
- Decontamination and Decommissioning OU Strategic Initiative

The BGOU consists of contamination associated with PGDP's landfills and burial grounds as listed in Table ES.1. In general, the contents of the burial grounds may include Resource Conservation and Recovery Act (RCRA) hazardous waste, PCB waste, and low-level radioactive waste (LLW). This waste may include low-level threat waste (LLTW) and PTW and affected media (see Section 1.3.3).

Table ES.1. BGOU Source Areas and Solid Waste Management Units

SWMU No.	Description
2*	**C-749 Uranium Burial Grounds**
3*	**C-404 Low-Level Radioactive Waste Burial Grounds**
4	C-747 Contaminated Burial Yard and C-748-B Burial Area
5	C-746-F Burial Yard
6	C-747-B Burial Grounds
7*	**C-747-A Burial Grounds**
30*	**C-747-A Burn Area**
145 (9 and 10)	Area P and C-746-S and C-746-T Landfills

***Bold** indicates SWMU addressed in this FS.

PTW is defined by EPA as "source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur" (EPA 1991). EPA also recognizes that "although no threshold level of risk has been established to identify principal threat waste, a general rule of thumb is to consider as a principal threat those source materials with toxicity and mobility characteristics that combine to pose a potential risk several orders of magnitude greater than the risk level that is acceptable for the current or reasonably anticipated future land use, given realistic exposure scenarios" (EPA 1997). It is EPA's expectation that PTW be treated wherever practicable [40 *CFR* § 300.430(a)(iii)(A)]. SWMU-specific PTW information is presented under "Source Areas." LLTW are those source materials that generally can be reliably contained and that could present a low risk in the event of release.

PREVIOUS INVESTIGATIONS AND OTHER INFORMATION USED FOR THIS FS

Table ES.2 identifies the previously completed reports and/or investigations related to SWMUs 2, 3, 7, and 30 used in the development of this FS. Additionally, information obtained after completion of these previous investigations has been included where that information has been deemed relevant to the development of remedial alternatives. In particular, *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume 1: Human Health,* DOE/OR/07-1506&D2/R0/V1, dated December 2001, has been superseded by *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky, Volume 1: Human Health,* DOE/LX-07-0107&D2/R2/V1 (DOE 2013a) and the latter document has been

Table ES.2. Summary of Previous Investigations of BGOU

Dates	Title	SWMU 2	SWMU 3	SWMU 7	SWMU 30
1987	Closure Plan C-404 Low-Level Radioactive Waste Burial Ground (DOE 1987)		✓		
1990-1992	Phase II Site Investigation (CH2M HILL 1992)	✓	✓	✓	✓
1994	Waste Area Grouping (WAG 22) SWMUs 2 and 3 Remedial Investigation and Addendum (DOE 1994b)	✓	✓		
1997	SWMU 2 Data Summary Report (DOE 1997a)	✓			
1996-1998	WAG 22 SWMUs 7 and 30 RI/FS (DOE 1998a; DOE 1998b)			✓	✓
1999-2001	Data Gaps Investigation (DOE 2000)			✓	✓
2002-2003	Scrap Yards Site Characterization (Paducah OREIS)			✓	✓
2006	Burial Grounds RI/FS Work Plan (DOE 2006)	✓	✓	✓	✓
2007	Burial Grounds Remedial Investigation (DOE 2010b)	✓	✓	✓	✓
2010	Soils OU RI (DOE 2013b)			✓	

Table ES.2 is based on Table 1.4 of the *Remedial Investigation Report for the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0030&D2/R1, February (DOE 2010b).
Blank cells indicate document is not applicable to SWMU.

used in this FS. Risk information and conclusions are from the baseline risk assessment performed for the BGOU RI Report (DOE 2010b) and are presented herein with no changes, recognizing that some of the methods and assumptions no longer reflect the current approaches. To address the change in the approaches and to incorporate information developed since the RI, this FS reevaluates the results of the BHHRA for the BGOU RI. Results of that reevaluation also are presented herein.

SOURCE AREAS

The SWMUs comprising the BGOU consist of landfills and burial cells in which PGDP waste has been placed. The four SWMUs covered by this FS are SWMUs 2, 3, 7, and 30.

SWMUs 2 and 3 are located in the west-central section of the PGDP secured area. SWMU 2 (~ 32,000 ft^2) operated from 1951 to 1977. SWMU 2 is a below-ground burial area with individual disposal cells that were used primarily for the disposal of uranium and uranium-contaminated waste, including machine shop turnings, shavings, and sawdust. Because small pieces of uranium metal may be pyrophoric (spontaneously burn in air), operating practices of the time included placing the materials in drums along with associated cutting oils and sweepings. Additional petroleum-based or synthetic oil may have been added to minimize the contact of these materials with air. Other waste documented as being disposed of at SWMU 2 includes drummed trichloroethene (TCE) and uranyl fluoride. After disposal, drummed buried wastes were covered with soil.

SWMU 3 (53,000 ft^2) is an aboveground disposal cell that operated as a surface impoundment to manage uranium-contaminated effluent from C-400 from 1952 to 1957; then it was converted to a solid waste disposal facility with a tamped earth bottom that accepted solid uranium-contaminated waste (precipitates, slag, uranium tetrafluoride, uranium oxides, sludge, etc.) until 1976. Documentation indicates that before landfill closure in 1986, drums of various materials were placed on top of a buffer soil layer over the previously disposed of material. SWMU 3 was subsequently covered with a Subtitle C cap.

SWMUs 7 and 30 are located in the northwest corner of the PGDP secured area. SWMU 7 (~ 240,900 ft^2) includes six discrete burial cell areas used for disposal of wastes from 1957 to 1979. Wastes disposed of in SWMU 7 include noncombustible contaminated and uncontaminated trash, scrap metal (including empty used drums), material, and equipment. Previous investigations have documented volatile organic compound (VOC) (TCE and degradation products) concentrations attributed to an Upper Continental Recharge System (UCRS) dense nonaqueous-phase liquid (DNAPL) and/or high concentration TCE residual soil contamination at SWMU 7. SWMU 30 (~ 117,600 ft^2) was used from 1957 to 1970 to burn combustible trash, which may have contained uranium contamination. Material disposed in this area included trash, ash and debris, as well as the remnants of the incinerator used to burn the trash.

The following PTW has been identified at SWMU 2 (DOE 2012):

- Approximately 270 tons of uranium (e.g., shavings and sawdust packed in oil) disposed of in burial pits in SWMU 2;

- Buried drums of uranium-contaminated TCE and any high soil concentrations of TCE present under and adjacent to the drums;

- Buried drums (thirty-five 30-gal drums documented) of uranyl fluoride solution and high soil concentrations of uranyl fluoride solution present under and adjacent to the drums; and

- High concentrations of TCE and *cis*-1,2-dichloroethene (DCE) (a toxic degradation product of TCE) in soil on the eastern side of SWMU 2.

There is the potential that at SWMU 2 up to 59,000 gal of oil that was co-disposed with the uranium contains polychlorinated biphenyls (PCBs) at concentrations greater than 500 mg/kg. Under EPA guidance, PCB concentrations greater than 500 mg/kg are considered PTW under certain exposure scenarios. Absent additional characterization (sampling and analysis) of the buried waste, it is uncertain whether PCBs are present at SWMU 2 at levels greater than 500 mg/kg. Notwithstanding the uncertainty, the 59,000 gal of oil could contain PCBs in excess of 500 mg/kg and has been identified as PTW.

Uranium-contaminated waste (approximately 3,200 tons) at SWMU 3 has been identified as PTW. (It is inconclusive whether some of the uranium may be pyrophoric) (DOE 2012).

TCE (including degradation products) present in UCRS at SWMU 7 as DNAPL and/or high concentration TCE residual soil contamination has been identified as PTW (DOE 2012).

No PTW has been identified at SWMU 30 (DOE 2012).

All other waste at SWMUs 2, 3, 7, and 30 is considered LLTW.

NATURE AND EXTENT OF CONTAMINATION

The current understanding of the nature and extent of contamination in surface and subsurface soils was derived from historical investigations and information collected since the BGOU RI as shown on Table ES.2. In the BGOU RI, additional soil samples were collected from angled borings beneath the wastes to establish if releases had occurred from the waste and, if so, their magnitude in the secondary media. Each of the SWMUs has a surface cover. The amount of surface soil data collected for each SWMU varied, since the focus of the BGOU was to identify releases and these would primarily be identified from samples beneath the waste. In some cases, the BGOU data set includes soil and sediment samples collected from locations outside the SWMU boundary that are not affected by releases from the wastes and will be addressed by other strategic initiatives.

SWMU-specific sections provide details on the distribution of selected COCs. The sampling locations and distribution of the target chemicals in surface and subsurface soils evaluated in this FS are shown on figures in Appendix A for each of the SWMUs.

MIGRATION PATHWAYS AND RISK SUMMARY

The FS considers two mechanisms by which residual contamination at the BGOU may pose a risk:

- Through direct contact with wastes or affected media; and
- Through migration to Regional Gravel Aquifer (RGA) groundwater.

The potential for migration to groundwater is informed by a discussion of the Conceptual Site Model.

Conceptual Site Model. Infiltration of water (e.g., precipitation) descending through the buried waste could mobilize contaminants within the waste. The potential for contaminants to migrate to groundwater was evaluated in the RI (DOE 2010b) and previous FS (DOE 2010a). If contaminants are mobilized, they have the potential to migrate downward through the UCRS soils and reach the RGA. Some lateral movement of contaminants could occur in the UCRS, but these pathways are known to be limited. Based on this conceptual model, any contamination resulting from buried waste found at these SWMUs would be expected to be found concentrated in the soils and groundwater of the UCRS immediately within and under the burial cells and landfills, with little lateral dispersion of contamination in the UCRS. The RI Report provides an assessment of data from the BGOU RI, along with data from historical investigations, to evaluate the nature and extent of contamination (vertical and lateral) associated with the BGOU SWMUs. Consistent with the BGOU FS scope, the source areas, contamination in secondary sources impacted by releases from the waste, and potential for future migration from the wastes were the basis for evaluation of remedial alternatives.

The BHHRA for the BGOU RI characterized the baseline risks posed to human health from contact with contaminants in soil and water at the BGOU SWMUs and at locations to which contaminants may migrate. Several COCs were identified that could pose unacceptable threats to human health and the environment under some future use scenarios, particularly if there were any of the following:

- Direct contact with buried wastes;
- Direct contact with surface soils;
- Direct contact with subsurface soils; and
- Migration of COCs to groundwater and/or surface water.

Sections 1.5 and 1.6 of this FS reevaluate the risk characterization in the BHHRA for the BGOU RI based on changes in the review process (e.g., some toxicity values have changed, background screening was not originally applied, etc.). Additionally, some COCs not previously determined in the BGOU RI will be added to the SWMUs 2, 3, 7, and 30 FS (e.g., based on process knowledge and the Soils OU RI).

Human Health—Direct Contact (As Summarized from the BGOU RI BHHRA)

The impact to human health from direct contact with buried wastes was not quantitatively characterized for all SWMUs included in this FS in the BHHRA; nevertheless, direct contact with both PTW and

LLTW wastes is assumed to be associated with unacceptable risks under some current or future use scenario and thus this exposure pathway must be addressed in this FS for SWMUs 2, 3, 7, and 30.

The impact to human health from direct contact with surface and subsurface soils was quantitatively characterized. For surface soil, results from previous risk assessments were used, and no new surface soil data were collected at most of the SWMUs. The cumulative excess lifetime cancer risk (ELCR) for the on-site resident for soil exceeds 1E-04, and the cumulative hazard index (HI) is greater than 1 at all SWMUs except for SWMUs 2 and 3, which were not evaluated for soil exposure for these scenarios. The contaminants that are risk drivers for soil are aluminum, arsenic, beryllium, chromium, iron, nickel, uranium, vanadium, Total PAHs, uranium-234 (U-234), and uranium-238 (U-238).

The most likely future scenario identified in the RI Report is the industrial worker. The cumulative ELCR for the scenario exceeded 1E-04 at SWMUs 2, 3, 7, and 30, primarily due to chemical-specific ELCRs from arsenic, beryllium, Total PAHs, uranium-235 (U-235), and U-238. The cumulative HI exceeds 1 for the industrial worker at SWMUs 7 and 30. Aluminum, beryllium, chromium, iron, manganese, uranium, and vanadium are the chemical-specific HI drivers. Cumulative ELCRs for the current worker (at 16 days per year for 25 years of exposure) were less than those for the future industrial worker; cumulative ELCRs for the current industrial worker exceeded 1E-04 at SWMUs 7 and 30.

The inclusion of beryllium as a risk driver is a result of incorporating the historical risk assessments. At the time those risk assessments were developed, beryllium still was evaluated as a carcinogen through the incidental ingestion and dermal exposure routes. The BGOU RI BHHRA identified this inclusion as an uncertainty. Since then, the oral cancer slope factor for beryllium has been withdrawn and no longer is used for PGDP risk assessments by EPA. As a result, the total cumulative ELCR becomes much lower at those SWMUs where beryllium was identified as a COC.

The ELCR and HI were found to be above EPA's acceptable risk range (ELCR > 1E-4 and/or HI > 1) for some residential and industrial worker land use scenarios at each of the SWMUs. In addition, there is some uncertainty in the evaluation of surface soils associated with the quantity and geographic distribution of samples.

Human Health—Direct Contact (Summarized from this FS)

Therefore, at a minimum, the FS must address for each SWMU:

- How the alternative will address the potential for direct contact with buried wastes and contaminated soils;

- How the alternative will address the risks/hazards or uncertainties associated with direct contact with surface soils; and

- How the alternative will address the potential for migration of contaminants from soils and buried waste to RGA groundwater.

Table ES.3 is a summary of the target compounds for direct contact exposures that will address risks and hazards identified in Section 1.6 of this FS for the worker scenarios.

Table ES.3. Summary of Target COCs To Be Addressed for Protection of Future Industrial and Excavation Workers (SWMUs 2, 3, 7, and 30 FS)

Media	SWMU 2	SWMU 3	SWMU 7	SWMU 30
Surface Soil See COCs for the "Future industrial worker at current concentrations (soil)" scenarios on Tables 1.5 through 1.8 in the main text of this FS report. Lists of COCs were updated based on information in Section 1.6 of this FS.	Arsenic U-234 U-235 U-238	Arsenic U-234 U-235 U-238	Total PAHs Arsenic Cobalt Iron Manganese Mercury Uranium Np-237 U-234 U-235 U-238	Total PAHs Total PCBs Uranium Np-237 U-234 U-235 U-238
Subsurface Soil and Waste See COCs for the "Future industrial worker at current concentrations (soil)" scenarios on Tables 1.5 and 1.6 and COCs for the "Future Excavation Worker" scenarios on Tables 1.7 and 1.8 in the main text of this FS report. Lists of COCs were updated based on information in Section 1.6 of this FS.	*cis*-1,2-DCE TCE Total PCBs Arsenic Uranium Tc-99 U-234 U-235 U-238	*cis*-1,2-DCE TCE Total PCBs Arsenic Uranium Tc-99 U-234 U-235 U-238	Total PAHs Arsenic Cobalt Iron Manganese Nickel Uranium U-234 U-235 U-238	Total PAHs Total PCBs Uranium U-234 U-235 U-238

Migration of COCs to Groundwater (Summarized from the BGOU RI)

The BGOU RI characterized potential releases from the wastes to groundwater. For RGA groundwater, the BHHRA evaluated the potential for unacceptable ELCRs or HIs posed by residential use of RGA groundwater at the SWMU boundaries, the plant boundary, property boundary and Ohio River (or seeps) for all SWMUs. At the SWMU boundary, cumulative ELCRs and HIs from groundwater use for all evaluated SWMUs exceeded a cumulative ELCR of 1E-04 and exceeded a cumulative HI of 1. The major contaminants driving the groundwater ELCRs and HIs at the SWMU boundary point of exposure (POE) are arsenic (at SWMUs 3, 7, and 30); *cis*-1,2- DCE (at SWMUs 2 and 7); 1-1-DCE (at SWMUs 7 and 30); manganese (at SWMU 3); Aroclor 1254 (at SWMU 7); TCE (at SWMUs 2, 7, and 30); Tc-99 (at SWMU 3); uranium (at SWMU 3); and vinyl chloride (at SWMU 7). At the plant boundary, cumulative ELCRs and HIs from groundwater for SWMUs 2, 3, 7, and 30 exceeded an ELCR of 1E-04 or exceeded an HI of 1. At the property boundary, cumulative ELCRs and HIs from groundwater for SWMUs 2, 7, and 30 exceeded an ELCR of 1E-04 or exceeded an HI of 1. At the Ohio River (or seeps), cumulative ELCRs and HIs from groundwater for SWMUs 2, 7, and 30 exceeded an ELCR of 1E-04 or exceeded an HI of 1. The major contaminants driving the groundwater cumulative ELCRs and HIs at the property boundary and Ohio River (or Little Bayou Creek seeps) POEs are arsenic, *cis*-1,2-DCE, 1,1-DCE, TCE, Tc-99, and vinyl chloride. While the migration of contamination from the potential TCE DNAPL zones at SWMUs 7 and 30 was not modeled due to uncertainties in source term development, a qualitative analysis, completed considering results from previous studies done for PGDP (e.g., C-400 DNAPL source), indicates that TCE migration from these sources would have resulted in potentially exceeding an

ELCR of 1E-04 at all POEs. It should be noted that these ELCRs/HIs are to the potential future resident and that scenario is unlikely.

Migration of COCs to Groundwater (SWMUs 2, 3, 7, and 30 FS)

Table ES.4 lists target compounds that were evaluated to address COCs identified based on assumptions that do not limit future use of RGA groundwater at the SWMU boundary (Appendix B) by considering the following:

Table ES.4. Target COCs for Protection of RGA Groundwater (SWMUs 2, 3, 7, and 30 FS)

Media	SWMU 2	SWMU 3	SWMU 7	SWMU 30
Protection of Groundwater See COCs for Total ELCR for the "Future adult rural resident at modeled concentrations (RGA groundwater drawn at plant boundary)" and for Total HI for the "Future child rural resident at modeled concentrations (RGA groundwater drawn at plant boundary)" scenarios on Tables 1.5 through 1.8 in the main text of this FS report. Lists of COCs were updated based on information in Section 1.6 of this FS.	*cis*-1,2-DCE TCE Total PCBs Arsenic Uranium Tc-99 U-234 U-235 U-238	TCE Arsenic Uranium Tc-99 U-234 U-235 U-238	1,1-DCE *cis*-1,2-DCE TCE Vinyl chloride Total PCBs Arsenic Manganese Uranium Tc-99 U-234 U-235 U-238	1,1-DCE TCE Uranium Tc-99 U-234 U-235 U-238

- Use of the maximum contaminant level (MCL) as the appropriate groundwater target concentration
- Background
- Travel time
- Attenuation/biodegradation

For each of these constituents, a preliminary remediation goal (PRG) protective of groundwater at the SWMU boundary was developed to support decision making.

Screening Ecological Risk Assessment

The results of previous Ecological Risk Assessments (ERAs) conducted for SWMUs 2, 7, and 30 are summarized in the BGOU RI (DOE 2010b). SWMU 3 is covered with a Subtitle C cap, so no ecological evaluation was undertaken.

The SERA identified chemicals of potential concern (COPCs) for ecological receptors in surface soils. Actions taken to address human health in this FS will reduce the potential for ecological exposures to these COPCs. Residual risks will be evaluated in a future sitewide ecological risk assessment.

IDENTIFICATION OF REMEDIAL ACTION OBJECTIVES

The general site cleanup objectives were developed that serve as guiding principles for creating more detailed remedial action objectives (RAOs) to focus OUs on site-specific problems. The FS includes general RAOs for the BGOU, and it also includes SWMU-specific RAOs. These RAOs address source areas, including treatment and/or removal of potential PTW consistent with CERCLA, the National Contingency Plan (including the Preamble), and any pertinent EPA guidance.

RAOs are goals for protection of human health and the environment. RAOs provide a general description of what a CERCLA cleanup is designed to accomplish. The BGOU FS evaluates taking actions as necessary to protect human health and the environment from the BGOU waste units and addressing potential releases from these source areas that may impact RGA groundwater or adjacent drainageways.

SWMUs 2, 3, 7, and 30 are located within the industrial area of the PGDP facility, and reasonable future use of this area is expected to remain industrial.

Considering the risks identified in the RI and new information evaluated in Chapter 1, the following general RAOs were developed and used in screening technologies and developing and evaluating alternatives in the FS for the BGOU SWMUs:

(1) Contribute to the protection of groundwater by eliminating, reducing, or controlling sources of groundwater contamination;

(2) Prevent exposure to waste and contaminated soils that present an unacceptable risk from direct contact; and

(3) Treat or remove PTW wherever practicable, consistent with 40 *CFR* § 300.430 (a)(1)(iii)(A).

At SWMUs 2, 3, 7, and 30, buried waste includes a range of materials that are not fully characterized. To address this uncertainty, this FS evaluates alternatives designed to eliminate direct contact with both wastes and soils to ensure no unacceptable risk is experienced by the future industrial and the future excavation worker.

The general RAOs for protection of groundwater and direct contact to soils are refined to more specifically guide the alternative selection process in this FS. These RAOs are further refined in the SWMU-specific sections of the document to include COCs identified at each SWMU. These SWMU-specific RAOs are as follows.

SWMU-Specific RAO for protection of groundwater. Contribute to the protection of groundwater by eliminating, reducing, or controlling sources of groundwater contamination that could result in an exceedance in RGA groundwater of the MCL (or risk-based concentration for residential use of groundwater in the absence of an MCL).

SWMU-Specific RAO for protection of direct contact with waste. Prevent exposure to waste that exceeds target cumulative ELCRs and cumulative noncancer HIs for the future excavation worker receptor. The acceptable cumulative risk levels for this RAO are defined as follows:

- Waste: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future excavation worker [considering a five-year exposure based upon the outdoor worker scenario in the 2013 Risk Methods Document (DOE 2013a)]

SWMU-Specific RAO for protection of direct contact with contaminated soils. Prevent exposure to contaminated soils that exceed target cumulative ELCRs and cumulative noncancer HIs for the future industrial and future excavation worker receptors. The acceptable cumulative risk levels for this RAO are defined as follows:

- Surface Soil: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future industrial worker [considering default exposures in the Risk Methods Document (DOE 2013a)]

- Surface and Subsurface Soil: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future excavation worker [considering a five-year exposure based on the outdoor worker scenario in the 2013 Risk Methods Document (DOE 2013a)]

Where the general RAO to address PTW applies (SWMUs 2, 3, and 7), it is restated as a SWMU-specific RAO.

SWMU-Specific RAO for PTW. Treat or remove PTW wherever practicable, consistent with 40 *CFR* § 300.430 (a)(1)(iii)(A).

PRELIMINARY REMEDIATION GOAL DEVELOPMENT

Soil PRGs are calculated for SWMUs 2, 3, 7, and 30 for both direct contact exposure to surface and subsurface soil and for protection of groundwater. The direct-contact PRGs for soil are based on NALs presented in the Risk Methods Document (DOE 2013a) and derived for the future excavation worker using a five-year exposure duration. Groundwater protective PRGs are calculated based on MCLs as directed in the Safe Drinking Water Act (EPA 2006a) or risk-based levels in the absence of an MCL. The PRGs are summarized in Tables ES.5, ES.6, and ES.7.

REMEDIAL ALTERNATIVES DEVELOPMENT

The FS alternatives are designed to reduce cumulative ELCR and HI for the reasonable maximum exposed receptors to acceptable levels. Upon completion of remedial actions at each SWMU, additional data will be collected to verify that the cumulative ELCR to the future industrial worker, the future excavation worker, and potential groundwater user from exposure to SWMU-specific COCs in surface soil will be below 1E-05 and the noncancer HI will be below 1 for all COCs at the SWMU and address the uncertainties associated with the coverage of the sampled locations. Verification of cleanup will be based on postremediation sampling conducted in accordance with the Risk Methods Document (DOE 2013a) and EPA guidance (EPA 1991a).

Once RAOs are established, the FS considers response actions. General response actions (GRAs) are broad categories of remedial measures that may be implemented individually or in combination to meet RAOs. The following are the GRAs evaluated for the BGOU FS.

- LUCs
- Surface controls
- Monitoring
- Monitored natural attenuation
- Removal
- Containment
- Treatment
- Disposal

Table ES.5. SWMUs 2, 3, 7, and 30 FS Preliminary Remediation Goals for Surface Soil

SWMU	COC	Units	Background[a]	Direct Contact PRG[b]	Groundwater-Protective PRG[c]	PRG for Surface Soil[d]
2	Arsenic	mg/kg	1.20E+01	1.91E+01	1.69E+01	1.69E+01
2	U-234	pCi/g	1.20E+00	3.06E+02	4.88E+06	3.06E+02
2	U-235	pCi/g	6.00E-02	9.20E+00	5.07E+04	9.20E+00
2	U-238	pCi/g	1.20E+00	3.74E+01	2.64E+02	3.74E+01
3	Arsenic	mg/kg	1.20E+01	1.91E+01	1.69E+01	1.69E+01
3	U-234	pCi/g	1.20E+00	3.06E+02	4.88E+06	3.06E+02
3	U-235	pCi/g	6.00E-02	9.20E+00	5.07E+04	9.20E+00
3	U-238	pCi/g	1.20E+00	3.74E+01	2.64E+02	3.74E+01
7	Total PAHs[f]	mg/kg	N/A	3.92E+00	2.51E-01	2.51E-01
7	Arsenic	mg/kg	1.20E+01	1.91E+01	1.69E+01	1.69E+01
7	Cobalt	mg/kg	1.40E+01	3.02E+02	8.18E-01	1.40E+01
7	Iron	mg/kg	2.80E+04	5.00E+05	1.07E+03	2.80E+04
7	Manganese	mg/kg	1.50E+03	2.11E+04	9.28E+01	1.50E+03
7	Mercury	mg/kg	2.00E-01	3.07E+02	6.03E+00	6.03E+00
7	Uranium[g]	mg/kg	4.90E+00	2.99E+03	7.83E+02	7.83E+02
7	Np-237	pCi/g	1.00E-01	6.05E+00	2.61E-01	2.61E-01
7	U-234	pCi/g	1.20E+00	3.06E+02	4.88E+06	3.06E+02
7	U-235	pCi/g	6.00E-02	9.20E+00	5.07E+04	9.20E+00
7	U-238	pCi/g	1.20E+00	3.74E+01	2.64E+02	3.74E+01
30	Total PAHs[f]	mg/kg	N/A	3.92E+00	2.51E-01	2.51E-01
30	Total PCBs	mg/kg	N/A	1.43E+01	4.54E+00[h]	1.00E+01[e]
30	Uranium[g]	mg/kg	4.90E+00	2.99E+03	7.83E+02	7.83E+02
30	Np-237	pCi/g	1.00E-01	6.05E+00	2.61E-01	2.61E-01
30	U-234	pCi/g	1.20E+00	3.06E+02	4.88E+06	3.06E+02
30	U-235	pCi/g	6.00E-02	9.20E+00	5.07E+04	9.20E+00
30	U-238	pCi/g	1.20E+00	3.74E+01	2.64E+02	3.74E+01

N/A = not available

[a] Background concentrations taken from Table A.12 of the 2013 Risk Methods Document (DOE 2013a).

[b] Direct contact PRGs are taken from 5 times the industrial worker NAL from Table A.4 of the 2013 Risk Methods Document (DOE 2013a). This value corresponds to the lesser of an ELCR of 5E-06 for carcinogenic COCs and an HI of 0.5 for noncarcinogenic COCs for chemical-specific targets to ensure that the residual cumulative ELCR will be equal to or below the ELCR target of 1E-05, and the residual cumulative HI will be equal to or below the HI target of 1.

[c] Groundwater protective PRGs are the soil screening level for the MCL or residential NAL using a dilution attenuation factor of 58 [see Table C1.2 of the Soils OU RI Report (DOE 2013b)].

[d] PRG for surface soil is the lower of the direct contact PRG and groundwater protective PRG for soil. If the risk-based value is less than background, then background becomes the revised PRG for surface soil. Shading indicates the revised PRG is set at background.

[e] Determined during June 2009 BGOU FS scoping meeting.

[f] Direct contact PRGs are based on total carcinogenic PAHs. The groundwater protective PRG is based on values for benz(a)anthracene.

[g] Direct contact PRGs are based on uranium, soluble salts.

[h] A groundwater protective PRG does not apply because BGOU RI modeling indicates that PCBs exhibited groundwater concentrations that were less than the groundwater child NAL.

Table ES.6. SWMUs 2, 3, 7, and 30 FS Preliminary Remediation Goals for Subsurface Soil

SWMU	COC	Units	Background[a]	Direct Contact PRG[b]	Groundwater-Protective PRG[c]	PRG for Subsurface Soil[d]
2	*cis*-1,2-DCE	mg/kg	N/A	2.88E+02	1.19E+00	1.19E+00
2	TCE	mg/kg	N/A	1.18E+01	1.03E-01	1.03E-01
2	Total PCBs	mg/kg	N/A	4.25E+00	4.54E+00[f]	1.00E+01[e]
2	Arsenic	mg/kg	7.90E+00	1.04E+01	1.69E+01	1.04E+01
2	Uranium	mg/kg	4.60E+00	4.31E+02	7.83E+02	4.31E+02
2	Tc-99	pCi/g	2.80E+00	7.73E+03	2.12E+01	2.12E+01
2	U-234	pCi/g	1.20E+00	2.18E+02	4.88E+06	2.18E+02
2	U-235	pCi/g	6.00E-02	1.21E+01	5.07E+04	1.21E+01
2	U-238	pCi/g	1.20E+00	4.53E+01	2.64E+02	4.53E+01
3	*cis*-1,2-DCE	mg/kg	N/A	2.88E+02	1.19E+00	1.19E+00
3	TCE	mg/kg	N/A	1.18E+01	1.03E-01	1.03E-01
3	Total PCBs	mg/kg	N/A	4.25E+00	4.54E+00[f]	1.00E+01[e]
3	Arsenic	mg/kg	7.90E+00	1.04E+01	1.69E+01	1.04E+01
3	Uranium	mg/kg	4.60E+00	4.31E+02	7.83E+02	4.31E+02
3	Tc-99	pCi/g	2.80E+00	7.73E+03	2.12E+01	2.12E+01
3	U-234	pCi/g	1.20E+00	2.18E+02	4.88E+06	2.18E+02
3	U-235	pCi/g	6.00E-02	1.21E+01	5.07E+04	1.21E+01
3	U-238	pCi/g	1.20E+00	4.53E+01	2.64E+02	4.53E+01
7	Total PAHs[g]	mg/kg	N/A	1.22E+00	2.51E-01	2.51E-01
7	Arsenic	mg/kg	7.90E+00	1.04E+01	1.69E+01	1.04E+01
7	Cobalt	mg/kg	1.30E+01	4.31E+01	8.18E-01	1.30E+01
7	Iron	mg/kg	2.80E+04	1.01E+05	1.07E+03	2.80E+04
7	Manganese	mg/kg	8.20E+02	3.40E+03	9.28E+01	8.20E+02
7	Nickel	mg/kg	2.20E+01	2.86E+03	7.89E+01	7.89E+01
7	Uranium[h]	mg/kg	4.60E+00	4.31E+02	7.83E+02	4.31E+02
7	U-234	pCi/g	1.20E+00	2.18E+02	4.88E+06	2.18E+02
7	U-235	pCi/g	6.00E-02	1.21E+01	5.07E+04	1.21E+01
7	U-238	pCi/g	1.20E+00	4.53E+01	2.64E+02	4.53E+01
30	Total PAHs[g]	mg/kg	N/A	1.22E+00	2.51E-01	2.51E-01
30	Total PCBs	mg/kg	N/A	4.25E+00	4.54E+00[f]	1.00E+01[e]
30	Uranium[h]	mg/kg	4.60E+00	4.31E+02	7.83E+02	4.31E+02
30	U-234	pCi/g	1.20E+00	2.18E+02	4.88E+06	2.18E+02
30	U-235	pCi/g	6.00E-02	1.21E+01	5.07E+04	1.21E+01
30	U-238	pCi/g	1.20E+00	4.53E+01	2.64E+02	4.53E+01

N/A = not available

[a] Background concentrations taken from Table A.12 of the 2013 Risk Methods Document (DOE 2013a).

[b] Direct contact PRGs are excavation worker corresponding to an ELCR of 5E-06 for carcinogenic COCs and an HI of 0.5 for noncarcinogenic COCs for chemical-specific targets to ensure that the residual cumulative ELCR will be equal to or below the ELCR target of 1E-05, and the residual cumulative HI will be equal to or below the HI target of 1.

[c] Groundwater protective PRGs are the soil screening level for the MCL or residential NAL using a dilution attenuation factor of 58 [see Soils OU RI Report (DOE 2013b)].

[d] PRG for subsurface soil is the lower of the direct contact PRG and groundwater protective PRG for soil. If the risk-based value is less than background, then background becomes the revised PRG for subsurface soil. Shading indicates the revised PRG is set at background.

[e] Determined during June 2009 BGOU FS scoping meeting.

[f] A groundwater protective PRG does not apply because BGOU RI modeling indicates that PCBs exhibited groundwater concentrations that were less than the groundwater child NAL for SWMU 30 and did not reach the water table in 1,000 years for SWMU 2. For SWMU 3, PCBs did not pass screening and therefore did not require modeling.

[g] Direct contact PRGs are based on total carcinogenic PAHs. The groundwater protective PRG is based on values for benz(a)anthracene.

[h] Direct contact PRGs are based on uranium, soluble salts.

Table ES.7. SWMUs 2, 3, 7, and 30 FS Preliminary Remediation Goals for Groundwater Protection

SWMU	COC	Units	Background[a]	Groundwater-Protective PRG[b]	PRG for Subsurface Soil[c]
2	*cis*-1,2-DCE	mg/kg	N/A	1.19E+00	1.19E+00
2	TCE	mg/kg	N/A	1.03E-01	1.03E-01
2	Total PCBs	mg/kg	N/A	4.54E+00[e]	1.00E+01[d]
2	Arsenic	mg/kg	7.90E+00	1.69E+01	1.69E+01
2	Uranium	mg/kg	4.60E+00	7.83E+02	7.83E+02
2	Tc-99	pCi/g	2.80E+00	2.12E+01	2.12E+01
2	U-234	pCi/g	1.20E+00	4.88E+06	4.88E+06
2	U-235	pCi/g	6.00E-02	5.07E+04	5.07E+04
2	U-238	pCi/g	1.20E+00	2.64E+02	2.64E+02
3	TCE	mg/kg	N/A	1.03E-01	1.03E-01
3	Arsenic	mg/kg	7.90E+00	1.69E+01	1.69E+01
3	Uranium	mg/kg	4.60E+00	7.83E+02	7.83E+02
3	Tc-99	pCi/g	2.80E+00	2.12E+01	2.12E+01
3	U-234	pCi/g	1.20E+00	4.88E+06	4.88E+06
3	U-235	pCi/g	6.00E-02	5.07E+04	5.07E+04
3	U-238	pCi/g	1.20E+00	2.64E+02	2.64E+02
7	1,1-DCE	mg/kg	N/A	1.46E-01	1.46E-01
7	*cis*-1,2-DCE	mg/kg	N/A	1.19E+00	1.19E+00
7	TCE	mg/kg	N/A	1.03E-01	1.03E-01
7	Vinyl chloride	mg/kg	N/A	3.97E-02	3.97E-02
7	Total PCBs	mg/kg	N/A	4.54E+00[e]	1.00E+01[d]
7	Arsenic	mg/kg	7.90E+00	1.69E+01	1.69E+01
7	Manganese	mg/kg	8.20E+02	9.28E+01	8.20E+02
7	Uranium	mg/kg	4.60E+00	7.83E+02	7.83E+02
7	Tc-99	pCi/g	2.80E+00	2.12E+01	2.12E+01
7	U-234	pCi/g	1.20E+00	4.88E+06	4.88E+06
7	U-235	pCi/g	6.00E-02	5.07E+04	5.07E+04
7	U-238	pCi/g	1.20E+00	2.64E+02	2.64E+02
30	1,1-DCE	mg/kg	N/A	1.46E-01	1.46E-01
30	TCE	mg/kg	N/A	1.03E-01	1.03E-01
30	Uranium	mg/kg	4.60E+00	7.83E+02	7.83E+02
30	Tc-99	pCi/g	2.80E+00	2.12E+01	2.12E+01
30	U-234	pCi/g	1.20E+00	4.88E+06	4.88E+06
30	U-235	pCi/g	6.00E-02	5.07E+04	5.07E+04
30	U-238	pCi/g	1.20E+00	2.64E+02	2.64E+02

N/A = not available

[a] Background concentrations taken from Table A.12 of the 2013 Risk Methods Document (DOE 2013a).

[b] Groundwater protective PRGs are the soil screening level for the MCL or residential NAL using a dilution attenuation factor of 58 [see Soils OU RI Report (DOE 2013b)].

[c] PRG for subsurface soil below 16 ft bgs is the groundwater protective PRG for soil because direct contact is unlikely. If the risk-based value is less than background, then background becomes the revised PRG for subsurface soil. Shading indicates the revised PRG is set at background.

[d] Determined during June 2009 BGOU FS scoping meeting.

[e] A groundwater protective PRG does not apply, because BGOU RI modeling indicated PCBs did not reach the water table in 1,000 years for SWMU 2 or SWMU 7. For SWMU 3, PCBs did not pass screening and therefore did not require modeling. For SWMU 30, modeling for PCBs showed that PCBs exhibited groundwater concentrations that were less than the groundwater child no action levels.

A variety of technologies and process options for each GRA are presented and preliminarily evaluated in the FS. Those technologies and process options that are recognized to be most effective in addressing the types of issues associated with SWMUs 2, 3, 7, and 30 are considered to be representative process options (RPOs). RPOs are selected on the basis of effectiveness, technical and administrative implementability, and cost relative to other technologies in the same technology class.

For this FS, multiple RPOs were considered and ultimately used in developing and evaluating remedial alternatives.

Table ES.8 identifies the RPOs that were selected to be included in alternative development based on the implementability screening and effectiveness evaluations. The treatment options were used as planned options in an alternative or as contingent options to address residual contamination present after an excavation. Not all technologies or process options were developed into components of remedial alternatives.

Table ES.8. Summary of Representative Process Options

<table>
<tr><th>General Response Actions</th><th>Technology Types</th><th>Representative Process Options</th></tr>
<tr><td rowspan="2">LUCs</td><td>Institutional Controls</td><td>Property record notice
Deed and/or lease restriction
CERCLA Section 120(h)
Excavation/penetration permit (E/PP) program
Environmental Covenant meeting the requirements of KRS 224.80-100 et seq. to be filed at the time of property transfer</td></tr>
<tr><td>Physical Controls</td><td>Fences
Signs</td></tr>
<tr><td>Surface Controls</td><td>Surface Barriers</td><td>Riprap
Soil cover</td></tr>
<tr><td>Monitoring</td><td>Groundwater Monitoring</td><td>Conventional sampling and analysis</td></tr>
<tr><td>Monitoring</td><td>Surface Water Monitoring</td><td>Conventional sampling and analysis</td></tr>
<tr><td>Removal</td><td>Excavators</td><td>Backhoes, trackhoes</td></tr>
<tr><td rowspan="3">Containment</td><td>Hydraulic Containment</td><td>Groundwater extraction</td></tr>
<tr><td>Capping</td><td>RCRA Subtitle C cap
Kentucky Subtitle D landfill cap</td></tr>
<tr><td>Subsurface Vertical Barriers</td><td>Sheet pile
Slurry wall</td></tr>
<tr><td rowspan="5">Treatment</td><td>Physical/Chemical (ex situ)</td><td>Air stripping (ex situ)
Ion exchange (ex situ)
Granular activated carbon (ex situ)</td></tr>
<tr><td>Biological (in situ)</td><td>In Situ Enhanced Biodegradation</td></tr>
<tr><td>Physical/Chemical (in situ)</td><td>Dual-phase extraction
Deep soil mixing
Jet grouting</td></tr>
<tr><td>Thermal (in situ)</td><td>Electrical resistance heating (ERH)</td></tr>
<tr><td>Chemical (in situ)</td><td>Zero-valent iron (ZVI)</td></tr>
</table>

Table ES.8. Summary of Representative Process Options (Continued)

General Response Actions	Technology Types	Representative Process Options
Disposal	Land Disposal	Off-site disposal Potential disposal unit C-746-U on-site landfill
	Discharge of Wastewater	Wastewater treatment demonstrating compliance with ARARs

For those alternatives with excavation, the potential for disposal of materials at a potential on-site waste disposal facility (OSWDF) was incorporated, as were contingent treatment remedies to address soils exceeding the PRGs in the base of the excavation. For those alternatives with containment/caps, specified relevant and appropriate Nuclear Regulatory Commission-and KY-equivalent regulations for disposal of radioactive waste provide performance requirements that would be factored into the design of any final cover meeting Subtitle C or KY Subtitle D applicable or relevant and appropriate requirements (ARARs).

The RPOs from GRAs, including controls, monitoring, removal, containment, treatment, and disposal, were used to develop general alternatives to address the general RAOs. Table ES.9 identifies the general alternatives that were developed.

Table ES.9. Summary of General Alternatives

General Alternative 1	General Alternative 2	General Alternative 3	General Alternative 4	General Alternative 5	General Alternative 6
No Action	**Limited Action (LUCs and Monitoring)**	**Containment, Surface Controls, LUCs, and Monitoring**	***In Situ* Source Treatment, Containment, Surface Controls, LUCs, and Monitoring**	**Excavation and Disposal, Treatment, LUCs, and Monitoring**	**Targeted Excavation and Disposal, Containment, Surface Controls, Treatment, LUCs, and Monitoring**
No action	LUCs • Physical Controls • Admini-strative Controls Monitoring • Ground-water Monitoring	Containment • Caps • Hydraulic Isolation Surface Controls • Surface Barriers LUCs • Physical Controls • Admini-strative Controls Monitoring • Ground-water Monitoring	Treatment • Biological • Physical/ Chemical • Thermal • Chemical Containment • Caps • Hydraulic Isolation Surface Controls • Surface Barriers LUCs • Physical Controls • Administrative Controls	Removal • Excavation Disposal • Landfill Disposal Treatment • Biological • Physical/ Chemical • Thermal • Chemical LUCs • Physical Controls • Administrative Controls Monitoring • Groundwater	Removal • Excavation Disposal • Landfill Disposal Containment • Caps • Hydraulic Isolation Surface Controls • Surface Barriers Treatment • Biological • Physical/ Chemical • Thermal • Chemical

Table ES.9. Summary of General Alternatives (Continued)

General Alternative 1	General Alternative 2	General Alternative 3	General Alternative 4	General Alternative 5	General Alternative 6
No action (continued)			Monitoring • Groundwater Monitoring	Monitoring	LUCs • Physical Controls • Administrative Controls Monitoring • Groundwater Monitoring

The six general alternatives were screened (using effectiveness, implementability, and cost as criteria) to limit the number of alternatives to be subjected to detailed analysis. Table ES.10 identifies the alternatives that are retained for detailed analysis for each SWMU.

Table ES.10. Summary of General Alternatives Retained and Eliminated

General Alternatives	**SWMU 2**	**SWMU 3**	**SWMU 7**	**SWMU 30**
1. No Action	Retained	Retained	Retained	Retained
2. Limited Action (LUCs and Monitoring)	Eliminated	Eliminated	Eliminated	Eliminated
3. Containment, Surface Controls, LUCs, and Monitoring • Recognizes existing Subtitle C cap at SWMU 3	Retained	Retained	Eliminated	Retained
4. *In Situ* Source Treatment, Containment, Surface Controls, LUCs, and Monitoring	Retained	Eliminated	Retained	Eliminated
5. Excavation and Disposal, Treatment, LUCs, and Monitoring • Includes treatment beneath excavation as applicable • Includes evaluation of disposal off-site and at a potential OSWDF • Attainment of unlimited use/unrestricted exposure (UU/UE) would preclude the need for LUCs	Retained	Retained	Retained	Retained
6. Targeted Excavation, Treatment, Disposal, Containment, Surface Controls, LUCs, and Monitoring • Includes treatment beneath excavation as applicable • Includes evaluation of disposal off-site and at a potential OSWDF	Retained	Eliminated	Eliminated	Eliminated

REMEDIAL ALTERNATIVES EVALUATION

This FS identifies a range of remedial alternatives that address the threats from SWMUs 2, 3, 7, and 30. EPA guidance (EPA/540/G-89/004 at page 4-7) states that alternatives for source control actions should range from one that would eliminate, to the extent feasible, long-term management, to one that would use treatment as a primary component to address principal threats. The guidance also requires inclusion of one or more alternatives that involve containment of the waste with little or no treatment, as well as a No Action alternative.

A multistep screening process is performed in this FS using SWMU-specific conditions to screen containment and treatment options to give the broadest consideration of technologies while developing and screening alternatives on a SWMU-by-SWMU basis. As previously described, the general alternatives developed in Section 3 are screened using the process described in EPA (1988) and the National Contingency Plan (NCP) to reduce the number of general alternatives and specific process options carried forward to detailed analysis. In the SWMU-specific sections, the retained alternatives and alternative elements are assembled into SWMU-specific alternatives to address conditions present at each SWMU.

Once assembled, SWMU-specific alternatives were analyzed in detail and compared based on the CERCLA evaluation criteria. Overall protection of human health and the environment and compliance with ARARs (in the absence of a CERCLA waiver) are categorized as threshold criteria that any viable alternative must meet. Long-term effectiveness and permanence; reduction of toxicity, mobility, and volume through treatment; short-term effectiveness; implementability; and cost are considered primary balancing criteria upon which the detailed analysis is primarily based. State and community acceptance are considered modifying criteria and are evaluated following state and community comments on the RI/FS report and the proposed plan. State and community comments may prompt a modification to the preferred alternative presented in the proposed plan. Table ES.9 identifies the alternatives that were analyzed in detail for each BGOU SWMU.

The summaries of the comparative analysis of alternatives are presented in Tables ES.11 through ES.14 for SWMUs 2, 3, 7, and 30, respectively.

Table ES.11. SWMU 2 Comparative Analysis

Criteria	Analysis
Overall Protection of Human Health and the Environment	• The No Action alternative does not meet the overall protection criterion. • All action alternatives meet the overall protection criterion.
Compliance with ARARs	
• Action-Specific ARARs	• No ARARs are identified for the no action alternative. • All action alternatives can meet ARARs.
• Chemical-Specific ARARs	• No chemical-specific ARARs are identified for any of the alternatives.
• Location-Specific ARARs	• Implementation of all action alternatives will require that a wetlands survey be performed; if wetlands are found, then location-specific ARARs will be met.
Long-Term Effectiveness and Permanence	
• Magnitude of Residual Risk	• Alternative 5 provides the greatest degree of residual risk reduction by removing the buried wastes and contaminated soils that exceed remediation goals (RGs) and by using chemical injection to treat the soils below/under the burial cells. Chemical injection would destroy TCE and immobilize uranyl fluoride. • Alternative 6 provides less residual risk reduction than Alternative 5 by removing a portion of the buried waste (i.e., the burial cells containing the known, mobile, PTW TCE, and uranyl fluoride from cells 6, 8, and 9); by using chemical injection to treat the soils below/under the burial cells; and by leaving the remaining buried waste and contaminated soils in place and mitigating risks to groundwater and direct contact with a Subtitle C cap. ZVI injection would destroy TCE and immobilize uranyl fluoride. • Alternatives 4 (SS) and 4 (CI) provide less residual risk reduction than Alternatives 5 and 6 by leaving the buried waste and contaminated soils in place and mitigating risks to groundwater and direct contact with a Subtitle C cap and by treating the soils below/under the burial cells. • Alternative 3 provides the least residual risk reduction by leaving the buried waste and contaminated soils in place and mitigating risks to groundwater and direct contact with a Subtitle C cap (with no excavation and no *in situ* treatment). • Cleanup will achieve RGs. If Alternative 5 does not support UU/UE, then a deed restriction would be implemented (contingent on property transfer) that restricts residential use. Alternatives 3, 4 (SS), 4 (CI), and 6 will not support UU/UE; LUCs would be implemented to restrict certain uses to ensure the remedy remains protective, and groundwater monitoring would be conducted.
• Need for Five-Year Review	• Alternative 5 removes waste; therefore, five-year reviews will be required if the remedy does not support UU/UE. • Alternatives 3, 4 (SS), 4 (CI), and 6 contain waste in place, and will not support UU/UE; therefore, five-year reviews would be necessary.

Table ES.11. SWMU 2 Comparative Analysis (Continued)

Criteria	Analysis
• Adequacy and Reliability of Controls	• Alternative 5 removes waste to meet RGs; if this alternative does not support UU/UE, then a deed restriction would be implemented (contingent on property transfer) that restricts residential use. • Alternatives 3, 4 (SS), 4 (CI), and 6 leave waste in place and therefore rely on LUCs to a greater degree than does Alternative 5.
Reduction of Toxicity, Mobility, or Volume through Treatment	• Alternative 4 (SS) stabilizes all wastes through the injection of cement grout in overlapping columns to form a monolithic block. While this will not destroy the COCs present, it will limit their mobility severely, thus mitigating risk to the RGA. Alternative 4 (SS) meets the statutory preference for treatment because all waste in the disposal area will be treated through stabilization/solidification. • Alternative 4 (CI) targets the mobile COCs for chemical injection. It does not, however, reduce the toxicity, mobility or volume of PCBs or uranium metal. Alternative 4 (CI), partially meets the statutory preference for treatment because only the mobile wastes at cells 6, 8, and 9 would be treated. • Alternatives 3, 4 (SS), 4 (CI), and 6 include groundwater extraction, which will mitigate the potential for COCs migrating to the RGA and provide a treatment of extracted groundwater. • Alternatives 5 and 6 remove waste, and treatment will be performed if necessary to meet the waste acceptance criteria (WAC) of the receiving facilities. If treatment is required, then these alternatives would meet the statutory preference for treatment. • Alternatives 1 and 3 do not include treatment, so they do not meet the statutory preference for treatment.
Short-Term Effectiveness	
• Protection of Community during Remedial Actions	• None of the alternatives present significant impact to the community.
• Protection of Workers during Remedial Actions	• Alternatives 3, 4 (SS), and 4 (CI) leave waste in place and do not place workers in contact with waste or contaminated soil. Protection of workers during implementation of these alternatives would largely entail protection against the physical hazards largely associated with heavy equipment operations during cap construction. Also, protection of workers during implementation of Alternatives 4 (SS) and 4 (CI) would entail protection against the chemical hazards associated with the treatment chemicals plus physical hazards associated with delivery/placement of the treatment phase. All of these hazards can be mitigated through work control practices such as engineering controls, physical controls, administrative controls, training, and personal protective equipment (PPE). • Alternatives 5 and 6 include excavation of the buried wastes and contaminated soils. Protection of workers during implementation of these alternatives is more complex because workers could be exposed during excavation and waste handling activities, but these hazards can be mitigated through work control practices such as engineering controls, physical controls, administrative controls, training, and PPE. Protection of workers during implementation of these alternatives also would entail protection against the physical hazards largely associated with heavy equipment operations.

Table ES.11. SWMU 2 Comparative Analysis (Continued)

Criteria	Analysis
• Environmental Impacts	• None of the action alternatives present significant environmental impacts.
Implementability	
• Ability to Construct and Operate Technology	• All construction means and methods are proven technologies and routinely used at other DOE sites as well as in private industry. The following process options have been implemented at PGDP: ERH, pump-and-treat (P&T), capping, monitoring, and LUCs.
• Reliability of Technology	• The evaluated technologies are highly reliable and in common use.
• Ease of Undertaking Additional Remediation	• Alternative 5 removes waste, so any additional remediation activities would not be impacted. • All other alternatives leave buried waste and contaminated soil in place, so any additional remediation activities may be impacted by the presence of the waste/contaminants and/or the cap and riprap; but they would not prevent additional remediation.
• Monitoring Considerations	• There are no impediments to monitoring; however, all action alternatives recognize the difficulties and limitations of monitoring in commingled plume conditions that exist at SWMU 2.
• Coordination with Other Agencies	• Agency coordination with EPA and KY will follow the FFA. No new agencies will be involved.
• Availability of Equipment and Specialists	• All equipment and specialists are commercially available.
Cost	The following analysis is based on the net present value costs (EPA 1988) for 1,000 years (EPA 2000). • The cost for Alternative 3 ($22M) is less than the costs for the other alternatives. • The costs for Alternative 4 (SS) ($32M) and Alternative 4 (CI) ($26M) are less than the costs for Alternative 5 ($100M) and Alternative 6 ($41M) without an OSWDF available. • The costs for Alternative 4 (SS) ($32M) and Alternative 4 (CI) ($26M) are less than the costs for Alternative 5 ($58M) and Alternative 6 ($34M) if an OSWDF is available. With or without an OSWDF available, the capital costs for Alternative 3, Alternative 4 (SS), and Alternative 4 (CI) are less than the capital costs for Alternative 5 and Alternative 6, but the average annual O&M costs for Alternative 5 are less than the average annual O&M costs for the other alternatives.

Table ES.12. SWMU 3 Comparative Analysis

Criteria	Analysis
Overall Protection of Human Health and the Environment	• The No Action alternative does not meet the overall protection criterion. • All action alternatives meet the overall protection criterion.
Compliance with ARARs	
• Action-Specific ARARs	• No ARARs are identified for the No Action alternative. • All action alternatives can meet ARARs.
• Chemical-Specific ARARs	• No chemical-specific ARARs are identified for any of the alternatives.
• Location-Specific ARARs	• Implementation of all alternatives will require that a wetlands survey be performed; if wetlands are found, then location-specific ARARs will be met.
Long-Term Effectiveness and Permanence	
• Magnitude of Residual Risk	• Alternative 5 provides the greatest degree of residual risk reduction by removing the buried wastes and contaminated soils that exceed RGs. • Alternative 3 provides less residual risk reduction (i.e., less than Alternative 5) by leaving the buried waste and contaminated soils in place and mitigating risks to groundwater and direct contact with the existing cap and adding a layer of riprap. • Cleanup will achieve RGs. If Alternative 5 does not support UU/UE, then a deed restriction would be implemented (contingent on property transfer) that restricts residential use. Alternative 3 will not support UU/UE; LUCs would be implemented to restrict certain uses to ensure the remedy remains protective, and groundwater monitoring would be conducted.
• Need for Five-Year Review	• Alternative 5 removes waste; therefore, five-year reviews will be required if the remedy does not support UU/UE. • Alternative 3 contains waste in place and will not support UU/UE; therefore, five-year reviews would be necessary.
• Adequacy and Reliability of Controls	• Alternative 5 removes waste to meet RGs; if this alternative does not support UU/UE, then a deed restriction would be implemented (contingent on property transfer) that restricts residential use. • Alternative 3 leaves waste in place and therefore relies on LUCs to a greater degree than does Alternative 5.

Table ES.12. SWMU 3 Comparative Analysis (Continued)

Criteria	Analysis
Reduction of Toxicity, Mobility, or Volume through Treatment	• Alternative 5 may require that a portion of the excavated waste be treated if necessary to meet the receiving facility's WAC prior to disposal. Alternative 5 removes PTW from the site. • Alternative 3 would not reduce the toxicity, mobility, or volume through treatment. Alternative 3 contains PTW in place.
Short-Term Effectiveness	
• Protection of Community during Remedial Actions	• None of the alternatives present significant impact to the community.
• Protection of Workers during Remedial Actions	• Alternative 3 leaves waste in place and does not place workers in contact with waste or contaminated soil. Protection of workers during implementation of this alternative largely would entail protection against the physical hazards largely associated with heavy equipment operations during cap construction. • Alternative 5 includes excavation of the buried wastes and contaminated soils. Protection of workers during implementation of this alternative is more complex because workers could be exposed during excavation and waste handling activities, but these hazards can be mitigated through work control practices such as engineering controls, physical controls, administrative controls, training, and PPE. Protection of workers during implementation of these alternatives also would entail protection against the physical hazards largely associated with heavy equipment operations.
• Environmental Impacts	• None of the alternatives presents significant environmental impacts.
Implementability	
• Ability to Construct and Operate Technology	• All construction means and methods are proven technologies and routinely used at other DOE sites as well as in private industry. The following process options have been implemented at PGDP: capping, monitoring, and LUCs.
• Reliability of Technology	• The evaluated technologies are highly reliable and in common use.
• Ease of Undertaking Additional Remediation	• Alternative 5 removes waste and contaminated soil, so any additional remediation activities would not be impacted. • Alternative 3 leaves buried waste and contaminated soil in place and includes construction of a cap, so any additional remediation activities may be impacted by the presence of the waste/contaminants and/or the cap.
• Monitoring Considerations	• Alternative 3 includes groundwater monitoring. There are no impediments to monitoring implementation; however, the difficulties and limitations of monitoring in commingled plume conditions that exist at SWMU 3 are recognized.
• Coordination with Other Agencies	• Agency coordination with EPA and KY will follow the FFA. No new agencies are involved.
• Availability of Equipment and Specialists	• All equipment and specialists are commercially available.

Table ES.12. SWMU 3 Comparative Analysis (Continued)

Criteria	Analysis
Cost	The following analysis is based on the net present value costs (EPA 1988) for 1,000 years (EPA 2000). • The cost for Alternative 3 ($15M) is significantly less than the cost for Alternative 5 ($130M) without an OSWDF available. • The cost for Alternative 3 ($15M) is less than the cost for Alternative 5 ($42M) if an OSWDF is available. The capital cost for Alternative 3 is less than the capital cost for Alternative 5 (with or without an OSWDF available), but the average annual O&M cost for Alternative 5 is less than the average annual O&M cost for Alternative 3.

Table ES.13. SWMU 7 Comparative Analysis

Criteria	Analysis
Overall Protection of Human Health and the Environment	• The No Action alternative does not meet the overall protection criterion. • All action alternatives meet the overall protection criterion.
Compliance with ARARs	
• Action-Specific ARARs	• No ARARs are identified for the No Action alternative. • All action alternatives can meet ARARs.
• Chemical-Specific ARARs	• No chemical-specific ARARs are identified for any of the alternatives.
• Location-Specific ARARs	• Implementation of all action alternatives will require that a wetlands survey be performed. If wetlands are found, then location-specific ARARs will be met.
Long-Term Effectiveness and Permanence	
• Magnitude of Residual Risk	• Alternatives 5 (P&T) and 5 (ERH) provide the greatest degree of residual risk reduction by removing the buried wastes and contaminated soils that exceed RGs and by using P&T/ERH to extract the TCE PTW source material. Alternative 5 (P&T) mitigates the uncertainty associated with the limited characterization of the TCE PTW source zone; Alternative 5 (ERH) would extract the TCE PTW source material from the source zone more aggressively to achieve RGs more quickly. • Alternatives 4 (P&T) and 4 (ERH) provide less residual risk reduction [i.e., less than Alternatives 5 (P&T) or 5 (ERH)] by leaving the buried waste and contaminated soils in place and mitigating risks to groundwater and direct contact with a KY Subtitle D cap. • Cleanup will achieve RGs. If Alternatives 5 (P&T) or 5 (ERH) does not support UU/UE, then a deed restriction would be implemented (contingent on property transfer) that restricts residential use. Alternatives 4 (P&T) and 4 (ERH) will not support UU/UE; LUCs would be implemented to restrict certain uses to ensure the remedy remains protective, and groundwater monitoring would be conducted.
• Need for Five-Year Review	• Alternatives 5 (P&T) and 5 (ERH) remove waste; therefore, five-year reviews may be required if remedy does not support UU/UE. • Alternatives 4 (P&T) and 4 (ERH) contain waste in place and will not support UU/UE; therefore, five-year reviews would be necessary.
• Adequacy and Reliability of Controls	• Alternatives 5 (P&T) and 5 (ERH) remove waste to meet RGs; if these alternatives do not support UU/UE, then a deed restriction would be implemented (contingent on property transfer) that restricts residential use. • Alternatives 4 (P&T) and 4 (ERH) leave waste in place; therefore, these rely on LUCs to a greater degree than do Alternatives 5 (P&T) and 5 (ERH).

Table ES.13. SWMU 7 Comparative Analysis (Continued)

Criteria	Analysis
Reduction of Toxicity, Mobility, or Volume through Treatment	• All action alternatives extract and treat TCE. • Alternatives 5 (P&T) and 5 (ERH) remove waste and may require some treatment of wastes to meet the disposal facility WAC. • All action alternatives extract and treat TCE PTW source material for groundwater protection.
Short-Term Effectiveness	
• Protection of Community during Remedial Actions	• None of the action alternatives present significant impact to the community.
• Protection of Workers during Remedial Actions	• Alternatives 4 (P&T) and 4 (ERH) leave waste in place and do not place workers in contact with waste or contaminated soil. Protection of workers during implementation of these alternatives would largely entail protection against the physical hazards largely associated with heavy equipment operations during cap construction. • Alternatives 5 (P&T) and 5 (ERH) include excavation of the buried wastes and contaminated soils. Protection of workers during implementation of these alternatives is more complex because workers could be exposed during excavation and waste handling activities, but these hazards can be mitigated through work control practices such as engineering controls, physical controls, administrative controls, training, and PPE. Protection of workers during implementation of these alternatives also would entail protection against the physical hazards largely associated with heavy equipment operations. • All action alternatives include extraction and treatment of contaminated water. Protection of workers during implementation of water extraction and treatment can be mitigated through work control practices such as engineering controls, physical controls, administrative controls, training, and PPE.
• Environmental Impacts	• None of the action alternatives presents significant environmental impacts.
Implementability	
• Ability to Construct and Operate Technology	• All construction means and methods are proven technologies and routinely used at other DOE sites as well as in private industry. The following process options have been implemented at PGDP: ERH, P&T, capping, monitoring, and LUCs.
• Reliability of Technology	• The evaluated technologies are highly reliable and in common use.
• Ease of Undertaking Additional Remediation	• Alternatives 5 (P&T) and 5 (ERH) remove waste and the TCE source material. Any additional remediation activities would not be impacted. • Alternative 4 (P&T) and 4 (ERH) leave buried waste and contaminated soil in place and remove TCE source material, so any additional remediation activities may be impacted by the presence of the waste/contaminants and/or the cap.

Table ES.13. SWMU 7 Comparative Analysis (Continued)

Criteria	Analysis
• Monitoring Considerations	• There are no impediments to monitoring implementation. • All action alternatives recognize the difficulties and limitations of monitoring in commingled plume conditions that exist at SWMU 7.
• Coordination with Other Agencies	• Agency coordination with EPA and KY will follow the FFA. No new agencies will be involved.
• Availability of Equipment and Specialists	• All equipment and specialists are commercially available.
Cost	The following analysis is based on the net present value costs (EPA 1988) for 1,000 years (EPA 2000). • The costs for Alternative 4 (P&T) ($37M) and Alternative 4 (ERH) ($80M) are much less than the costs for Alternative 5 (P&T) ($172M) and Alternative 5 (ERH) ($216M) without an OSWDF available. • If an OSWDF is available, the costs for Alternative 4 (P&T) ($37M) and Alternative 4 (ERH) ($80M) are less than the costs for Alternative 5 (P&T) ($65M) and Alternative 5 (ERH) ($108M), respectively. With or without an OSWDF available, the capital costs for Alternative 4 (P&T) and Alternative 4 (ERH) are less than the capital cost for Alternative 5 (P&T) and Alternative 5 (ERH), but the average annual O&M costs for Alternative 5 (P&T) and Alternative 5 (ERH) are less than the average annual O&M costs for Alternative 4 (P&T) and Alternative 4 (ERH).

Table ES.14. Summary of SWMU 30 Detailed Analysis

Criteria	Analysis
Overall Protection of Human Health and the Environment	• The No Action alternative does not meet the overall protection criterion. • All action alternatives meet the overall protection criterion.
Compliance with ARARs	
• Action-Specific ARARs	• No action-specific ARARs are identified for the No Action alternative. • All action alternatives can meet ARARs.
• Chemical-Specific ARARs	• No chemical-specific ARARs are identified for any of the alternatives.
• Location-Specific ARARs	• Implementation of all action alternatives will require that a wetlands survey be performed. If wetlands are found, then location-specific ARARs will be met.
Long-Term Effectiveness and Permanence	
• Magnitude of Residual Risk	• Alternative 5 provides the greatest degree of residual risk reduction by removing the buried wastes and contaminated soils that exceed RGs. • Alternative 3 provides less residual risk reduction (i.e., less than Alternative 5) by leaving the buried waste and contaminated soils in place and mitigating risks to groundwater and direct contact with a KY Subtitle D cap. • Cleanup will achieve RGs. If Alternative 5 does not support UU/UE, then a deed restriction would be implemented (contingent on property transfer) that restricts residential use. Alternative 3 will not support UU/UE; LUCs would be implemented to restrict certain uses to ensure the remedy remains protective, and groundwater monitoring would be conducted.
• Need for Five-Year Review	• Alternative 5 removes waste; therefore, five-year reviews may be required if remedy does not support UU/UE. • Alternative 3 contains waste in place and will not support UU/UE; therefore, five-year reviews would be necessary.
• Adequacy and Reliability of Controls	• All remedies may rely on continuation of LUCs selected as part of the CERCLA remedy. Alternative 5 removes waste to meet RGs; if this alternative does not support UU/UE, then a deed restriction would be implemented (contingent on property transfer) that restricts residential use. • Alternative 3 leaves waste in place and, therefore, relies on controls to a greater degree than does Alternative 5.

Table ES.14. SWMU 30 Comparative Analysis (Continued)

Criteria	Analysis
Reduction of Toxicity, Mobility, or Volume through Treatment	• Neither Alternatives 3 nor 5 reduces the toxicity, mobility or volume through treatment. Alternative 5 may require that a limited amount of waste be treated to meet WAC requirements prior to disposal. • No PTW is identified at SWMU 30.
Short-Term Effectiveness	
• Protection of Community during Remedial Actions	• None of the action alternatives present significant impact to the community.
• Protection of Workers during Remedial Actions	• Alternative 3 leaves waste in place and does not place workers in contact with waste or contaminated soil. Protection of workers during implementation of this alternative largely would entail protection against the physical hazards mainly associated with heavy equipment operations during cap construction. • Alternative 5 includes excavation of the buried wastes and contaminated soils. Protection of workers during implementation of this alternative is more complex because workers could be exposed during excavation and waste handling activities, but these hazards can be mitigated through work control practices, such as engineering controls, physical controls, administrative controls, training, and PPE. Protection of workers during implementation of these alternatives also would entail protection against the physical hazards largely associated with heavy equipment operations.
• Environmental Impacts	• None of the action alternatives presents significant environmental impacts.
Implementability	
• Ability to Construct and Operate Technology	• All construction means and methods are proven technologies and routinely used at other DOE sites as well as in private industry. The following process options have been implemented at PGDP: ERH, P&T, capping, monitoring, and LUCs.
• Reliability of Technology	• The evaluated technologies are highly reliable and in common use.
• Ease of Undertaking Additional Remediation	• Alternative 5 removes waste and contaminated soil, so any additional remediation activities would not be impacted. • Alternative 3 leaves buried waste and contaminated soil in place and includes construction of a cap, so any additional remediation activities may be impacted by the presence of the waste/contaminants and/or the cap.

Table ES.14. SWMU 30 Comparative Analysis (Continued)

Criteria	Analysis
• Monitoring Considerations	• Alternative 3 includes groundwater monitoring. There are no impediments to monitoring implementation; however, the difficulties and limitations of monitoring in commingled plume conditions that exist at SWMU 30 are recognized.
• Coordination with Other Agencies	• Agency coordination with EPA and KY will follow the FFA. No new agencies will be involved.
• Availability of Equipment and Specialists	• All equipment and specialists are available commercially.
Cost	The following analysis is based on the net present value costs (EPA 1988) for 1,000 years (EPA 2000). • The cost for Alternative 3 ($11M) is much less than the cost for Alternative 5 ($45M) without an OSWDF available. • The cost for Alternative 3 ($11M) is roughly equivalent to the cost for Alternative 5 ($14M) if an OSWDF is available. The capital cost for Alternative 3 is less than the capital cost for Alternative 5, but the average annual O&M cost for Alternative 5 is less than the average annual O&M cost for Alternative 3.

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1. INTRODUCTION

This *Feasibility Study for Solid Waste Management Units 2, 3, 7, and 30 of the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-1274&D2/R1 (FS), was prepared to evaluate remedial alternatives for Solid Waste Management Units (SWMUs) 2, 3, 7, and 30 at the Burial Grounds Operable Unit (BGOU) in support of remedy selection under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) at the Paducah Gaseous Diffusion Plant (PGDP). This work was prepared in accordance with the requirements of the *Federal Facility Agreement for the Paducah Gaseous Diffusion Plant* (FFA) (EPA 1998a). Only SWMUs 2, 3, 7, and 30 are addressed in this D2 FS. Other SWMUs and source areas within the BGOU are addressed in separate documents.

This introduction explains the BGOU and the purpose and organization of the report. It provides background information and the regulatory framework for this FS. Site and area-specific descriptions are provided, including land use, demographics, climate, air quality, noise, ecological resources, and cultural resources. An overview also is provided of the topography, surface water hydrology, geology, and hydrogeology of the region and the study area. Previous investigations of the BGOU are discussed, as is a conceptual site model (CSM) summarizing the nature and extent of contamination and fate and transport modeling of selected contaminants of concern (COCs). Additional sections in this FS address the potential threat from direct contact with the waste buried within SWMUs 2, 3, 7, and 30, as well as a range of remedial alternatives that are protective of the public and future workers.

1.1 SCOPE OF THE BGOU

The BGOU at PGDP is one of five media-specific, sitewide operable units (OUs) associated with pre-shutdown efforts to evaluate and implement remedial actions. A final Comprehensive Site OU evaluation will be conducted following plant shutdown and completion of pre- and post-shutdown actions to ensure long-term protectiveness of human health and the environment. The five media-specific, strategic cleanup initiatives that have been agreed upon by the U.S. Department of Energy (DOE), U.S. Environmental Protection Agency (EPA), and the Commonwealth of Kentucky (KY), as documented in the current *Site Management Plan* (SMP) (DOE 2015), are as follows:

- Groundwater OU Strategic Initiative
- Burial Grounds OU Strategic Initiative
- Surface Water OU Strategic Initiative
- Soils OU Strategic Initiative
- Decontamination and Decommissioning OU Strategic Initiative

The BGOU consists of contamination associated with PGDP's landfills and burial grounds as listed in Table 1.1. The CERCLA remedial process is employed at the BGOU. In general, the contents of the burial grounds upon excavation and characterization for disposal may include Resource Conservation and Recovery Act (RCRA) hazardous waste, polychlorinated biphenyl (PCB) waste, and low-level waste (LLW). This waste may include low-level threat waste (LLTW) and principal threat waste (PTW) and affected media (see Section 1.3.3). PTW is defined by EPA as "source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur" (EPA 1991a). The National Contingency Plan (NCP) [as promulgated at 40 *CFR* § 300.30(a)(iii)(A)] states that EPA expects to use treatment to address principal threats posed by PTW, where practicable.

Table 1.1. BGOU Source Areas and Solid Waste Management Units

SWMU No.	Description
2*	**C-749 Uranium Burial Grounds**
3*	**C-404 Low-Level Radioactive Waste Burial Grounds**
4	C-747 Contaminated Burial Yard and C-748-B Burial Area
5	C-746-F Burial Yard
6	C-747-B Burial Grounds
7*	**C-747-A Burial Grounds**
30*	**C-747-A Burn Area**
145 (9 and 10)	Area P and C-746-S and C-746-T Landfills

***Bold** indicates SWMU addressed in this FS.

The scope of the BGOU FS includes evaluating actions as necessary to protect human health and the environment from the waste units and addressing potential releases from these source areas that may impact Regional Gravel Aquifer (RGA) groundwater or adjacent drainageways. Remedial decisions for sediments within the BGOU SWMUs fall primarily within the scope of the Surface Water OU. The Groundwater OU will address dissolved-phase groundwater contamination in the RGA.

1.2 PURPOSE AND ORGANIZATION OF FS REPORT

Under a work plan approved by EPA and KY (DOE 2006), DOE conducted a Remedial Investigation (RI), which was the continuation of earlier investigative activities, to evaluate source areas of contamination associated with PGDP's landfills and burial grounds. Results of the RI were reported in the *Remedial Investigation Report for the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0030&D2/R1 (DOE 2010b). This report included a baseline human health risk assessment (BHHRA) that evaluated the full range of BGOU-related risks to human health, and a screening ecological risk assessment (SERA) that evaluated impacts to the environment under a range of potential exposure scenarios associated with current and future land use.

Following approval of the RI, an FS was prepared that addresses each of the BGOU SWMUs, the latest version of which is the *Feasibility Study for the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0130&D2, submitted in December 2010 (DOE 2010a). Following review and discussion of that document by the FFA parties, it was agreed that the BGOU FS should be subdivided into focused groupings with a separate FS covering SWMUs 2, 3, 7, and 30; therefore, this document, DOE/LX/07-1274&D2/R1, addresses SWMUs 2, 3, 7, and 30. The other SWMUs and source areas in the BGOU are addressed in separate documents.

This FS was prepared in accordance with NCP requirements and is consistent with EPA RI/FS guidance to support CERCLA remedy selection. In accordance with Section IV of the FFA, this integrated technical document was developed to satisfy applicable requirements of CERCLA (42 USC § 9601 *et seq*.) and RCRA (42 USC § 6901 *et seq*.). In addition to the EPA requirements, National Environmental Policy Act of 1969 (NEPA) values, consistent with the DOE's Secretarial Policy Statement on NEPA in June 1994 (DOE 1994a), are evaluated and documented in this FS. In consideration of the U.S. Department of the Interior's Natural Resource Damage Assessment (NRDA) and Restoration Program, the BGOU FS will be provided to trustee agencies for their review. It is DOE's policy to integrate natural resource concerns early into the investigation and remedy selection process to minimize unnecessary resource injury.

This FS also has been prepared in accordance with the Integrated FS/Corrective Measures Study Report outline prescribed in Appendix D of the FFA for PGDP, except for minor format changes. As such, this

FS is considered a primary document. All subsections contained in the referenced outline have been included for completeness. Additional subsections have been added to the outline, as appropriate, to provide clarity and enhance the organization of the document. The following are the sections of this FS:

Chapter 1—Introduction
Chapter 2—Identification and Screening of Technologies
Chapter 3—Development and Screening of General Alternatives
Chapter 4—Detailed and Comparative Analyses of Alternatives
Chapter 5—SWMU 2
Chapter 6—SWMU 3
Chapter 7—SWMU 7
Chapter 8—SWMU 30
Chapter 9—References

Appendix A—Information Supporting Evaluation of BGOU COCs

Appendix B—Development of Preliminary Soil Remediation Goals for Protection of Groundwater

Appendix C—Development of Preliminary Remediation Goals for Soil that Ensure Protection of Future Industrial and Future Excavation Workers

Appendix D—Reserved

Appendix E—Cost Estimates

Appendix F—Applicable or Relevant and Appropriate Requirements and To Be Considered Guidance

Appendix G—SWMU 3 RCRA Post-Closure Permit Conditions Summary

Appendix H—Analytical Data

1.3 BACKGROUND INFORMATION

The following subsections present background information concerning the site and regulatory setting at PGDP. They also provide a description of the PGDP region and source areas, as well as highlight key factors of the process history, nature and extent of contamination, migration potential, and risks associated with the source areas that provide the basis for screening technologies and remedial alternatives for SWMUs 2, 3, 7, and 30.

Additional details about SWMUs 2, 3, 7, and 30 are included in Sections 5, 6, 7, and 8, respectively.

1.3.1 PGDP Description

PGDP is located approximately 10 miles west of Paducah, KY, and 3.5 miles south of the Ohio River in the western part of McCracken County (Figure 1.1). The PGDP industrial area occupies approximately 650 acres of the DOE site and is surrounded by an additional 800-acre buffer zone. DOE licenses most of the remaining acreage to KY as part of the West Kentucky Wildlife Management Area (WKWMA). Tennessee Valley Authority's (TVA's) Shawnee Fossil Plant borders the DOE site to the northeast, between the plant and the Ohio River (Figure 1.2).

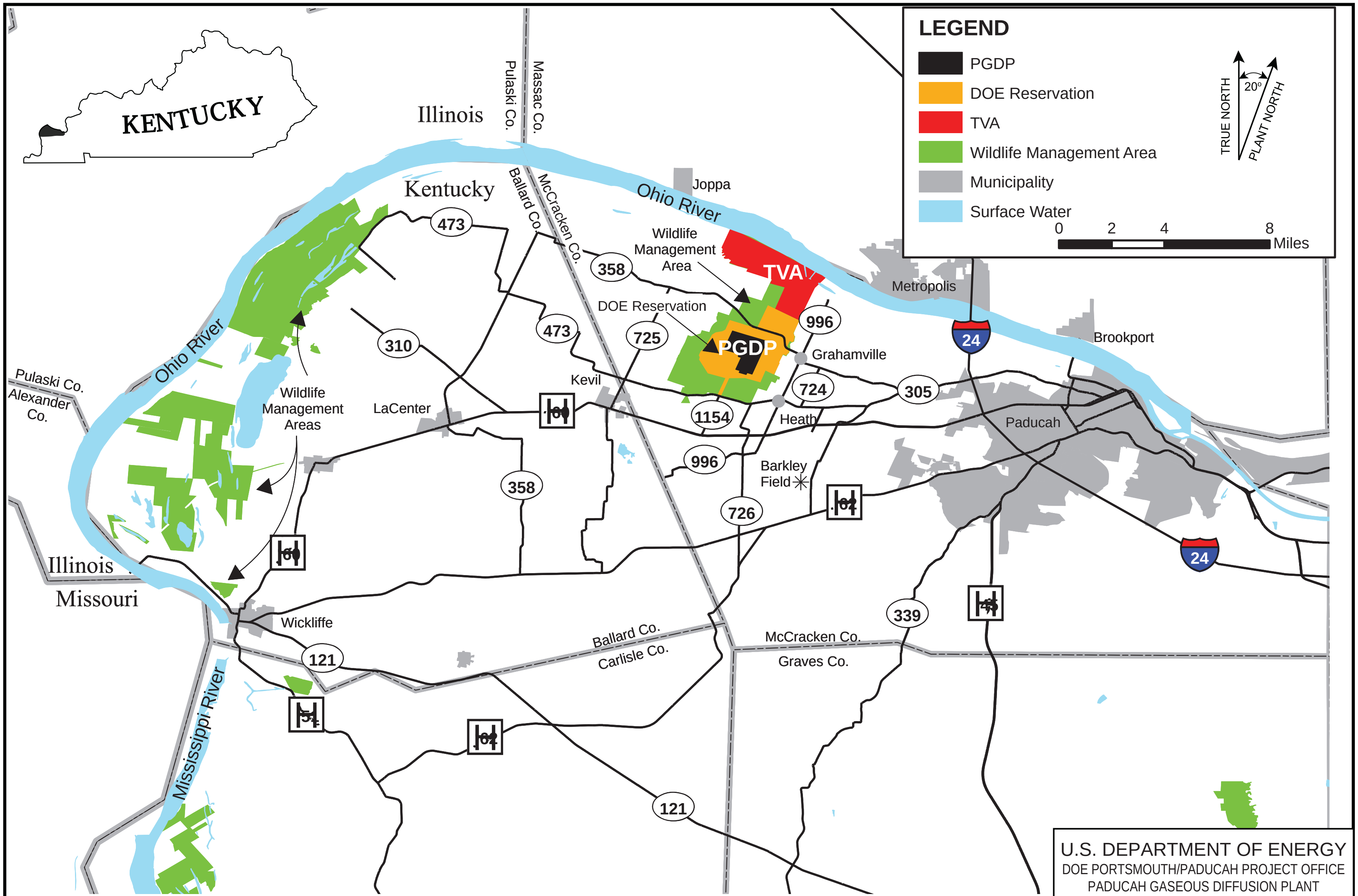

Figure 1.1. PGDP Site Location

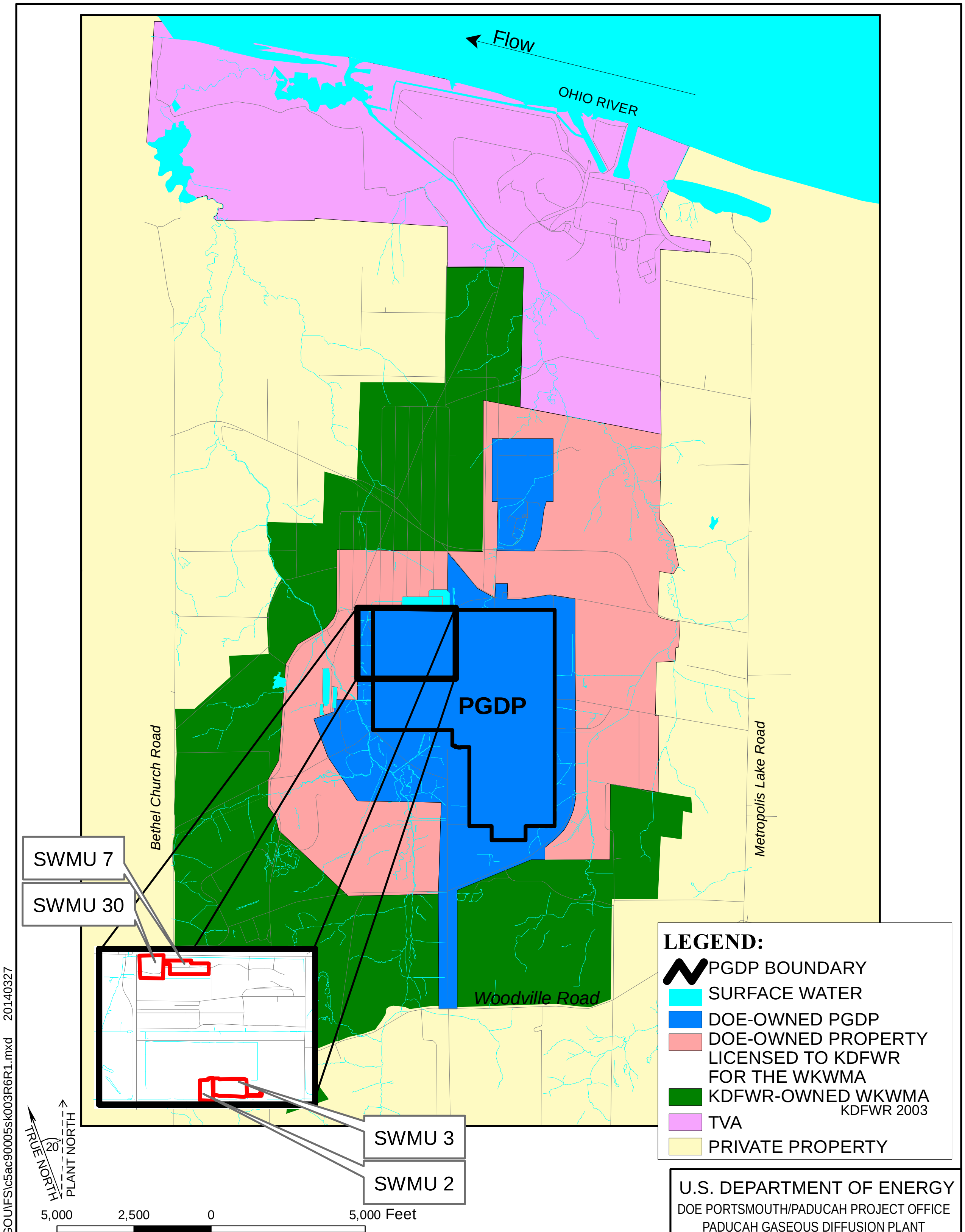

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Figure 1.2. PGDP Land Ownership Map

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Before the PGDP was built, a munitions-production facility, the Kentucky Ordnance Works (KOW), was operated at the current PGDP location and in adjoining areas southwest of the site. Munitions, including trinitrotoluene, were manufactured in an area southwest of PGDP and stored at the KOW between 1942 and 1945. The KOW was shut down immediately after World War II. Construction of PGDP was initiated in 1951, and the plant began operations in 1952. Construction was completed in 1955, and PGDP became fully operational in 1955, supplying enriched uranium for commercial reactors and military defense reactors.

PGDP was operated by Union Carbide Corporation until 1984, when Martin Marietta Energy Systems, Inc., (which later became Lockheed Martin Energy Systems, Inc.) was contracted to operate the plant for DOE. On July 1, 1993, DOE leased the plant production/operations facilities to the United States Enrichment Corporation; however, DOE maintains ownership of the plant and is responsible for environmental restoration. On April 1, 1998, Bechtel Jacobs Company LLC, replaced Lockheed Martin Energy Systems, Inc., in implementing the Environmental Management Program at PGDP. On April 23, 2006, Paducah Remediation Services, LLC, replaced Bechtel Jacobs Company LLC, in implementing the Environmental Management Program at PGDP. On July 26, 2010, LATA Environmental Services of Kentucky, LLC, replaced Paducah Remediation Services, LLC, in implementing the Environmental Management Program at PGDP.

Contamination as a result of PGDP operations has resulted in three dissolved-phase trichloroethene (TCE) plumes that are migrating from PGDP toward the Ohio River. These groundwater plumes are the Northwest Groundwater Plume (SWMU 201), the Northeast Groundwater Plume (SWMU 202), and the Southwest Plume (SWMU 210) (Figure 1.3). There also is a technetium-99 (Tc-99) plume that is consistent with the footprint of the TCE Northwest Groundwater Plume, but the high concentration Tc-99 plume is contained within the fenced area of the site. SWMUs 2, 3, 7, and 30 are not identified as significant sources for these plumes in *Trichloroethene and Technetium-99 Groundwater Contamination in the Regional Gravel Aquifer for Calendar Year 2012* (LATA Kentucky 2014). In this reference, the primary or significant source of the Northwest TCE Plume is at the C-400 Building, and the primary sources of the Southwest TCE Plume appear to be SWMUs 1 and 4.

1.3.1.1 Regulatory setting

This section summarizes the regulatory framework for environmental restoration at PGDP, including the major statutes and accompanying regulations driving response actions, such as CERCLA, RCRA, and NEPA. It also describes environmental programs and the documents controlling response actions such as the FFA and the SMP (DOE 2015). The scope of this action within the overall response strategy for PGDP is described.

1.3.1.1.1 Major statutes, regulations, and controlling documents

On June 30, 1994, EPA placed PGDP on the National Priorities List (NPL) [59 *Federal Register* (*FR*) 27989 (May 31, 1994)]. The NPL lists sites that are designated by EPA as high priority sites for remediation under CERCLA in accordance with CERCLA's NCP. As the lead agency under CERCLA, DOE is responsible for conducting cleanup activities at PGDP in compliance with NCP. CERCLA is not the only driver for cleanup at PGDP. RCRA requires corrective action for releases of hazardous constituents from SWMUs.

Section 120 of CERCLA requires federal facilities listed on the NPL to enter into an FFA. The FFA coordinates the CERCLA remedial action and RCRA corrective action process into a set of

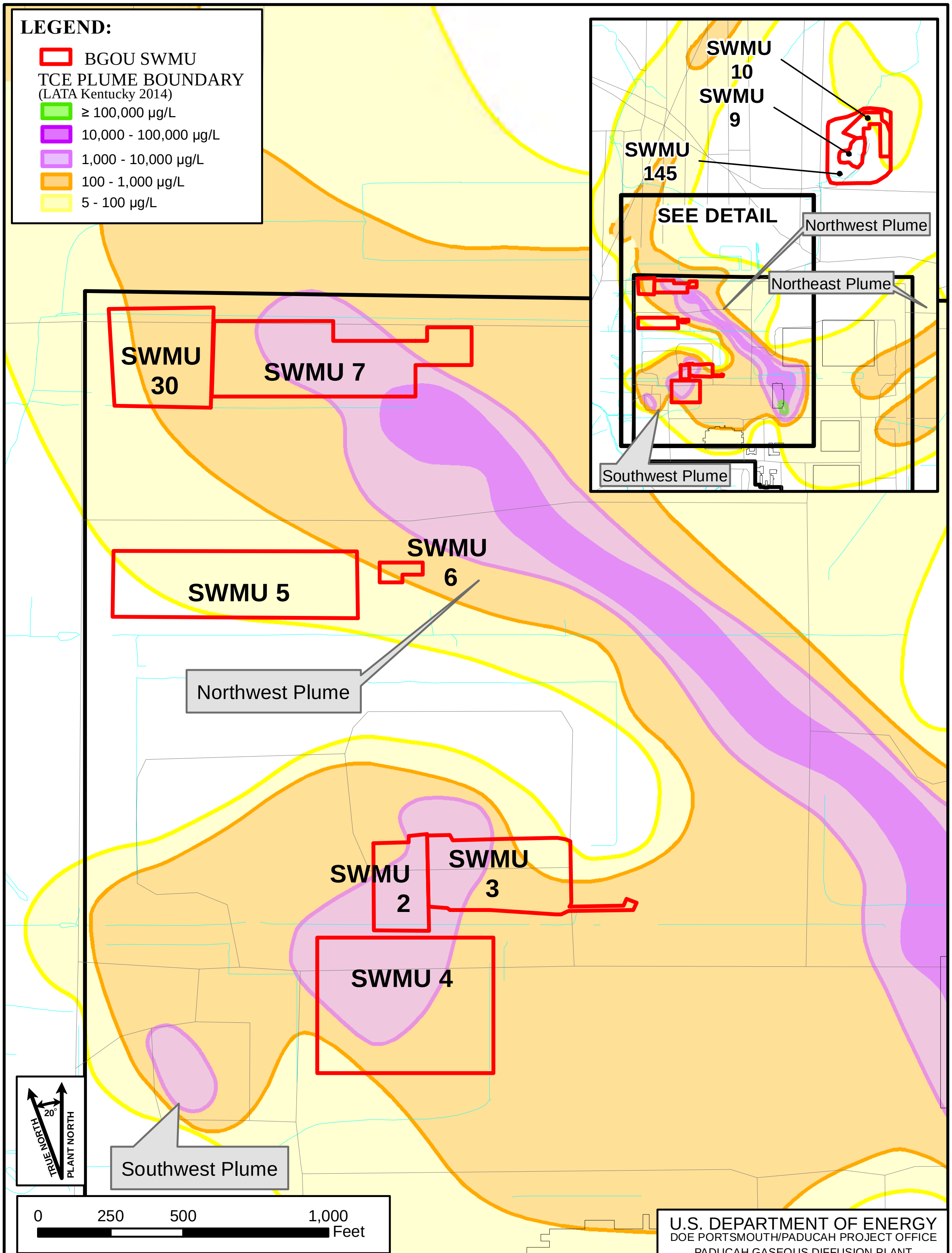

Figure 1.3 BGOU SWMUs in Relation to PGDP Groundwater Plumes

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comprehensive requirements for site remediation. Section XII of the PGDP FFA addresses FSs and includes the following requirement:

> At a minimum, an evaluation of alternative remedies (i.e., an FS) to address any Release shall be conducted when the circumstances listed below are present.
>
> - The Baseline Risk Assessment shows that the cumulative carcinogenic risk for an individual exposed to a given Release, based on a reasonable maximum exposure for both current and future land use, is greater than 10^{-6};
> - The Baseline Risk Assessment shows that the noncarcinogenic hazard quotient[1] for an individual exposed to a given Release, based on a reasonable maximum exposure for both current and future land use, is greater than 1;
> - The release has caused adverse environmental impacts;
> - Maximum contaminant levels (MCLs), non-zero MCL goals, or other chemical-specific applicable or relevant and appropriate requirements (ARARs) are exceeded; or
> - Other site-specific or release-specific circumstances warranting an evaluation of alternatives.

The FFA requires that DOE develop and submit an annual SMP to EPA and Kentucky Department for Environmental Protection (KDEP). The SMP outlines the programmatic framework for implementing the FFA.

1.3.1.1.2 Environmental programs

Environmental sampling at PGDP is a multimedia (air, water, soil, sediment, direct radiation, and biota) program of chemical, radiological, and ecological monitoring. Environmental monitoring consists of two activities: effluent monitoring and environmental surveillance. As part of the ongoing environmental activities, SWMUs and areas of concern have been identified under Section IX of the FFA. Characterization and/or remediation of these sites will continue pursuant to CERCLA and Hazardous and Solid Waste Amendments corrective action conditions of the RCRA Permit. RCRA corrective action requirements have been integrated through the FFA.

1.3.1.1.3 National Environmental Policy Act

The intent of NEPA is to promote a decision making process that results in minimization of adverse impacts to human health and the environment. On June 13, 1994, the Secretary of Energy issued a Secretarial Policy (Policy) on NEPA that addresses NEPA requirements for actions taken under CERCLA. Section II.E of the Policy indicates that DOE CERCLA documents will incorporate NEPA values, to the extent practicable, such as analysis of cumulative, off-site, ecological, cultural, and socioeconomic impacts.

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[1] The FFA uses the term hazard quotient; however, the intent of the text is the hazard index (HI).

1.3.1.2 Land use, demographics, surface features, and environment

1.3.1.2.1 Land use

The area of PGDP that includes SWMUs 2, 3, 7, and 30, is heavily industrialized. The area immediately beyond the secured industrial area is mostly agricultural and open land, with some forested areas (see Figure 1.4). TVA's Shawnee Fossil Plant, adjacent to the northeast border of the DOE Reservation, is the only other major industrial facility in the immediate area. PGDP is a posted government property and trespassing is prohibited. PGDP is an industrial facility. The future use scenario considered reasonable for SWMUs 2, 3, 7, and 30 is that of industrial (DOE 2015). The PGDP site includes 1,986 acres licensed to the Kentucky Department of Fish and Wildlife Resources. This area is part of the WKWMA and borders PGDP to the north, west, and south. The WKWMA is an important recreational resource for western Kentucky and is used by more than 10,000 people each year. Major recreational activities include hunting, field trials for dogs and horses, trail riding, fishing, and skeet shooting.

1.3.1.2.2 Demographics

Approximately 89,000 people live within the three counties that are included in the 10-mile radius of PGDP. The estimated population of Paducah, Kentucky, for 2009 was approximately 25,700. Metropolis, Illinois, had an estimated population in 2009 of approximately 6,500 (U.S. Census Bureau 2009). The closest communities to PGDP are the unincorporated towns of Grahamville [about 1.6 kilometers (1 mile) to the east] and Heath [about 1.6 kilometers (1 mile) southeast]. Current and anticipated future land use for PGDP and surrounding areas is depicted in Figure 1.5 and represents the future land use scenario from the PGDP SMP (DOE 2015).

As of 2012, major employers in the area of PGDP included the United States Enrichment Corporation (approximately 1,200 employees); Babcock & Wilcox Conversion Services, LLC (approximately 140 employees); DOE Environmental Management contractors (approximately 500 employees); and TVA's Shawnee Fossil Plant (approximately 260 employees).

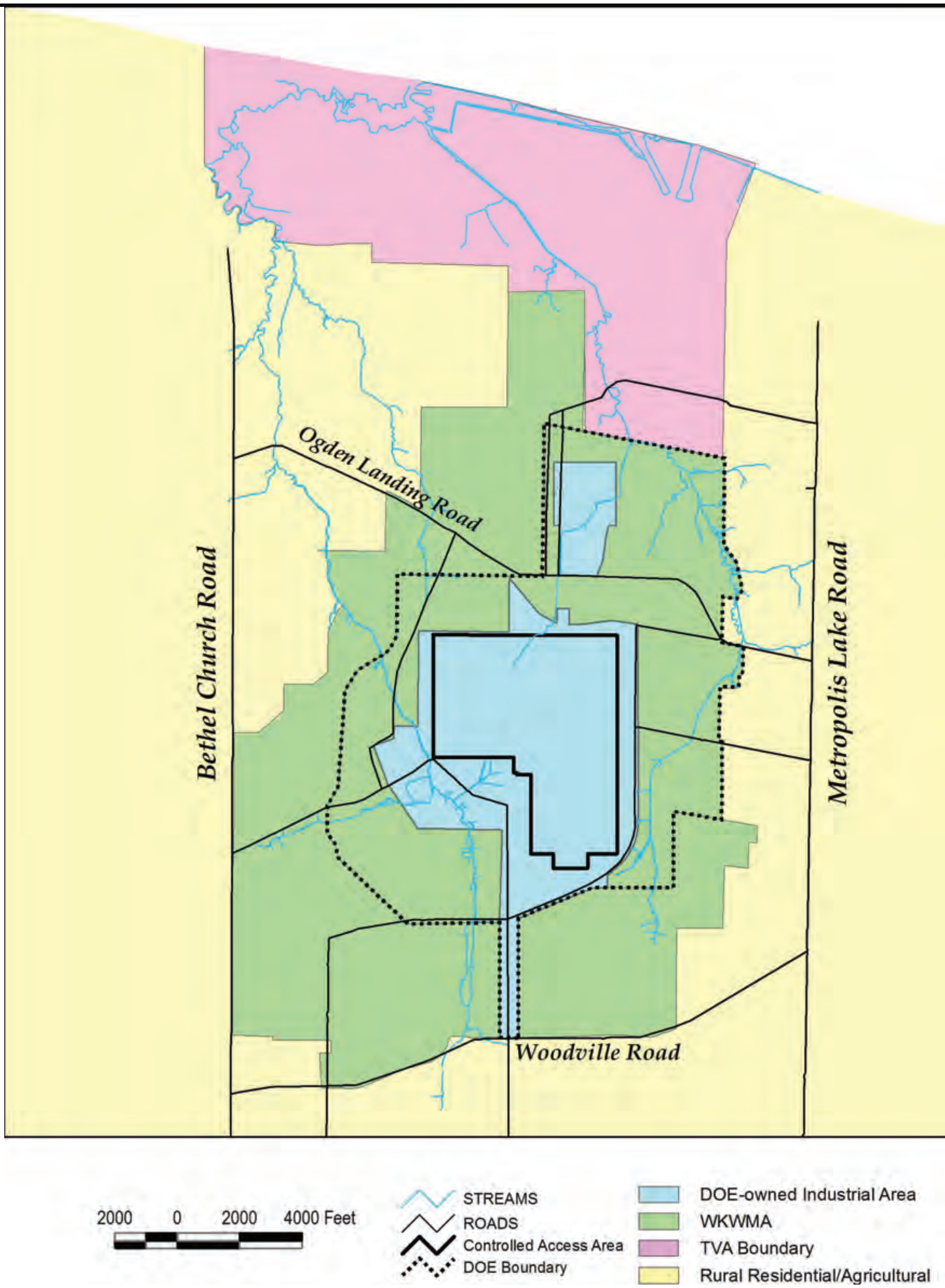
1.3.1.2.3 Surface features and topography

PGDP lies in the Jackson Purchase Region of western Kentucky between the Tennessee and Mississippi Rivers, bounded on the north by the Ohio River. The confluence of the Ohio and Mississippi Rivers is approximately 35 miles downstream (southwest) from the site. The confluence of the Ohio and Tennessee Rivers is approximately 15 miles upstream (east) from the site.

Local elevations range from 290 ft above mean sea level (amsl) along the Ohio River to 450 ft amsl southwest of PGDP near Bethel Church Road. Generally, the topography in the PGDP area slopes toward the Ohio River at an approximate 27-ft/mile gradient (CH2M Hill 1992). Within the plant boundaries where most of the BGOU SWMUs are located, ground surface elevations vary from 360 to 390 ft amsl.

The terrain in the vicinity of the plant is slightly modified by the dendritic drainage systems associated with the two principal streams in the area, Bayou Creek and Little Bayou Creek. These streams have eroded small valleys, which are about 20 ft below the adjacent plain.

SWMU 2 is a uranium burial ground, C-749, located in the west-central portion of the plant (Figure 1.2). Graveled storage yards bound SWMU 2, to the north and west, respectively. The main drainage ditch to the Kentucky Pollutant Discharge Elimination System (KPDES) Outfall 015 passes between SWMU 2 and Virginia Avenue, to the south. SWMU 2 is grass covered. The land surface at SWMU 2 is relatively flat (with a slight mound on the east side); surface elevations range from 370 to 375 ft amsl. The SWMU



Adapted from Site Management Plan, DOE 2013.
NOTE: Boundaries are approximate.

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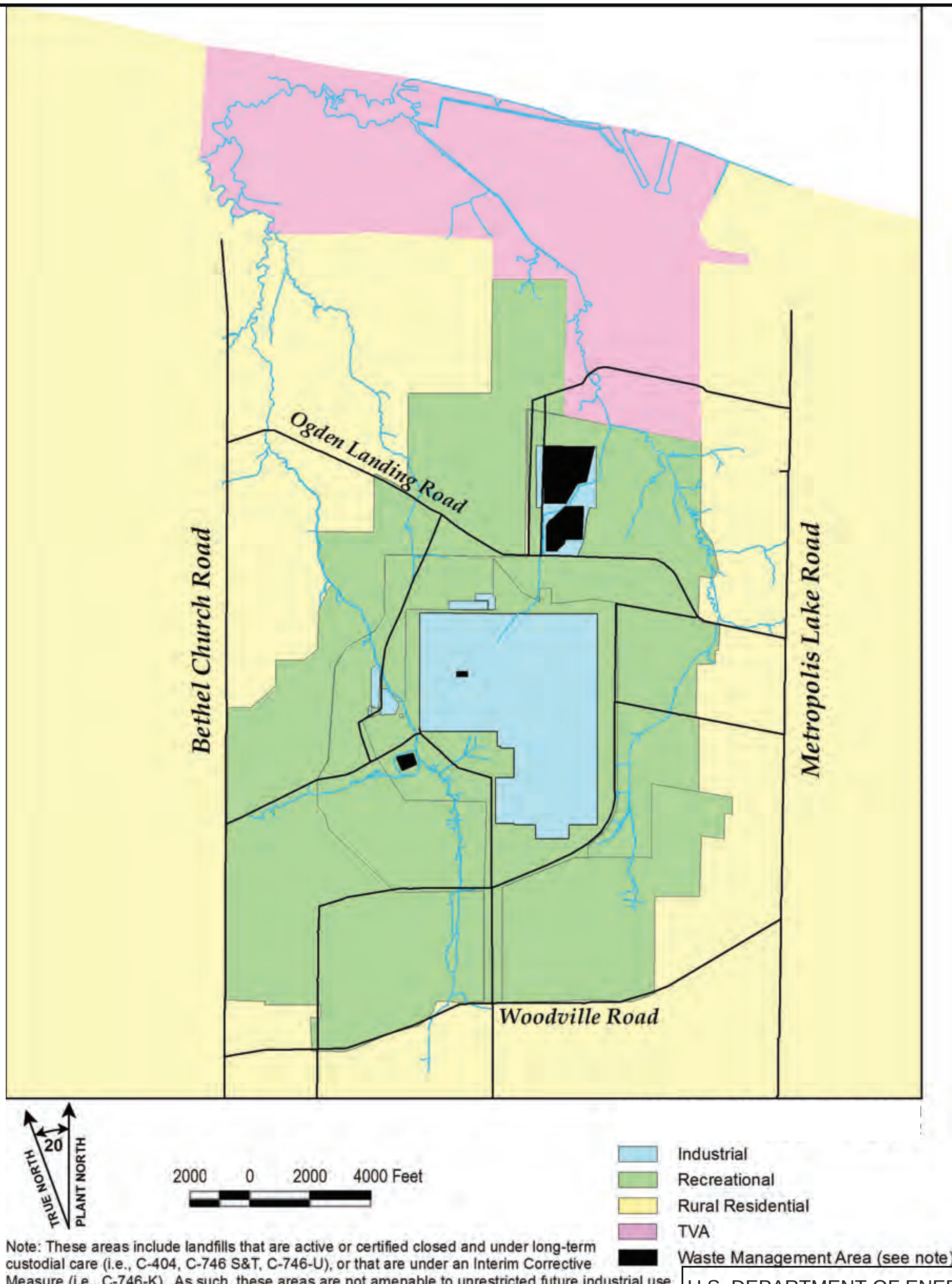
Figure 1.4. Current Land Use in Proximity to PGDP



Adapted from Site Management Plan, DOE 2013.
NOTE: Boundaries are approximate.

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Figure 1.5. Anticipated Future Land Use

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is posted and controlled under DOE work rules, which limit access and limit the potential for spread of contamination.

SWMU 3 (Figure 1.2), located immediately east of SWMU 2, consists of an aboveground surface impoundment that was converted to a solid waste disposal facility (C-404) and a pipeline leading to a northeast-southwest ditch that once drained the C-404 surface impoundment to the North-South Diversion Ditch (NSDD). C-404 is a grass covered mound with steep, 10-ft high sides and a gently sloping cap (highest on the east side). Elevations at C-404 range from 375 to 392 ft amsl. An empty, graveled, cylinder storage yard borders C-404 to the north. The same main drainage ditch to KPDES Outfall 015 passes between C-404 and Virginia Avenue to the south. Gravel roads provide limited access to the east and south sides of C-404. The SWMU is posted and controlled under DOE work rules, which limit access and limit the potential for spread of contamination.

SWMU 7 is a burial cell area in the northwest corner of the plant (Figure 1.2). KPDES Outfall 001 drainage system ditches border SWMU 7 to the north and south. A scrap yard lies to the east. The earthen cover over the burial cells forms slight hills (2-ft high) on the north and south sides of SWMU 7. A gravel pad covers the east end of SWMU 7. PGDP maintains grass cover over the west burial cells. The SWMU is posted and controlled under DOE work rules, which limit access and limit the potential for spread of contamination.

SWMU 30 adjoins SWMU 7 to the west. The same KPDES Outfall 001 drainage ditches bound SWMU 30 on the north and south sides. A paved road borders SWMU 30 on the west side. The surface of the SWMU 30 earthen cover ranges from an elevation of 375 ft at its highest point near the northeast corner of the SWMU to 371 ft near the edges of the burial cell. As at SWMU 7, PGDP maintains a grass cover over the burial cell. The SWMU is posted and controlled under DOE work rules, which limit access and limit the potential for spread of contamination.

1.3.1.2.4 Climate

The climate of the region may be broadly classified as humid-continental. The term "humid" refers to the surplus of precipitation versus evapotranspiration that normally is experienced throughout the year. The 30-year average monthly precipitation for the period 1961 through 1990 is 4.11 inches,[2] varying from an average of 3.00 inches in October (the monthly average low) to an average of 5.01 inches in April (the monthly average high). Monthly estimates of evapotranspiration using the Thornthwaite method (Thornthwaite and Mather 1957) equal or exceed average rainfall for the period May through September (season of no net infiltration).

The "continental" nature of the local climate refers to the dominating influence of the North American landmass. Continental climates typically experience large temperature changes between seasons. The 22-year average monthly temperature is 58.0°F, with the coldest month being January with an average temperature of 35°F and the warmest month being July with an average temperature of 79°F. The average mean prevailing wind speed is 10 miles per hour. Historically, stronger winds are recorded when the winds are from the southwest.

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[2] For the five-year period June 2002 through May 2007, average monthly precipitation was slightly less (3.90 inches), ranging from 3.25 inches in October (monthly average low) to 4.94 inches in September (monthly average high).

1.3.1.2.5 Air quality

DOE operates and maintains a network of nine air monitoring stations for the site, which includes one background station. Samples from these air monitoring stations are analyzed for radionuclides. Air monitoring data are reviewed and included in the National Emission Standards for Hazardous Air Pollutants Annual Reports.

1.3.1.2.6 Noise

Noises associated with plant activities generally are restricted to areas inside buildings located on-site. Currently, noise levels beyond the security fence are limited to wildlife, hunting, traffic moving through the area, and operation and maintenance (O&M) activities associated with outside waste storage areas located close to the security fence.

1.3.1.3 Ecological, cultural, archeological, and historical resources

The following sections give a brief overview of the soils, terrestrial and aquatic systems, wetlands, and cultural resources at PGDP. A more detailed description, including an identification and discussion of sensitive habitats and threatened and endangered (T&E) species, is contained in the *Investigation of Sensitive Ecological Resources Inside the Paducah Gaseous Diffusion Plant, Paducah, Kentucky* (CDM 1994) and the *Environmental Investigations at the Paducah Gaseous Diffusion Plant and Surrounding Area, McCracken County, Kentucky* (COE 1994).

1.3.1.3.1 Soils and prime farmland

Six soil types are associated with PGDP as mapped by the Natural Resources Conservation Service (NRCS), formerly the Soil Conservation Service (USDA 1976). These are Calloway silt loam, Grenada silt loam, Loring silt loam, Falaya-Collins silt loam, Vicksburg silt loam, and Henry silt loam.

The dominant soil types, the Calloway and Henry silt loams, consist of nearly level, somewhat poorly drained to poorly drained soils that formed in deposits of loess and alluvium. These soils tend to have low organic content, low buffering capacity, and acidic hydrogen-ion concentration (pH) ranging from 4.5 to 5.5. The Henry and Calloway series have a fragipan horizon, a compact and brittle silty clay loam layer that extends from 26 inches below ground surface (bgs) to a depth of 50 inches or more. The fragipan reduces the vertical movement of water and causes a seasonally perched water table in some areas at PGDP. In areas within the PGDP where past construction activities have disturbed the fragipan layer, the soils are best classified as "urban."

The area of SWMUs 2, 3, 7, and 30 is mapped as Henry Silt Loam with fragipans common from 1.5–7 ft (USDA 1976). Grading operations during the construction of the plant largely disturbed the soils; nearby ditching dissected the fragipan. Moreover, subsequent diggings, fills, and cover in the burial areas of SWMUs 2, 3, 7, and 30 would have destroyed the fragipan. The cover for SWMUs 2, 3, 7, and 30 is likely a mixture of Henry silt loam and the underlying silt unit (loess).

Prime farmland, as defined by the NRCS, is land that is best suited for food, feed, forage, fiber, and oilseed productions, excluding "urban built-up land or water" (7 *CFR* § 657 and 658). The NRCS determines prime farmland based on soil types found to exhibit soil properties best suited for growing crops. These characteristics include suitable moisture and temperature regimes, pH, drainage class, permeability, erodibility factor, and other properties needed to produce sustained high yields of crops in an economical manner. Prime farmland is located north of the PGDP plant area. The prime farmland north of the plant is predominantly located in areas having soil types of Calloway, Grenada, and Waverly.

1.3.1.3.2 Terrestrial systems

The terrestrial component of the PGDP ecosystem includes the plants and animals that use the upland habitats for food, reproduction, and protection. The upland vegetative communities consist primarily of grassland, forest, and thicket habitats with agricultural areas. The main crops grown in the PGDP area include soybeans, corn, tobacco, and sorghum.

Most of PGDP has been cleared of vegetation at some time, and much of the grassland habitat currently is mowed by PGDP personnel. The Kentucky Division of Fish and Wildlife Resources manages a large percentage of the adjacent WKWMA to promote native prairie vegetation by burning, mowing, and various other techniques. These areas have the greatest potential for restoration and for establishment of a sizeable prairie preserve in the Jackson Purchase area (KSNPC 1991).

Dominant overstory species of the forested areas include oaks, hickories, maples, elms, and sweetgum. Understory species include snowberry, poison ivy, trumpet creeper, Virginia creeper, and Solomon's seal. Thicket areas consist predominantly of maples, black locust, sumac, persimmon, and forest species in the sapling stage with herbaceous ground cover similar to that of the forest understory.

Wildlife commonly found in the PGDP area consists of species indigenous to open grassland, thicket, and forest habitats. Small mammal surveys conducted on WKWMA documented the presence of southern short-tailed shrew, prairie vole, house mouse, rice rat, and deer mouse (KSNPC 1991). Large mammals commonly present in the area include coyote, eastern cottontail, opossum, groundhog, whitetail deer, raccoon, and gray squirrel.

Typical birds of the area include European starling, cardinal, red-winged blackbird, mourning dove, bobwhite quail, turkey, killdeer, American robin, eastern meadowlark, eastern bluebird, bluejay, red-tail hawk, and great horned owl.

Amphibians and reptiles present include cricket frog, Fowler's toad, common snapping turtle, green tree frog, chorus frog, southern leopard frog, eastern fence lizard, and red-eared slider (KSNPC 1991).

Mist netting activities in the area have captured red bat, little brown bat, Indiana bat, northern long eared bat, evening bat, and eastern pipistrelle (KSNPC 1991).

1.3.1.3.3 Aquatic systems

The aquatic communities in and around PGDP area that could be contaminated by plant discharges include two perennial streams (Bayou Creek and Little Bayou Creek), the NSDD (a former ditch for the discharge of plant effluents to Little Bayou Creek), a marsh located at the confluence of Bayou Creek and Little Bayou Creek, and other smaller drainage areas. The dominant taxa in all surface waters include several species of sunfish, especially bluegill and green sunfish, as well as bass and catfish. Shallow streams, characteristic of the two main area creeks, are dominated by bluegill, green and longear sunfish, and stonerollers.

1.3.1.3.4 Threatened and endangered species

Potential habitat for federally listed T&E species was evaluated for the area surrounding PGDP during the 1994 U.S. Army Corps of Engineers (COE) environmental investigation of PGDP (COE 1994) and inside the fence of the PGDP during the 1994 investigation of sensitive resources at PGDP (CDM 1994). Investigation inside the PGDP security fence did not detect any T&E species or their preferred habitats, and the U.S. Fish and Wildlife Service (USFWS) has not designated critical habitat for any species within

DOE property; however, a 2007 USFWS investigation determined that most of the PGDP is within a maternity circle for Indiana bat (listed endangered). Subsequently, the USFWS has conducted a biological assessment of Indiana bat in support of the draft Indiana Bat Recovery Plan (USFWS 2007). No bat habitat exists at SWMUs 2, 3, 7, or 30.

1.3.1.3.5 Cultural, archaeological, and historic resources

No archaeological resources have been identified within the vicinity of the BGOU facilities.

1.3.1.4 Surface water hydrology, wetlands, and floodplains

1.3.1.4.1 Surface water hydrology

PGDP is located in the western portion of the Ohio River drainage basin, approximately 15 miles downstream of the confluence of the Ohio River with the Tennessee River and approximately 35 miles upstream of the confluence of the Ohio River with the Mississippi River. Locally, PGDP is within the drainage areas of the Ohio River, Bayou Creek, and Little Bayou Creek.

The plant is situated on the divide between the two creeks. Surface flow is east-northeast toward Little Bayou Creek and west-northwest toward Bayou Creek. Bayou Creek is a perennial stream on the western boundary of the plant that flows generally northward, from approximately 2.5 miles south of the plant site to the Ohio River along a 9-mile course. The Little Bayou Creek's intermittent drainage originates within WKWMA and extends northward and joins Bayou Creek near the Ohio River along a 6.5-mile course.

Most of the flow within Bayou and Little Bayou Creeks is from process effluents or surface water runoff from PGDP. Plant discharges are monitored at the KPDES outfalls prior to discharge into the creeks.

1.3.1.4.2 Wetlands

The 1994 COE environmental investigations identified 1,083 separate wetland areas and grouped them into 16 vegetative cover types encompassing forested, scrub/shrub, and emergent wetlands (COE 1994). Wetland vegetation consists of species such as sedges, rushes, spikerushes, and various other grasses and forbs in the emergent portions; red maple, sweet gum, oaks, and hickories in the forested portions; and black willow and various other saplings of forested species in the thicket portions.

Five acres of potential wetlands were identified inside the fence at PGDP (COE 1995). The COE made the determination that these areas are jurisdictional wetlands. Wetlands inside the plant security fence are confined to portions of drainage ditches traversing the site. These areas provide some groundwater recharge, floodwater retention, and sediment retention. While the opportunity for these functions and values is high, the effectiveness is low due to water exiting the area quickly through the drainage system. Other functions and values (e.g., wildlife benefits, recreation, diversity, etc.) are very low.

1.3.1.4.3 Floodplains

Floodplains were evaluated during the 1994 COE environmental investigation of PGDP (COE 1994). This evaluation used the Hydrologic Engineering Center Computer Program-2 model to estimate 100- and 500-year flood elevations. Flood boundaries from the Hydrologic Engineering Center Computer Program-2 model were delineated on topographic maps of the PGDP area to determine areal extent of the flood waters associated with these events.

Flooding is associated with the Ohio River, Bayou Creek, and Little Bayou Creek. The majority of overland flooding at PGDP is associated with storm water runoff and flooding from Bayou and Little Bayou Creeks. A floodplain analysis performed by COE (COE 1994) found that much of the built-up portions of the plant lie outside the 100- and 500-year floodplains of these streams. Drainage ditches inside the PGDP security fence can contain nearly all of the expected 100- and 500-year flood discharges (COE 1994). It should be noted that precipitation frequency estimates for the 100- and 500-year events were updated in 2004 in the National Oceanic and Atmospheric Administration's (NOAA) Atlas 14 (NOAA 2004). In the updated report, the mean precipitation estimate for the 100-year, 24-hour event in Atlas 14 for the Paducah area is 10.1% to 15% greater than the mean estimate in previous publications. As stated in Atlas 14, in many cases, the mean precipitation estimate used previously still is within the confidence limits provided in Atlas 14; therefore, it is assumed the plant ditches still will contain the 100- and 500-year discharges. SWMUs 2, 3, 7, and 30 are not located within the 100-year or 500-year floodplains.

1.3.1.5 Regional and study area geology and hydrogeology

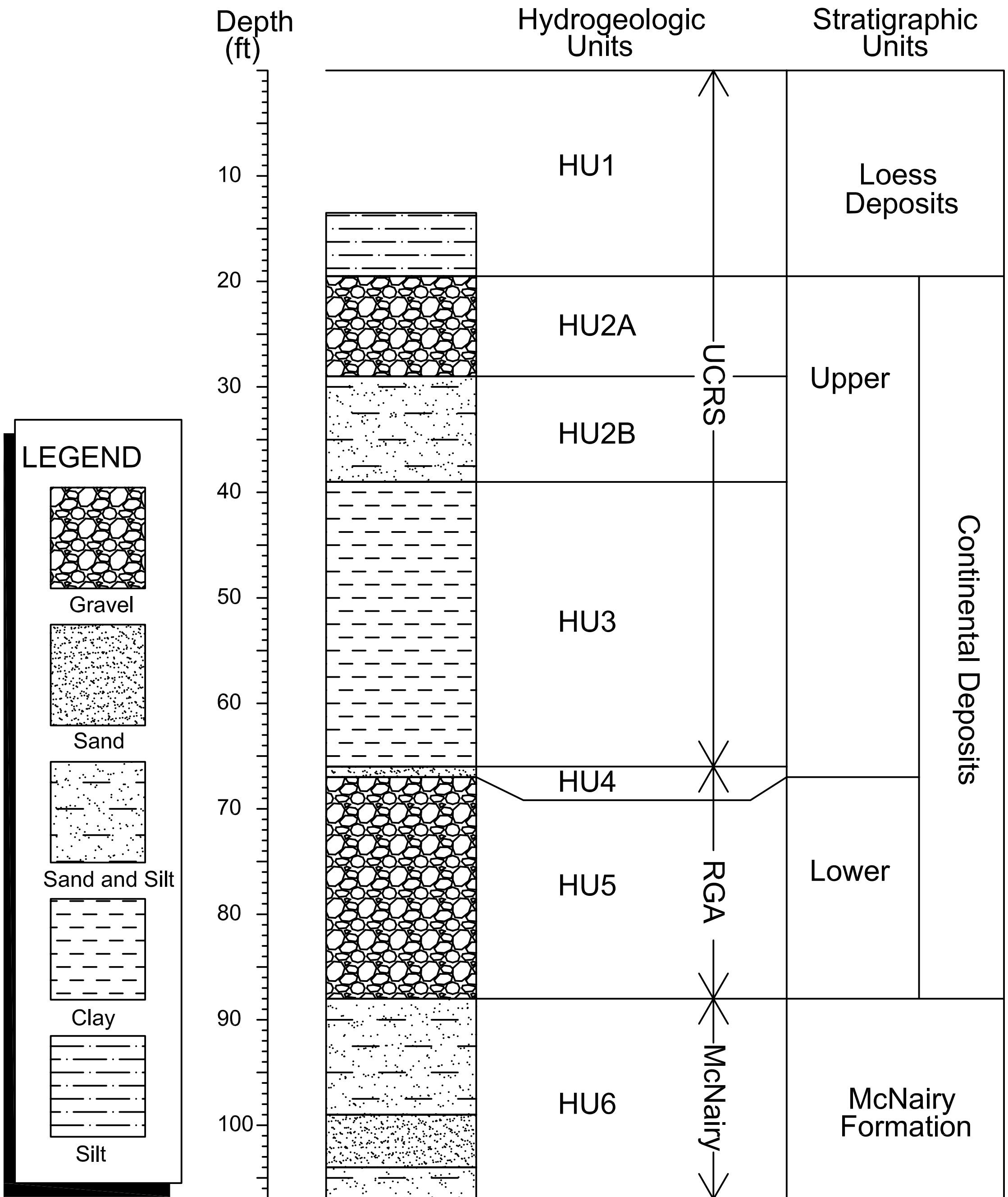
1.3.1.5.1 Regional geology

PGDP is located in the Jackson Purchase Region of Western Kentucky, which represents the northern tip of the Mississippi Embayment portion of the Coastal Plain Province. The stratigraphic sequence in the region consists of Cretaceous, Tertiary, and Quaternary sediments unconformably overlying Paleozoic bedrock. Figure 1.6 summarizes the geologic and hydrogeologic systems of the PGDP region.

Within the Jackson Purchase Region, strata deposited above the Precambrian basement rock attain a maximum thickness of 12,000 to 15,000 ft. Exposed strata in the region range in age from Devonian to Holocene. The Devonian stratum crops out along the western shore of Kentucky Lake. Mississippian carbonates form the nearest outcrop of bedrock and are exposed approximately 9 miles northwest of PGDP in southern Illinois (MMES 1992). The Coastal Plain deposits unconformably overlie Mississippian carbonate bedrock and consist of the following: the Tuscaloosa Formation; the sand and clays of the Clayton/McNairy Formations; the Porters Creek Clay; and the Eocene sand and clay deposits (undivided Jackson, Claiborne, and Wilcox Formations). Continental Deposits unconformably overlie the Coastal Plain deposits, which are, in turn, covered by loess and/or alluvium.

Relative to the shallow groundwater flow system in the vicinity of PGDP, the Continental Deposits and the overlying loess and alluvium are of key importance. The Continental Deposits resemble a large low-gradient alluvial fan that covered much of the region and eventually buried the erosional topography. A principal geologic feature in the PGDP area is the Porters Creek Clay Terrace, a subsurface terrace that trends approximately east to west across the southern portion of the plant. The Porters Creek Clay Terrace represents the southern limit of erosion or scouring of the ancestral Tennessee River. Thicker sequences of Continental Deposits, as found underlying PGDP, represent valley fill deposits and can be informally divided into a lower unit (gravel facies) and an upper unit (clay facies). The Lower Continental Deposits (LCD) is the gravel facies consisting of chert gravel in a matrix of poorly sorted sand and silt that rests on an erosional surface representing the beginning of the valley fill sequence. In total, the gravel units average an approximate 30-ft thickness, but some thicker deposits (as much as 50 ft) exist in deeper scour channels. The Upper Continental Deposits (UCD) is primarily a sequence of fine-grained, clastic facies varying in thickness from 15 to 60 ft that consist of clayey silts with lenses of sand and occasional gravel.

The BGOU area lies within the buried valley of the ancestral Tennessee River in which Pleistocene Continental Deposits (the fill deposits of the ancestral Tennessee River Basin) rest unconformably on Cretaceous marine sediments. Pliocene through Paleocene formations in the BGOU area have been removed by erosion from the ancestral Tennessee River Basin. In this area, the upper McNairy Formation



Geology based on SI Phase 1 Boring H007.
Actual depths of hydrogeologic units and stratigraphic units vary across the site.

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Figure 1.6. Example Stratigraphic and Hydrogeologic Units

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consists of 60 to 70 ft of interbedded units of silt and fine sand and underlies the Continental Deposits. Total thickness of the McNairy Formation is approximately 225 ft.

The surface deposits found in the vicinity of PGDP consist of loess and alluvium. Both units are composed of clayey silt or silty clay and range in color from yellowish-brown to brownish-gray or tan, making field differentiation difficult.

1.3.1.5.2 Regional hydrogeology

The significant geologic units relative to shallow groundwater flow at PGDP include the Terrace Gravel and Porters Creek Clay (south sector of the DOE site) and the Pleistocene Continental Deposits and McNairy Formation (underlying PGDP and adjacent areas to the north). Groundwater flow in the Pleistocene Continental Deposits is a primary pathway for transport of dissolved contamination from PGDP. The following paragraphs provide the framework of the shallow groundwater flow system at PGDP.

Terrace Gravel Flow System. The Porters Creek Clay is a confining unit to downward groundwater flow south of PGDP. A shallow water table flow system is developed in the Terrace Gravel, where it overlies the Porters Creek Clay south of PGDP. Discharge from this water table flow system provides baseflow to Bayou Creek and underflow to the Pleistocene Continental Deposits to the east of PGDP.

The elevation of the top of the Porters Creek Clay is an important control to the area's groundwater flow trends. A distinct groundwater divide is centered in hills located approximately 9,000 ft southwest of PGDP, where the Terrace Gravel and Eocene sands overlie a "high" on the top of the Porters Creek Clay. In adjacent areas where the top of the Porters Creek Clay approaches land surface, as it does south of PGDP and near the subcrop of the Porters Creek Clay to the west of the industrial complex, the majority of groundwater flow is forced to discharge into surface streams (gaining reaches) and little underflow occurs into the Pleistocene Continental Deposits. To the east of PGDP, the Terrace Gravel overlies a lower terrace eroded into the top of the Porters Creek Clay. In this area, a thick sequence of Terrace Gravel occurs adjacent to the Pleistocene Continental Deposits, allowing significant underflow from the Terrace Gravel. Surface drainages in this area are typically loosing reaches.

Upper Continental Recharge System (UCRS). The upper stratum, where infiltration of water from the surface occurs and where the uppermost zone of saturation exists in the UCD (beneath PGDP and the contiguous land to the north) is called the UCRS. Groundwater flow is primarily downward in the UCD. Vertical hydraulic gradients generally range from 0.5 to 1 ft/ft where measured by wells completed at different depths in the UCRS. Vertical gradients are 1 to 2 orders of magnitude greater than lateral hydraulic gradients. While groundwater flow is predominantly downward, there will be some lateral flow due to heterogeneities in the shallow soils.

Direct measurements of the UCRS water table elevation are available only for the south-central PGDP industrial area, where water levels commonly occur in the screened interval of the wells, and the location of two source unit investigations (the SWMU 2 Interim Remedial Design Investigation and the SWMUs 7 and 30 RI) in the west PGDP industrial area. All other well measurements, where water levels occur above the well screen interval, provide lower bounds to the elevation of the water table. Hydrographs of UCRS monitoring wells (MWs) on-site indicate fluctuations of only a few ft over the past 10 years. The main features of the water table are a broad trough in the northeast and central areas, a linear discharge area associated with a ditch in the northwest, and a lateral hydraulic gradient toward Bayou Creek on the west side. In general, the water table is less than 20 ft deep in the western half of PGDP and as much as 40 ft deep in the northeastern corner.

The infiltration rate for the PGDP area is approximately 6.6 inches/yr based on site-specific groundwater modeling. This 6.6 inches/yr applied over the area of the industrial area of the plant yields approximately 0.4 mgd of recharge to the shallow groundwater system. Leakage from plant water utilities, ditches, lagoons, and cooling tower basins is suspected to be another important source of infiltration at PGDP. Water use for PGDP for calendar year 2006 averaged 13 mgd. Municipal water systems lose as much as 24% of their daily conveyance (Jowitt and Xu 1990). A similar loss of the PGDP system would equal 3.1 mgd. Since the UCRS groundwater flow is predominantly downward, areas with higher anthropogenic recharge creates mounding of hydraulic head in the RGA that can affect contaminant transport. Because the hydraulic conductivity in the RGA on-site is relatively large, the mounding is only slight (often less than 1 ft) and difficult to measure.

Regional Gravel Aquifer. Vertically infiltrating water from the UCRS moves downward into a basal sand member of the UCD and the Pleistocene gravel member of the LCD and then laterally north toward the Ohio River. This lateral flow system is called the RGA. The RGA is the shallow aquifer beneath PGDP and contiguous lands to the north. The RGA is considered by EPA as Class IIA groundwater, current drinking water source, because it was an actual drinking water supply for nearby residents before it was contaminated by PGDP and continues to be a drinking water source outside the Water Policy protection area. It currently is not used on-site within the DOE property or off-site within the Water Policy Box for drinking water. DOE provides municipal water to certain nearby residences and businesses and this serves to limit off-site human exposure to contaminated groundwater.

Hydraulic potential in the RGA declines toward the Ohio River, which is the control of base level of the region's surface water and groundwater systems. The RGA potentiometric surface gradient beneath PGDP is commonly 10^{-4} ft/ft, but increases by an order of magnitude near the Ohio River. (Vertical gradients are not well documented, but small.) The hydraulic conductivity of the RGA varies spatially. Pumping tests have documented the hydraulic conductivity of the RGA ranges from 53 ft/day to 5,700 ft/day. East-to-west flow of the ancestral Tennessee River, which laid down the Pleistocene Continental Deposits gravel member, tended to orient permeable gravel and sand lenses east-west. Thus, with the hydraulic head in the RGA generally decreasing northward toward the Ohio River, groundwater flow trends to the northeast and northwest from PGDP in response to the anisotropy of the hydraulic conductivity as well as the anthropogenic recharge, which is greatest in the industrial portion of the plant. Anthropogenic recharge from waterline leaks, lagoons, cooling tower basins, and other sources provides the primary driving force in moving groundwater in northeastern and northwestern flow directions from the industrial plant area. Ambient groundwater flow rates in the more permeable pathways of the RGA commonly range from 1 to 3 ft/day.

McNairy Flow System. Groundwater flow in the fine sands and silts of the McNairy Formation is called the McNairy Flow System. The overall McNairy groundwater flow direction in the area of PGDP is northward to the Ohio River, similar to that of the RGA. Hydraulic potential is greater in the RGA than in the McNairy Flow System beneath PGDP. Area MW clusters document an average downward vertical gradient of 0.03 ft/ft. Because the RGA has a steeper hydraulic potential slope toward the Ohio River than does the McNairy Flow System, the vertical gradient reverses nearer the Ohio River. [The "hinge line," which is where the vertical hydraulic gradient between the RGA and McNairy Flow System changes from a downward vertical gradient to an upward vertical gradient and parallels the Ohio River near the northern DOE property boundary (LMES 1996).]

The contact between the LCD and the McNairy Formation is a marked hydraulic properties boundary. Representative lateral and vertical hydraulic conductivities of the upper McNairy Formation in the area of PGDP are approximately 0.02 ft/day and 0.0005 ft/day, respectively. Vertical infiltration of groundwater into the McNairy Formation beneath PGDP is on the order of 0.1 inch per year. (Lateral flow in the

McNairy Formation beneath PGDP is on the order of 0.03 inch per year.) As a result, little interchange occurs between the RGA and McNairy Flow System.

1.3.1.5.3 Hydrogeologic units

Five hydrogeologic units (HUs) are commonly used to discuss the shallow groundwater flow system beneath the DOE site and the contiguous lands to the north (Figure 1.6). In descending order, the HUs are described below:

- Upper Continental Deposits
  - HU 1 (UCRS): Loess that covers the entire site.
  - HU 2 (UCRS): Discontinuous, sand and gravel lenses in a clayey silt matrix. In some areas of the plant, the HU2 interval consists of an upper sand and gravel member (HU2A) and a lower sand and gravel member (HU2B) separated by a thin silt unit.
  - HU 3 (UCRS): Relatively impermeable unit that acts as the upper semiconfining-to-confining layer for the RGA. The lithologic composition of HU 3 varies from clay to fine sand, but is predominantly silt and clay.
  - HU 4 (RGA): Near-continuous sand unit with a clayey silt matrix that forms the top of the RGA.
- Lower Continental Deposits
  - HU 5 (RGA): Gravel, sand, and silt.

1.3.1.6 DOE plant controls

Current DOE plant controls for the PGDP are described below.

- The SWMUs are within areas protected from trespassing under the 1954 Atomic Energy Act as amended (referred to as the 229 Line). These areas are posted as "no trespassing" and trespassers are subject to arrest and prosecution. Physical access to the PGDP is prohibited by security fencing, and armed guards patrol the DOE property 24 hours per day to restrict workers' entry and prevent uncontrolled access by the public/site visitors.
- Vehicle access to SWMUs 2, 3, 7, and 30 is restricted by passage through a security post and by the plant vehicle protection barrier.
- SWMUs 2, 3, 7, and 30 are in areas that are subject to routine patrol and visual inspection by plant protective forces, at a minimum once per shift.
- Protection of the current PGDP industrial workers is addressed under DOE's Integrated Safety Management System/Environmental Management System program and 29 *CFR* § 1910. Interim work area access controls that may be used under these programs during implementation of a remedy include warning and informational signage, temporary fencing and/or barricades, and visitor sign-in controls.

These existing access controls are maintained due to the nature and security needs of the facility or implemented for protection of worker safety and health and are being maintained outside of the requirements of CERCLA; nonetheless, the existing controls serve to protect against unacceptable/uncontrolled exposures.

Additionally, Section XLII of the FFA requires that the sale or transfer of the PGDP comply with Section 120(h) of CERCLA. In the event DOE determines to enter into any contract for the sale or transfer of any of the site, DOE will comply with the applicable requirements of Section 120(h) in effecting that sale or transfer, including all notice requirements. In addition, Section XLII of the FFA requires DOE to notify EPA and KY of any such sale or transfer at least 90 days prior to such sale or transfer.

1.3.2 SWMUs 2, 3, 7, and 30 History

The disposal of solid waste began with construction of the plant in 1951. Scrap and wastes have been buried in a minimum of 22 different locations, and scrap has been stored in at least five storage yards (Union Carbide 1978). These known areas have been identified as SWMUs or areas of concern.

Table 1.2 identifies the previously completed reports and/or investigations primarily used as information for SWMUs 2, 3, 7, and 30. Reference information for these investigations can be found in Section 9. In addition to the reports of previous investigations, the following documents provide important information on the content and volume of SWMUs 2, 3, 7, and 30.

- *The Discard of Scrap Materials by Burial at the Paducah Plant* (Union Carbide 1973)
- *The Disposal of Solid Waste at the Paducah Gaseous Diffusion Plant* (Union Carbide 1978)

Table 1.2. Summary of Previous Relevant Investigations of BGOU

Dates	Title	SWMU 2	SWMU 3	SWMU 7	SWMU 30
1987	Closure Plan C-404 Low-Level Radioactive Waste Burial Ground (DOE 1987)		✓		
1990-1992	Phase II Site Investigation (CH2M HILL 1992)	✓	✓	✓	✓
1994	Waste Area Grouping (WAG) 22 SWMUs 2 and 3 Remedial Investigation and Addendum (DOE 1994b)	✓	✓		
1997	SWMU 2 Data Summary Report (DOE 1997a)	✓			
1996-1998	WAG 22 SWMUs 7 and 30 RI/FS (DOE 1998a; DOE 1998b)			✓	✓
1999-2001	Data Gaps Investigation (DOE 2000)			✓	✓
2002-2003	Scrap Yards Site Characterization [Paducah Oak Ridge Environmental Information System (OREIS)]			✓	✓
2006	Burial Grounds RI/FS Work Plan (DOE 2006)	✓	✓	✓	✓
2007	Burial Grounds Remedial Investigation (DOE 2010b)	✓	✓	✓	✓
2010	Soils OU RI (DOE 2013b)			✓	

Table 1.2 is based on Table 1.4 of the *Remedial Investigation Report for the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-0030&D2/R1, February (DOE 2010b).
Blank cells indicate document is not applicable to SWMU.

Historical information that is known about the waste units for these SWMUs is summarized in Table 1.3. Additional details about the individual SWMUs are provided in the SWMU-specific sections of this document, Sections 5, 6, 7, and 8.

Table 1.3. Summary of Historical Information for BGOU SWMUs 2, 3, 7, and 30

Sub Unit	Dates of Operation	Area of Waste	Cap[a]	Known or Expected Contents (Special Hazards)
SWMU 2 C-749 Uranium Burial Ground				
	1951–1977	32,000 ft^2 (7–17 ft deep)	6 inch clay 18 inch soil	Uranium (including uranium metal that may be pyrophoric and uranyl fluoride), waste oil (potentially containing PCB), TCE
SWMU 3 C-404 Low-Level Radioactive Waste Burial Ground				
	1952–1986	53,000 ft^2 (8–12 ft deep)	RCRA multilayered cap	Uranium precipitated from aqueous solutions, uranium tetrafluoride (UF_4), uranium metal, uranium oxides, degreasing sludge, and radioactively contaminated trash
SWMU 7 C-747-A Burial Ground				
Cell B	?	10,320 ft^2 (6–7 ft-deep)	3 ft soil	Noncombustible trash, contaminated material, and equipment
Cell C	?	10,320 ft^2 (6–7 ft-deep)	3 ft soil	Noncombustible trash, contaminated material, and equipment
Cell D	?	1,485 ft^2 (6–7 ft-deep)	3 ft soil	Uranium-contaminated concrete pieces of reactor tray bases from fluorination process of UF_4 to uranium hexafluoride (UF_6)
Cell E	?	2,145 ft^2 (6–7 ft-deep)	3 ft soil	Uranium-contaminated concrete pieces of reactor tray bases
Cells F1–F5	?	1,600 ft^2 (6–7 ft-deep)	3 ft soil	Uranium-contaminated scrap metal, equipment, empty uranium/magnesium powder drums
Cell G	?	3,294 ft^2 (6–7 ft-deep)	3 ft soil	Noncombustible trash, contaminated material, and equipment
SWMU 30 C-747-A Burn Area				
Cell A	1951–1970	128,000 ft^2 (12-ft deep)	4 ft soil	Ash and debris from combustible trash, possibly uranium-contaminated

Table 1.3 is based on Table 1.3 of the BGOU RI (DOE 2010b).
[a] The source material used for capping is unknown with the exception of the SWMU 3 Subtitle C cap that came from the Old Hickory Clay Company.
? indicates dates of operation are not known.

1.3.3 Nature and Extent of Contamination

The SWMUs comprising the BGOU consist primarily of landfills and below ground burial cells in which various PGDP wastes have been placed. The BGOU CSM indicates infiltration of water (i.e., precipitation) descending through the buried waste has mobilized or could mobilize contaminants within the waste. Once mobilized, the most likely pathway of the contaminants would be downward through the UCRS soils, ultimately reaching the RGA. Some lateral movement of contaminants would occur in the UCRS, but these pathways are known to be limited.

1.3.3.1 Source characteristics

The nature and dimensions of the source term is based on the information available on the wastes. The chemicals associated with the wastes are highlighted in Table 1.3 and may contain PTW. PTW is defined by EPA as "source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur" (EPA 1991a). EPA also recognizes that "although no threshold level of risk has been established to identify principal threat waste, a general rule of thumb is to consider as a principal threat those source materials with toxicity and mobility characteristics that combine to pose a potential risk several orders of magnitude greater than the risk level that is acceptable for the current or reasonably anticipated future land use, given realistic exposure scenarios" (EPA 1997).

The following PTW is identified at SWMU 2:

- Approximately 270 tons of uranium (e.g., shavings and sawdust packed in oil) disposed in burial pits in SWMU 2;

- Buried drums of uranium-contaminated TCE and any high soil concentrations of TCE present under and adjacent to the drums;

- Buried drums (thirty-five 30-gal drums documented) of uranyl fluoride solution and high soil concentrations of uranyl fluoride solution present under and adjacent to the drums; and

- High concentrations of TCE and *cis*-1,2-dichloroethene (DCE) (a toxic degradation product of TCE) in soil on the eastern side of SWMU 2.

Additionally, there is the potential that the 59,000 gal of oil with which the uranium disposed of at SWMU 2 was packaged in drums contains PCBs at concentrations greater than 500 ppm. Under EPA guidance, PCBs greater than 500 ppm generally are considered PTW. Absent additional characterization (sampling and analysis) of the buried waste, it is uncertain whether PCBs are widely present at SWMU 2 at levels greater than 500 ppm. Notwithstanding the uncertainty, the 59,000 gal of oil could contain PCBs in excess of 500 ppm; thus it would be considered PTW.

Approximately 3,200 tons of uranium-contaminated waste at SWMU 3 has been identified as PTW. (It is inconclusive whether some of the uranium may be pyrophoric.)

TCE (including degradation products) present in the UCRS at SWMU 7 as dense nonaqueous-phase liquid (DNAPL) and/or high concentration TCE residual soil contamination constitutes PTW.

No PTW has been identified at SWMU 30.

1.3.3.2 Nature and extent of soil impacts

The current understanding of the nature and extent of contamination in surface and subsurface soils was derived from historical investigations as shown on Table 1.2. In the BGOU RI, additional soil samples were collected from angled borings beneath the wastes to establish if releases had occurred from the waste and, if so, their magnitude in the secondary media. Each of the SWMUs has a surface cover. The amount of surface soil data collected for each SWMU varied, since the focus of the BGOU was to identify releases and these would primarily be identified from samples beneath the waste. In some cases, the BGOU data set includes soil and sediment samples collected from locations outside the SWMU boundary that are not affected by releases from the wastes and will be addressed by other CERCLA actions such as the Soils OU or Surface Water OU.

SWMU-specific sections provide details on the distribution of selected COCs. The sampling locations and distribution of the target COCs in surface and subsurface soils evaluated in this FS are shown on figures in Appendix A for each of the SWMUs. The following are key general observations across all SWMUs:

- Radionuclides were detected at each of the SWMUs. Radionuclides of greatest impact when evaluating releases include Tc-99, at SWMUs 7 and 30, and uranium-238 (U-238), at SWMUs 2, 7, and 30. Tc-99 is generally considered one of the more mobile radionuclides and has been detected in RGA groundwater. Tc-99 was detected above background at the highest frequency in surface samples. A similar pattern was observed for U-238.

- Selected chlorinated volatile organic compounds (VOCs) were identified in soil samples at SWMUs 2 and 7. There was one hot spot sample in SWMU 2 at a depth of 12 ft bgs with concentrations of TCE and *cis*-DCE (its anaerobic biodegradation product) each above 100 mg/kg. These concentrations are below the soil saturation concentration, a concentration above which you may expect to have a solvent phase. Other detected concentrations of TCE range from detection limits to 0.428 mg/kg.

- Total PCBs were detected in soil samples from SWMUs 2, 7, and 30. These were typically at higher concentrations and greater frequencies in surface soil, with no detections of total PCBs in the soil samples collected at depths greater than 20 ft bgs. The maximum concentration was 14.8 mg/kg, the only concentration above 10 mg/kg.

- Polycyclic aromatic hydrocarbons (PAHs) were detected most frequently in surface samples at SWMUs 7 and 30. These were not detected in any samples below 20 ft.

- Naturally occurring metals infrequently exceeded both the no action level (NAL) and background concentrations. No clear patterns or gradients of concentrations were identified. For surface soils, these metals include antimony, arsenic, chromium, iron, nickel uranium and vanadium. Uranium exceeded most frequently. For other metals that contribute to the noncancer hazards, only one or occasionally two were detected in a single sample, suggesting these detections were typically not colocated.

In general, the contents of the burial grounds upon excavation and characterization for disposal may include RCRA hazardous waste, PCB waste, and LLW. Depending on the originating source, the TCE could be a listed hazardous waste with one or more waste codes (F001, F002, or U228) and/or be a characteristic hazardous waste (D040), if generated by the response action. Any soils or wastes with PCB concentrations at or greater than 50 ppm would be regulated for disposal as TSCA PCB waste if generated by the response action. Excavated soil and/or debris from the burial grounds could be RCRA characteristic hazardous waste (e.g., toxicity for metals).

1.3.4 Conceptual Site Model

The buried waste and contaminated soils in SWMUs 2, 3, 7, and 30 include both potentially mobile and low mobility chemicals. To the extent these chemicals are mobile, the most likely pathway of the contaminants released from wastes would be downward migration through the UCRS soils, ultimately reaching the RGA (Figure 1.7). Some lateral movement of contaminants could occur in the UCRS, but these pathways are known to be limited. Based on this conceptual model, any contamination resulting from buried waste found at these SWMUs would be expected to be found concentrated in the soils and

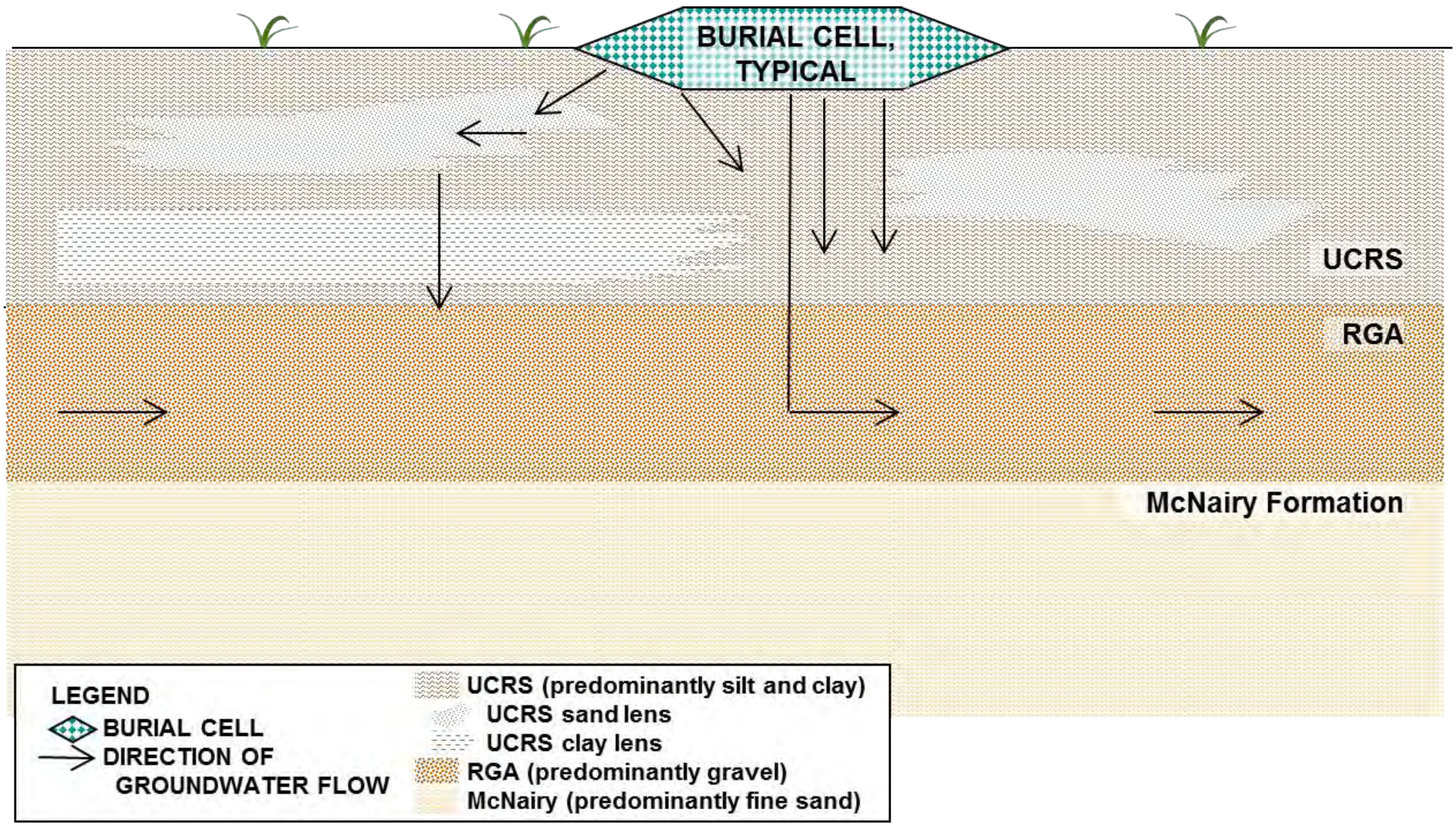

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Figure 1.7. Pictorial Conceptual Model of the BGOU

groundwater of the UCRS immediately within and under the burial cells, with little lateral dispersion of contamination in the UCRS from the cells and immediately adjacent soils. Consistent with the BGOU goals, the source areas, contamination in secondary sources impacted by releases from the waste, and potential for future migration from the wastes were the focus of the investigations and basis for evaluation of remedial alternatives. In general, there is a surface cover on these SWMUs; however, contamination identified in the surface soils within the SWMU boundary has the potential to migrate with runoff to adjacent drainageways.

1.3.5 Contaminant Fate and Transport

Release of chemicals from the wastes and subsequent migration to the RGA considers the potential for chemicals to degrade/transform (fate) and the rate at which these may migrate through the UCRS (transport). The following briefly highlights some of the factors that are considerations when evaluating releases from the waste for the key chemical groups: chlorinated VOCs, radionuclides, PAHs, and metals.

The assumptions used in modeling are shown and discussed in Appendix B.

1.3.5.1 Contaminant fate

Some contaminants may be transformed to new constituents in the environment; organic compounds may decompose or be transformed by various processes including hydrolysis, oxidation/reduction, photolysis, or biological processes, and radioisotopes may decay by nuclear reactions. All transformations produce new constituents or daughter products, some of which also may have hazardous or toxic effects. Transformations of organic compounds are governed by environmental conditions, pH or oxidation reduction potential (ORP) levels, and the presence of bacteria and electron donors. Transformations of radionuclides are dependent on the decay constant of the isotope alone.

The distribution, mobility, and bioavailability of heavy metals and radionuclides in the environment depend not only on their total concentration but also on the association form in the solid phase to which they are bound. The potential rate of dissolution or release (leachability) of these compounds is not easily estimated by the bulk soil concentration. In some cases, minerals may be encapsulated in quartz or other chemically inert minerals; while in other cases, soils may contain reactive minerals in lower abundance. The release and subsequent mobility of metals and radionuclides released into infiltrating water may be dependent on oxidation state; therefore, considerations of potential changes to the form of these compounds in the UCRS are a factor in potential migration.

Chlorinated Volatile Organic Compounds. TCE is identified as a COC at SWMUs 2, 3, 7, and 30. TCE is the parent of an anaerobic degradation chain that produces *cis*-1,2-DCE and vinyl chloride as daughter products. Each step in the degradation has a lower rate than TCE and requires stronger reducing conditions than those required for reduction of TCE. Degradation products of TCE are identified as COCs at the SWMUs where TCE also is identified as a COC. Anaerobic reductive dechlorination in the UCRS can be very localized; however, anaerobic degradation products (*cis*-1,2-DCE or vinyl chloride) have been observed at SWMUs 2, 3, 7, and 30. In addition, the BGOU RI states that it has been assumed, based on dissolved oxygen levels in a nearby shallow MW, that anaerobic degradation of TCE has occurred and still may occur within the UCRS at SWMU 7. In addition to the anaerobic pathway, aerobic biodegradation of TCE may occur under certain conditions where specialized microorganisms are present. The aerobic degradation pathway requires the presence of ammonia, methane, and toluene, and degrades TCE directly to epoxides, aldehydes, chlorinated oxides, and ethanols. TCE degradation is assumed to be occurring at the BGOU and is considered in the screening and evaluation of alternatives.

Radionuclides. Although radionuclides behave chemically as metals, the radioactive nuclides undergo spontaneous transformations that involve the emission of particles (alpha and beta particles) and radiant energy (gamma energy). The resulting daughters (i.e., product nuclides) may be radioactive themselves or may be stable nuclides. Natural uranium consists of three primary isotopes: U-234, U-235, and U-238. Decay products of uranium isotopes also are radioactive, with unique decay chains.

Half-lives for radioisotope decay for the radioactive contaminants at PGDP are listed in a prior 2011 PGDP Risk Methods Documents (DOE 2011a).

Additional considerations include potential changes in oxidation state for technetium and uranium that may influence their release (dissolution) and transport. Dissolved technetium is present as pertechnetate ($TcO4^{-}$), the most common form of technetium in oxidizing environments. Pertechnetate forms no sparingly soluble solids and, being anionic, sorbs sparingly at best. Under reducing conditions, however, dissolved technetium is present in the +4 valence state, which forms sparingly soluble solids such as $TcO_2 \cdot 2H_2O$. Similarly, reduction of mobile uranium+6 to immobile uranium+4 occurs under reducing conditions; therefore, the reducing conditions that may be present locally within and/or underneath the burial cells in the UCRS essentially may immobilize Tc-99 and uranium (see Appendix B). Evidence of reducing conditions and associated uncertainties in the BGOU SWMUs is presented in Section 3.9.3 of the BGOU RI Report (DOE 2010b).

Naphthalene and carcinogenic PAHs have been identified in a number of surface soil and sediment samples and detected in only one sample at depths greater than 1 ft at the BGOU SWMUs. These are present generally as a mixture and likely are highly weathered in surface soils, making the residuals higher molecular weight components that are less soluble and more persistent. Naphthalene has been identified at some locations and, using screening values, were identified as potentially migrating to groundwater. However, biodegradation of naphthalene released into soils in the dissolved phase has been demonstrated to occur under both aerobic and anaerobic conditions, with rates that are more rapid under aerobic conditions. Howard et al. (1991) reports naphthalene half-lives in soil from 16.6 to 48 days, based upon a soil-die away test, and in groundwater from 24 hours (aerobic) to 258 days (anaerobic). The attenuation of hydrocarbons that may dissolve into infiltrating water and migrate vertically to deeper soils or groundwater is supported by the fact that these are not detected in subsurface soils or RGA groundwater samples.

Metals. Although metals do not decrease in total concentrations through degradation, they may change oxidation states, which can impact the mobility of the metals. For example, hexavalent chromium is considered the more mobile and toxic form of this metal. Under reducing conditions that may be present in the UCRS, this metal would be in the less mobile and less toxic trivalent form.

1.3.5.2 Contaminant transport

The transport of contaminants from the BGOU SWMUs will occur primarily in the dissolved phase, due to partitioning from the solid or adsorbed phase to infiltration from rainfall or to groundwater where waste is saturated, which is a common condition in the BGOU. The dissolution of contaminants will be controlled by the rate of water infiltrating through soil and waste at the waste units, the solubility of the contaminants, and equilibrium partitioning between the liquid phase and the soil, described by a partitioning coefficient (K_d). For volatile compounds, partitioning to the soil gas phase, described by a Henry's Law constant, also may be an important transport pathway. The K_d for organic compounds is a function of the organic carbon coefficient (K_{oc}) and fraction of organic carbon in the soil (f_{oc}). The range of K_{oc} for the volatile COCs and f_{oc} values for the BGOU soils indicates that chlorinated VOCs are relatively mobile through soils as dissolved constituents and tend not to partition significantly from water to soil (DOE 2010a).

The mobility of metals is dependent on a range of factors, including, but not limited to, soil pH, cation exchange capacity of the soils, redox of the disposal cell and soils below the cell, and the heterogeneity the HUs.

The K_d for metals and radionuclides is a measure of the interactions of the chemicals in the infiltrating water and the soil surfaces that control adsorption/retardation behavior of selected contaminants. As stated in the previous section, this is not a prediction of the equilibrium concentration based on the total concentration in the solids, in which much of the naturally occurring metals or radionuclides may be not be readily leachable or present at the exchangeable surface. The range of K_d for inorganic COCs is very large, and some metals are expected to be relatively mobile and some are expected to be immobile. The high clay content and neutral pH of the UCRS is expected to limit migration of metals at these SWMUs.

Of the radionuclides, several (e.g., uranium, plutonium) have high K_d values and typically are considered immobile. Technetium has a low K_d, is soluble, and typically is more mobile in soils; therefore, this radionuclide in waste-impacted soils has a greater potential to reach the RGA. If Tc-99 is reduced to the +4 valence state, its potential mobility in the soil would decrease.

Solvent disposal has been documented in some of the SWMUs (e.g., SWMU 2) as a liquid waste and may be DNAPL, which forms discreet masses that are immiscible with water. The transport mechanisms for a DNAPL include gravity-driven migration of this liquid as a mobile mass; however, some of the liquid may be retained in pore spaces as residual saturation. A DNAPL migrates principally under the influence of gravity and will migrate vertically, but can spread laterally by fingering out among available pore space, and may spread laterally along lower permeability zones, potentially pooling at a lower permeability zone. Capillary forces act to retain a portion of the DNAPL within the soil matrix (DNAPL at residual saturation) and remain unless there is a change in the matrix. The amount of DNAPL that will be trapped in pore space is a function of the soil texture and may range from approximately 4% to 10% of the pore space in the unsaturated soil zone to as high as 20% of the pore space in the saturated zone (Abriola et al. 1998). Thus, DNAPL may take a circuitous path downward and may be trapped at residual saturation within the vadose and saturated zone, or form pools at changes of lithology, making characterizing its presence difficult in the subsurface soils at the BGOU.

The identification of residual TCE DNAPL source areas in the BGOU RI (DOE 2010b) was based on process knowledge. None of the soil concentrations exceed saturation concentration and none of the data suggest levels above residual saturation. TCE trends in the RGA indicate that TCE DNAPL could be present in the vicinity of the shared border between SWMUs 7 and 30. TCE trends at SWMUs 7 and 30 indicate that this potential TCE DNAPL source likely is constrained to the UCRS soils. There is potential for a TCE DNAPL source at SWMU 2 based on historical disposal records; however, neither the subsurface soil nor shallow groundwater data at SWMU 2 support the presence of a DNAPL source. Samples collected from two angled borings from below the waste cells showed no evidence of DNAPL. However, vertical sampling into and beneath the waste generally was avoided during previous investigations, leaving significant uncertainty as to the presence of DNAPL or intact drums containing TCE, as reported in the disposal inventory.

1.3.5.3 Groundwater fate and transport modeling

Modeling for the BGOU RI used the Spatial Analysis and Decision Assistance (SADA), Seasonal Soil Compartment Model (SESOIL), and Analytical Transient 1-,2-,3-Dimensional (AT123D) models, consistent with Tier 3 of the modeling matrix in the PGDP Risk Methods Document (DOE 2011a). Source term development for the models performed for the BGOU RI was based on soil sample analyses (not waste sample analyses) and may not be representative of the contamination present within the units themselves. (Note: Earlier modeling performed for SWMUs 2 and 3 and for SWMUs 7 and 30 had considered waste disposal information and developed source terms for waste.) SADA was used for the definition of the source terms, SESOIL for fate and transport modeling through the UCRS, and AT123D for fate and transport modeling through the RGA to the points of exposure (POEs). In addition to the models used, the MODFLOW/MODPATH models were used along with the previously developed PGDP sitewide groundwater model to establish input parameters for AT123D (i.e., distances to the POEs along flow paths, hydraulic gradient, and hydraulic conductivity). These models, along with the fixed parameter values chosen for the analyses (i.e., deterministic analysis), and model implementation are discussed in detail in the BGOU RI (DOE 2010b).

Table 1.4 presents the results of the deterministic modeling effort for the BGOU RI for the SWMU boundary, plant boundary and off-site POEs. These data were used to update the risk assessment for residential use of RGA groundwater as discussed in the next section. The chemicals shown on Table 1.4 at the SWMU Boundary are the COCs identified for future residential use of RGA groundwater in the BHHRA at that location. As discussed in Appendix B, although these constituents were modeled in the RI, these were not all constituents to be addressed in the FS based on factors including background, risk/MCL comparisons, and travel times. Among the modeled analytes, arsenic, Tc-99, TCE, and related VOCs commonly exceeded MCLs.

Table 1.4. Concentrations of the Analytes in Groundwater Predicted in SESOIL and AT123D Modeling of the BGOU SWMUs

Analyte	Predicted Maximum Groundwater Concentration[a]					
	SWMU Boundary (mg/L or pCi/L)[b]	Plant Boundary (mg/L or pCi/L)[b]	Property Boundary	Little Bayou seeps	Ohio River	MCL or Risk-Based Concentration (mg/L or pCi/L)
SWMU 2						
Arsenic	***3.54E-02***	2.91E-03	8.35E-09	N/A	0.00E+00	0.01
cis-1,2-DCE	***1.15E+01***	***1.74E+00***	***8.58E-01***	N/A	***3.38E-01***	0.07
Manganese	***7.16E-01***	1.86E-05	0.00E+00	N/A	0.00E+00	0.0245[c]
Naphthalene	***9.38E-04***	***1.57E-04***	8.27E-05	N/A	3.42E-05	0.000143[c]
PCB-1248	***1.54E-03***	1.28E-09	0.00E+00	N/A	0.00E+00	0.0000284[c]
PCB-1260	***8.73E-05***	0.00E+00	0.00E+00	N/A	0.00E+00	0.0000284[c]
Tc-99	1.02E+02	1.59E+01	8.06E+00	N/A	3.11E+00	900[d]
TCE	***1.48E+00***	***2.17E-01***	***1.10E-01***	N/A	***4.12E-02***	0.005
Uranium-234	1.58E+00	1.75E-05	0.00E+00	N/A	0.00E+00	10.24[e]
Uranium-238	1.81E+00	2.03E-05	0.00E+00	N/A	0.00E+00	9.99[e]
Uranium	9.86E-03	8.33E-08	0.00E+00	N/A	0.00E+00	0.03
SWMU 3						
Arsenic	***3.29E-02***	1.22E-03	0.00E+00	0.00E+00	N/A	0.01
Manganese	***8.95E-01***	4.08E-10	0.00E+00	0.00E+00	N/A	0.0245[c]
Tc-99	***5.560E+03***	***1.81E+03***	***1.36E+03***	8.04E+02	N/A	900[d]
Uranium-238	***1.59E+01***	***1.59E+01***	7.32E-11	0.00E+00	N/A	9.99[e]
Uranium	***4.89E-02***	2.27E-13	0.00E+00	0.00E+00	N/A	0.03
SWMU 7						
1,1-DCE	***8.98E-02***	***8.24E-02***	***1.10E-02***	4.02E-03	N/A	0.007[f]
Arsenic	***1.78E-02***	***1.26E-02***	2.35E-03	0.00E+00	N/A	0.01
cis-1,2-DCE	2.35E-02	2.15E-02	3.13E-03	1.17E-03	N/A	0.07
Manganese	***3.32E-01***	***2.41E-01***	1.05E-06	0.00E+00	N/A	0.0245[c]
PCB-1254	***5.23E-05***	***3.09E-05***	3.05E-06	1.32E-12	N/A	0.0000209[c]
Tc-99	***9.09E+02***	8.25E+02	2.70E+02	1.32E+02	N/A	900[d]
TCE	***1.09E-02***	***9.87E-03***	1.42E-03	5.06E-04	N/A	0.005
Uranium-234	7.94E+00	5.79E+00	5.84E-06	0.00E+00	N/A	10.24[e]

Table 1.4. Concentrations of the Analytes in Groundwater Predicted in SESOIL and AT123D Modeling of the BGOU SWMUs (Continued)

Analyte	Predicted Maximum Groundwater Concentration[a,b]					
	SWMU Boundary (mg/L or pCi/L)[b]	Plant Boundary (mg/L or pCi/L)[b]	Property Boundary	Little Bayou seeps	Ohio River	MCL or Risk-Based Concentration (mg/L or pCi/L)
Uranium-238	7.59E+00	5.58E+00	5.85E-06	0.00E+00	N/A	9.99[e]
Uranium	3.46E-03	2.53E-03	2.68E-09	0.00E+00	N/A	0.03
Vinyl Chloride	***1.35E-02***	***1.24E-02***	1.21E-03	4.13E-04	N/A	0.002
SWMU 30						
1,1-DCE	8.18E-05	7.65E-05	6.14E-06	1.86E-06	N/A	0.007 [f]
Arsenic	***1.82E-02***	***1.21E-02***	2.50E-03	0.00E+00	N/A	0.01
Manganese	***3.78E-01***	***2.51E-01***	2.85E-04	0.00E+00	N/A	0.0245[c]
Selenium	1.51E-02	8.30E-03	9.21E-04	3.15E-04	N/A	0.05
SWMU 30						
Tc-99	2.87E+02	2.64E+02	7.08E+01	2.92E+01	N/A	900[d]
TCE	9.11E-04	8.60E-04	7.70E-05	2.60E-05	N/A	0.005
Uranium-234	3.99E+00	2.75E+00	1.44E-03	0.00E+00	N/A	10.24[e]
Uranium-238	5.91E+00	4.07E+00	1.98E-03	0.00E+00	N/A	9.99[e]
Uranium	8.40E-03	4.81E-03	2.41E-06	0.00E+00	N/A	0.03

Table 1.4 is taken from Table 5.3 of the BGOU RI (DOE 2010b); changes to the original are footnoted.
[a] Values in bold, italic font exceed the analyte's MCL.
[b] Radionuclide concentrations are in pCi/L.
[c] MCLs not available for these contaminants. A value was not included in the original table in the BGOU RI, but was added for this FS. Values are the groundwater NALs [i.e., the lesser of the hazard-based (using a target HI of 0.1) and cancer-based (using a target ELCR of 1E-06) values when both are calculated] for the child resident taken from the 2013 Risk Methods Document [ELCRs (i.e., cancer NALs) were calculated using the child/adult age-adjusted lifetime scenario] (DOE 2013a). Additionally, modeled values that exceed this NAL have been shown in bold, italic font, as appropriate.
[d] Tc-99 MCL based on a critical organ dose at 4 mrem/yr from drinking water consumption.
[e] The MCLs for U-234 and U-238 are from Table A.14 of the Risk Methods Document (DOE 2013a).
[f] The value shown in the BGOU RI was incorrect; the value was corrected for this FS. Additionally, modeled values have been shown in bold, italic font, as appropriate.
N/A = The POE is not applicable. Groundwater flow pathways do not reach the specific discharge point from this SWMU as demonstrated in the RI Report (DOE 2010b).

1.3.6 Baseline Human Health Risk Summary

This section highlights the results of the BGOU BHHRA, then provides a summary of the COCs identified in the RI to be considered in this FS to meet the remedial action objectives (RAOs). These COCs are refined based on updated toxicity and exposure information and additional information in Section 1.5. Details on this process are provided in Appendix B for migration to groundwater, and Appendix C for direct contact risks. Concentrations of target COCs are shown in figures in Appendix A.

1.3.6.1 BHHRA for the BGOU RI

A BHHRA was conducted as part of the RI. The BHHRA for the BGOU RI characterized the baseline risks posed to human health from contact with contaminants in soil and water at the BGOU SWMUs and at locations to which contaminants may migrate. Several COCs were identified that could pose unacceptable threats to human health and the environment under some future use scenarios, particularly if there were any of the following.

- Direct contact with buried wastes
- Direct contact with surface soils

- Direct contact with subsurface soils
- Migration of COCs to groundwater and/or surface water

The impact to human health from direct contact with buried wastes was not characterized quantitatively in the BHHRA for SWMUs 2, 3, 7, and 30. The source characteristics (Section 1.3.3.1) identify potential hazards, including pyrophoric uranium, solvents, and PCBs that may be present in one or more of these SWMUs.

The BHHRA reported the hazards and risks for current and future land use scenarios, some of which are unlikely or hypothetical. The risk characterization summary for all scenarios evaluated in the RI for these SWMUs is included in Tables 1.5 through 1.8. For SWMUs 2 and 3, there was no scenario evaluated for exposure to the waste because it was not sampled at the time the risk characterization was completed. For SWMUs 7 and 30, limited sampling of the waste was performed and the data were included in the evaluation of the excavation worker scenario. Due to the limited sampling, waste has been determined to contain PTW based on process knowledge as described in Section 1.3.3.1. The risk characterization for direct contact scenarios was reported in the WAG 22 RI (DOE 1998a) for SWMUs 7 and 30 and the WAG 22 RI Addendum (DOE 1994b) for SWMUs 2 and 3. The emphasis in the BGOU RI was to better characterize potential releases from the wastes to subsurface soils and potential impacts to the RGA and to update the risk assessment for use of RGA groundwater at the SWMU boundary and downgradient POEs. Additional data collected in the 0–20 ft interval subsequent to the WAG 22 BHHRA were not used to revise the risks associated with direct contact exposures. These additional data were reviewed in the uncertainty section to determine potential impacts on the identification of COCs and magnitude of the risk estimates.

In the BGOU RI BHHRA, the individual COCs with chemical-specific excess lifetime cancer risk (ELCR) greater than 1E-04 or HI greater than 1 were identified as "priority COCs." "Priority COCs" were identified in the RI BHHRA and in this FS as an aid to risk managers during decision making; however, all COCs will be addressed during alternative analysis. The recreational scenario was evaluated for SWMUs 7 and 30, and was within the acceptable risk range. The excavation worker was evaluated at SWMUs 7 and 30 showing unacceptable risks. Although excavation worker scenario was not explicitly evaluated at SWMUs 2 and 3, the samples used to estimate risks to the industrial worker included samples collected to depths of approximately 8 ft; for this FS it is assumed that if the future industrial worker should have unacceptable risks from the surface soils, then the future excavation worker also likely will have unacceptable risks since he potentially would be exposed to both surface and subsurface soils, albeit at a different exposure duration and frequency.

The land use is expected to remain industrial, and the emphasis of the review of the BHHRA for this FS was focused on the future industrial worker and the future excavation worker. The COCs identified in the BHHRA for these receptors are summarized in Table 1.9.

Potential migration of contaminants from the waste that may pose an ongoing source to RGA groundwater was evaluated in the BHHRA and those chemicals listed on Table 1.4 represent the COCs identified in the BGOU RI risk assessment at the SWMU boundary following the modeling. These COCs may be revised in Sections 1.5 and 1.6 of this FS.

1.3.6.2 Uncertainties in the BHHRA for the BGOU RI

Uncertainties are associated with each step of a risk assessment process. The potential effect of the uncertainties on risk characterization should be considered when interpreting the results of the risk characterization (DOE 2013a) because a number of assumptions are made during the BHHRA. Types of uncertainties considered are divided into four broad categories: those associated with data, exposure

Table 1.5. Summary of Risk Characterization for SWMU 2

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs[b]	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs[b]	% Total HI
Current industrial worker/intruder at current concentrations (soil) (from WAG 22 RI Addendum[c])	1.2E-05	U-235 + daughters U-238 + daughters	83.8 10.7	External exposure	94.7	6.8E-03	*No COCs		*No COCs	
Future industrial worker at current concentrations (soil) (from WAG 22 RI Addendum[c])	1.2E-04	Arsenic U-235 + daughters U-238 + daughters	2.8 83.9 10.7	Ingestion External exposure	4.7 94.7	7.0E-02	*No COCs		*No COCs	
Future child rural resident at current concentrations (RGA groundwater only)	N/A	N/A	N/A	N/A	N/A	1.30E+03	Arsenic Manganese Uranium *cis*-1,2-DCE Naphthalene TCE	0.9 0.1 0.1 46.8 0.0 52.1	Ingestion Dermal Inhalation while showering Household inhalation	46.0 11.7 4.8 37.5

Table 1.5. Summary of Risk Characterization for SWMU 2 (Continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs[b]	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs[b]	% Total HI
Future adult rural resident at current concentrations (RGA groundwater only)	4.72E-02	Arsenic Aroclor 1248 Aroclor 1268 TCE Tc-99 U-234 U-238	2.0 0.4 0.1 97.5 0.0 0.0 0.0	Ingestion Dermal Inhalation while showering Household inhalation	19.8 11.3 7.8 61.0	3.79E+02	Arsenic Manganese Uranium *cis*-1,2-DCE Naphthalene TCE	0.9 0.1 0.1 36.8 0.0 62.1	Ingestion Dermal Inhalation while showering Household inhalation	45.0 23.9 3.5 27.5
Future child rural resident at modeled concentrations (RGA groundwater drawn at plant boundary)	N/A	N/A	N/A	N/A	N/A	1.92E+02	Arsenic *cis*-1,2-DCE Naphthalene TCE	0.5 48 0.1 52	Ingestion Dermal Inhalation while showering Household inhalation	45 12.4 5.4 38
Future adult rural resident at modeled concentrations (RGA groundwater drawn at plant boundary)	6.82E-03	Arsenic TCE	1.1 98.9	Ingestion Dermal Inhalation while showering Household inhalation	19.2 11.1 7.9 61.8	5.08E+01	Arsenic *cis*-1,2-DCE Naphthalene TCE	0.5 16.2 0.1 83.1	Ingestion Dermal Inhalation while showering Household inhalation	60 32 1 7.2
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary)	N/A	N/A	N/A	N/A	N/A	9.56E+01	*cis*-1,2-DCE TCE	47.4 52.6	Ingestion Dermal Inhalation while showering Household inhalation	45.4 11.8 4.9 38.0
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary)	3.42E-03	TCE	100	Ingestion Dermal Inhalation while showering Household inhalation	18.3 11.2 8.0 62.5	2.79E+01	*cis*-1,2-DCE TCE	37.3 62.7	Ingestion Dermal Inhalation while showering Household inhalation	44.4 24.1 3.6 27.9
Future child rural resident at modeled concentrations (RGA groundwater drawn at Ohio River)	N/A	N/A	N/A	N/A	N/A	2.25E+01	*cis*-1,2-DCE TCE	79.4 20.5	Ingestion Dermal Inhalation while showering Household inhalation	16.2 18.8 7.4 57.7
Future adult rural resident at modeled concentrations (RGA groundwater drawn at Ohio River)	1.28E-03	TCE	100	Ingestion Dermal Inhalation while showering Household inhalation	18.3 11.2 8.0 62.5	6.7E+00	*cis*-1,2-DCE TCE	61.2 38.7	Ingestion Dermal Inhalation while showering Household inhalation	15.5 37.7 5.3 41.5

Table 1.5 is taken from Table 6.6 of the BGOU RI (DOE 2010b).
Note: N/A = ELCR not applicable to child and teen cohorts. ELCR for adult is for lifetime exposure and takes into account exposure as child and teen.
*No COCs = There are no COCs or routes of exposure at this SWMU for this endpoint (may apply to ELCR or HI).
[a] Total ELCR and total HI represent total risk or hazard summed across all routes of exposure for all COCs.
[b] Pathways of concern (POCs) are exposure routes whose cumulative ELCR exceeded 1E-6 or cumulative HI exceeded 0.1.
[c] RI Addendum for WAG 22 (DOE 1994b), Attachments 2-1 through 2-6. This risk assessment combined SWMUs 2 and 3.

Table 1.6. Summary of Risk Characterization for SWMU 3

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs[b]	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs[b]	% Total HI
Current industrial worker/intruder at current concentrations (soil) (from WAG 22 RI Addendum[c])	1.2E-05	U-235 + daughters U-238 + daughters	83.8 10.7	External exposure	94.7	6.8E-03	*No COCs		*No COCs	NE
Future industrial worker at current concentrations (soil) (from WAG 22 RI Addendum[c])	1.2E-04	Arsenic U-235 + daughters U-238 + daughters	2.8 83.9 10.7	Ingestion External exposure	4.7 94.7	7.0E-02	*No COCs		*No COCs	NE
Future child rural resident at current concentrations (RGA groundwater only)	N/A	N/A	N/A	N/A	N/A	2.03E+01	Arsenic Manganese Uranium	51.9 9.6 38.6	Ingestion Dermal	99.5 0.5
Future adult rural resident at current concentrations (RGA groundwater only)	1.20E-03	Arsenic Tc-99 U-238	72.4 25.3 2.3	Ingestion Dermal	99.8 0.2	5.83E+00	Arsenic Manganese Uranium	51.7 9.9 38.3	Ingestion Dermal	98.9 1.1
Future child rural resident at modeled concentrations (RGA groundwater drawn at plant boundary)	N/A	N/A	N/A	N/A	N/A	3.98E-01	Arsenic	100	Ingestion	97.9
Future adult rural resident at modeled concentrations (RGA groundwater drawn at plant boundary)	1.32E-04	Arsenic Tc-99	24.6 75.4	Ingestion	99.9	1.12E-01	Arsenic	100	Ingestion	99.6
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary)	N/A	N/A	N/A	N/A	N/A		*No COCs		*No COCs	
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary)	7.46E-05	Tc-99	100	Ingestion	100		*No COCs		*No COCs	

Table 1.6. Summary of Risk Characterization for SWMU 3 (Continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs[b]	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs[b]	% Total HI
Future child rural resident at modeled concentrations (RGA groundwater drawn at Little Bayou seeps)	N/A	N/A	N/A	N/A	N/A		*No COCs		*No COCs	
Future adult rural resident at modeled concentrations (RGA groundwater drawn at Little Bayou seeps)	4.41E-05	Tc-99	100.0	Ingestion	100		*No COCs		*No COCs	
Future child rural resident at modeled concentrations (RGA groundwater drawn at Ohio River)		Not a POE for groundwater from this SWMU.								
Future adult rural resident at modeled concentrations (RGA groundwater drawn at Ohio River)		Not a POE for groundwater from this SWMU.								

Table 1.6 is taken from Table 6.7 of the BGOU RI (DOE 2010b).

Note: N/A = ELCR not applicable to child and teen cohorts. ELCR for adult is for lifetime exposure and takes into account exposure as child and teen.

*No COCs = There are no COCs or routes of exposure.

[a] Total ELCR and total HI represent total risk or hazard summed across all routes of exposure for all COCs.

[b] POCs are exposure routes whose cumulative ELCR exceeded 1E-6 or cumulative HI exceeded 0.1.

[c] RI Addendum for WAG 22 (DOE 1994b), Attachment 2-1 through 2-6. This risk assessment combined SWMUs 2 and 3.

Table 1.7. Summary of Risk Characterization for SWMU 7

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs[b]	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs[b]	% Total HI
Current industrial worker at	3.8E-03	Arsenic	0.6	Ingestion	0.5	5.0E+00	Aluminum	4.1	Ingestion	3.6
current concentrations (soil)		Beryllium[d]	97.6	Dermal	97.4		Antimony	4.4	Dermal	96.4
(from WAG 22 RI[c])		Benzo(a)anthracene	< 0.1	External exposure	2.5		Arsenic	2.6		
		Benzo(a)pyrene	0.3				Beryllium	9.6		
		Benzo(b)fluoranthene	< 0.1				Chromium	13.6		
		Dibenzo(a,h)anthracene	0.4				Iron	20.6		
		Indeno(1,2,3-cd)pyrene	0.1				Manganese	10.7		
		Np-237	< 0.1				Uranium	13.7		
		U-234	< 0.1				Vanadium	17.7		
		U-235	0.2							
		U-235/236	0.3							
		U-238	2.1							
Future industrial worker at	3.9E-03	Arsenic	0.6	Ingestion	0.5	5.0E+00	Aluminum	4.1	Ingestion	3.6
current concentrations (soil)		Beryllium[d]	96.0	Dermal	97.1		Antimony	4.4	Dermal	96.4
(from WAG 22 RI[c])		Benzo(a)anthracene	< 0.1	External exposure	2.4		Arsenic	2.6		
		Benzo(a)pyrene	0.3				Beryllium	9.6		
		Benzo(b)fluoranthene	< 0.1				Chromium	13.6		
		Dibenzo(a,h)anthracene	0.4				Iron	20.6		
		Indeno(1,2,3-cd)pyrene	0.1				Manganese	10.7		
		Np-237	< 0.1				Uranium	13.7		
		U-234	< 0.1				Vanadium	17.7		
		U-235	0.2							
		U-235/236	0.3							
		U-238	2.1							
Future child rural resident at	N/A	N/A	N/A	N/A	N/A	3.7E+02	Aluminum	2.7	Ingestion	1.4
current concentrations (soil)							Antimony	0.9	Dermal	7.7
(from WAG 22 RI[c])							Arsenic	6.2	Ingestion of vegetables from	90.9
							Barium	0.3	soil	
							Beryllium	1.3		
							Cadmium	0.8		
							Chromium	2.7		
							Cobalt	0.1		
							Copper	0.3		
							Iron	19.7		
							Manganese	1.9		
							Nickel	0.4		
							Uranium	58.4		
							Vanadium	2.4		
							Zinc	0.2		
							Aroclor 1254	1.7		

Table 1.7. Summary of Risk Characterization for SWMU 7 (Continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs[b]	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs[b]	% Total HI
Future adult rural resident at current concentrations (soil) (from WAG 22 RI[c])	3.4E-02	Arsenic Beryllium[d] Aroclor 1254 Aroclor 1260 Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene Dibenzo(a,h)anthracene Indeno(1,2,3-cd)pyrene Np-237 Pu-239 U-234 U-235 U-235/236 U-238	7.3 65.4 0.2 0.4 0.2 1.7 0.2 < 0.1 1.9 0.3 0.2 0.4 3.3 0.3 0.5 17.6	Ingestion Dermal External exposure Ingestion of vegetables from soil	0.5 33.0 1.9 64.6	1.1E+02	Aluminum Antimony Arsenic Barium Beryllium Cadmium Chromium Copper Iron Manganese Nickel Uranium Vanadium Zinc Aroclor 1254	2.7 0.8 6.5 0.3 1.1 0.8 2.3 0.3 19.8 1.6 0.4 59.5 2.0 0.2 1.7	Ingestion Dermal Ingestion of vegetables from soil	0.5 5.0 94.6
Future child rural resident at current concentrations (RGA groundwater only)	N/A	N/A	N/A	N/A	N/A	1.89E+01	Arsenic Manganese Uranium 1,1-DCE *cis*-1,2-DCE Aroclor 1254 TCE Vinyl chloride	30.2 3.7 2.9 4.5 6.6 22.3 26.4 3.4	Ingestion Dermal contact Inhalation while showering Inhalation household use	60.9 21.0 2.0 16.0
Future adult rural resident at current concentrations (RGA groundwater only)	3.13E-03	Arsenic 1,1-DCE Total PCBs TCE Vinyl chloride Tc-99 U-234 U-238	15.1 66.4 0.2 4.1 11.9 1.6 0.4 0.4	Ingestion Dermal contact Inhalation while showering Inhalation during household use	61.2 3.7 4.9 30.3	6.39E+00	Arsenic Manganese Uranium 1,1-DCE *cis*-1,2-DCE Total PCBs TCE Vinyl chloride	25.5 3.2 2.5 3.1 4.5 31.4 27.1 2.7	Ingestion Dermal contact Inhalation while showering Inhalation household use	51.4 37.2 1.3 10.1

Table 1.7. Summary of Risk Characterization for SWMU 7 (Continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs[b]	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs[b]	% Total HI
Future child rural resident at modeled concentrations (RGA groundwater drawn at plant boundary)	N/A	N/A	N/A	N/A	N/A	1.45E+01	Arsenic Manganese Uranium 1,1-DCE *cis*-1,2-DCE Total PCBs TCE Vinyl chloride	27.9 3.6 2.8 5.4 7.9 17.2 31.2 4.1	Ingestion Dermal contact Inhalation while showering Inhalation household use	62.3 18.7 2.2 16.9
Future adult rural resident at modeled concentrations (RGA groundwater drawn at plant boundary)	2.98E-03	Arsenic 1,1-DCE Total PCBs TCE Vinyl chloride Tc-99 U-234 U-238	11.2 63.9 0.2 10.3 12.3 1.5 0.3 0.3	Ingestion Dermal contact Inhalation while showering Inhalation during household use	55.4 3.4 4.7 36.5	4.78E+00	Arsenic Manganese Uranium 1,1-DCE *cis*-1,2-DCE Total PCBs TCE Vinyl chloride	24.2 3.1 2.4 3.8 5.5 24.8 32.9 3.3	Ingestion of groundwater Dermal contact Inhalation household use	53.8 33.8 11.0
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary)	N/A	N/A	N/A	N/A	N/A	1.97E+00	Arsenic 1,1-DCE *cis*-1,2-DCE Total PCBs TCE	38.1 5.3 8.4 12.4 32.9	Ingestion Dermal contact Inhalation household use	66.3 15.8 15.9
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary)	4.11E-04	Arsenic 1,1-DCE TCE Vinyl chloride Tc-99	15.1 61.8 10.7 8.7 3.6	Ingestion Dermal contact Inhalation while showering Inhalation during household use	56.7 3.2 4.5 35.5	6.36E-01	Arsenic Total PCBs TCE	33.9 18.4 35.5	Ingestion Dermal contact	58.8 29.3
Future child rural resident at modeled concentrations (RGA groundwater drawn at Little Bayou seeps)	N/A	N/A	N/A	N/A	N/A	3.373E-01	TCE	61.0	Ingestion Inhalation household use	52.5 30.0
Future adult rural resident at modeled concentrations (RGA groundwater drawn at Little Bayou seeps)	1.28E-04	1,1-DCE TCE Vinyl chloride Tc-99	72.6 12.3 9.5 5.7	Ingestion Dermal contact Inhalation while showering Inhalation during household use	49.6 3.6 5.3 41.4	1.15E-01	*No COCs		*No COCs	

Table 1.7. Summary of Risk Characterization for SWMU 7 (Continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs[b]	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs[b]	% Total HI
Future child rural resident at modeled concentrations (RGA groundwater drawn at Ohio River)		Not a POE for groundwater from this SWMU.								
Future adult rural resident at modeled concentrations (RGA groundwater drawn at Ohio River)		Not a POE for groundwater from this SWMU.								
Future child recreational user at current concentrations (from WAG 22 RI[c])	N/A	N/A	N/A	N/A	N/A	7.3E-02	*No COCs		*No COCs	
Future teen recreational user at current concentrations (from WAG 22 RI[c])	N/A	N/A	N/A	N/A	N/A	6.4E-02	*No COCs		*No COCs	
Future adult recreational user at current concentrations (from WAG 22 RI[c])	1.1E-05	Aroclor 1260 Benzo(a)pyrene Dibenzo(a,h)anthracene U-238	18.6 9.5 42.5 15.7	Ingestion of deer Ingestion of rabbit Ingestion of quail	10.0 70.9 21.8	7.5E-02	*No COCs		*No COCs	
Future excavation worker at current concentrations (soil) (from WAG 22 RI[c])	1.6E-03	Arsenic Beryllium[d] Benzo(a)pyrene Dibenzo(a,h)anthracene Np-237 Pu-239 U-234 U-235 U-235/236 U-238	1.8 42.2 0.1 1.7 0.4 0.5 3.4 9.1 0.4 41.3	Ingestion Dermal External exposure	25.6 43.8 32.5	5.4E+00	Aluminum Antimony Arsenic Chromium Copper Iron Manganese Nickel Uranium Vanadium	5.0 11.3 3.4 17.6 2.9 21.3 11.0 3.9 7.5 10.9	Ingestion Dermal	18.4 81.5

Table 1.7 is taken from Table 6.11 of the BGOU RI (DOE 2010b).
Note: The summary risk tables list both U-235 and U-235/236 because both U-235 (alpha spec and wt. %) and U-235/U-236 data are in the database. These data were assessed separately in the BHHRA as presented in the RI.
Note: Excavation worker as referenced in the RI was calculated using and exposure frequency of 185 days per year and an exposure duration of 25 years.
Note: N/A = ELCR not applicable to child and teen cohorts. ELCR for adult is for lifetime exposure and takes into account exposure as child and teen.
*No COCs = There are no COCs or routes of exposure.
[a] Total ELCR and total HI represent total risk or hazard summed across all routes of exposure for all COCs.
[b] POCs are exposure routes whose cumulative ELCR exceeded 1E-6 or cumulative HI exceeded 0.1.
[c] RI for SWMUs 7 and 30 (DOE 1998a), Tables 1.59 through 1.68, excluding lead as a COC. Lead was excluded as a COC because it had exceedingly high HIs and was the overwhelming risk driver, most likely attributed to the use of a very conservative (1.0E-07 mg/kg-day) reference dose (RfD) value provided by KDEP. That RfD is no longer in use by KDEP. The current EPA screening levels for lead in soil for residential use is 400 mg/kg. The maximum detected concentrations of lead detected in soil at SWMUs 2, 3, 7, and 30 are all less than 100 mg/kg. These maximum detected values all are less than half the EPA screening level for residential soil, indicating that lead does not need to be considered as a COC at any of the BGOU SWMUs based on comparison with the EPA screening value.
The future excavation worker was based an exposure duration of 25 years and an exposure frequency of 185 days/year.
[d] The oral slope factor for beryllium has been withdrawn since this evaluation. Because of this change, the total ELCR for the future industrial worker at current concentrations and the future excavation worker at current concentrations was revised in Table 1.19.

Table 1.8. Summary of Risk Characterization for SWMU 30

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs[b]	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs[b]	% Total HI
Current industrial worker at current concentrations (soil) (from WAG 22 RI[c])	3.7E-03	Arsenic	0.5	Ingestion	0.5	4.4E+00	Aluminum	5.1	Ingestion	2.9
		Beryllium[d]	97.5	Dermal	97.3		Antimony	3.7	Dermal	97.1
		Aroclor 1260	0.1	External exposure	1.7		Arsenic	2.7		
		Benzo(a)anthracene	0.1				Beryllium	10.8		
		Benzo(a)pyrene	0.8				Cadmium	3.5		
		Benzo(b)fluoranthene	0.1				Chromium	13.5		
		Dibenzo(a,h)anthracene	0.3				Iron	19.8		
		Indeno(1,2,3-cd)pyrene	0.1				Manganese	11.3		
		Np-237	< 0.1				Uranium	9.0		
		U-234	< 0.1				Vanadium	17.6		
		U-235	0.2							
		U-235/236	0.3							
		U-238	1.4							
Future industrial worker at current concentrations (soil) (from WAG 22 RI[c])	3.8E-03	Arsenic	0.5	Ingestion	0.5	4.4E+00	Aluminum	5.1	Ingestion	2.9
		Beryllium[d]	96.2	Dermal	97.8		Antimony	3.7	Dermal	97.1
		Aroclor 1260	0.1	External exposure	1.7		Arsenic	2.7		
		Benzo(a)anthracene	0.1				Beryllium	10.8		
		Benzo(a)pyrene	0.8				Cadmium	3.5		
		Benzo(b)fluoranthene	0.1				Chromium	13.5		
		Dibenzo(a,h)anthracene	0.3				Iron	19.8		
		Indeno(1,2,3-cd)pyrene	0.1				Manganese	11.3		
		Np-237	< 0.1				Uranium	9.0		
		U-234	< 0.1				Vanadium	17.6		
		U-235	0.2							
		U-235/236	0.3							
		U-238	1.4							
Future child rural resident at current concentrations (soil) (from WAG 22 RI[c])	N/A	N/A	N/A	N/A	N/A	2.6E+02	Aluminum	4.1	Ingestion	1.3
							Antimony	0.9	Dermal	9.4
							Arsenic	7.5	Ingestion of vegetables from soil	89.3
							Barium	0.6		
							Beryllium	1.8		
							Cadmium	2.2		
							Chromium	3.2		
							Copper	0.6		
							Iron	22.6		
							Manganese	2.5		
							Mercury	0.7		
							Nickel	0.8		
							Uranium	46.8		
							Vanadium	3.0		
							Zinc	0.2		
							Aroclor 1254	2.6		

Table 1.8. Summary of Risk Characterization for SWMU 30 (Continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs[b]	% Total ELCR	Total HI[a]	COCs[b]	% Total HI	POCs	% Total HI
Future adult rural resident at current concentrations (soil) (from WAG 22 RI[c])	3.2E-02	Arsenic Beryllium[d] Aroclor 1254 Aroclor 1260 Benzo(a)anthracene Benzo(a)pyrene Benzo(b)fluoranthene Benzo(k)fluoranthene bis(2-ethylhexyl)phthalate Chrysene Dibenzo(a,h)anthracene Indeno(1,2,3-cd)pyrene Np-237 U-234 U-235 U-235/236 U-238	6.8 66.7 0.2 1.8 0.4 4.4 0.5 < 0.1 < 0.1 < 0.1 1.7 0.4 0.2 4.5 0.3 0.6 11.5	Ingestion Dermal External exposure Ingestion of vegetables from soil	0.5 35.4 1.3 62.8	7.9E+01	Aluminum Antimony Arsenic Barium Beryllium Cadmium Chromium Copper Iron Manganese Mercury Nickel Uranium Vanadium Zinc Aroclor 1254	4.1 0.8 7.9 0.6 1.5 2.2 2.9 0.6 22.8 2.1 0.7 0.9 47.5 2.4 0.2 2.7	Ingestion Dermal Ingestion of vegetables from soil	0.5 6.1 93.4
Future child rural resident at current concentrations (RGA groundwater only)	N/A	N/A	N/A	N/A	N/A	9.14E+00	Arsenic Manganese Selenium Uranium 1,1-DCE TCE	63.8 8.8 3.2 14.7 5 4.6	Ingestion Dermal contact Inhalation while showering Inhalation household use	93.3 1.3 0.6 4.7
Future adult rural resident at current concentrations (RGA groundwater only)	5.44E-04	Arsenic 1,1-DCE TCE Tc-99 U-234 U-238	88.6 0.3 5.2 2.9 1 1.3	Ingestion Dermal contact Inhalation while showering Inhalation household use	95.3 0.9 0.4 3.4	3.31E+00	Arsenic Manganese Selenium Uranium 1,1-DCE TCE	50.5 7.1 2.5 11.6 23.9 4.4	Ingestion Dermal contact Inhalation while showering Inhalation household use	88.8 9.8 0.2 1.2
Future child rural resident at modeled concentrations (RGA groundwater drawn at plant boundary)	N/A	N/A	N/A	N/A	N/A	6.14E+00	Arsenic Manganese Selenium Uranium 1,1-DCE TCE	63.1 8.7 2.6 12.5 0.1 12.9	Ingestion of groundwater Dermal contact Inhalation while showering Inhalation household use	91.1 1.7 0.1 7.1
Future adult rural resident at modeled concentrations (RGA groundwater drawn at plant boundary)	3.75E-04	Arsenic 1,1-DCE TCE Tc-99 U-234 U-238	85.6 0.5 7.1 3.9 1 1.9	Ingestion Dermal contact Inhalation while showering Inhalation household use	93.6 1.1 0.6 4.7	2.10E+00	Arsenic Manganese Selenium Uranium 1,1-DCE TCE	52.9 7.4 2.2 10.5 0.4 26.6	Ingestion Dermal contact Inhalation while showering Inhalation household use	76.1 3 0 20.8

Table 1.8. Summary of Risk Characterization for SWMU 30 (Continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs[b]	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs[b]	% Total HI
Future child rural resident at modeled concentrations (RGA groundwater drawn at property boundary)	N/A	N/A	N/A	N/A	N/A	8.40E-01	Arsenic Selenium 1,1-DCE TCE Manganese	89.2 2.1 0.1 8.5 0.1	Ingestion Dermal contact Inhalation while showering Inhalation household use	94.2 1.1 0 4.6
Future adult rural resident at modeled concentrations (RGA groundwater drawn at property boundary)	6.85E-05	Arsenic 1,1-DCE TCE Tc-99	90.6 0.2 3.5 5.7	Ingestion Dermal contact Inhalation while showering Inhalation household use	96.7 0.7 0.3 2.3	2.76E-01	Arsenic Selenium 1,1-DCE TCE Manganese	77.9 1.8 0.3 19.9 0.1	Ingestion Dermal contact Inhalation while showering Inhalation household use	82 2 1.8 14.2
Future child rural resident at modeled concentrations (RGA groundwater drawn at Little Bayou seeps)	N/A	N/A	N/A	N/A	N/A	3.02E-02	Selenium 1,1-DCE TCE	20 0.6 79.3	Ingestion Dermal contact Inhalation household use	47.5 8.6 0.4 43.5
Future adult rural resident at modeled concentrations (RGA groundwater drawn at Little Bayou seeps)	2.45E-06	1,1-DCE TCE Tc-99	1.8 32.9 65.3	Ingestion Dermal contact Inhalation while showering Inhalation household use	72.1 3.7 2.7 21.4	9.17E-03	Selenium 1,1-DCE TCE	18.9 2.3 78.8	Ingestion Dermal contact Inhalation while showering Inhalation household use	44.7 17 18.3 20
Future child rural resident at modeled concentrations (RGA groundwater drawn at Ohio River)		Not a POE for groundwater from this SWMU								
Future adult rural resident at modeled concentrations (RGA groundwater drawn at Ohio River)		Not a POE for groundwater from this SWMU								
Future child recreational user at current concentrations (from WAG 22 RI[c])	N/A	N/A	N/A	N/A	N/A	4.2E-02	*No COCs		*No COCs	
Future teen recreational user at current concentrations (from WAG 22 RI[c])	N/A	N/A	N/A	N/A	N/A	3.8E-02	*No COCs		*No COCs	

Table 1.8. Summary of Risk Characterization for SWMU 30 (Continued)

Receptor	Total ELCR[a]	COCs	% Total ELCR	POCs[b]	% Total ELCR	Total HI[a]	COCs	% Total HI	POCs[b]	% Total HI
Future adult recreational user at current concentrations (from WAG 22 RI[c])	1.5E-05	Aroclor 1260	48.2	Ingestion of deer	8.7	4.3E-02	*No COCs		*No COCs	
		Benzo(a)pyrene	12.9	Ingestion of rabbit	80.0					
		Dibenzo(a,h)anthracene	20.8	Ingestion of quail	11.3					
Future excavation worker at current concentrations (soil) (from WAG 22 RI[c])	1.2E-03	Arsenic	1.9	Ingestion	6.3	4.5E+00	Aluminum	4.6	Ingestion	26.4
		Beryllium[d]	93.7	Dermal	91.7		Antimony	6.3	Dermal	73.5
		Aroclor 1248	0.1	External exposure	3.3		Arsenic	3.3		
		Benzo(a)anthracene	0.1				Beryllium	3.8		
		Benzo(a)pyrene	0.8				Cadmium	3.0		
		Benzo(b)fluoranthene	0.1				Chromium	10.2		
		Dibenzo(a,h)anthracene	0.4				Copper	7.6		
		Indeno(1,2,3-cd)pyrene	0.1				Iron	19.8		
		Np-237	0.3				Manganese	14.3		
		Pu-239	0.2				Uranium	12.2		
		U-234	0.8				Vanadium	12.7		
		U-235	0.1							
		U-235/236	0.8							
		U-238	0.6							

Table 1.8 is taken from Table 6.12 of the BGOU RI (DOE 2010b).

Note: The summary risk tables list both U-235 and U-235/236 because both U-235 (alpha spec and wt. %) and U-235/U-236 data are in the database. These data were assessed separately in the BHHRA as presented in the RI.

Note: Excavation worker as referenced in the RI was calculated using and exposure frequency of 185 days per year and an exposure duration of 25 years.

Note: N/A = ELCR not applicable to child and teen cohorts. ELCR for adult is for lifetime exposure and takes into account exposure as child and teen.

[a] Total ELCR and total HI represent total risk or hazard summed across all routes of exposure for all COCs.

[b] POCs are exposure routes whose cumulative ELCR exceeded 1E-6 or cumulative HI exceeded 0.1.

[c] RI for SWMUs 7 and 30 (DOE 1998a), Tables 1.59 through 1.68, excluding lead as a COC. Lead was excluded as a COC because it had exceedingly high HIs and was the overwhelming risk driver, most likely attributed to the use of a very conservative (1.0E-07 mg/kg-day) RfD value provided by the KDEP. That RfD is no longer in use by KDEP. The current EPA screening levels for lead in soil for residential use is 400 mg/kg. The maximum detected concentrations of lead detected in soil at SWMUs 2, 3, 7, and 30 are all less than 100 mg/kg. These maximum detected values all are less than half the EPA screening level for residential soil, indicating that lead does not need to be considered as a COC at any of the BGOU SWMUs based on comparison with the EPA screening value.

The future excavation worker was based an exposure duration of 25 years and an exposure frequency of 185 days/year.

[d] The oral slope factor for beryllium has been withdrawn since this evaluation. Because of this change, the total ELCR for the future industrial worker at current concentrations and the future excavation worker at current concentrations was revised in Table 1.19.

Table 1.9. Summary of COCs Identified in the RI for Future Industrial Worker and Future Excavation Worker at BGOU SWMUs 2, 3, 7, and 30

	SWMU 2	SWMU 3	SWMU 7	SWMU 30
Carcinogenic COCs (Chemical-Specific ELCR > 1E-06)	Arsenic Uranium-235 Uranium-238	Arsenic Uranium-235 Uranium-238	Arsenic Beryllium[a] Total PAHs[b] Neptunium-237 Uranium-234 Uranium-235 Uranium-235/236[c] Uranium-238 *Plutonium-239*	Arsenic Beryllium[a] Total PCBs Total PAHs[b] Neptunium-237 Uranium-234 Uranium-235 Uranium-235/236 [c] Uranium-238 *Plutonium-239*
Noncancer Hazard COCs (Chemical-Specific HI > 0.1)	None	None	Aluminum Antimony Arsenic Beryllium Chromium Iron Manganese Uranium Vanadium *Nickel*	Aluminum Antimony Arsenic Beryllium Cadmium Chromium Iron Manganese Uranium Vanadium *Copper*

Reference: Table 1.9 is taken from the BGOU RI (DOE 2010b).
Analytes in italics identified as COCs only for future excavation worker scenario (determined at an exposure frequency of 185 days/year and an exposure duration of 25 years).
Analytes not italicized are COCs for both future industrial and future excavation worker scenarios.
[a] Beryllium's oral slope factor has changed significantly since this evaluation. Because of this change, the total ELCR for the future industrial worker at current concentrations and the future excavation worker at current concentrations was revised in Table 1.19.
[b] Total PAHs include individual carcinogenic PAHs were identified at SWMUs 7 and 30.
[c] The summary risk tables list both U-235 and U-235/236 because both U-235 (alpha spec and wt. %) and U-235/U-236 data are in the database. These data were assessed separately in the BHHRA as presented in the RI.

assessment, toxicity assessment, and risk characterization. Uncertainties identified in the BGOU RI BHHRA included those for the risk characterization of impacts of contamination on groundwater, which was the new work completed in the BGOU RI BHHRA, and those identified in earlier BHHRAs, which are summarized in the BGOU RI BHHRA. These uncertainties are listed here, and the impacts of the uncertainties on the FS, in terms of COC identification and preliminary remediation goal (PRG) derivation, are evaluated in Sections 1.5 and 1.6 of the FS.

In addition to discussing the uncertainties in each of the categories, the BHHRAs also estimated the effect of the uncertainty on the risk estimates. The effects were categorized as small, moderate, or large. Uncertainties categorized as small were assumed not to affect the risk estimates by more than one order of magnitude; those categorized as moderate were assumed to affect the risk estimates by between one and two orders of magnitude; and uncertainties categorized as large were assumed to affect the risk estimate by more than two orders of magnitude.

As noted in the BGOU RI BHHRA, the uncertainties and their estimated effects on the risk estimates are neither independent nor mutually exclusive. The total effect of all uncertainties on the risk estimates (i.e., total ELCRs and HIs), therefore, is not necessarily the sum of the estimated effects.

As is shown in the BGOU RI BHHRA, the risk estimates could vary if different assumptions were used in deriving the risk estimates or if better information was available for some parameters. The following text summarizes the estimated effects of each uncertainty mentioned previously.

No uncertainties were estimated to have a large effect on the risk characterization, and only three were estimated to have a moderate effect.

Following is a list of uncertainties with effects estimated to be moderate:

- Exclusion of some potential biota pathways (fish from ponds) for future receptors,
- Migration of groundwater to off-site receptors, and
- Calculation of toxicity values for chemicals (particularly Kentucky's value for TCE).

Following is a list of uncertainties with effects estimated to be small:

- Determination of exposure points for future concentrations,

- Use of reasonable maximum exposure (RME) default exposure values instead of central tendency exposure values,

- Use of provisional and withdrawn toxicity values,

- Determination of radionuclide toxicity values, and values.

The following is summary information of the historical investigations and risk assessments that were performed for SWMUs that are included in the BGOU.

Evaluation of Uncertainty in SWMUs 2 and 3 (Summary)

The following discusses the key assumptions and uncertainties that affect the level of confidence placed on the quantitative risk estimates derived for the SWMUs 2 and 3 risk assessments. Because uncertainties are inherent in any risk assessment, a qualitative discussion of these uncertainties puts into perspective the risks calculated for the site.

Data Evaluation. Of the variables used in performing the risk assessment, the error terms related to the laboratory analyses are probably the best defined and provide less uncertainty than other factors in the assessment. Individual errors or biases in the data are possible, but the size of the database minimizes uncertainties in the overall concentration estimates.

The primary data limitations and uncertainties associated with concentration estimates and data at SWMUs 2 and 3 include the following observations:

- Sampling strategies at SWMUs 2 and 3 were designed to detect migration to off-site areas, not for current or future exposures to surface soil. In some samples, data may reflect "hot spots" and overestimate risks; in other samples, data may reflect contamination adjacent to the site and may underestimate risks.

- Risks from direct contact exposures to surface soils were evaluated using the results from soil samples from zero to 6 ft bgs. Thus, this evaluation closely approximates conditions that might occur during shallow excavations around the SWMUs. Current direct contact exposures to soils 6 inches to 1 ft bgs were not evaluated since only two samples were available at these depths.

- No direct sampling was conducted of the waste itself. No quantification was made, therefore, of the potential risk if excavation into the waste were to occur.

- There is considerable potential variability associated with VOC concentration results because of losses from the soil matrix even with good sampling technique. In addition, with typical laboratory holding times of 14 days at 4°C, a loss in concentration typically occurs (from the time of collection) of 40% to 90% of the original concentration, depending on the specific chemical. These uncertainties can lead to underestimates of risks associated with VOCs.

- Disposal records have been shown to be inaccurate; therefore, the low reliability of the buried waste materials inventory introduces uncertainties that may result in under or over estimates of risks.

The discrepancy between maximum detected beta activity levels and maximum detected Tc-99 activity levels is a source of data uncertainty and may result in underestimation of radiological risks.

Exposure Assessment. Worker exposures to contaminated surface soils at SWMUs 2 and 3 are considered conservative in terms of protecting human health; however, the surface water pathway was not quantitatively evaluated in this assessment. SWMUs 2 and 3 are not considered to contribute to the surface water exposure pathway. A reasonable deviation resulting from erosion of sediments in runoff from the site will be evaluated for the Surface Water OU.

The 250, 8-hour days per year, assumption for workers is excessive for current on-site worker exposures at a single SWMU. This exposure level would be appropriate for exposures in areas where continuous activities were required outside the domain of OSHA regulations. Further, it is unreasonable to assume that a worker would remain in the vicinity of a single SWMU for a 25-year exposure period.

Current, PGDP worker exposure to SWMUs 2 and 3 is better estimated using the worker/intruder scenario, which reflects 10% of a worker's time spent at a single SWMU. This scenario also conservatively addresses potential intruder exposures at PGDP. The assumption of biweekly 8-hour exposure periods at a single SWMU over a 25-year period overestimates risks to visitors/intruders, even if fences and security measures were eliminated.

The assumption that adult workers ingest 50 mg of soil per day likely is conservative. In addition, the assumption that 100% of soil ingested per day comes from the contaminated source is conservative. Thus, both soil ingestion rates and the fraction from the contaminated source tend to overestimate risks.

The assumptions for dermal absorption are also conservative for the amount of soil adhering to skin, skin surface area available for contact, and the amount of a chemical absorbed from soil. These three factors tend to overestimate the amount of chemical absorbed from soil by the dermal route.

Toxicity Assessment. Uncertainty is associated with the use of the method to determine carcinogenic risks in humans. In discussing uncertainty, the EPA expressed the following:

> It should be emphasized that the linearized multistage procedure leads to a plausible upper limit to the risk that is consistent with some proposed mechanisms of carcinogenesis. Such an estimate, however, does not necessarily give a realistic prediction of the risk. The true value of risk is unknown, and may be as low as zero. The range of risks, defined by the upper limit given by the chosen model and the lower limit which may be stated as low as zero, should be explicitly stated. (*FR* 51:34013, September 24, 1986).

To assess the overall potential for cancer and noncancer effects posed by multiple chemicals, cancer risks or HIs are summed. This method may be conservative because it does not account for potential differences in toxic end points.

Uncertainty in toxicity assessment can arise from the use of models or test systems that do not accurately describe the exposed population or the relevant exposure environment. This type of uncertainty can be found in the toxicity values derived from animal experiments and in assumptions made about dose-response models, which may or may not be valid.

Several of the constituents reported at the site do not have a current oral, inhalation, and/or dermal slope factor or RfD. Because no dermal toxicity values are available, oral toxicity values were used. No adjustments were made on the basis of absorbance, which tends to underestimate risks via dermal absorption.

Risk Characterization. Standard ground surface conversion factors were used to determine doses and risks associated with external exposures to radiation from contaminated surface soil at SWMUs 2 and 3. The ground surface dose and risk factors are based on assumptions of uniform contamination over a large surface area. Use of generic surface risk factors will result in overestimates of risks from external gamma radiation at SWMUs 2 and 3.

The risk factors used in this report are based on EPA guidance in Health Effects Assessment Summary Tables (HEAST) and are greater than the risk factors shown in the BEIR III Report, but slightly less than the factors shown in the BEIR V Report; thus, they represent an estimate of risk that falls within the range of risk estimates from the most recent data. The EPA regards these risk estimates as "reasonable," but not "conservative." Consequently, use of the EPA risk factors should not tend to greatly overestimate the risk of low-level radiation exposure. Although several uncertainties produce both over- and underestimated risk calculations in this assessment, factors that tend to overestimate risks outweigh those that underestimate risks; therefore, risks calculated in this assessment are considered conservative.

Some portion of the risks estimated for SWMUs 2 and 3 may be attributed to naturally occurring background concentrations of inorganics and radionuclides in soil and groundwater. For example, arsenic, beryllium, and manganese contribute to risks exceeding 1E-06 and an HI of 1 in reference groundwater and soil samples. This background risk, while not subtracted from site-related risk, presents additional uncertainty in the risk characterization.

Summary of Uncertainties for SWMUs 7 and 30

The only uncertainty with an effect estimated to be large is the use of the provisional toxicity values for lead systemic toxicity.

Uncertainties with effects estimated to be moderate are as follows:

- Migration of groundwater to off-site receptors may underestimate risk,
- Use of KDEP dermal absorption values instead of EPA values on the dermal pathway,
- Use of site-specific exposure values on ELCR for the excavation worker,
- Use of site-specific exposure values on ELCR for the current industrial worker,
- Calculation of toxicity values for chemicals (specifically Kentucky's value for TCE), and
- Combination of chemical with radiological ELCRs.

Uncertainties with effects estimated to be small are as follows:

- Inclusion of infrequently detected chemicals of potential concern (COPCs),
- Determination of temporal patterns in data,
- Use of quantitation limits that exceed human health PRGs,
- Use of historical data with data collected as part of the RI,
- Inclusion of common laboratory contaminants in the data,
- Removal of analytes based on comparison to blanks,
- Contribution of analytes removed based on comparison to PRGs,
- Removal of analytes based on comparison to background values,
- Assuming that the ditches contained soil and not sediment,
- Determination of exposure points for current concentrations,
- Determination of exposure points for future concentrations,
- Use of total water samples versus filtered,
- Inclusion of biota exposure pathways,
- Use of RME default exposure values instead of central tendency exposure values,
- Inclusion of groundwater in future land use scenarios,
- Omission of livestock in future rural resident land use scenario,
- Omission of an intruder/infrequent recreator land use scenario,
- Lack of summation across land use scenarios and SWMUs on risk characterization,
- Use of KDEP dermal absorption values instead of EPA values on the total risk,
- Use of site-specific exposure values on systemic toxicity for the excavation worker,
- Use of site-specific exposure values on systemic toxicity for the current industrial worker,
- Use of chronic toxicity values for the excavation worker land use scenario,
- Use of provisional and withdrawn toxicity values, except for lead, on ELCR and HI,
- Selection of toxicity values for PCBs,
- Use of inhalation toxicity values extrapolated from oral toxicity values,
- Determination of radionuclide toxicity values,
- Use of absorbed toxicity values calculated from administered toxicity values,
- Combination of risk from chemicals and radionuclides in pathways, and
- Combination of pathway risks to determine land use scenario risk.

1.3.6.3 Remedial goal options developed in the BHHRA for the BGOU RI

Remedial goal options (RGOs) were presented in the BGOU RI for soil for the industrial worker, excavation worker, and residential user scenarios and for the residential groundwater user. RGOs were calculated for each COC from the modeled groundwater concentrations considering residential use of groundwater at each source and at the property boundary POE. When calculating the HI-based RGOs, the more conservative child-based values are reported. In addition, for comparison to the RGOs, the MCL for each COC was presented. The RGOs presented in the BGOU RI are presented in this FS in Tables 1.10 and 1.11. These RGOs provide risk managers with the range within which the revised PRGs are expected to fall.

Table 1.10. RGOs for Soil COCs from the BGOU RI BHHRA

COC	Cancer NAL	Noncancer NAL	RGO[a] at HI = 0.1	RGO at HI = 1	RGO at HI = 3	RGO at ELCR = 1×10^{-6}	RGO at ELCR = 1×10^{-5}	RGO at ELCR = 1×10^{-4}	Units
Residential User Soil Exposure									
Aluminum		9.69E+02	9.69E+01	9.69E+02	2.91E+03				mg/kg
Arsenic	1.44E-01	1.16E+00	1.16E-01	1.16E+00	3.48E+00	1.44E-01	1.44E+00	1.44E+01	mg/kg
Antimony		8.69E-02	8.69E-03	8.69E-02	2.61E-01				mg/kg
Arsenic	1.44E-01	1.16E+00	1.16E-01	1.16E+00	3.48E+00	1.44E-01	1.44E+00	1.44E+01	mg/kg
Barium		1.40E+02	1.40E+01	1.40E+02	4.20E+02				mg/kg
Beryllium and compounds	1.19E-03	2.20E-01	2.20E-02	2.20E-01	6.60E-01	1.19E-03	1.19E-02	1.19E-01	mg/kg
Cadmium	2.00E+00	3.26E+00	3.26E-01	3.26E+00	9.78E+00	2.00E+00	2.00E+01	2.00E+02	mg/kg
Chromium	1.10E+02	8.32E+01	8.32E+00	8.32E+01	2.50E+02	1.10E+02	1.10E+03	1.10E+04	mg/kg
Cobalt	4.69E+02	6.95E+01	6.95E+00	6.95E+01	2.09E+02	4.69E+02	4.69E+03	4.69E+04	mg/kg
Copper		9.39E+01	9.39E+00	9.39E+01	2.82E+02				mg/kg
Iron		4.14E+02	4.14E+01	4.14E+02	1.24E+03				mg/kg
Manganese		5.60E+01	5.60E+00	5.60E+01	1.68E+02				mg/kg
Nickel	5.06E+03	4.35E+01	4.35E+00	4.35E+01	1.31E+02	5.06E+03	5.06E+04	5.06E+05	mg/kg
Uranium		2.57E+00	2.57E-01	2.57E+00	7.71E+00				mg/kg
Vanadium		7.71E-01	7.71E-02	7.71E-01	2.31E+00				mg/kg
Zinc		5.21E+02	5.21E+01	5.21E+02	1.56E+03				mg/kg
Aroclor 1260	6.08E-02					6.08E-02	6.08E-01	6.08E+00	mg/kg
Benz[a]anthracene	7.48E-02					7.48E-02	7.48E-01	7.48E+00	mg/kg
Benzo[a]pyrene	7.48E-03					7.48E-03	7.48E-02	7.48E-01	mg/kg
Benzo[b]fluoranthene	7.48E-02					7.48E-02	7.48E-01	7.48E+00	mg/kg
Dibenz[a,h]anthracene	7.48E-03					7.48E-03	7.48E-02	7.48E-01	mg/kg
Total Dioxins/Furans	6.78E-07					6.78E-07	6.78E-06	6.78E-05	mg/kg
Indeno[1,2,3-cd]pyrene	7.48E-02					7.48E-02	7.48E-01	7.48E+00	mg/kg
Total PCBs	5.78E-02					5.78E-02	5.78E-01	5.78E+00	mg/kg
Total PAHs	7.48E-03					7.48E-03	7.48E-02	7.48E-01	mg/kg
Neptunium-237+D	8.39E-02					8.39E-02	8.39E-01	8.39E+00	pCi/g
Plutonium-239	3.15E+00					3.15E+00	3.15E+01	3.15E+02	pCi/g
Radium-226+D	7.94E-03					7.94E-03	7.94E-02	7.94E-01	pCi/g
Uranium-234	5.47E+00					5.47E+00	5.47E+01	5.47E+02	pCi/g
Uranium-235+D	1.22E-01					1.22E-01	1.22E+00	1.22E+01	pCi/g
Uranium-238+D	5.17E-01					5.17E-01	5.17E+00	5.17E+01	pCi/g

Table 1.10. RGOs for Soil COCs from the BGOU RI BHHRA (Continued)

COC	Cancer NAL	Noncancer NAL	RGO[a] at HI = 0.1	RGO at HI = 1	RGO at HI = 3	RGO at ELCR = 1×10^{-6}	RGO at ELCR = 1×10^{-5}	RGO at ELCR = 1×10^{-4}	Units
Industrial Worker Soil Exposure									
Aluminum		4.22E+03	4.22E+02	4.22E+03	1.27E+04				mg/kg
Antimony		3.46E-01	3.46E-02	3.46E-01	1.04E+00				mg/kg
Arsenic	4.84E-01	7.78E+00	7.78E-01	7.78E+00	2.33E+01	4.84E-01	4.84E+00	4.84E+01	mg/kg
Barium		5.92E+02	5.92E+01	5.92E+02	1.78E+03				mg/kg
Beryllium and compounds	2.83E-03	8.68E-01	8.68E-02	8.68E-01	2.60E+00	2.83E-03	2.83E-02	2.83E-01	mg/kg
Cadmium	1.49E+01	1.97E+01	1.97E+00	1.97E+01	5.91E+01	1.49E+01	1.49E+02	1.49E+03	mg/kg
Chromium	2.11E+02	3.26E+02	3.26E+01	3.26E+02	9.78E+02	2.11E+02	2.11E+03	2.11E+04	mg/kg
Cobalt	9.05E+02	4.48E+02	4.48E+01	4.48E+02	1.34E+03	9.05E+02	9.05E+03	9.05E+04	mg/kg
Copper		4.91E+02	4.91E+01	4.91E+02	1.47E+03				mg/kg
Iron		1.90E+03	1.90E+02	1.90E+03	5.70E+03				mg/kg
Manganese		2.29E+02	2.29E+01	2.29E+02	6.87E+02				mg/kg
Nickel	9.75E+03	2.22E+02	2.22E+01	2.22E+02	6.66E+02	9.75E+03	9.75E+04	9.75E+05	mg/kg
Uranium		1.88E+01	1.88E+00	1.88E+01	5.64E+01				mg/kg
Vanadium		3.04E+00	3.04E-01	3.04E+00	9.12E+00				mg/kg
Zinc		2.50E+03	2.50E+02	2.50E+03	7.50E+03				mg/kg
Aroclor 1260	1.75E-01					1.75E-01	1.75E+00	1.75E+01	mg/kg
Benz[a]anthracene	1.94E-01					1.94E-01	1.94E+00	1.94E+01	mg/kg
Benzo[a]pyrene	1.94E-02					1.94E-02	1.94E-01	1.94E+00	mg/kg
Benzo[b]fluoranthene	1.94E-01					1.94E-01	1.94E+00	1.94E+01	mg/kg
Dibenz[a,h]anthracene	1.94E-02					1.94E-02	1.94E-01	1.94E+00	mg/kg
Total Dioxins/Furans	1.89E-06					1.89E-06	1.89E-05	1.89E-04	mg/kg
Indeno[1,2,3-cd]pyrene	1.94E-01					1.94E-01	1.94E+00	1.94E+01	mg/kg
Total PCBs	1.63E-01					1.63E-01	1.63E+00	1.63E+01	mg/kg
Total PAHs	1.94E-02					1.94E-02	1.94E-01	1.94E+00	mg/kg
Neptunium-237+D	2.71E-01					2.71E-01	2.71E+00	2.71E+01	pCi/g
Plutonium-239	1.07E+01					1.07E+01	1.07E+02	1.07E+03	pCi/g
Radium-226+D	2.56E-02					2.56E-02	2.56E-01	2.56E+00	pCi/g
Uranium-234	1.89E+01					1.89E+01	1.89E+02	1.89E+03	pCi/g
Uranium-235+D	3.95E-01					3.95E-01	3.95E+00	3.95E+01	pCi/g
Uranium-238+D	1.70E+00					1.70E+00	1.70E+01	1.70E+02	pCi/g

Table 1.10. RGOs for Soil COCs from the BGOU RI BHHRA (Continued)

COC	Cancer NAL	Noncancer NAL	RGO[a] at HI = 0.1	RGO at HI = 1	RGO at HI = 3	RGO at ELCR = 1×10^{-6}	RGO at ELCR = 1×10^{-5}	RGO at ELCR = 1×10^{-4}	Units
Excavation Worker Soil Exposure									
Aluminum		4.84E+03	4.84E+02	4.84E+03	1.45E+04				mg/kg
Antimony		4.52E-01	4.52E-02	4.52E-01	1.36E+00				mg/kg
Arsenic	3.13E-01	5.03E+00	5.03E-01	5.03E+00	1.51E+01	3.13E-01	3.13E+00	3.13E+01	mg/kg
Barium		7.11E+02	7.11E+01	7.11E+02	2.13E+03				mg/kg
Beryllium and compounds	3.83E-03	1.15E+00	1.15E-01	1.15E+00	3.45E+00	3.83E-03	3.83E-02	3.83E-01	mg/kg
Cadmium	2.12E+00	1.45E+01	1.45E+00	1.45E+01	4.35E+01	2.12E+00	2.12E+01	2.12E+02	mg/kg
Chromium	2.85E+02	4.36E+02	4.36E+01	4.36E+02	1.31E+03	2.85E+02	2.85E+03	2.85E+04	mg/kg
Cobalt	1.22E+03	3.11E+02	3.11E+01	3.11E+02	9.33E+02	1.22E+03	1.22E+04	1.22E+05	mg/kg
Copper		4.37E+02	4.37E+01	4.37E+02	1.31E+03				mg/kg
Iron		2.02E+03	2.02E+02	2.02E+03	6.06E+03				mg/kg
Manganese		2.90E+02	2.90E+01	2.90E+02	8.70E+02				mg/kg
Nickel	1.32E+04	2.05E+02	2.05E+01	2.05E+02	6.15E+02	1.32E+04	1.32E+05	1.32E+06	mg/kg
Uranium		1.10E+01	1.10E+00	1.10E+01	3.30E+01				mg/kg
Vanadium		4.03E+00	4.03E-01	4.03E+00	1.21E+01				mg/kg
Zinc		2.50E+03	2.50E+02	2.50E+03	7.50E+03				mg/kg
Aroclor 1260	1.55E-01					1.55E-01	1.55E+00	1.55E+01	mg/kg
Benz[a]anthracene	2.16E-01					2.16E-01	2.16E+00	2.16E+01	mg/kg
Benzo[a]pyrene	2.16E-02					2.16E-02	2.16E-01	2.16E+00	mg/kg
Benzo[b]fluoranthene	2.16E-01					2.16E-01	2.16E+00	2.16E+01	mg/kg
Dibenz[a,h]anthracene	2.16E-02					2.16E-02	2.16E-01	2.16E+00	mg/kg
Total Dioxins/Furans	1.79E-06					1.79E-06	1.79E-05	1.79E-04	mg/kg
Indeno[1,2,3-cd]pyrene	2.16E-01					2.16E-01	2.16E+00	2.16E+01	mg/kg
Total PCBs	1.48E-01					1.48E-01	1.48E+00	1.48E+01	mg/kg
Total PAHs	2.16E-02					2.16E-02	2.16E-01	2.16E+00	mg/kg
Neptunium-237+D	3.27E-01					3.27E-01	3.27E+00	3.27E+01	pCi/g
Plutonium-239	1.62E+00					1.62E+00	1.62E+01	1.62E+02	pCi/g
Radium-226+D	3.30E-02					3.30E-02	3.30E-01	3.30E+00	pCi/g
Uranium-234	2.83E+00					2.83E+00	2.83E+01	2.83E+02	pCi/g
Uranium-235+D	4.55E-01					4.55E-01	4.55E+00	4.55E+01	pCi/g
Uranium-238+D	1.17E+00					1.17E+00	1.17E+01	1.17E+02	pCi/g

Table is taken from Table 6.14 of the BGOU RI Report (DOE 2010b).
[a] RGOs for soil for both HI and ELCR were calculated from the 2008 draft NALs (DOE 2010b).

Table 1.11. RGOs for Groundwater COCs from the BGOU RI BHHRA

Residential User Groundwater Exposure												
COC	**EPC[a]**	**SWMU[b]**	**ELCR at EPC**	**HI at EPC**	**RGO at HI = 0.1**	**RGO at HI = 1**	**RGO at HI = 3**	**RGO at ELCR = 1×10^{-6}**	**RGO at ELCR = 1×10^{-5}**	**RGO at ELCR = 1×10^{-4}**	**MCL**	**Units**
Selenium	1.51E-02	30		2.90E-01	5.21E-03	5.21E-02	1.56E-01				0.05	mg/L
Uranium	4.89E-02	3		7.82E+00	6.25E-04[c]	6.25E-03[c]	1.88E-02				0.03	
Aroclor 1254	5.23E-05	7	7.09E-06	4.20E+00	1.25E-06	1.25E-05	3.74E-05	7.38E-06	7.38E-05	7.38E-04	0.0005	mg/L
1,1-DCE	8.98E-02	7	2.08E-03	8.51E-01	1.06E-02	1.06E-01	3.17E-01	4.32E-05	4.32E-04	4.32E-03	---	mg/L
cis-1,2-DCE	1.15E+01	2		6.07E+02	1.89E-03	1.89E-02	5.68E-02				0.07	mg/L
Uranium-234	7.94E+00	7	1.11E-05					7.12E-01	7.12E+00	7.12E+01	20[d]	pCi/L
Uranium-238	1.59E+01	3	2.76E-05					5.76E-01	5.76E+00	5.76E+01	20[d]	pCi/L

Table is taken from Table 6.15 of the BGOU RI Report (DOE 2010b).
[a] EPC = exposure point concentration; represents maximum EPC value for all SWMUs where constituent was a COC for the applicable scenario.
[b] SWMU = the SWMU associated with the maximum EPC value.
[c] Values presented in the BGOU RI Report are 604 and 603, respectively (DOE 2010b). These values are erroneous; therefore, the values presented in the D2 version for the BGOU RI Report are used.
[d] Converted from MCL for total uranium of 0.03 mg/L (DOE 2011a).

1.3.7 Screening Ecological Risk Assessment

For the ecological risk characterization for soil, the results of previous Ecological Risk Assessments (ERAs) conducted for SWMUs 2, 7, and 30 are summarized in the BGOU RI (DOE 2010b). At the time of the BGOU RI, no new surface data had been collected for these SWMUs since the previous risk assessments were performed. SWMU 3 is covered with a RCRA Subtitle C cap, so no ecological evaluation was undertaken.

A summary of the results of the comparison in previous assessments of the site data to the ecological screening levels is provided in Table 1.12. This table lists the number of COPCs in each suite retained for each site and the medium for further consideration. This table shows that a number of inorganic and organic analytes detected above background values were retained. Radionuclides were retained for SWMUs 7 and 30.

Table 1.12. Summary of Suite of Ecological COPCs Retained in Surface Soil

Area	Media	Metal	Rad	Pesticide/PCB	SVOC	VOC
SWMU 2	Soil	6[a]	----	----	----	----
SWMU 3	Soil	NE	NE	NE	NE	NE
SWMU 7	Soil	19[b]	Total*	1[d]	----	----
SWMU 30	Soil	17[c]	Total*	1[e]	----	----

Table 1.12 is taken from Table 6.16 of the BGOU RI (DOE 2010b).
---- No ecological COPCs
NE SWMU did not undergo an ecological evaluation.
*Radionuclide risk was assessed based on a total dose benchmark for all radionuclides.
[a] Based on information in Appendix G of the BGOU RI (DOE 2010b), the 6 metals that are ecological COPCs at SWMU 2 are arsenic, chromium, manganese, nickel, silver, and vanadium.
[b] Based on information in Appendix G of the BGOU RI (DOE 2010b), the 19 metals that are ecological COPCs at SWMU 7 are aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, fluoride, iron, lead, manganese, mercury, nickel, selenium, thallium, uranium, vanadium, and zinc.
[c] Based on information in Appendix G of the BGOU RI (DOE 2010b), the 17 metals that are ecological COPCs at SWMU 30 are aluminum, arsenic, barium, beryllium, cadmium, chromium, cobalt, copper, iron, manganese, mercury, nickel, silver, thallium, uranium, vanadium, and zinc.
[d] Based on information in Appendix G of the BGOU RI (DOE 2010b), the pesticide/PCB that is an ecological COPC at SWMU 7 is Aroclor 1260.
[e] Based on information in Appendix G of the BGOU RI (DOE 2010b), the pesticide/PCB that is an ecological COPC at SWMU 30 is Aroclor 1260.

1.4 SUMMARY AND CONCLUSIONS FROM THE BGOU RI

This section lists the major findings from the BGOU RI with regard to SWMUs 2, 3, 7, and 30.

1.4.1 Major Findings from the BGOU RI

The following are the major contaminant distribution findings for sources investigated in the BGOU RI.

- Environmental media, specifically subsurface soil and groundwater, have been impacted by releases of contaminants at SWMUs 2, 3, 7, and 30.

- Analytical data and review of disposal records indicate a potential exists for DNAPL in subsurface soils at SWMU 2 and in the vicinity of the shared border between SWMUs 7 and 30. TCE trends at SWMUs 7 and 30 indicate that the potential TCE DNAPL source likely is constrained to the UCRS soils.

- The BHHRA indicates that ELCRs greater than the upper end of EPA's acceptable risk range (i.e., 1E-04) and HIs greater than 1 exist at all SWMUs. The metals arsenic, beryllium, and uranium, the organic compounds Total PAHs and Total PCBs, and the radionuclides uranium-235 (U-235) and U-238 are common contaminants that present the dominant risks from exposure to surface and subsurface soil. The major contaminants present in soil that pose potential threats to groundwater are arsenic, 1,1-DCE, TCE, Tc-99, and vinyl chloride.

- Migration of contaminants through groundwater from SWMUs 2, 3, 7, and 30 to locations at the SWMU boundary, the plant boundary, property boundary, and near the Ohio River also posed greater than *de minimis* risks to a hypothetical residential groundwater user, in some case exceeding MCLs. Arsenic, TCE, 1,1-DCE, Tc-99, and vinyl chloride are the primary risk drivers.

- The SERA retained a number of ecological COPCs, primarily metals and Aroclor 1260, at each of the sites.

1.4.2 Uncertainties Identified in the BGOU RI Report

The BGOU Work Plan identified data gaps for individual SWMUs that were necessary to be filled in order to move forward with the FS (DOE 2006). The Work Plan was implemented to reduce uncertainties from previous investigations regarding the nature of the source zone, extent of the source zone and secondary sources, surface and subsurface transport mechanisms, and to support evaluation of remedial technologies in this FS. These uncertainties are documented in the RI Report (DOE 2010b).

The BGOU RI was a comprehensive investigation of the BGOU SWMUs; however, there were some uncertainties that still remained after completion of the RI that were to be managed in the FS. These uncertainties are documented in the RI Report and are the following (DOE 2010b).

- Uncertainty related to risks associated with the mobility of uranium (the FS will manage this uncertainty by evaluating appropriate technologies for SWMUs where uranium is a primary contaminant);

- Uncertainty concerning the extent of source zones (burial areas) and unidentified single-point geophysical anomalies and the impact on alternative analyses (the FS will use existing knowledge and manage the uncertainties regarding the volume requiring removal or treatment);

- Uncertainties regarding the potential for acidic leachate,[3] oxidation/reduction conditions, and degree of waste saturation (the FS will manage these uncertainties by evaluating robust technologies that are not sensitive to these types of uncertainties);

- Uncertainties regarding the extent and volume of secondary source zones (TCE DNAPL) (the FS will manage uncertainties regarding the extent and volume of these sources for comparison);

- Uncertainty related to limited groundwater monitoring around the BGOU SWMUs (the FS will manage this uncertainty by incorporating additional groundwater monitoring where appropriate at SWMUs where effectiveness monitoring is needed or where waste is left in place);

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[3] The acidic leachate uncertainty from the BGOU RI was greatest for SWMUs 4 and 6, not SWMUs 2, 3, 7, or 30. The BGOU RI states, "SWMUs with the greatest potential for acidic leachate are SWMU 6 (exhaust fans with perchloric acid) and SWMU 4 (records of chemicals buried are incomplete)."

- Uncertainties related to the potential for releases from burial areas to impact adjacent surface water ditches (the FS will manage these uncertainties by recommending additional shallow groundwater monitoring during remedial design (RD); and

- Uncertainties related to the nature and extent of contaminants in surface soil at selected SWMUs (the FS will manage this uncertainty by evaluating remedial alternatives that would address this uncertainty).

The uncertainties associated with SWMUs 2, 3, 7, and 30, the approach taken to address the uncertainties, and the locations in the FS where the uncertainties are addressed are summarized in Section 1.5 and discussed in the following sections.

1.4.2.1 Nature of the source zone

The BGOU RI did not conduct intrusive sampling in the existing burial cells. As a result, specific waste characterization data are limited. Historical records and data, past observations, and waste disposal documentation referenced in the BGOU RI Report were used to supplement the RI data to establish the basis for selecting remedial alternatives and preparing cost estimates for those alternatives (DOE 2010b). A key project assumption for the FS is that the available historical documentation and soil and groundwater characterization data are sufficient relative to waste characteristics, to chemical and physical properties, and to waste volume estimates to evaluate general response actions, to screen technology types, to develop effective alternatives, and to conduct a detailed alternative analysis. While the RI field investigation sampled directly beneath the waste units using angled borings, it remains possible that the buried waste contains hazards or constituents that current sample results do not characterize (historical disposal records and waste manifests are incomplete).

Many of the SWMUs have been investigated previously. The BGOU RI used a combination of historical and current sample results of soil and groundwater from the area of each SWMU. The results of previous investigations, as well as the recent RI sampling, document the presence or absence of metals, organic compounds, and radionuclides in the burial grounds. The associated samples were collected and analyzed over several previous and continuing investigations, as well as in the BGOU RI, using several methods. Changes to analytical methods and variations in detection limits restrict a rigorous comparison of data (e.g., laboratory reporting limits have varied over time). During development of the BGOU RI Work Plan, it was decided to limit the historical sample analyses used in the RI to groundwater samples collected in January 1995 and later and soil samples collected in June 1996 and later to minimize the potential for "age" to bias the analysis of the data. This approach maximized the number of historical sample analyses available to the RI, while providing a reasonable assurance of the comparability of the data. There are limited MWs in close proximity to many of the SWMUs that would allow analyses of seasonal variations and analyte trending, but temporary borings provide a snapshot of the conditions where groundwater samples could be obtained. The presence of PTW at SWMUs 2, 3, and 7, as discussed in Section 1.3.3.1, provides additional basis for evaluating certain types of remedial action (i.e., treatment or removal).

Maximum COC Concentrations May Not Be Known. Because only limited source-term data are available, it is possible that the maximum concentration of the COCs present at the SWMUs has not been established; however, sufficient data exist to determine if an action is needed at each unit. Although these uncertainties exist, postremediation sampling and groundwater monitoring performed in conjunction with implementation of individual remedies will satisfy the RAOs. Screening of technologies and development of alternatives considered this uncertainty. In consideration of this uncertainty, the screening of technologies and development of alternatives included best engineering judgment to ensure that alternatives were developed to provide protection of human health and the environment. In addition, the uncertainty concerning the maximum concentration has been considered in the selection of the alternatives by recognizing the general transport and fate mechanisms and their potential impact on maximum concentrations.

Approach for Addressing the Limited Source Term Data in the FS. The PRGs for the BGOU were developed based on exposure pathways and either direct contact risk levels or soil concentrations protective of groundwater. It should be noted that PRGs developed in this FS are revised PRGs. The SWMUs were evaluated for the FS by comparing actual soils data adjacent to or beneath each SWMU to the PRGs to determine if an action is needed. The comparison of soils data to PRGs complemented the modeling data performed in the RI and helped to better identify the specific locations and depths of contamination that warranted remedial action.

1.4.2.2 Acid leachate, oxidation/reduction conditions, and degree of waste saturation

Historically, DOE finds no evidence of acidic leaching from the BGOU SWMUs; however, the potential for acidic leachate at each SWMU is uncertain due to the lack of disposal records and the amount of time elapsed since disposal. It is unlikely that any acid moieties remain. Any change from this baseline condition would be detected by monitoring and addressed as part of the Five-Year Review.

Uncertainty exists with regard to the dissolved oxygen in the UCRS. Data from all BGOU SWMUs combined demonstrate the trends of dissolved oxygen (517 measurements) and oxidation/reduction potential (136 measurements) in the UCRS. The relative abundance of measurements demonstrates a trend that appears to be representative of conditions across the BGOU.

Although there is some potential for some wastes to be intermittently present in saturated conditions, this condition does not materially affect the alternative evaluation. The selected alternatives will need to include technologies that take into account any groundwater that is encountered by removing, isolating, or containing the waste or providing a mechanism to dewater the waste.

For SWMU 2, where the last disposal occurred more than 30 years ago, it is reasonable to assume most, if not all, drums have failed (an Oak Ridge National Laboratory researcher estimated that drum failure would be expected to occur within 18 to 36 years). For SWMUs 7 and 30, it can be assumed that drums likely are breached, since they were dumped rather than being carefully stacked. The BGOU RI modeled the case of all drums being released, and the risk assessment concluded that these uncertainties related to the source zone were not estimated to have a large effect on the risk characterization; however, the current state of the drums is uncertain. Because of this uncertainty, particularly at SWMU 2, the observed conditions currently may not reflect a full release of the drum contents. The remedial alternatives will be designed to manage this uncertainty.

1.4.2.3 Extent and volume of source zone and secondary sources

There remains some uncertainty with regard to the boundaries of the burial cells. Geophysical surveys have not been completed across the entire area of all SWMUs. Engineering drawings and currently assumed burial cell extent were used as the basis for FS assumptions; however, to manage this uncertainty, a geophysical survey potentially will be needed and specified in the remedial design work plan (RDWP) to optimize planning/implementing the selected alternative, as appropriate.

Secondary sources of groundwater contamination that are derived from the BGOU SWMUs are within the scope of the BGOU for evaluation and remedial action. In addition to TCE DNAPL, soils with high concentrations of TCE and degradation products are considered source material. At SWMU 2, this source material may be present under and adjacent to buried drums and may be present on the eastern side of the unit. At SWMU 7, source material is present in the UCRS. The evidence for UCRS DNAPL presence is documented in previous investigations (DOE 2007; DOE 1998a) and discussed in the RI. Sample data suggest a potential DNAPL in the UCRS at SWMUs 7 and 30. There also is potential for a TCE DNAPL at SWMU 2 based on historical disposal records; however, sample data provide little evidence of a DNAPL source. The volumetric extent of secondary source contamination has been approximated and constitutes a project assumption for evaluation of the alternatives.

Assumptions Used for Area, Depth, and Volume of Contaminant Source Areas are Based on Available RI Data. Assumptions are made regarding the area, depth, and volumes of contaminated source areas throughout the different SWMUs. To address these issues, engineering data collection to support technology sizing, design, and optimization will be included as a component for remedial alternatives where additional information regarding the source term is needed to support the detailed design of the alternative. These assumptions are discussed below.

A VOC source, possibly DNAPL, is suspected at SWMU 2 and in the vicinity of the shared border between SWMUs 7 and 30 (UCRS). As part of the RD of a potential source action at SWMUs 2 and 7, engineering data collection will be performed to support technology sizing, design, and optimization to determine the placement of the source action wells or system components.

The vertical extent of TCE contamination in soil attributable to SWMU 2 is uncertain. Additional evaluation will be required to determine if TCE from SWMU 2 actually is impacting groundwater. Based on the RI data, it is likely that most, if not all, TCE contamination would be remediated if an alternative involving excavation is implemented.

Groundwater monitoring at SWMU 2 (primarily as facility monitoring for adjacent SWMU 3) continues to demonstrate the presence of upgradient TCE contamination of the RGA, which masks the potential impact of TCE contamination from SWMU 2. This contamination previously has been associated with the Southwest Plume (derived in part from the south end of the C-400 Cleaning Building), located to the east of SWMU 2, but also may originate from SWMU 4, located to the immediate south of SWMU 2. Another potential source area to the Southwest Plume is the C-720 Building area. DOE currently is planning or implementing response actions to address these sources of TCE. As these response actions reduce the upgradient TCE contamination level, the contribution of SWMU 2, if any, to dissolved TCE in the RGA will be better defined.

Removal of COCs from Soil and Waste Layers. For alternatives that involve excavation, it is assumed that excavation will remove all COCs present in soils from the surface to approximately 20 ft below grade. Based on evaluation of RI data (see Appendix A), the COC concentrations present in Layers 4-7 (20 to 64 ft bgs) are representative of residual values that are below PRGs, and RAOs should be met for radioactive and inorganic COCs. VOC contamination above acceptable levels should be remediated by implementing an appropriate alternative for these contaminants.

Previous work has shown that the primary pathway for groundwater flow and the site-related contaminants is vertical migration through the UCRS, followed by lateral migration in the RGA. Contaminated groundwater could migrate to the POEs identified in the RI Report for the BGOU SWMUs at the plant boundary, property boundary, surface seeps at Little Bayou Creek, and near the Ohio River. While there is some uncertainty related to modeling in predicting whether a SWMU would contribute to the Little Bayou seeps or the Ohio River, this uncertainty has almost no effect on the modeled contaminant concentrations used to develop PRGs and should not affect remedial decisions.

Use of Postremediation Sampling to Reduce Uncertainties. During the FS, PRGs are established that are protective of the groundwater exposure pathway or direct contact, if more restrictive. The soils at the SWMUs have been adequately characterized during the BGOU RI to identify that there are potential exposure risks, and the data are sufficient for selection of appropriate remedies to mitigate those risks to acceptable levels. Without understanding the full nature and extent of contaminant sources or concentrations, uncertainty is managed by specifying postremediation sampling and groundwater monitoring, as appropriate, during implementation of the selected remedy to verify that target concentrations are met. No additional analyses for characterization are required, except to support waste management if needed.

Estimation of Waste Volumes for Remediation. This section presents the approaches applied to estimating the volumes of waste to be remediated at the BGOU SWMUs.

As part of the excavation alternative, it was assumed that selected SWMUs will require excavation. In general, the volume of waste to be excavated was estimated based on the areal footprint of the SWMU and an assumed excavation depth not to exceed 20 ft bgs. This depth is several ft deeper than the greatest disposal depth reported for any of the SWMUs and corresponds to the bottom of SADA modeling Layer 3. If documentation was available indicating that only a portion of the SWMU was used for waste disposal, the volume of waste material was reduced by an estimated percentage corresponding to the volume of soil that is not likely to have been impacted by contact with wastes. This was accomplished by evaluating the historical layout figures for each SWMU and estimating the volume of the SWMU likely to be in contact with waste, based on the size and position of disposal cells within the SWMU.

If an alternative that includes application of a cap to the SWMU was considered, the reported surface area of the SWMU, plus an additional buffer, was assumed for development of an estimate for installing a cap.

The RI Report concludes that DNAPL may be present in soil beneath SWMU 7. This DNAPL is assumed to be confined to the UCRS. In addition, DNAPL potentially is present in the soils beneath SWMU 2.

1.5 POST REMEDIAL INVESTIGATION REPORT INFORMATION

Section 1.4 summarized the results of the BGOU RI; this section presents data obtained since the completion of the RI. This information is included in the following subsections and includes the following:

- BGOU FS scoping meetings,
- Soils OU RI sampling information,
- Seep observations and conclusions,
- Refinement of COCs for soils data,
- Identification of target COCs[4] over all media by SWMU, and
- PTW determination.

1.5.1 BGOU FS Scoping Meeting

Upon commencement of the FS preparation, during June and July 2009, meetings were held among DOE, KY, and EPA to review the uncertainties identified in the RI. Table 1.13 summarizes the global BGOU uncertainties and uncertainties associated with individual SWMUs discussed at the June/July 2009 BGOU

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[4] Target COCs are those contaminants that are believed to be distributed generally throughout a SWMU, drive the risk characterization for the reasonably foreseeable future industrial use and groundwater protection for the SWMU, and represent a class of chemicals present or thought to be present in the SWMU. Target COCs are identified to simplify the screening of alternatives. While target COCs are used to simplify screening of alternatives, all COCs at a SWMU will be addressed in the FS by alternatives analysis.

Table 1.13. Summary of the Uncertainties from the 2010 BGOU RI Report and the June/July 2009 BGOU FS Scoping Meetings

SWMU	Uncertainty Description	Response and Selected Citations of Discussion in FS
Global	Whether process knowledge and existing data sufficiently characterize the contents of waste cells and allow for management of uncertainties.	In this FS, uncertainties related to data gaps are discussed in the context of remedial alternatives development for each SWMU. Remedial alternatives are designed to provide a degree of protection greater than that necessary to protect against the maximum observed concentrations of COCs, and to mitigate uncertainties in available data.
	Whether the expected industrial land use will continue in perpetuity.	This uncertainty is addressed throughout the FS document, which develops remedial alternatives according to CERCLA guidance, and will support remediation under CERCLA when executed. The remedial alternatives include the necessary postremediation sampling, monitoring, costs, and land use controls (LUCs) appropriate for each SWMU. Alternatives that do not achieve unlimited use (UU)/unlimited exposure (UE) conditions will require five-year reviews under CERCLA. Consistent with guidance, five-year reviews would consider the effects of any changes in land use on the protectiveness of the selected remedy.
	Whether the lateral extent of the burial cell is adequately delineated. Nature and extent of the source zone. Acidic leachate, oxidation/reduction conditions, and degree of waste saturation. Extent and volume of the source zone (burial cell) and secondary sources (TCE DNAPL).	RD includes the opportunity to collect engineering data to support technology sizing, design and optimization. These are the features or attributes of the alternatives evaluated for the BGOU. For excavation: • Criterion to remove visible waste. • Postremediation sampling. • Removal of contaminant source.
	Limited groundwater monitoring around the BGOU SWMUs. Potential for leachate from burial areas to impact adjacent surface water ditches. Nature and extent of contaminants in surface soil at selected SWMUs.	For cap or containment: • Geophysics to fully delineate burial cells. • A cap will be engineered to mitigate infiltration and promote runoff. • Elimination of direct contact exposure pathway. • Surface water and groundwater monitoring. • Leachate collection and treatment. • Cap maintenance.

Table 1.13. Summary of the Uncertainties from the 2010 BGOU RI Report and the June/July 2009 BGOU FS Scoping Meetings (Continued)

SWMU	Uncertainty Description	Response and Selected Citations of Discussion in FS
Global		For DNAPL and/or high VOC contaminated soil source treatment: • Sampling and laboratory analysis for determining extent of DNAPL and/or high VOC contaminated soil source sample collection may be augmented by membrane ion probe surveys. Remediation will not be considered complete until verified by postremediation sampling or long-term monitoring, or both. Appendix E contains area and volume assumptions for remediation and cost estimates, including postremediation sampling. An FS cost estimate assumes -30%/+50% accuracy to account for some degree of site uncertainty.
	Uranium mobility[a]	Uranium is relatively immobile. Site-specific conditions (i.e., pH, ORP, and certain other contaminants) can increase mobility. The absence of detectable uranium present in downgradient RGA wells provides evidence that supports the assumption that these conditions currently are not present. Groundwater modeling performed for the RI indicates that uranium metal may migrate from the units to the RGA in less than 1,000 years, but not to the extent to exceed MCLs. Alternatives evaluated for the FS either remove or further immobilize uranium or reduce infiltration, thereby mitigating the mobility uncertainty associated with site-specific conditions.
	Whether waste has been completely or partially released from buried drums.	The RI modeled the case of all drums being degraded and releasing contaminants; however, the current state of the drums is uncertain. Because of this uncertainty, particularly at SWMU 2, the modeled conditions currently may not reflect the current conditions of the drum contents. The remedial alternatives will be designed to manage this uncertainty. A discussion of drum integrity is included in Sections 1.4.2.2 and 1.5.1.6.
	The uncertainty associated with the 1,000-year time horizon used in the groundwater modeling effort and the ingrowth of U-238 daughters after 1,000 years.	This uncertainty was discussed in the RI Report (Appendix E, DOE 2010b). The ingrowth of U-238 daughters is slow, such that the contributions of U-238 daughters and their related radiation doses to an exposed worker will occur over the next 100,000 to 1 million years. The mechanism, time frames, and activity concentrations for U-238 daughter ingrowth is discussed in more detail in Appendix B.

Table 1.13. Summary of the Uncertainties from the 2010 BGOU RI Report and the June/July 2009 BGOU FS Scoping Meetings (Continued)

SWMU	Uncertainty Description	Response and Selected Citations of Discussion in FS
Global	Whether arsenic and other metals are COCs for future residential groundwater users and whether their concentrations might exceed regulatory limits in the RGA.	The BGOU is a source removal action, not a groundwater action. MCLs and risk-based concentrations in groundwater are used only to develop groundwater protective soil PRGs, as described in Section 2 and Appendix C.
2	Cesium-137 exceeds NALs and background at one location (sample 2-15) within the SWMU boundary, but the cesium-137 sample location is in the drainage ditch in the southern portion of the SWMU. As such, it will be considered by the Surface Water OU and is excluded from the BGOU scope.	See Section 1.6.2.1.
2	Whether TCE and/or Tc-99 are present at the bottom of the waste cells at levels that will exceed MCLs in the RGA within 1,000 years.	Postremediation sampling is included in all excavation alternatives. The maximum predicted groundwater concentrations in Table B.4 are associated with samples collected from under or near the source areas, but not directly from the buried waste materials and affected soils. As a result, the maximum TCE and Tc-99 concentrations may not have been identified at this SWMU. Because the shallow groundwater has saturated the waste at SWMU 2, it is possible that the vertical infiltration reduction provided by a cap would require augmentation by lateral infiltration reduction via a vertical barrier and shallow groundwater extraction. Appendix B also shows the rates for TCE degradation.
	Whether COCs have migrated into a subgrade electrical conduit underlying SWMU 2 and/or outside the current SWMU boundary.	This conduit is described in Figure 5.1 and related text. Cost for engineering data collection prior to remediation and postremediation sampling to determine conduit status is in Appendix E.
	Whether waste has been completely or partially released from drums into the environment and whether modeling has correctly predicted the extent of future TCE migration.	See response to global uncertainty regarding drum integrity.

Table 1.13. Summary of the Uncertainties from the 2010 BGOU RI Report and the June/July 2009 BGOU FS Scoping Meetings (Continued)

SWMU	Uncertainty Description	Response and Selected Citations of Discussion in FS
2	Because the RI Report risk assessment for SWMUs 2 and 3 did not evaluate an outdoor worker[b] scenario, develop the PRGs for the outdoor worker scenario for these SWMUs using the full list of COCs for the residential soil direct contact receptor, which is expected to be the inclusive.	The RI Report risk assessment for SWMUs 2 and 3 did not evaluate an outdoor or excavation worker scenario for soil or for residential soil direct contact, but did evaluate hypothetical exposure to an adult or child resident to off-site groundwater. The COCs for SWMU 2 and SWMU 3 include COCs identified through the assessments of both the on-site industrial worker for soil and off-site groundwater user (see Tables 1.5 and 1.6). Because the soils PRGs were developed to include protection of groundwater, these lists are the most comprehensive possible for each SWMU based on the RI Report risk assessment. This is addressed in Section 2.2.3 on PRGs.
2	Whether PCBs exist within the waste at levels that would present a direct contact risk to a future outdoor worker, given that PCBs were detected at 4.2 mg/kg in a sample in waste located at 10 ft bgs.	This uncertainty was addressed in the June/July 2009 scoping meetings and throughout this document, which incorporates a 10 mg/kg target for Total PCBs in soil. Excavation alternatives include postremediation sampling. Capping alternatives provide containment for PCBs should they be present in concentrations above 10 mg/kg.
	Some discharge has been observed to the ditch south of SWMU 2.	If waste remains in place, shallow groundwater monitoring would be conducted to determine if any contaminants leach from the SWMU to the ditch.
	Whether DNAPL is present after soil/waste excavation is complete.	Alternatives 5 and 6 in Chapter 5 address this uncertainty.
3	Whether subsurface arsenic exists above background concentrations, although the likelihood is considered low.	A comparison of the observed concentrations for arsenic and other naturally occurring metals to PGDP background was performed. Based on the results of this comparison, arsenic was not determined to be an important COC for alternative screening and evaluation. This will be further examined as part of postremediation activities for some alternatives (i.e., excavation).
	Whether the existing Subtitle C cap presents a radiological surface risk to industrial workers or presents hotspot risks, although the likelihood is considered low.	The excavation/penetration permit (E/PP) will prevent site workers from conducting work that would penetrate the cap. Include additional soil or riprap cover if the cap is left in place to prevent unacceptable exposure risk. Cap materials will be properly characterized and disposed of as necessary if an excavation alternative is implemented.
	Whether waste in drums has been released into environment.	A general review of drum integrity is in Sections 1.4.2.2 and 1.5.1.6.

Table 1.13. Summary of the Uncertainties from the 2010 BGOU RI Report and the June/July 2009 BGOU FS Scoping Meetings (Continued)

SWMU	Uncertainty Description	Response and Selected Citations of Discussion in FS
7	Whether DNAPL is present.	A remedy for DNAPL and/or high VOC contaminated soil, should its presence be confirmed, has been included in the alternatives evaluated for SWMU 7. Recognizing that buried construction debris may interfere with identification and remediation also has been considered in the alternatives. This uncertainty is addressed in Section 7.
	Whether buried materials will interfere with potential TCE characterization and treatment options, although the likelihood of this occurrence is considered to be low.	See previous response.
30	SWMU 30 uncertainties.	Addressed previously under global uncertainties.

[a] Under the uranium mobility uncertainty, the RI report did not consider uranyl fluoride; there is an uncertainty regarding how uranium as a COC in the form of uranyl fluoride impacts groundwater.
[b] Initially, the FS focused on the outdoor worker exposure to surface and subsurface soils, as defined in the Risk Methods Document (DOE 2013a); this FS has been revised to focus on the excavation worker, who is most likely to be exposed to surface and subsurface soils.

FS scoping meetings, the approach taken to address the uncertainties, and the locations in the FS where the uncertainties are addressed.

These and other uncertainties identified for the BGOU SWMUs 2, 3, 7, and 30 FS are discussed in the subsections that follow.

1.5.1.1 Uranium data

The analytical results for U-235 are reported in the WAG 22 (SWMUs 7 and 30) risk assessment either as U-235 or U-235/236 in some soil and groundwater samples from SWMUs 7 and 30 (DOE 1998a). The identification of combined U-235/236 isotopes for some samples is due to the difficulty of differentiating between U-235 activity and uranium-236 (U-236) activity. This uncertainty is expected to be minor because the same PRG value is calculated for U-235 and U-235/236 in the risk assessment (DOE 1998a), and the same applicable PRG for soil was developed for both in Section 1.6.6 of this FS. The trace amounts of U-236 at PGDP originated from reactor recycled uranium. Less than 10% of the material handled at PGDP was reactor recycled uranium; 0.002% of the reactor recycled uranium would be U-236. The important isotopes in assessing risk at PGDP are uranium-234 (U-234), U-235, and U-238; therefore, these are the critical uranium isotopes that must be analyzed for in material at PGDP.

The preliminary surface and subsurface soil PRGs developed for U-235 are applied to U-235/236 for the development of remediation alternatives at SWMUs 7 and 30. If the same PRG concentration were to be carried through the cumulative risk assessments and radiological dose assessments for both U-235 and U-236 at SWMUs 7 and 30, the cumulative risk and total radiological doses estimated are expected to be overestimated by the contribution of the uncertain U-236 concentration. Section 2 shows that the radiotoxicities of U-235 and U-236 are sufficiently similar that the uncertainty introduced by U-236 is small so that remediation alternatives for these SWMUs can be based on the U-235 PRG alone. This uncertainty will be mitigated by analysis of future postremediation samples by analytical methods that can speciate both uranium isotopes, allowing more accurate cancer risk and radiological dose estimates.

1.5.1.2 Uranium mass estimate

BGOU RI soil sample analytical data from each SWMU were evaluated to develop assumptions for the remedial alternatives. The available data indicate that uranium concentrations below the waste layer decrease to background levels, consistent with the observed mobility of uranium in SWMU 2, 3, 7, and 30 soils. These concentrations do not exceed the PRGs established in the FS; however, postremediation sampling will be required to verify that these assumptions are correct and that uranium contamination above target concentrations can be remediated by excavation or *in situ* processes.

1.5.1.3 Uranium transport modeling

There was uncertainty associated with the 1,000 year time horizon used in the groundwater modeling effort and the ingrowth of U-238 daughters after 1,000 years. The fate and transport modeling for the RI, as documented in Appendix E of the RI Report (DOE 2010b), uses a K_d of 66.8 mL/g to minimize the potential of eliminating uranium as a COC so that it could be properly addressed in the BGOU FS. The ingrowth of U-238 daughters is slow, such that the contributions of U-238 daughters and their related radiation doses to an exposed worker will occur over the next 100,000 years. The mechanism, time frames, and activity concentrations for U-238 daughter ingrowth are discussed in more detail in Appendix B.

Uranium modeling demonstrates that uranium is relatively immobile; however, this modeling was performed for uranium metal. In a paper by Nic Korte, "Assessment of Uranium Mobility Based on the 'Inventory of Uranium-Bearing Scrap in SWMU 2,' " provided as an attachment to the comment response summary for the Data Summary and Interpretation Report (DOE 1997), the following conclusions were made:

(1) The uranium that was dumped as uranyl fluoride is subject to continued solubility and migration either as carbonate or fluoride complexes.

(2) Uranium disposed of as metal or alloy or as U_3O_8 has a low propensity for solubility and subsequent migration. (Note, if acidic solutions were disposed of, they would cause some dissolution of metallic uranium). It would still be low because of the low surface area of the metal that was disposed of.

(3) Metallic and U_3O_8 waste above the water table will be especially resistant to dissolution. Uranyl fluoride solutions that leaked into the unsaturated zone would be subject to leaching and migration but that would also limit the release and spread it over a greater period of time.

(4) Sorption of soluble uranium is difficult to assess with the information available but could be a very significant (> 90%) removal mechanism for soluble uranium and its complexes. Any data on what else may have been disposed of with the uranium wastes would be helpful in assessing the situation. For example, if sanitary and organic wastes were disposed of, there could be locally reducing conditions which would inhibit uranium solubility and migration. Likewise, other metallic waste or naturally occurring hydrous oxides of iron would provide substrate for sorption of uranium and its complexes.

1.5.1.4 Uranium isotopic abundance

The isotopic abundance of uranium in PGDP soils is uncertain. Under natural conditions, the mass abundance of uranium is 0.01% U-234, 0.26% U-235, and 99.73% U-238. The activity abundance is 49.6% U-234, 0.8% U-235, and 49.6% U-238. The enrichment activities at the PGDP likely altered these abundances in some waste placed in SWMU 2, 3, 7, and 30.

1.5.1.5 Northwest Plume alternate hypothesis

Evaluation of disposal records, soil data, and spatial/temporal groundwater data from SWMU 7 suggests that the peak contaminant concentrations measured in MW66 may result from the influence of the Northwest Plume. The result of this evaluation questions the role of significant vertical transport from local contaminant sources in SWMU 7 into the RGA. This updated evaluation supports the 2006 conceptualization by Becker et al. that suggested the high and low concentrations in MW66 represent different flow conditions (i.e., local versus regional influences) (Becker et al. 2006). Becker et al. highlighted the spiking of contaminant concentrations in MW66, MW248, and extraction well 230 (EW230). TCE concentrations in EW230 oscillated between a lower range of 3,000 to 5,000 µg/L and a higher range of 15,000 to 40,000 µg/L. Incorporation of the additional lines of evidence from data collected since 2006 provides a relatively strong basis to link high contaminant concentrations in MW66 (peaks) to the Northwest Plume and to an upgradient source, specifically, the C-400 Building Area. This alternate hypothesis that suggests that SWMU 7 may not be a significant source to the Northwest Plume was developed in *Technical Evaluation of Temporal Groundwater Monitoring Variability in MW66 and Nearby Wells, Paducah Gaseous Diffusion Plant* (CSGSS 2012).

1.5.1.6 Drum integrity

Several pieces of information regarding the drum integrity in PGDP burial grounds have been presented. One piece of information, "Prediction of Drum Failure," was presented in an attachment to the comment response summary for the Data Summary and Interpretation Report (DOE 1997a). This information shows the estimated rate of drum failure varies widely. As noted in Section 1.4.2.2, information provided in the BGOU RI Report indicated that an Oak Ridge National Laboratory researcher estimated that failure of steel drums would be expected to occur within 18 to 36 years (DOE 2010b). Regardless, the integrity of the drums containing waste that were placed in burial grounds at PGDP is uncertain.

1.5.2 Soils OU RI Sampling Information

As part of the Soils OU RI field work conducted during the summer of 2010, SWMUs 12 and 14 were sampled (DOE 2013b). As further shown in Section 7, SWMUs 12 and 14 overlie a portion of SWMU 7. Subsequent to the Soils OU RI field work, a revised SWMU Assessment Report (SAR) was submitted for SWMU 12, C-747-A UF_4 Drum Yard. The revised SAR documents that the SWMU was the aboveground scrap metal that has been removed; therefore, SWMU 12 no longer exists and has been moved to a no further action (NFA) status. The soils underneath the former SWMU 12 site are SWMU 7, which is part of the BGOU and will be addressed accordingly.

Predominantly, data for the Soils OU RI was collected using X-ray fluoroscopy (XRF). The Soils OU RI report documents the uncertainties associated with the use of this data. Due to these uncertainties, XRF results for antimony, barium, and cadmium were not used. The Soils OU RI data showed uranium isotopes and some metals (mercury and uranium) significantly above background values in surface and subsurface soil. The data collected from SWMU 12 for the Soils OU RI within the SWMU 7 area that exceed background and NALs are summarized in Table 1.14 to determine if additional COPCs result.

Of these constituents that exceed background and the lesser of the outdoor worker/gardener[5] and the industrial worker, cobalt, and mercury, and thallium previously were not included as COCs for surface soil and cobalt and thallium for subsurface soil. These will be included as COCs for SWMU 7.

Table 1.14. Summary of Soils OU RI SWMU 12 Data Exceeding Background and NALs

Chemical	Maximum Concentration	Units	# of Analyses	# of Detects	Background Concentration[a]	NAL[b]
Surface Soils						
Arsenic	8.59E+01	mg/kg	52	31	1.20E+01	4.15E-01
Cobalt	1.75E+01	mg/kg	4	4	1.40E+01	8.62E+00
Iron	1.07E+05	mg/kg	52	52	2.80E+04	2.01E+04
Manganese	4.38E+03	mg/kg	52	52	1.50E+03	6.79E+02
Mercury	8.80E+00	mg/kg	52	6	2.00E-01	8.63E+00
Thallium	7.40E-01	mg/kg	4	3	2.10E-01	2.88E-01
Uranium	1.38E+03	mg/kg	54	39	4.90E+00	8.61E+01
Uranium-234	2.51E+01	pCi/g	2	2	1.20E+00	8.72E+00
Uranium-235	2.66E+00	pCi/g	2	2	6.00E-02	4.85E-01
Uranium-238	1.17E+02	pCi/g	2	2	1.20E+00	1.81E+00
Subsurface Soils						
Arsenic	3.13E+01	mg/kg	117	55	7.90E+00	4.15E-01
Cobalt	1.07E+02	mg/kg	9	9	1.30E+01	8.62E+00
Iron	1.12E+05	mg/kg	117	117	2.80E+04	2.01E+04
Manganese	4.33E+03	mg/kg	117	117	8.20E+02	6.79E+02
Thallium	5.10E-01	mg/kg	9	5	3.40E-01	2.88E-01
Uranium	4.33E+03	mg/kg	118	63	4.60E+00	8.61E+01
Uranium-234	9.12E+00	pCi/g	1	1	1.20E+00	8.72E+00
Uranium-235	1.16E+00	pCi/g	1	1	6.00E-02	4.85E-01
Uranium-238	4.74E+01	pCi/g	1	1	1.20E+00	1.81E+00

[a] Background concentrations are taken from Table A.12 of the 2013 Risk Methods Document (DOE 2013a).
[b] NALs are the lesser of the outdoor worker/gardener and the industrial worker from Table A.4 of the 2013 Risk Methods Document (DOE 2013a). The outdoor worker/gardener NALs are used so that the exposure frequency (185 days/year), and exposure duration (25 years) are consistent with those used in the BGOU RI BHHRA.

Initial results of the Soils OU RI identified SWMU 12 as having potential for ongoing impacts to groundwater from residual contamination of 1,1-DCE in soil (DOE 2013b). This constituent already is identified as a COC for protection of groundwater for SWMU 7.

The Soils OU RI data for the portion of SWMU 14 that overlies SWMU 7 showed some metals (nickel and uranium) significantly above background values in surface and subsurface soil. The data collected from SWMU 14 for the Soils OU RI within the SWMU 7 area that exceed background and NALs are summarized in Table 1.15 to determine if additional COPCs result.

Of these constituents that exceed background and the lesser of the outdoor worker/gardener[6] and the industrial worker scenario, all previously were included as COCs for surface soil.

[5] The outdoor worker/gardener NALs are used so that the exposure frequency and exposure duration are consistent with those used in the BGOU RI BHHRA.
[6] The outdoor worker/gardener NALs are used so that the exposure frequency (185 days/year) and exposure duration (25 years) are consistent with those used in the BGOU RI BHHRA.

Table 1.15. Summary of Soils OU RI SWMU 14 Data Exceeding Background and NALs

Chemical	Maximum Concentration	Units	# of Analyses	# of Detects	Background Concentration[a]	NAL[b]
Surface Soils						
Arsenic	1.21E+01	mg/kg	13	5	1.20E+01	4.15E-01
Iron	2.97E+04	mg/kg	13	13	2.80E+04	2.01E+04
Uranium	1.75E+02	mg/kg	14	9	4.90E+00	8.61E+01
Subsurface Soils						
Arsenic	1.52E+01	mg/kg	18	11	7.90E+00	4.15E-01
Iron	8.07E+04	mg/kg	18	18	2.80E+04	2.01E+04
Manganese	1.23E+03	mg/kg	18	17	8.20E+02	6.79E+02
Nickel	1.29E+03	mg/kg	18	13	2.20E+01	5.71E+02
Uranium	3.52E+02	mg/kg	19	14	4.60E+00	8.61E+01
Uranium-238	9.14E+00	pCi/g	1	1	1.20E+00	1.81E+00

[a] Background concentrations are taken from Table A.12 of the 2013 Risk Methods Document (DOE 2013a).
[b] NALs are the lesser of the outdoor worker/gardener and the industrial worker from Table A.4 of the 2013 Risk Methods Document (DOE 2013a). The outdoor worker/gardener NALs are used so that the exposure frequency (185 days/year), and exposure duration (25 years) are consistent with those used in the BGOU RI BHHRA.

Based on the modeling results from the Soils OU RI (DOE 2013b), Tc-99 present in soil at SWMU 14 has the potential to impact RGA groundwater at the SWMU boundary at concentrations (1,700 pCi/L) that exceed 900 pCi/L [which is the value derived by EPA from the 4 mrem/yr MCL (EPA 2002)]. This constituent already is identified as a COC for protection of groundwater for SWMU 7.

1.5.3 Seep Observations and Conclusions

Surface water samples were collected after unusually heavy rainfalls in April 2011 from apparent seeps at two BGOU SWMUs (SWMUs 3 and 30). One sample was collected from each SWMU, plus one field duplicate. No seeps were observed at SWMUs 2 or 7 in April 2011. The hydrogeologic interaction between the UCRS (HU1) and the drainage ditches adjacent to the SWMUs also were evaluated. Results of these samples are summarized in Table 1.16.

Table 1.16. Summary of Detected Surface Water Data from Apparent Seeps at SWMUs 3 and 30

SWMU	Detected Analyte	Results	Units	Detection Limit	NAL Child Recreator[a]	Surface Water NFA[b]
3	Benzoic acid	0.012	mg/L	0.005	[c]	0.042
	cis-1,2-DCE	0.0032	mg/L	0.001	0.0661	[e]
	Barium, Dissolved	0.1	mg/L	0.005	6.38	0.004
	Calcium, Dissolved	103	mg/L	1	[d]	[e]
	Magnesium, Dissolved	17.5	mg/L	0.025	[d]	[e]
	Sodium, Dissolved	2.16	mg/L	1	[d]	[e]
	Uranium, Dissolved	0.231	mg/L	0.01	1.37	0.0026
	Tc-99	159	pCi/L	8.95	10,400	247,000
	Uranium-234, Dissolved	30.2	pCi/L	1.76	403	20.2
	Uranium-235, Dissolved	2.33	pCi/L	0.16	409	737
	Uranium-238, Dissolved	94.3	pCi/L	0.36	327	22.4

Table 1.16. Summary of Detected Surface Water Data from Apparent Seeps at SWMUs 3 and 30 (Continued)

SWMU	Detected Analyte	Results	Units	Detection Limit	NAL Child Recreator[a]	Surface Water NFA[b]
30	Acetone	0.021	mg/L	0.01	[f]	1.5
	Benzoic acid	0.0086	mg/L	0.005	[c]	0.042
	Chlorobenzene	0.049	mg/L	0.005	[g]	0.195
	Chloroethane	0.098	mg/L	0.005	[h]	[e]
	1,1-Dichloroethane	0.007	mg/L	0.001	[i]	0.047
	1,4-Dichlorobenzene	0.013	mg/L	0.005	[j]	0.0112
	Arsenic, Dissolved	0.0128	mg/L	0.001	0.0355	0.0031
	Barium, Dissolved	0.328	mg/L	0.005	6.38	0.004
	Calcium, Dissolved	28.2	mg/L	1	[d]	[e]
	Magnesium, Dissolved	39.7	mg/L	0.025	[d]	[e]
	Manganese, Dissolved	0.237	mg/L	0.005	0.438	0.12
	Molybdenum, Dissolved	0.056	mg/L	0.001	2.28	0.37
	Sodium, Dissolved	19.8	mg/L	1	[d]	[e]
	Uranium, Dissolved	0.0582	mg/L	0.001	1.37	0.0026
	Uranium-234, Dissolved	3.91	pCi/L	1.74	403	20.2
	Uranium-235, Dissolved	0.412	pCi/L	0.137	409	737
	Uranium-238, Dissolved	21.7	pCi/L	0.34	327	22.4

[a] Child recreator NALs taken from Table A.6 of DOE 2013a for the child recreational user wading scenario for metals and organics and for the child recreational user swimming scenario for radionuclides.
[b] Surface water NFA level taken from DOE 2011a (Volume 2, Ecological: Table A.6 for metals and organics and Table A.7 for radionuclides).
[c] Child recreator NALs not available for benzoic acid. EPA Regional Screening Level for tap water is 150 mg/L.
[d] Analyte is an essential nutrient; therefore, NALs are not applicable.
[e] Surface water NFA level is not available.
[f] Child recreator NALs not available for acetone. EPA Regional Screening Level for tap water is 22 mg/L.
[g] Child recreator NALs not available for chlorobenzene. MCL for tap water is 0.1 mg/L.
[h] Child recreator NALs not available for chloroethane. An EPA Regional Screening Level for tap water also is not available.
[i] Child recreator NALs not available for 1,1-dichloroethane. MCL for tap water is 0.005 mg/L.
[j] Child recreator NALs not available for 1,4-dichlorobenzene. EPA Regional Screening Level for tap water is 0.0024 mg/L.

The surface water found near SWMU 3 was determined actually to be flowing from a pipe that drains the cover over the RCRA cap, not a seep. A sample was collected from this surface water and analyzed for VOAs, semivolatile organic analytes (SVOAs), metals, radionuclides, and PCBs. Eleven constituents were detected from the analyses. None of the analytes exceeded the child recreator NAL for the wading scenario (swimming scenario for the radionuclides). Barium, uranium (metal), U-234, and U-238 were detected above the surface water NFA value for ecological screening.

Results of geophysical surveys show that the burial cell at SWMU 30 extends to the ditch to the north of the SWMU. The seep location has created a visible lineament in the vegetative cover at SWMU 30 and is likely the result of cell overflow. Regrading of the ditch to the north of SWMU 30 was conducted as part of the removal action for scrap metal disposition infrastructure modifications in 2002 (DOE 2003a).

A seep was documented at SWMU 30 in the 1998 WAG 22 RI Report. Sampling of that seep indicated only elevated nickel (DOE 1998a). More recently, a sample was collected from this surface water in April 2011 and was analyzed for VOAs, SVOAs, metals, radionuclides, and PCBs. Seventeen constituents were detected from the analyses. Chloroethane, 1,1-dichloroethane, and 1,4-dichlorobenzene were detected and were retained for consideration in this FS, although they are not listed as significant COPCs at PGDP in the Risk Methods Document (DOE 2013a). Arsenic, barium, 1,4-dichlorobenzene, manganese, and uranium (metal) were retained for ecological evaluation.

The ditches surrounding SWMU 2 were investigated as part of the Surface Water (On-Site) SI (see Figure 1.8). The action memorandum for the project concluded that the ditches south of the SWMU did not require action in order to be protective of the industrial worker (DOE 2009). The sediments in the ditch north of the SWMU were removed as part of the project's removal action (Figure 1.9) (DOE 2011b).

1.5.4 Refinement of COCs for Soils Data

COCs for industrial use, groundwater protection, and ecological receptors are identified in the RI and summarized in Sections 1.3.6, 1.3.7, and 1.4 of this FS; however, the COC list is different due to changes in the review process and do not require action as part of this FS as discussed in this subsection (e.g., toxicity values have changed, background screening was not applied originally, etc.). Additionally, some COCs not determined previously in the RI will be added to the SWMUs 2, 3, 7, and 30 FS (e.g., based on process knowledge and the Soils OU RI), also as discussed in this subsection. Further, Section 1.6 describes how target COCs (from those remaining to be addressed) have been selected to help focus the alternative selection. In order to refine COCs, the following processes were used.

- Screening of metals and naturally occurring radionuclides against background criteria;
- Identifying the impact of revised and accepted chemical toxicity values (subsequent to the BGOU RI) on COCs; and
- Reviewing historical disposal records to identify COCs that should be considered based on historical records, but not identified in the RI.

1.5.4.1 Screening of metals and naturally occurring radionuclides against background soils criteria

Additional background screening of metals and naturally occurring radionuclides was performed using data reported in the BHHRA and any additional data collected as part of the Soils OU RI to identify distribution of metals at the site so that those metals best suited for remedy selection are retained (DOE 2013a; DOE 2010b).

As part of the RI evaluation of metal and radionuclide data for soils, the background 95% upper tolerance limit (UTL) concentration was used as a criterion to establish if a particular metal is a contaminant. This is one line of evidence to support whether the detected concentrations of a metal should be considered to be within the range of background. Tables 1.17 and 1.18 provide a summary of the range of detected concentrations of metal and radionuclide constituents in surface and subsurface soil samples for the BGOU SWMUs and a comparison to the background concentrations.

The distributions of concentrations were considered to be consistent with the range of background concentrations by screening against other values representing the range of background (i.e., additional background information). Additional background information for metals can be found in the "Kentucky Guidance for Ambient Background Assessment," which is included in Appendix E of the Risk Methods Document (DOE 2013a). Values expected from global fallout for radionuclides can be found in *Radiological and Chemical Fact Sheets to Support Health Risk Analyses for Contaminated Areas* (ANL 2007). Comparisons to the range of background concentrations are made in Appendix A, Attachment 1.

Naturally occurring constituents present at the PGDP that also are known to be site-related contaminants (i.e., technetium and uranium and the isotopes U-234, U-235, and U-238) were not screened out based on the aforementioned screenings.

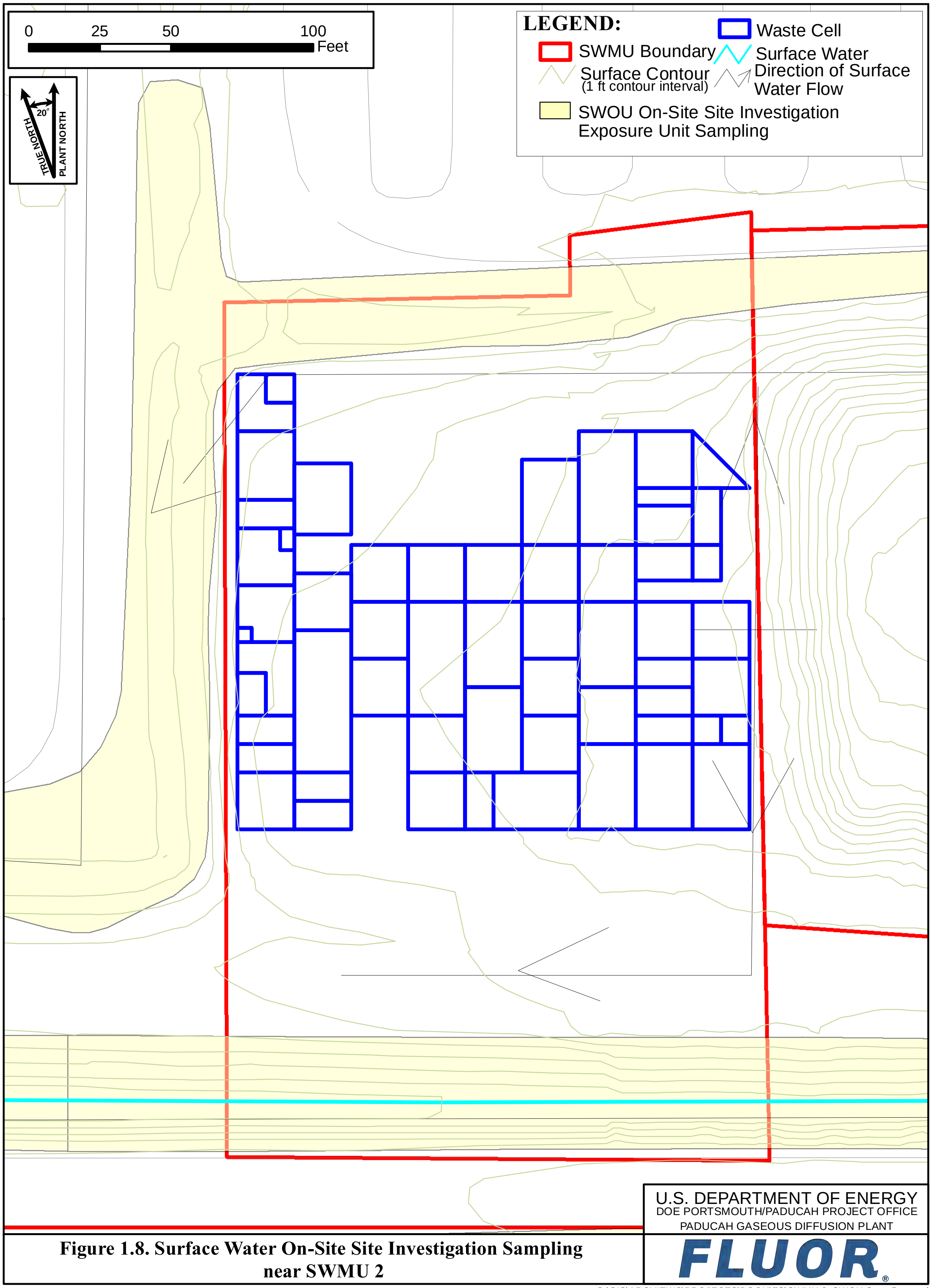

Figure 1.8. Surface Water On-Site Site Investigation Sampling near SWMU 2

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2/27/2014

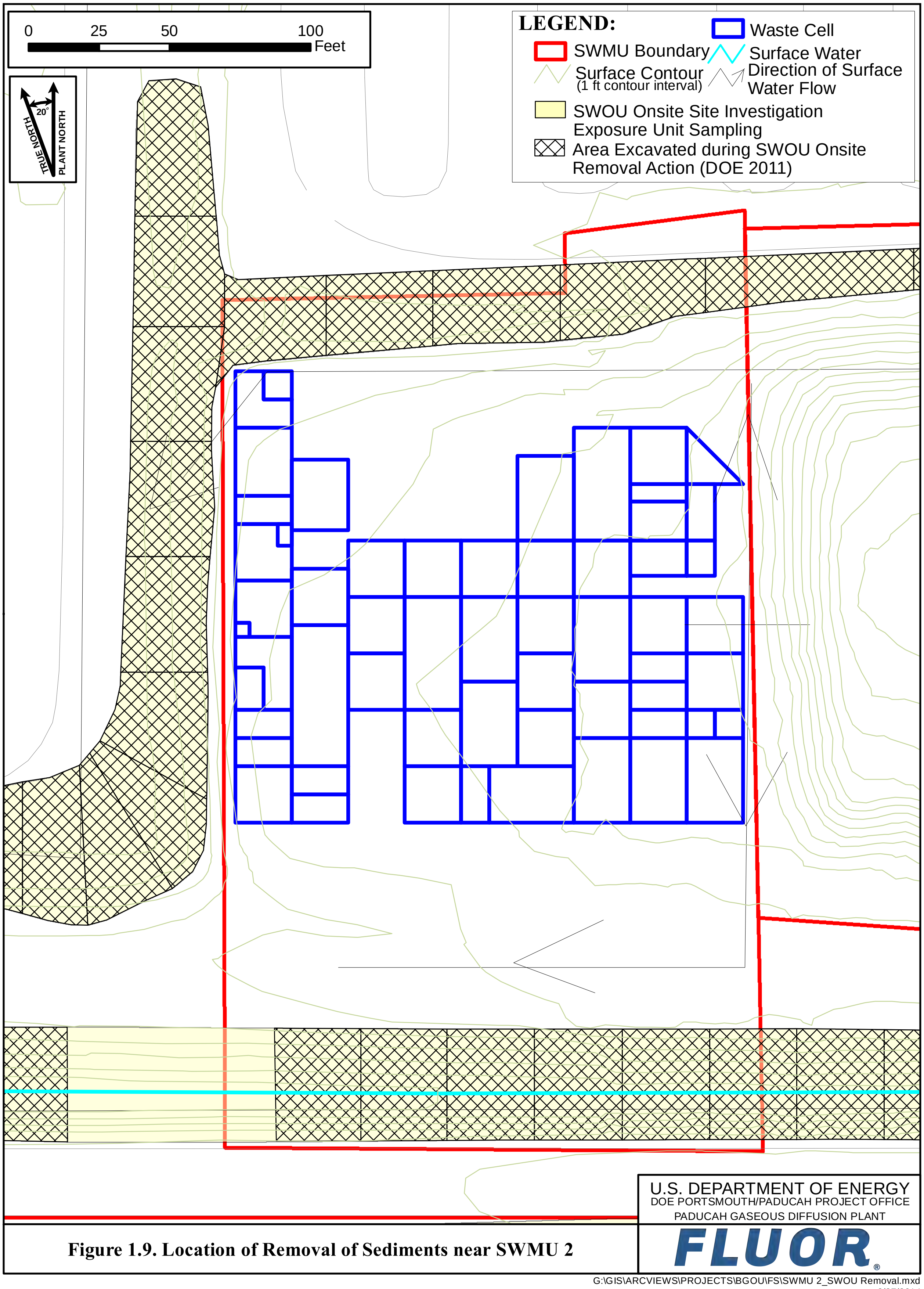

Figure 1.9. Location of Removal of Sediments near SWMU 2

Table 1.17. Summary of Detected Concentrations and Comparison to Background and No Action Screening Levels for Metals and Radionuclides in Surface Soils

	BGOU Data Summary					Screening			
Parameter	Number of Analyses	Detectable Concen-trations	Min	Mean[a]	Max	Back-ground[b]	Number Above Background	No Action Level[b]	Number above NAL
SWMU 2									
Metals (mg/kg)									
Arsenic	3	3	3.40E+00	1.95E+01	3.00E+01	1.20E+01	2	4.15E-01	3
Manganese	3	3	2.40E+02	3.53E+02	5.40E+02	1.50E+03	0	6.79E+02	0
Uranium[c]	3	3	1.30E+02	1.83E+02	2.80E+02	4.90E+00	3	8.61E+01	3
Radionuclides (pCi/g)									
Tc-99[c]	8	8	2.30E-01	3.11E+00	1.46E+01	2.50E+00	3	3.09E+02	0
Uranium-234[c,f]	8	8	1.75E+00	1.51E+01	5.19E+01	1.20E+00	8	8.72E+00	5
Uranium-235[c,f,g]	8	8	1.10E-01	2.41E+00	7.70E+00	6.00E-02	8	4.85E-01	7
Uranium-238[c]	8	8	2.20E+00	8.56E+01	3.14E+02	1.20E+00	8	1.81E+00	8
SWMU 3									
No surface soil data is available.									
SWMU 7									
Metals (mg/kg)									
Aluminum	19	19	2.55E+03	6.87E+03	1.40E+04	1.30E+04	1	2.86E+04	0
Antimony[e]	19	15	2.70E-01	7.03E-01	1.70E+00	2.10E-01	15	1.15E+01	0
Arsenic	79	50	2.40E+00	9.18E+00	8.59E+01	1.20E+01	5	4.15E-01	50
Barium	19	19	2.10E+01	7.88E+01	3.08E+02	2.00E+02	1	5.67E+03	0
Beryllium	21	15	1.70E-01	6.28E-01	1.30E+00	6.70E-01	5	5.73E+01	0
Cadmium	19	13	2.30E-02	5.43E-01	1.30E+00	2.10E-01	9	2.06E+01	0
Chromium (total)	81	44	9.20E+00	3.70E+01	6.36E+01	1.60E+01	40	1.98E+02	0
Cobalt	19	19	2.00E+00	7.26E+00	1.75E+01	1.40E+01	1	8.62E+00	8
Copper	79	25	2.70E+00	3.01E+01	9.90E+01	1.90E+01	10	1.15E+03	0
Iron	79	79	5.75E+03	2.22E+04	1.07E+05	2.80E+04	21	2.01E+04	38
Lead	79	62	3.30E+00	1.59E+01	1.20E+02	3.60E+01	3	8.00E+02	0
Manganese	79	79	1.07E+02	5.35E+02	4.38E+03	1.50E+03	1	6.79E+02	20
Mercury	81	17	1.18E-02	9.96E-01	8.80E+00	2.00E-01	4	8.63E+00	1
Molybdenum	79	9	4.40E-01	1.02E+01	3.42E+01	N/A	N/A	1.44E+02	0
Nickel	79	37	5.00E+00	6.45E+01	3.04E+02	2.10E+01	25	5.71E+02	0
Selenium	79	10	5.40E-01	1.20E+00	4.65E+00	8.00E-01	5	1.44E+02	0
Silver	79	13	1.50E-02	5.71E+00	1.70E+01	2.30E+00	5	1.44E+02	0
Thallium	19	13	6.60E-02	1.01E+00	2.00E+00	2.10E-01	11	2.88E-01	10
Uranium[c]	84	63	1.00E+00	2.11E+02	1.38E+03	4.90E+00	62	8.61E+01	26
Vanadium	79	20	8.30E+00	2.54E+01	7.33E+01	3.80E+01	2	1.45E+02	0
Zinc	79	79	1.24E+01	6.06E+01	2.40E+02	6.50E+01	21	8.63E+03	0
Radionuclides (pCi/g)									
Cesium-137	8	3	9.06E-02	1.24E-01	1.83E-01	4.90E-01	0	1.37E-01	1
Neptunium-237[d]	22	17	1.00E-02	2.51E-01	7.20E-01	1.00E-01	12	3.22E-01	6
Plutonium-238	9	1	2.10E-02	2.10E-02	2.10E-02	7.30E-02	0	4.23E+00	0
Plutonium-239[d,g]	22	20	1.00E-02	1.69E-01	6.80E-01	2.50E-02	16	3.70E+00	0
Tc-99[c]	20	20	2.05E-01	4.11E+01	4.06E+02	2.50E+00	12	3.09E+02	1
Thorium-230	20	20	6.36E-01	1.63E+00	3.94E+00	1.50E+00	9	5.70E+00	0
Uranium-234[c,f]	21	21	1.01E+00	4.29E+01	3.18E+02	1.20E+00	20	8.72E+00	19
Uranium-235[c,f,g]	19	19	6.10E-02	4.78E+00	4.21E+01	6.00E-02	19	4.85E-01	17
Uranium-238[c]	21	21	1.69E+00	2.22E+02	2.39E+03	1.20E+00	21	1.81E+00	20

Table 1.17. Summary of Detected Concentrations and Comparison to Background and No Action Screening Levels for Metals and Radionuclides in Surface Soils (Continued)

	BGOU Data Summary					Screening			
Parameter	Number of Analyses	Detectable Concen-trations	Min	Mean[a]	Max	Back-ground[b]	Number Above Background	No Action Level[b]	Number above NAL
SWMU 30									
Metals (mg/kg)									
Aluminum	8	8	8.40E+03	1.21E+04	1.60E+04	1.30E+04	3	2.86E+04	0
Antimony[e]	10	8	4.80E-01	1.15E+00	3.00E+00	2.10E-01	8	1.15E+01	0
Arsenic	10	8	4.20E+00	5.76E+00	8.90E+00	1.20E+01	0	4.15E-01	8
Barium	10	10	5.13E+01	9.19E+01	1.70E+02	2.00E+02	0	5.67E+03	0
Beryllium	8	8	4.40E-01	6.36E-01	8.50E-01	6.70E-01	3	5.73E+01	0
Cadmium	10	6	4.80E-02	9.82E-01	2.80E+00	2.10E-01	3	2.06E+01	0
Chromium (total)	10	10	1.80E+01	3.02E+01	4.57E+01	1.60E+01	10	1.98E+02	0
Copper	8	8	1.10E+01	5.56E+01	1.70E+02	1.90E+01	5	1.15E+03	0
Iron	8	8	1.30E+04	1.85E+04	2.40E+04	2.80E+04	0	2.01E+04	3
Manganese	8	8	2.70E+02	3.60E+02	4.90E+02	1.50E+03	0	6.79E+02	0
Mercury	10	7	3.60E-02	1.17E-01	1.70E-01	2.00E-01	0	8.63E+00	0
Nickel	10	10	1.32E+01	1.14E+02	5.70E+02	2.10E+01	5	5.71E+02	0
Selenium	10	4	4.30E-01	5.60E-01	6.60E-01	8.00E-01	0	1.44E+02	0
Uranium[c]	8	5	1.30E+02	5.92E+02	1.40E+03	4.90E+00	5	8.61E+01	5
Vanadium	8	8	1.80E+01	2.68E+01	3.40E+01	3.80E+01	0	1.45E+02	0
Zinc	8	8	3.30E+01	2.17E+02	7.50E+02	6.50E+01	4	8.63E+03	0
Radionuclides (pCi/g)									
Neptunium-237[d]	8	8	6.00E-02	4.80E-01	1.68E+00	1.00E-01	6	3.22E-01	3
Plutonium-239[d]	8	7	5.00E-02	2.07E-01	6.20E-01	2.50E-02	7	3.70E+00	0
Tc-99[c]	8	8	1.01E-01	6.01E+01	3.60E+02	2.50E+00	3	3.09E+02	1
Uranium-234[c,f]	8	8	4.27E+00	5.81E+01	1.15E+02	1.20E+00	8	8.72E+00	6
Uranium-235[c,f,g]	8	8	3.80E-01	6.39E+00	1.66E+01	6.00E-02	8	4.85E-01	7
Uranium-238[c]	8	8	7.82E+00	1.45E+02	5.65E+02	1.20E+00	8	1.81E+00	8

[a] The mean used in this table is the arithmetic average.
[b] Background concentrations for surface soil at the PGDP from the 2013 Risk Methods Document (DOE 2013a). NALs are the lesser of the outdoor worker/gardener and the industrial worker from the 2013 Risk Methods Document (DOE 2013a). The NAL for the outdoor worker/gardener is used in order to be consistent with the exposure duration (25 years) and exposure frequency (185 days/year) used in the BGOU RI BHHRA.
[c] Not screened against background because the COC is suspected of being present in the waste based on process knowledge.
[d] Background concentrations for neptunium and plutonium were determined only for surface soil.
[e] Consistent with the discussion in Table ES.2 of DOE 1997b, these background levels are set at the detection limit used in the background study.
[f] The values listed for U-234 and U-235 are not from the 1996 background study, but are derived from the natural isotopic abundance ratio and the U-238 values as described in the 2013 Risk Methods Document (DOE 2013a).
[g] Summaries of data reported as U-235 and U-235/236 are included together in this table as U-235. Similarly, data reported as plutonium-239 and plutonium-239/240 are included together in this table as plutonium-239.
N/A = Not Applicable. For radioisotopes, isotope is not naturally occurring and a background screening value is not available.
Background Screen Results (orange) = All detected results are less than the initial screening value; therefore, this parameter is not considered under this FS as a COC.
Background Screen Results (blue) = Considered to be within the range of background (see Appendix A, Attachment 1) and therefore not considered under this FS as a COC.

Table 1.18. Summary of Detected Concentrations and Comparison to Background and No Action Screening Levels for Metals and Radionuclides in Subsurface Soils

	BGOU Data Summary					Screening			
Parameter	Number of Analyses	Detectable Concen-trations	Min	Mean[a]	Max	Back-ground[b]	Number Above Background	No Action Level[b]	Number above NAL
SWMU 2									
Metals (mg/kg)									
Arsenic	29	28	1.10E+00	6.42E+00	2.20E+01	7.90E+00	8	4.15E-01	28
Manganese	29	29	1.88E+01	3.15E+02	1.20E+03	8.20E+02	2	6.79E+02	3
Uranium[c]	58	12	1.05E+00	1.38E+02	1.50E+03	4.60E+00	10	8.61E+01	1
Radionuclides (pCi/g)									
Tc-99[c,d]	57	46	-4.37E-02	1.37E-01	2.24E+00	2.80E+00	0	3.09E+02	0
Uranium-234 [c,f]	58	52	1.76E-01	3.77E+00	1.55E+02	1.20E+00	4	8.72E+00	1
Uranium-235 [c,f,g]	58	48	1.00E-02	6.09E-01	2.58E+01	6.00E-02	21	4.85E-01	1
Uranium-238 [c]	58	52	1.32E-01	1.94E+01	9.47E+02	1.20E+00	11	1.81E+00	7
SWMU 3									
Metals (mg/kg)									
Arsenic	21	18	9.56E-01	2.99E+00	8.25E+00	7.90E+00	1	4.15E-01	18
Manganese	21	21	9.12E+00	2.06E+02	6.44E+02	8.20E+02	0	6.79E+02	0
Uranium[c]	21	6	1.05E+00	2.11E+01	8.36E+01	4.60E+00	3	8.61E+01	0
Radionuclides (pCi/g)									
Tc-99 [c,d]	21	1	2.40E+00	2.40E+00	2.40E+00	2.80E+00	0	3.09E+02	0
Uranium-234 [c,f]	21	9	1.44E-01	6.01E-01	3.02E+00	1.20E+00	1	8.72E+00	0
Uranium-235 [c,f]	21	2	1.40E-01	2.51E-01	3.62E-01	6.00E-02	2	4.85E-01	0
Uranium-238 [c]	21	11	1.29E-01	2.89E+00	2.24E+01	1.20E+00	2	1.81E+00	2
SWMU 7									
Metals (mg/kg)									
Aluminum	80	80	9.39E+02	6.63E+03	1.60E+04	1.20E+04	2	2.86E+04	0
Antimony[e]	80	11	1.80E-01	3.65E-01	5.60E-01	2.10E-01	8	1.15E+01	0
Arsenic	204	116	9.17E-01	6.13E+00	3.13E+01	7.90E+00	43	4.15E-01	116
Barium	80	80	6.14E+00	7.69E+01	6.57E+02	1.70E+02	4	5.67E+03	0
Beryllium	80	18	3.80E-01	7.61E-01	1.80E+00	6.90E-01	7	5.73E+01	0
Cadmium	80	13	2.10E-02	2.21E-01	1.80E+00	2.10E-01	2	2.06E+01	0
Chromium (total)	204	140	2.64E+00	2.62E+01	7.27E+01	4.30E+01	30	1.98E+02	0
Cobalt	80	53	2.41E+00	8.18E+00	1.07E+02	1.30E+01	5	8.62E+00	6
Copper	204	83	2.25E+00	1.85E+01	1.77E+02	2.50E+01	13	1.15E+03	0
Iron	204	204	1.05E+03	1.57E+04	1.12E+05	2.80E+04	19	2.01E+04	37
Lead	204	185	1.59E+00	1.09E+01	6.24E+01	2.30E+01	9	8.00E+02	0
Manganese	204	203	4.88E+00	2.96E+02	4.33E+03	8.20E+02	9	6.79E+02	12
Mercury	204	24	1.38E-02	7.09E-01	8.57E+00	1.30E-01	2	8.63E+00	0
Molybdenum	204	20	1.60E-01	1.17E+01	9.49E+01	N/A	N/A	1.44E+02	0
Nickel	204	93	5.30E+00	6.57E+01	1.29E+03	2.20E+01	42	5.71E+02	2
Selenium	204	15	4.10E-01	1.05E+00	1.90E+00	7.00E-01	11	1.44E+02	0
Silver	204	18	3.10E-02	4.56E+00	1.43E+01	2.70E+00	7	1.44E+02	0
Thallium	80	7	8.90E-02	1.71E-01	5.10E-01	3.40E-01	1	2.88E-01	1
Uranium[c]	206	89	7.20E-01	2.22E+02	4.33E+03	4.60E+00	73	8.61E+01	36
Vanadium	204	82	2.53E+00	2.42E+01	1.06E+02	3.70E+01	13	1.45E+02	0
Zinc	204	168	9.87E+00	4.17E+01	3.33E+02	6.00E+01	16	8.63E+03	0
Radionuclides (pCi/g)									
Neptunium-237[d]	69	4	3.16E-02	1.02E-01	2.66E-01	N/A	N/A	3.22E-01	0
Plutonium-239[d,g]	69	5	1.60E-02	8.72E-02	1.36E-01	N/A	N/A	3.70E+00	0
Tc-99 [c,d]	69	21	6.10E-01	3.14E+00	8.23E+00	2.80E+00	7	3.09E+02	0
Thorium-230	69	41	1.31E-01	6.59E-01	3.70E+00	1.40E+00	3	5.70E+00	0
Uranium-234 [c,f]	78	43	1.40E-01	7.97E+00	1.15E+02	1.20E+00	17	8.72E+00	7
Uranium-235 [c,f,g]	69	14	5.09E-02	4.00E-01	1.16E+00	6.00E-02	13	4.85E-01	4
Uranium-238 [c]	78	37	1.47E-01	1.51E+01	1.50E+02	1.20E+00	24	1.81E+00	19

Table 1.18. Summary of Detected Concentrations and Comparison to Background and No Action Screening Levels for Metals and Radionuclides in Subsurface Soils (Continued)

	BGOU Data Summary					Screening			
Parameter	Number of Analyses	Detectable Concen-trations	Min	Mean[a]	Max	Back-ground[b]	Number Above Background	No Action Level[b]	Number above NAL
SWMU 30									
Metals (mg/kg)									
Aluminum	25	25	3.74E+03	8.18E+03	1.90E+04	1.20E+04	1	2.86E+04	0
Antimony[e]	25	0	N/A	N/A	N/A	2.10E-01	0	1.15E+01	0
Arsenic	25	18	8.98E-01	2.53E+00	4.03E+00	7.90E+00	0	4.15E-01	18
Beryllium	25	7	4.84E-01	1.06E+00	1.48E+00	6.90E-01	5	5.73E+01	0
Cadmium	25	0	N/A	N/A	N/A	2.10E-01	0	2.06E+01	0
Chromium (total)	25	25	3.84E+00	1.47E+01	4.90E+01	4.30E+01	1	1.98E+02	0
Copper	25	24	2.57E+00	1.06E+01	3.50E+01	2.50E+01	2	1.15E+03	0
Iron	25	25	5.02E+03	1.41E+04	2.90E+04	2.80E+04	1	2.01E+04	4
Manganese	25	25	1.56E+01	1.80E+02	1.20E+03	8.20E+02	1	6.79E+02	2
Selenium	25	3	6.00E-01	7.63E-01	1.00E+00	7.00E-01	1	1.44E+02	0
Uranium[e]	25	11	9.58E-01	1.31E+00	2.03E+00	4.60E+00	0	8.61E+01	0
Vanadium	25	24	3.21E+00	1.10E+01	4.00E+01	3.70E+01	1	1.45E+02	0
Radionuclides (pCi/g)									
Neptunium-237[d]	26	2	5.00E-02	5.50E-02	6.00E-02	N/A	N/A	3.22E-01	0
Plutonium-239[d,g]	26	4	5.00E-02	1.00E-01	1.90E-01	N/A	N/A	3.70E+00	0
Tc-99 [c,d]	26	5	1.20E-01	1.94E+00	6.79E+00	2.80E+00	1	3.09E+02	0
Uranium-234 [c,f]	26	17	1.50E-01	1.34E+00	6.56E+00	1.20E+00	5	8.72E+00	0
Uranium-235 [c,f,g]	26	6	2.00E-02	2.26E-01	5.50E-01	6.00E-02	5	4.85E-01	1
Uranium-238 [c]	26	14	1.35E-01	1.96E+00	1.03E+01	1.20E+00	4	1.81E+00	4

[a] The mean used in this table is the arithmetic average.
[b] Background concentrations for surface soil at the PGDP from the 2013 Risk Methods Document (DOE 2013a). NALs are the lesser of the outdoor worker/gardener and the industrial worker from the 2013 Risk Methods Document (DOE 2013a). The NAL for the outdoor worker/gardener is used in order to be consistent with the exposure duration (25 years) and exposure frequency (185 days/year) used in the BGOU RI BHHRA.
[c] Not screened against background because the COC is suspected of being present in the waste based on process knowledge.
[d] Cesium-137, neptunium, plutonium, and technetium are not naturally occurring elements.
[e] Consistent with the discussion in Table ES.2 of DOE 1997b, these background levels are set at the detection limit used in the background study.
[f] The values listed for U-234 and U-235 are not from the 1996 background study, but are derived from the natural isotopic abundance ratio and the U-238 values as described in the 2013 Risk Methods Document (DOE 2013a).
[g] Summaries of data reported as U-235 and U-235/236 are included together in this table as U-235. Similarly, data reported as plutonium-239 and plutonium-239/240 are included together in this table as plutonium-239.
N/A = Not Applicable. For radioisotopes, isotope is not naturally occurring and a background screening value is not available.
Background Screen Results (orange) = All detected results are less than the initial screening value; therefore this parameter is not considered under this FS as a COC.
Background Screen Results (blue) = Considered to be within the range of background (see Appendix A, Attachment 1) and therefore not considered under this FS as a COC.

1.5.4.2 Identifying the impact on COCs of accepted soils toxicity values revised subsequent to the RI

Since the completion of the BGOU RI, some toxicity values used in risk calculations have been updated by the EPA's Integrated Risk Information System (IRIS) database (EPA 2004a), National Center for Environmental Assessment, or the HEAST database (EPA 1998b). Additional information regarding these updates is presented in the BGOU BHHRA (DOE 2010b). Since the initial assessment performed for risk at these sites (see the BHHRA in the 2010 BGOU RI), the oral and dermal slope factors [i.e., plausible upperbound estimates of the probability of a development of cancer per unit intake of a chemical over a lifetime (EPA 2004b)] were removed for beryllium and cadmium, as these chemicals no longer are considered cancerous through the oral and dermal pathways. Table 1.19 summarizes the cumulative ELCR for the future industrial worker and the future excavation worker (if available) that was presented for each SWMU in Tables 1.5 through 1.8, as revised by deleting beryllium's contribution to the cumulative ELCR. (Cadmium was not a COC contributing to the cumulative ELCR for SWMUs 2, 3, 7, and 30.)

Table 1.19. Cumulative ELCRs Estimates for SWMUs 2, 3, 7, and 30

Receptor	Total ELCR[a]	Revised Total ELCR[b]
SWMU 2		
Future industrial worker at current concentrations (surface soil)	1.2E-04	1.2E-04
SWMU 3		
Future industrial worker at current concentrations (surface soil)	1.2E-04	1.2E-04
SWMU 7		
Future industrial worker at current concentrations (surface soil)	3.90E-03	1.56E-04
Future excavation worker at current concentrations (surface and subsurface soil)[c]	1.60E-03	9.23E-04
SWMU 30		
Future industrial worker at current concentrations (surface soil)	3.80E-03	1.48E-04
Future excavation worker at current concentrations (surface and subsurface soil)[c]	1.20E-03	7.56E-05

[a] Total ELCR is presented in the BGOU RI (DOE 2010b) for surface and subsurface soil.
[b] Revised total ELCR estimated by removing the percentage contribution received from beryllium (Tables 1.5 through 1.8).
[c] ELCR for future excavation worker was determined at an exposure frequency of 185 days per year and an exposure duration of 25 years.

In addition to revised toxicity values, changes in methodology in which toxicity values are applied have been updated. Dermal contact with soil has been a driving exposure route in previous BHHRAs at PGDP; this is a direct result of using dermal absorption factors that exceed gastrointestinal absorption values and may be overly conservative. Although chemical-specific absorption values were used when available, default absorption values were used for most chemicals because chemical-specific values still are not available. These NALs used for screening in Tables 1.17 and 1.18 were derived with updated absorption values consistent with the 2013 Risk Methods Document, addressing this issue.

Some of the COCs listed in Tables 1.17 and 1.18 do not exceed their NALs. These COCs may have been identified as COCs for scenarios other than the excavation worker or the industrial worker. Because the focus of this FS is to address industrial use, these COCs no longer may be necessary for consideration in this FS; that determination is further explained in Section 1.6.

1.5.4.3 Review of historical disposal records and possible additional COCs

Disposal records were reviewed and COCs have been added based on those historical disposal records. The following COCs have been added and will be retained for consideration in this FS.

SWMU 2. Total PCBs in subsurface soils/waste has been added as a COC based on information presented in the FS for Final Action at SWMU 2 (DOE 1998b). That FS states the following:

> Additional analytical data obtained in September 1997 has provided information concerning whether Tc-99 and PCBs are likely waste contaminants at SWMU 2. A 55-gal drum recently was located and identified as having been one of those removed from Area 9 of SWMU 2 during the 1984 excavation. These results indicate that PCBs are present in the waste sludge at a maximum detected level of 7,900 ppm.

Additionally, TCE was not identified as a COC in the RI for the future industrial worker or future excavation worker at SWMU 2. The BGOU RI Report states 450 gal of TCE were disposed of in the unit. An excavation in August 1984, where intent was to remove TCE in the soil or drums reportedly disposed of in this area, found none of the 15 30-gal drums containing TCE intact. Because uncertainty exists with respect to sample representation of the burial area, TCE has been added as a COC for direct contact for the future excavation worker in subsurface soils/waste.

In the BGOU RI, uranium was included as a COC for SWMU 2. Uranyl fluoride is more mobile than uranium metal; therefore, uranium has been retained as a COC for protection of groundwater.

SWMU 3. Leachate data from SWMU 3 have been reviewed for the potential for additional COCs. Although TCE has not been detected in SWMU 3 leachate since 2004, earlier detections, process knowledge, and its presence in nearby shallow groundwater warrants TCE's being added as a COC. No other contaminants are being added as COCs based on leachate data. The presence of PCBs, metals, and radionuclides detected in SWMU 3 leachate provides an uncertainty for the SWMU 3 COCs and will be managed as such in this FS.

1.5.5 Identification of Target COCs over All Media

All COCs requiring remediation will be addressed by the remedy selected in the proposed plan; however, target COCs have been selected to help focus the alternative selection. All COCs on a SWMU-specific and media-specific basis for the reasonably foreseeable industrial land use and whether they are addressed or screened by this FS are listed in Section 1.6. Section 1.6 further defines the target COCs that are addressed by this FS for each SWMU.

1.5.6 PTW Determination

The PTW determinations per the dispute resolution agreement are presented here on a SWMU-specific basis (DOE 2012).

EPA defines PTW as those source materials considered to be highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment should exposure occur. They include liquids and other highly mobile materials (e.g., solvents) or materials with high concentrations of toxic compounds. No "threshold level" of toxicity/risk has been established to equate to "principal threat"; however, where toxicity and mobility of source material combine to pose a potential risk of 1E-03, or greater, generally treatment alternatives should be evaluated.

The identification of principal threats is made on a site-specific basis. For the BGOU, a senior executive committee consisting of representatives from DOE, EPA, and KDWM successfully resolved a formal dispute and reached unanimous decision regarding PTW determinations in SWMUs 2, 3, and 7 that are included in this FS. The terms of the dispute resolution agreement are set forth below.

SWMU 2. The following PTW has been identified at SWMU 2 (DOE 2012):

- Approximately 270 tons of uranium (e.g., shavings and sawdust packed in oil) disposed of in burial pits in SWMU 2;
- Buried drums of uranium-contaminated TCE and any high soil concentrations of TCE present under and adjacent to the drums;
- Buried drums (thirty-five 30-gal drums documented) of uranyl fluoride solution and high soil concentrations of uranyl fluoride solution present under and adjacent to the drums; and
- High concentrations of TCE and *cis*-1,2-DCE (a toxic degradation product of TCE) in soil on the eastern side of SWMU 2.

There is the potential that the 59,000 gal of oil with which the uranium was packaged in drums contains PCBs at concentrations greater than 500 ppm considering sample results of 7,900 ppm PCB from a drum excavated from SWMU 2. The drum came from Area 9 and contained TCE sludge as well as uranium contamination, which suggests that likely it is not from the same waste stream as the pyrophoric uranium. Under EPA guidance, PCBs greater than 500 ppm generally are considered PTW. The parties acknowledge that, absent additional characterization (sampling and analysis) of the buried waste, it is uncertain whether PCBs are widely present in SWMU 2 at levels greater than 500 ppm. Notwithstanding the uncertainty, 59,000 gal of oil could contain PCBs in excess of 500 ppm and thus be considered PTW (DOE 2012).

SWMU 3. The estimated 3,200 tons of bulk uranium disposed in the former surface impoundment at SWMU 3 has been identified to be PTW (DOE 2012).

There are contradictory statements in the historical records regarding the potential presence of pyrophoric uranium in SWMU 3. It is inconclusive as to whether pyrophoric uranium is present in SWMU 3 (DOE 2012).

SWMU 7. TCE (including degradation products) is present in the UCRS as DNAPL and/or high concentration TCE residual soil contamination and constitute PTW (DOE 2012).

Analytical results of waste in drums removed from the TP-5 area of SWMU 7 during the 1992 SI are summarized in Section 1.6 and provided in Appendix G. The results do not support declaration of this waste as PTW.

SWMU 30. No PTW has been identified at SWMU 30.

1.5.7 SWMU 3 Leachate Pit Evaluation

The C-404 Low-Level Radioactive Waste Burial Ground (SWMU 3) originally was constructed as an aboveground surface impoundment (circa 1952). The floor of the surface impoundment was constructed of well-tamped clay and surrounded by earth dikes to a height of 6 ft. The impoundment was designed with an overflow weir in the dike near its southwest corner. Immediately downstream of the weir, discharges passed through a flow-through sump. The walls and floor of the sump were constructed with 10” reinforced concrete. In 1957, the C-404 surface impoundment was converted to a disposal facility for solid uranium-contaminated wastes; as part of the conversion, the flow-through sump immediately downstream of the existing weir, was placed into service as a leachate collection pit.

Subsequent to the approval of the BGOU RI Report, C-404 Semiannual reports were reviewed to understand any trends in the amount of leachate removed and frequency of removal. Also the analytical results of the leachate were reviewed to understand better contaminant levels in the leachate and any trends in contaminant concentrations through time.

The timing of historic leachate influx and removal suggests a seasonal relationship (i.e., most influx and removal has occurred in winter months when UCRS groundwater elevations are high). During the period from 2001 to 2009, approximately 2,000 gallons of leachate were generated annually and removed from the leachate pit. The base of the leachate pit is 369 ft amsl or 2 ft below the highest UCRS groundwater elevation (371 amsl). This information indicates that it is possible that groundwater could infiltrate into the leachate pit when UCRS groundwater elevations are high. This infiltration could occur through imperfections not detected during routine visual inspections or sump tests. High levels of U-238 (ranging from 2,290 pCi/L to 39,700 pCi/L) suggest that water collected from the pit contains a leachate component (i.e., water that has been in contact with the waste in the disposal cell). There is no apparent relationship/correlation between the rate at which water flows into the pit/sump and the uranium concentration in that water. The amount of leachate (versus groundwater) that contributes to the total water withdrawn from the sump is an uncertainty. Possible origins of the leachate in the pit include: 1) waste dewatering over time, 2) groundwater intrusion into wastes through former impoundment bottom liner, and 3) rain water infiltration through RCRA cap. If, or how much, any of these mechanism are contributing to the leachate is an uncertainty.

A leachate sump integrity test is conducted annually at C-404 as specified in Attachment I of the Kentucky Division of Waste Management Hazardous Waste Facility Permit, KY8-890-008-982. The test is a measure of water elevations monitored over a one-month period during the year, and reported in the appropriate semiannual report. According to the *C-404 Hazardous Waste Landfill November 2015 Semiannual Groundwater Report (April 2015–September 2015), Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* PAD-ENM-0095/V2, the leachate level was monitored most recently from September 9 through October 10, 2015, using an automated system that collects data at 15 minute intervals. The test shows the leachate level was constant (within 0.06 ft) over the monitoring period; the measurement shows no evidence of the C-404 unit leaking. A printout of the data is provided in an appendix of the Semiannual Groundwater Report.

Available data indicates the intrusion of groundwater into wastes through the former impoundment bottom liner is unlikely. Based upon piezometric data, there is a 2-ft separation between the base of waste and the highest UCRS groundwater elevation (373 ft and 371 ft amsl, respectively). This information shows, therefore, that the waste does not sit in groundwater even when UCRS groundwater elevations are high. The base of the leachate pit, however, is 369 ft amsl or 2 ft below the highest UCRS groundwater elevation (371 amsl).

1.6 SUMMARY OF SWMU-SPECIFIC ISSUES IMPACTING IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section is organized on a SWMU-specific/media-specific basis (i.e., surface soil, waste and subsurface soil, and groundwater protection) to summarize the known information about each SWMU/media and uncertainties and present it in a manner that is useful for technology screening. That is, this final section of the introduction will provide the reader a basis for why subsequent decisions regarding technology screening are being made. Each subsection will contain the following information.

COCs. COCs are presented in this section. Of these COCs, target COCs are identified. Target COCs are those contaminants that are believed to be distributed generally throughout a SWMU, drive the risk characterization for the reasonably foreseeable future industrial use and groundwater protection for the SWMU, and represent a class of chemicals present or thought to be present in the SWMU. Target COCs are identified to simplify the screening of alternatives. While target COCs are used to simplify screening of alternatives, all COCs at a SWMU will be addressed in the FS by the alternatives' analysis.

The estimated volumes of soils potentially affected by DNAPL and/or high VOC contaminated soil were developed for the affected SWMUs and are discussed more fully in the SWMU-specific sections.

It is anticipated that the extent of DNAPL and/or high VOC contaminated soil contamination at these SWMUs will be delineated more fully during the RD.

PTW. A brief summary of the disposal records and the known conditions are presented. PTW is identified per the dispute resolution agreement.

Uncertainties. Uncertainties are summarized with an emphasis placed on the need for remedies to manage uncertainties.

Summary of Conditions. A summary of conditions is made. This summary identifies the issues that impact technology identification and screening.

1.6.1 Additional Uncertainties

Additional uncertainties associated with SWMUs 2, 3, 7, and 30 are discussed in the following sections.

1.6.1.1 Limited groundwater monitoring around SWMUs

The assumption carried forward from the BGOU RI is that all of the wastes disposed of in the SWMUs potentially contained hazardous and/or radioactive materials. The conceptual model applicable to all of the BGOU SWMUs is that releases from the SWMUs have impacted soils below or immediately adjacent to the source zones and, through vertical infiltration in the soil, have the potential to contaminate the groundwater underlying these sources.

While the transport modeling conducted for the RI necessarily made simplifying assumptions, the data were adequate to identify the COCs, determine their contribution to risks to human health, and develop PRGs for evaluating alternatives. To the extent practicable, the modeling approach simulated actual PGDP site conditions using, as an example, K_ds for metals in soils based on acidic soils with a low cation exchange capacity, consistent with known site conditions. Uncertainty still exists with respect to source material because of limited source data.

1.6.1.2 Potential for leachate from burial areas to impact adjacent surface water ditches

Another potential pathway that exists at SWMUs 7 and 30 is lateral seepage from the burial cells into nearby ditches. The SWMUs 7 and 30 RI Report reported that water was observed emanating from the slope of the ditch following a heavy rainfall (DOE 1998a). It is uncertain whether the seepage was derived from the burial cells. The RI report concluded that uranium isotope activity ratios in surface water in the ditch argued against waste burial pit waters as contributors to surface water contamination. Section 1.5 of this FS notes the uncertainty in uranium isotopic abundance. Likewise, some discharge of shallow groundwater in the ditch south of SWMU 2 has been observed, but the report was unclear as to the contribution of contamination to the ditch (the report concluded that contaminant migration to Outfall 015 and Bayou Creek is unlikely to exceed PRGs) (DOE 1997a). This FS will consider the pathway for leachate flow from the BGOU SWMUs to adjacent surface water features. Waste excavation will eliminate this pathway. A cap will be engineered to eliminate vertical infiltration and manage runoff. This or any other remedial alternatives that leaves waste in place will be augmented by shallow groundwater monitoring to understand the extent, if any, to which contaminants leach from the SWMU to the ditch.

1.6.1.3 Nature and extent of contaminants in surface soil

Delineation Uncertainties. PRGs established in the FS (see Section 1.6.6) are protective of both the direct contact and groundwater exposure pathways. Alternatives will address containment, removal or treatment of soils to meet the PRGs, as applicable. In a removal alternative, uncertainties regarding the extent of contamination above the PRGs will be managed by excavation guided by postremediation sampling until the effectiveness of excavation is demonstrated or by groundwater monitoring where cleanup goals selected in the record of decision (ROD) cannot be met in the subsurface soils or media.

Animals that burrow to 5 ft bgs would be expected to encounter ecological COPCs which extend to 10 ft bgs. Because these soils are the only media that would affect ecological receptors and are addressed in the FS by removing the top 20 ft at the SWMUs during waste excavation or, if waste is left in place, selecting an alternative that places an appropriate surface barrier over the soils of interest to prevent contact with residuals also would prevent exposure by ecological receptors.

1.6.1.4 Cost estimate between -30% and +50%

The unknowns associated with source, volume, and characterization information related to waste types and volumes for treatment and/or disposal add uncertainty to the development of remedial cost estimates. Assumptions for these parameters were used to develop costs. Cost estimates are provided in Appendix E. Additional information regarding cost estimates can be found in Section 4.1.2.7, Cost (balancing criterion).

1.6.2 SWMU 2 Summary

SWMU 2 was a burial ground that contains uranium (including uranium metal that may be pyrophoric and uranyl fluoride), waste oil (potentially containing PCBs), and TCE. Contaminants from the buried waste and contaminated soils in SWMU 2 are expected to be found concentrated in the soils and groundwater of the UCRS immediately within and under the burial cells.

1.6.2.1 Surface soil

COCs. COCs in surface soil at SWMU 2 taken from the "Future industrial worker at current concentrations (soil)" scenario on Table 1.5 are the following: arsenic, U-235, and U-238. U-234 was added to the COC list because this isotope is expected to be present where U-235 and U-238 are found. Arsenic and the uranium isotopes (U-234, U-235, and U-238) are the classes of target COCs.

Uncertainties. Uncertainties associated with the surface soil at SWMU 2 are presented in Table 1.13.

1.6.2.2 Waste and subsurface soil

COCs. As stated in Table 1.13, the risk assessment for SWMUs 2 and 3 did not evaluate an outdoor or excavation worker scenario for soil, but did evaluate hypothetical exposure to an adult or child resident to off-site groundwater. The COCs for SWMU 2 include COCs identified through the assessments of both the on-site industrial worker for soil and off-site groundwater user in order to include the most comprehensive list of COCs.

The full list of COCs at SWMU 2 (see Table 1.5) are the following: *cis*-1,2-DCE; TCE; naphthalene; Total PCBs (assessed as Aroclor 1248 and Aroclor 1268); arsenic; manganese; uranium; Tc-99; U-234; U-235; and U-238.

These COCs were compared to background and NALs (see Table 1.18). Manganese was considered to be within the range of background and, therefore, no longer is considered. Tc-99 was not screened based on background and NALs. Naphthalene was determined not to pose a threat to groundwater and is not retained as a COC (see Appendix B). Thus, the COCs retained for SWMU 2 subsurface soil are *cis*-1,2-DCE; TCE; Total PCBs; arsenic; uranium; Tc-99; U-234, U-235, and U-238. All of these COCs should be considered target COCs.

PTW. PTW at SWMU 2 is described in Section 1.5.6.

Uncertainties. Uncertainties associated with the waste and subsurface soil at SWMU 2 are presented in Table 1.13.

1.6.2.3 Groundwater protection

COCs. COCs for the protection of groundwater are taken from the future adult rural resident at modeled concentrations for RGA groundwater drawn at the SWMU 2 boundary for total ELCR and the future child rural resident at modeled concentrations for RGA groundwater drawn at the SWMU 2 boundary for total HI scenarios on Table 1.5. These COCs include *cis*-1,2-DCE; TCE; naphthalene; Total PCBs (assessed as Aroclor 1248 and Aroclor 1268); arsenic; manganese; uranium; Tc-99; U-234; and U-238.

These COCs were compared to background and NALs (see Table 1.18). Manganese was considered to be within the range of background and therefore, is no longer considered. Naphthalene was determined not to pose a threat to groundwater and is not retained as a COC (see Appendix B). U-235 was added to the COC list because this isotope is expected to be present where U-234 and U-238 are found. Thus, TCE and it degradation products, Total PCBs, metals, Tc-99, and the uranium isotopes (U-234, U-235, and U-238) are the classes of target COCs.

PTW. See Section 1.6.2.2.

Uncertainties. Uncertainties associated with the protection of groundwater at SWMU 2 are presented in Table 1.13.

1.6.3 SWMU 3 Summary

SWMU 3 was a burial ground that contains uranium precipitated from aqueous solutions, UF_4, uranium metal, uranium oxides, degreasing sludge, and radioactively-contaminated trash. Contaminants from the buried waste and contaminated soils in SWMU 3 are expected to be found concentrated in the soils and groundwater of the UCRS immediately within and under the burial cells.

1.6.3.1 Surface soil

COCs. COCs in surface soil at SWMU 3 taken from the "Future industrial worker at current concentrations (soil)" scenario on Table 1.6 are the following: arsenic, U-235, and U-238. U-234 was added to the COC list because this isotope is expected to be present where U-235 and U-238 are found. No surface soil data are available for comparison. Metals and uranium isotopes (U-234, U-235, and U-238) are the target COCs.

Uncertainties. Uncertainties associated with the surface soil at SWMU 3 are presented in Table 1.13 (including whether the existing Subtitle C cap presents a radiological surface risk to industrial workers or presents hotspot risks).

1.6.3.2 Waste and subsurface soil

COCs. As stated in Table 1.13, the risk assessment for SWMUs 2 and 3 did not evaluate an outdoor or excavation worker scenario for soil, but did evaluate hypothetical exposure to an adult or child resident to off-site groundwater. The COCs for SWMU 3 include COCs identified through the assessments of both the on-site industrial worker for soil and off-site groundwater user to include the most comprehensive list of COCs. The full list of COCs at SWMU 3 (see Table 1.6) are the following: arsenic, manganese, uranium, Tc-99, U-235, and U-238. U-234 was added to the COC list because this isotope is expected to be present where U-235 and U-238 are found.

These COCs were compared to background and NALs (see Table 1.18). Manganese was determined to be less than background and thus no longer is considered. Uranium, uranium isotopes (U-234, U-235, and

U-238), and Tc-99 were not screened based on background and NALs. Naphthalene was determined to not pose a threat to groundwater and is not retained as a COC (see Appendix B).

The COCs retained for SWMU 3 subsurface soil are *cis*-1,2-DCE; TCE; Total PCBs; arsenic; uranium; Tc-99; U-234, U-235, and U-238. All of these COCs should be considered target COCs.

PTW. The estimated 3,200 tons of bulk uranium disposed of in the former surface impoundment at SWMU 3 is PTW. It is inconclusive whether pyrophoric uranium is present in SWMU 3.

Uncertainties. Uncertainties associated with the waste and subsurface soil at SWMU 3 are presented in Table 1.13.

In addition, the following uncertainties have been identified: (1) the integrity of the existing Subtitle C cap, (2) the integrity of the clay bottom liner (i.e., the well-tamped clay floor that served as the floor of the former surface impoundment), and (3) the integrity of the concrete leachate collection sump/pit. Elevated U-238 contaminant levels in the leachate indicate (a) waste may be dewatering over time; (b) groundwater may be intruding through the clay bottom liner and contacting the waste; and/or (c) rain water may be infiltrating through the existing Subtitle C cap and contacting the waste. Also, the groundwater level with respect to the leachate collection sump/pit suggest that the sump/pit may be leaking.

1.6.3.3 Groundwater protection

COCs. COCs for the protection of groundwater are taken from the future adult rural resident at modeled concentrations for RGA groundwater drawn at the SWMU 3 boundary for total ELCR and the future child rural resident at modeled concentrations for RGA groundwater drawn at the SWMU 3 boundary for total HI scenarios on Table 1.6. These COCs include arsenic, manganese, uranium (metal), Tc-99, U-235, and U-238.

The COCs listed above were compared to background (see Table 1.18). Manganese was determined to be less than background or within the range of background and thus no longer is considered in this FS. U-234 was added to the COC list because this isotope is expected to be present where U-235 and U-238 are found. TCE was added to the COC list based on historical leachate data from SWMU 3; thus the target COCs are TCE, arsenic, uranium (metal), Tc-99, and the uranium isotopes (U-234, U-235, and U-238).

PTW. No COCs associated with PTW currently are identified for groundwater protection at SWMU 3.

Uncertainties. Uncertainties associated with the protection of groundwater at SWMU 3 are presented in Table 1.13. Section 1.5.4.3 identifies that the presence of PCBs, metals, and radionuclides detected in SWMU 3 leachate provides an uncertainty that the list of SWMU 3 COCs is comprehensive.

1.6.4 SWMU 7 Summary

SWMU 7 was a burial ground that contains noncombustible trash; contaminated material and equipment; uranium-contaminated concrete pieces of reactor tray bases from the fluorination process of UF_4 to UF_6; uranium-contaminated scrap metal; and empty uranium/magnesium powder drums. Contaminants from the buried waste and contaminated soils in SWMU 7 are expected to be found concentrated in the soils and groundwater of the UCRS immediately within and under the burial cells.

1.6.4.1 Surface soil

COCs. COCs in surface soil at SWMU 7 taken from the "Future industrial worker at current concentrations (soil)" scenario on Table 1.7 are the following: Total PAHs [assessed as benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; dibenzo(a,h)anthracene; indeno(1,2,3-cd)pyrene]; aluminum; antimony; arsenic; beryllium; chromium; iron; manganese; uranium; vanadium; neptunium-237; U-234; U-235; and U-238. Additionally, as a result of Soils OU RI sampling at SWMU 7, cobalt, mercury, and thallium were COPCs and were added to the COC list in this FS in order not to underestimate the potential risk.

The COCs listed above were compared to background and NALs (see Table 1.17). Aluminum, beryllium, and thallium were determined to be less than background or within the range of background and thus no longer are considered. The following did not exceed NALs and also no longer will be considered: antimony, beryllium, chromium, and vanadium.

Total PAHs, arsenic, cobalt, iron, manganese, mercury, uranium, neptunium-237, U-234, U-235, and U-238 are retained as COCs. Of these, target COCs are total PAHs, metals, neptunium-237, and the uranium isotopes (U-234, U-235, and U-238).

Uncertainties. No uncertainties specific to the surface soil at SWMU 7 are presented in Table 1.13. The presence of seeps are an uncertainty for SWMU 7.

1.6.4.2 Waste and subsurface soil

COCs. COCs in waste and subsurface soils at SWMU 7 taken from the "Future excavation worker at current concentrations (soil)" scenario on Table 1.7 are the following: Total PAHs [assessed as benzo(a)pyrene; and dibenzo(a,h)anthracene]; aluminum; antimony; arsenic; beryllium; chromium; copper; iron; manganese; nickel; uranium; vanadium; neptunium-237; plutonium-239; U-234; U-235; and U-238. Additionally, as a result of Soils OU RI sampling at SWMU 7, cobalt and thallium were COPCs and were added to the COC list in this FS in order to not underestimate the potential risk.

The COCs listed above were compared to background and NALs (see Table 1.18). Aluminum and thallium were determined to be less than background or within the range of background and thus no longer are considered. The following did not exceed NALs and also no longer will be considered in this FS: antimony; beryllium; chromium; copper; vanadium; neptunium-237; and plutonium-239.

The COCs retained in waste and subsurface soils at SWMU 7 are Total PAHs, arsenic, cobalt, iron, manganese, nickel, uranium, U-234, U-235, and U-238. Target COCs are Total PAHs, metals, and uranium isotopes (U-234, U-235, and U-238) and are the classes of target COCs.

PTW. TCE (including degradation products) present in the UCRS as DNAPL and/or high concentration TCE residual soil contamination constitute PTW at SWMU 7. Additionally, the dispute resolution agreement stated that the FS for SWMU 7 would document analytical results of waste in drums removed from the TP-5 area of SWMU 7 during the 1992 SI. (Note: TP-5 refers to a sampling location at a test pit.) A summary of the TCE results is presented in Table 1.20. The remaining results for all analytes are available in Appendix H. Because all results shown in Table 1.20 are "U" qualified nondetected values, the results do not support a declaration of the waste as PTW.

Table 1.20. TP-5 TCE Results in SWMU 7 on May 23, 1991

Sample Number	Sample Description	Results	Laboratory Qualifier	Units	Detection Limit	Validation Qualifier
CH214195-00000	Drummed material removed from pit	6	U	µg/kg	6	=
CH214196-DUP	Duplicate of sample No. 14195	6	U	µg/kg	6	=
CH214197-00000	Soils around drum on spoils pad	6	U	µg/kg	6	=

Uncertainties. Uncertainties associated with the waste and subsurface soil at SWMU 7 are presented in Table 1.13.

1.6.4.3 Groundwater protection

COCs. COCs for the protection of groundwater are taken from the future adult rural resident at modeled concentrations for RGA groundwater drawn at the SWMU 7 boundary for total ELCR and the future child rural resident at modeled concentrations for RGA groundwater drawn at the SWMU 7 boundary for total HI scenarios on Table 1.7. These COCs include 1,1-DCE; *cis*-1,2-DCE; TCE; vinyl chloride; Total PCBs (assessed as Aroclor 1254); arsenic; manganese; uranium (metal); Tc-99; U-234; and U-238. U-234 was added to the COC list because this isotope is expected to be present where U-235 and U-238 are found.

TCE and its degradation products, Total PCBs, metals, Tc-99, and the uranium isotopes (U-234, U-235, U-238) are the classes of target COCs.

PTW. See Section 1.6.4.2.

Uncertainties. Uncertainties associated with the protection of groundwater at SWMU 7 are presented in Table 1.13.

1.6.5 SWMU 30 Summary

SWMU 30 was a burn area with a burial ground that contains ash and debris from combustible trash, possibly uranium-contaminated. Contaminants from the buried waste and contaminated soils in SWMU 30 are expected to be found concentrated in the soils and groundwater of the UCRS immediately within and under the burial cells.

1.6.5.1 Surface soil

COCs. COCs in surface soil at SWMU 30 taken from the "Future industrial worker at current concentrations (soil)" scenario on Table 1.8 are the following: Total PAHs [assessed as benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; dibenzo(a,h)anthracene; indeno(1,2,3-cd)pyrene]; Total PCBs (assessed as Aroclor 1260); aluminum; antimony; arsenic; beryllium; cadmium; chromium; iron; manganese; uranium (metal); vanadium; neptunium-237; U-234; U-235; and U-238.

The COCs listed above were compared to background and NALs (see Table 1.17). Arsenic, beryllium, iron, manganese, and vanadium were determined to be less than background or within the range of background and thus no longer are considered. Additionally, the following did not exceed NALs and also no longer will be considered: aluminum, antimony, cadmium, and chromium. Total PAHs, Total PCBs, uranium (metal), neptunium-237, U-234, U-235, and U-238. Of these, target COCs are Total PAHs, Total PCBs, metals, neptunium-237, and the uranium isotopes (U-234, U-235, and U-238).

Uncertainties. No uncertainties specific to the surface soil at SWMU 30 are presented in Table 1.13. The presence of seeps is an uncertainty for SWMU 30.

1.6.5.2 Waste and subsurface soil

COCs. COCs in waste and subsurface soils at SWMU 30 taken from the "Future excavation worker at current concentrations (soil)" scenario on Table 1.8 are the following: Total PAHs [assess as benzo(a)anthracene; benzo(a)pyrene; benzo(b)fluoranthene; dibenzo(a,h)anthracene; and indeno(1,2,3-cd)pyrene]; total PCBs (assessed as Aroclor 1248); aluminum; antimony; beryllium; cadmium; chromium; copper; iron; manganese; uranium; vanadium; neptunium-237; plutonium-239; U-234; U-235; U-238.

The COCs listed above were compared to background and NALs (see Table 1.18). Aluminum, antimony, arsenic, cadmium, copper, iron, manganese, and vanadium were determined to be less than background or within the range of background and thus no longer are considered. Additionally, the following did not exceed NALs and no longer will be considered in this FS: beryllium; chromium; copper; neptunium-237; and plutonium-239.

The COCs retained in waste and subsurface soils at SWMU 7 are Total PAHs, Total PCBs, uranium, U-234, U-235, and U-238. Total PAHs, Total PCBs, and uranium, and the uranium isotopes (U-234, U-235, and U-238) are the classes of target COCs.

PTW. No PTW has been identified in waste or subsurface soils at SWMU 30.

Uncertainties. Table 1.13 does not identify uncertainties specific to waste and subsurface soils at SWMU 30.

1.6.5.3 Groundwater protection

COCs. COCs for the protection of groundwater are taken from the future adult rural resident at modeled concentrations for RGA groundwater drawn at the SWMU 30 boundary for total ELCR and the future child rural resident at modeled concentrations for RGA groundwater drawn at the SWMU 30 boundary for total HI scenarios on Table 1.8. These COCs include 1,1-DCE; TCE; arsenic; manganese; selenium; uranium; Tc-99; U-234; and U-238.

The COCs listed above were compared to background (see Table 1.18). Arsenic, manganese, and selenium were determined to be less than background or within the range of background and thus no longer are considered in this FS. U-235 was added to the COC list because this isotope is expected to be present where U-234 and U-238 are found.

TCE and its degradation products, uranium, Tc-99, and the uranium isotopes (U-234, U-235, U-238) are the classes of target COCs.

PTW. No PTW has been identified with respect to groundwater protection at SWMU 30.

Uncertainties. There are no identified uncertainties for the protection of groundwater specific to SWMU 30, as presented in Table 1.13.

Summary of Remedial Need. A summary of remedial needs will be presented as it applies to this media.

1.6.6 Preliminary Remediation Goals

The revised PRGs for the target COCs are presented in this section, Tables 1.21 through 1.23. The revised PRG for surface soil (0 to 1-ft bgs) is the lesser of the direct contact PRG for the future industrial worker, future excavation worker, and the groundwater protective PRG, unless this risk-based value is less than background [see Table A.12 of the 2013 Risk Methods Document (DOE 2013a)]. If the risk-based value is less than background, then background becomes the revised PRG for surface soil. The revised PRG for subsurface soil (0 to 16 ft bgs) is the lesser of the direct contact PRG for the future excavation worker and the groundwater protective PRG, unless this risk-based value is less than background. If the risk-based value is less than background, then background becomes the revised PRG for subsurface soil. Finally, the revised PRG for subsurface soil below 16 ft bgs is the greater of the groundwater protective PRG and background. Direct contact does not apply for soil below 16 ft consistent with guidance in the 2013 Risk Methods Document (DOE 2013a). For cost estimating purposes, an excavation depth of 20 ft is assumed in other portions of this document.

To ensure that the residual cumulative ELCR will be equal to or below the ELCR target of 1E-05, and the residual cumulative HI will be equal to or below the HI target of 1, PRGs were calculated using chemical-specific targets of an ELCR = 5E-06 and HI = 0.5.

One exception to the revised PRG determination described in the preceding paragraph is for the direct contact PRG for Total PCBs. The direct contact PRG for Total PCBs of 10 mg/kg was agreed upon as part of risk management discussions during a June 2009 BGOU FS scoping meeting among DOE, EPA, and KY and is applied at other PGDP OUs as the PRG for soil at the BGOU. The 10 mg/kg PRG will be used as a starting point for PRG evaluation. The final remediation goal (RG) for PCBs protective of the future industrial worker and future excavation worker will be presented in the ROD. The 10 mg/kg value is not a Toxic Substances Control Act (TSCA) value, but was consistent with the risk-based clean-up value used for the Surface Water OU On-site Removal Action (i.e., 16 mg/kg), which was derived for industrial use and was determined to be protective for cumulative risk.

Table 1.21. SWMUs 2, 3, 7, and 30 FS Preliminary Remediation Goals for Surface Soil

SWMU	COC	Units	Background[a]	Direct Contact PRG[b]	Groundwater-Protective PRG[c]	PRG for Surface Soil[d]
2	Arsenic	mg/kg	1.20E+01	1.91E+01	1.69E+01	1.69E+01
2	U-234	pCi/g	1.20E+00	3.06E+02	4.88E+06	3.06E+02
2	U-235	pCi/g	6.00E-02	9.20E+00	5.07E+04	9.20E+00
2	U-238	pCi/g	1.20E+00	3.74E+01	2.64E+02	3.74E+01
3	Arsenic	mg/kg	1.20E+01	1.91E+01	1.69E+01	1.69E+01
3	U-234	pCi/g	1.20E+00	3.06E+02	4.88E+06	3.06E+02
3	U-235	pCi/g	6.00E-02	9.20E+00	5.07E+04	9.20E+00
3	U-238	pCi/g	1.20E+00	3.74E+01	2.64E+02	3.74E+01
7	Total PAHs[f]	mg/kg	N/A	3.92E+00	2.51E-01	2.51E-01
7	Arsenic	mg/kg	1.20E+01	1.91E+01	1.69E+01	1.69E+01
7	Cobalt	mg/kg	1.40E+01	3.02E+02	8.18E-01	1.40E+01
7	Iron	mg/kg	2.80E+04	5.00E+05	1.07E+03	2.80E+04
7	Manganese	mg/kg	1.50E+03	2.11E+04	9.28E+01	1.50E+03
7	Mercury	mg/kg	2.00E-01	3.07E+02	6.03E+00	6.03E+00
7	Uranium[g]	mg/kg	4.90E+00	2.99E+03	7.83E+02	7.83E+02
7	Np-237	pCi/g	1.00E-01	6.05E+00	2.61E-01	2.61E-01
7	U-234	pCi/g	1.20E+00	3.06E+02	4.88E+06	3.06E+02
7	U-235	pCi/g	6.00E-02	9.20E+00	5.07E+04	9.20E+00
7	U-238	pCi/g	1.20E+00	3.74E+01	2.64E+02	3.74E+01
30	Total PAHs[f]	mg/kg	N/A	3.92E+00	2.51E-01	2.51E-01
30	Total PCBs	mg/kg	N/A	1.43E+01	4.54E+00[h]	1.00E+01[e]
30	Uranium[g]	mg/kg	4.90E+00	2.99E+03	7.83E+02	7.83E+02
30	Np-237	pCi/g	1.00E-01	6.05E+00	2.61E-01	2.61E-01
30	U-234	pCi/g	1.20E+00	3.06E+02	4.88E+06	3.06E+02
30	U-235	pCi/g	6.00E-02	9.20E+00	5.07E+04	9.20E+00
30	U-238	pCi/g	1.20E+00	3.74E+01	2.64E+02	3.74E+01

N/A = not available

[a] Background concentrations taken from Table A.12 of the 2013 Risk Methods Document (DOE 2013a).

[b] Direct contact PRGs are taken from 5 times the industrial worker NAL from Table A.4 of the 2013 Risk Methods Document (DOE 2013a). This value corresponds to the lesser of an ELCR of 5E-06 for carcinogenic COCs and an HI of 0.5 for noncarcinogenic COCs for chemical-specific targets to ensure that the residual cumulative ELCR will be equal to or below the ELCR target of 1E-05, and the residual cumulative HI will be equal to or below the HI target of 1.

[c] Groundwater protective PRGs are the soil screening level for the MCL or residential NAL using a dilution attenuation factor of 58 [see Table C1.2 of the Soils OU RI Report (DOE 2013b)].

[d] PRG for surface soil is the lower of the direct contact PRG and groundwater protective PRG for soil. If the risk-based value is less than background, then background becomes the revised PRG for surface soil. Shading indicates the revised PRG is set at background.

[e] Determined during June 2009 BGOU FS scoping meeting.

[f] Direct contact PRGs are based on total carcinogenic polycyclic aromatic hydrocarbons. The groundwater protective PRG is based on values for benz(a)anthracene.

[g] Direct contact PRGs are based on uranium, soluble salts.

[h] A groundwater protective PRG does not apply because BGOU RI modeling indicates that PCBs exhibited groundwater concentrations that were less than the groundwater child NAL.

Table 1.22. SWMUs 2, 3, 7, and 30 FS Preliminary Remediation Goals for Subsurface Soil

SWMU	COC	Units	Background[a]	Direct Contact PRG[b]	Groundwater-Protective PRG[c]	PRG for Subsurface Soil[d]
2	*cis*-1,2-DCE	mg/kg	N/A	2.88E+02	1.19E+00	1.19E+00
2	TCE	mg/kg	N/A	1.18E+01	1.03E-01	1.03E-01
2	Total PCBs	mg/kg	N/A	4.25E+00	4.54E+00[f]	1.00E+01[e]
2	Arsenic	mg/kg	7.90E+00	1.04E+01	1.69E+01	1.04E+01
2	Uranium	mg/kg	4.60E+00	4.31E+02	7.83E+02	4.31E+02
2	Tc-99	pCi/g	2.80E+00	7.73E+03	2.12E+01	2.12E+01
2	U-234	pCi/g	1.20E+00	2.18E+02	4.88E+06	2.18E+02
2	U-235	pCi/g	6.00E-02	1.21E+01	5.07E+04	1.21E+01
2	U-238	pCi/g	1.20E+00	4.53E+01	2.64E+02	4.53E+01
3	*cis*-1,2-DCE	mg/kg	N/A	2.88E+02	1.19E+00	1.19E+00
3	TCE	mg/kg	N/A	1.18E+01	1.03E-01	1.03E-01
3	Total PCBs	mg/kg	N/A	4.25E+00	4.54E+00[f]	1.00E+01[e]
3	Arsenic	mg/kg	7.90E+00	1.04E+01	1.69E+01	1.04E+01
3	Uranium	mg/kg	4.60E+00	4.31E+02	7.83E+02	4.31E+02
3	Tc-99	pCi/g	2.80E+00	7.73E+03	2.12E+01	2.12E+01
3	U-234	pCi/g	1.20E+00	2.18E+02	4.88E+06	2.18E+02
3	U-235	pCi/g	6.00E-02	1.21E+01	5.07E+04	1.21E+01
3	U-238	pCi/g	1.20E+00	4.53E+01	2.64E+02	4.53E+01
7	Total PAHs[g]	mg/kg	N/A	1.22E+00	2.51E-01	2.51E-01
7	Arsenic	mg/kg	7.90E+00	1.04E+01	1.69E+01	1.04E+01
7	Cobalt	mg/kg	1.30E+01	4.31E+01	8.18E-01	1.30E+01
7	Iron	mg/kg	2.80E+04	1.01E+05	1.07E+03	2.80E+04
7	Manganese	mg/kg	8.20E+02	3.40E+03	9.28E+01	8.20E+02
7	Nickel	mg/kg	2.20E+01	2.86E+03	7.89E+01	7.89E+01
7	Uranium[h]	mg/kg	4.60E+00	4.31E+02	7.83E+02	4.31E+02
7	U-234	pCi/g	1.20E+00	2.18E+02	4.88E+06	2.18E+02
7	U-235	pCi/g	6.00E-02	1.21E+01	5.07E+04	1.21E+01
7	U-238	pCi/g	1.20E+00	4.53E+01	2.64E+02	4.53E+01
30	Total PAHs[g]	mg/kg	N/A	1.22E+00	2.51E-01	2.51E-01
30	Total PCBs	mg/kg	N/A	4.25E+00	4.54E+00[f]	1.00E+01[e]
30	Uranium[h]	mg/kg	4.60E+00	4.31E+02	7.83E+02	4.31E+02
30	U-234	pCi/g	1.20E+00	2.18E+02	4.88E+06	2.18E+02
30	U-235	pCi/g	6.00E-02	1.21E+01	5.07E+04	1.21E+01
30	U-238	pCi/g	1.20E+00	4.53E+01	2.64E+02	4.53E+01

N/A = not available
[a] Background concentrations taken from Table A.12 of the 2013 Risk Methods Document (DOE 2013a).
[b] Direct contact PRGs are excavation worker corresponding to an ELCR of 5E-06 for carcinogenic COCs and an HI of 0.5 for noncarcinogenic COCs for chemical-specific targets to ensure that the residual cumulative ELCR will be equal to or below the ELCR target of 1E-05, and the residual cumulative HI will be equal to or below the HI target of 1.
[c] Groundwater protective PRGs are the soil screening level for the MCL or residential NAL using a dilution attenuation factor of 58 [see Soils OU RI Report (DOE 2013b)].
[d] PRG for subsurface soil is the lower of the direct contact PRG and groundwater protective PRG for soil. If the risk-based value is less than background, then background becomes the revised PRG for subsurface soil. Shading indicates the revised PRG is set at background.
[e] Determined during June 2009 BGOU FS scoping meeting.
[f] A groundwater protective PRG does not apply because BGOU RI modeling indicates that PCBs exhibited groundwater concentrations that were less than the groundwater child NAL for SWMU 30 and did not reach the water table in 1,000 years for SWMU 2. For SWMU 3, PCBs did not pass screening and therefore did not require modeling.
[g] Direct contact PRGs are based on total carcinogenic polycyclic aromatic hydrocarbons. The groundwater protective PRG is based on values for benz(a)anthracene.
[h] Direct contact PRGs are based on uranium, soluble salts.

Table 1.23. SWMUs 2, 3, 7, and 30 FS Preliminary Remediation Goals for Groundwater Protection

SWMU	COC	Units	Background[a]	Groundwater-Protective PRG[b]	PRG for Subsurface Soil[c]
2	*cis*-1,2-DCE	mg/kg	N/A	1.19E+00	1.19E+00
2	TCE	mg/kg	N/A	1.03E-01	1.03E-01
2	Total PCBs	mg/kg	N/A	4.54E+00[e]	1.00E+01[d]
2	Arsenic	mg/kg	7.90E+00	1.69E+01	1.69E+01
2	Uranium	mg/kg	4.60E+00	7.83E+02	7.83E+02
2	Tc-99	pCi/g	2.80E+00	2.12E+01	2.12E+01
2	U-234	pCi/g	1.20E+00	4.88E+06	4.88E+06
2	U-235	pCi/g	6.00E-02	5.07E+04	5.07E+04
2	U-238	pCi/g	1.20E+00	2.64E+02	2.64E+02
3	TCE	mg/kg	N/A	1.03E-01	1.03E-01
3	Arsenic	mg/kg	7.90E+00	1.69E+01	1.69E+01
3	Uranium	mg/kg	4.60E+00	7.83E+02	7.83E+02
3	Tc-99	pCi/g	2.80E+00	2.12E+01	2.12E+01
3	U-234	pCi/g	1.20E+00	4.88E+06	4.88E+06
3	U-235	pCi/g	6.00E-02	5.07E+04	5.07E+04
3	U-238	pCi/g	1.20E+00	2.64E+02	2.64E+02
7	1,1-DCE	mg/kg	N/A	1.46E-01	1.46E-01
7	*cis*-1,2-DCE	mg/kg	N/A	1.19E+00	1.19E+00
7	TCE	mg/kg	N/A	1.03E-01	1.03E-01
7	Vinyl chloride	mg/kg	N/A	3.97E-02	3.97E-02
7	Total PCBs	mg/kg	N/A	4.54E+00[e]	1.00E+01[d]
7	Arsenic	mg/kg	7.90E+00	1.69E+01	1.69E+01
7	Manganese	mg/kg	8.20E+02	9.28E+01	8.20E+02
7	Uranium	mg/kg	4.60E+00	7.83E+02	7.83E+02
7	Tc-99	pCi/g	2.80E+00	2.12E+01	2.12E+01
7	U-234	pCi/g	1.20E+00	4.88E+06	4.88E+06
7	U-235	pCi/g	6.00E-02	5.07E+04	5.07E+04
7	U-238	pCi/g	1.20E+00	2.64E+02	2.64E+02
30	1,1-DCE	mg/kg	N/A	1.46E-01	1.46E-01
30	TCE	mg/kg	N/A	1.03E-01	1.03E-01
30	Uranium	mg/kg	4.60E+00	7.83E+02	7.83E+02
30	Tc-99	pCi/g	2.80E+00	2.12E+01	2.12E+01
30	U-234	pCi/g	1.20E+00	4.88E+06	4.88E+06
30	U-235	pCi/g	6.00E-02	5.07E+04	5.07E+04
30	U-238	pCi/g	1.20E+00	2.64E+02	2.64E+02

N/A = not available

[a] Background concentrations taken from Table A.12 of the 2013 Risk Methods Document (DOE 2013a).

[b] Groundwater protective PRGs are the soil screening level for the MCL or residential NAL using a dilution attenuation factor of 58 [see Soils OU RI Report (DOE 2013b)].

[c] PRG for subsurface soil below 16 ft bgs is the groundwater protective PRG for soil because direct contact is unlikely. If the risk-based value is less than background, then background becomes the revised PRG for subsurface soil. Shading indicates the revised PRG is set at background.

[d] Determined during June 2009 BGOU FS scoping meeting.

[e] A groundwater protective PRG does not apply, because BGOU RI modeling indicated PCBs did not reach the water table in 1,000 years for SWMU 2 or SWMU 7. For SWMU 3, PCBs did not pass screening and therefore did not require modeling. For SWMU 30, modeling for PCBs showed that PCBs exhibited groundwater concentrations that were less than the groundwater child no action levels.

2. IDENTIFICATION AND SCREENING OF TECHNOLOGIES

RAOs and PRGs for potential remedial actions are introduced and developed in this section. In addition, technology types and process options that may be applicable for remediation of BGOU sources are identified, screened, and evaluated in this section. A primary objective of this FS is to identify remedial technologies and process options that potentially meet the RAOs for actions at SWMUs 2, 3, 7, and 30 and then combine them into a range of remedial alternatives. The potential remedial technologies are evaluated for implementability, effectiveness, and relative cost in eliminating, reducing, or controlling risks to human health and the environment. The criteria for identifying, screening, and evaluating potentially applicable technologies are provided in EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (EPA 1988) and the NCP.

CERCLA requires development and evaluation of a range of responses, including a No Action alternative, to ensure that an appropriate remedy is selected. The selected final remedy must comply with ARARs, unless waived, and must protect human health and the environment. The technology screening process consists of a series of steps that include the following:

- Identifying general response actions (GRAs) that will meet RAOs, either individually or in combination with other GRAs;

- Identifying a volume or area of media to which the GRA will be applied;

- Identifying, screening, and evaluating remedial technology types for each GRA; and

- Selecting one or more representative process options (RPOs) for each technology type.

Following the technology screening, the RPOs are assembled into remedial alternatives that are evaluated further in the detailed and comparative analyses of alternatives.

2.1 INTRODUCTION

Previous PGDP investigations and reports used to develop the CSM and to identify and screen remedial technologies are listed in Section 1. Other sources used in technology identification and screening, including EPA, DOE, and peer-reviewed databases, reports, and journal publications, are cited, and the references are provided in Section 9.

Technologies are identified and evaluated in this FS based on their effectiveness in reducing or eliminating the primary sources.[7] Primary sources fall into four broad categories based on their physical and chemical properties: (1) VOCs to include TCE, TCE degradation products, and other chlorinated solvents; (2) radioactive materials; (3) inorganic chemicals; and (4) PCBs. Technologies also are identified and evaluated for their effectiveness in reducing or eliminating secondary sources[8] such as DNAPL originating from primary VOC sources, eliminating or mitigating the secondary release mechanisms, or eliminating the exposure pathways, as shown in the CSM of the BGOU source areas (Figure 2.1).

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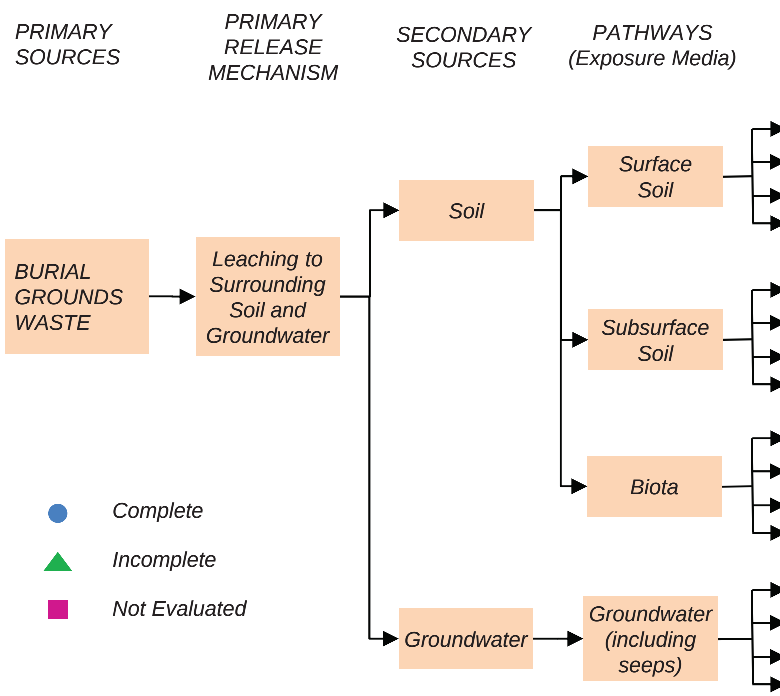
[7] A primary source is contamination present in the waste disposed of in a waste management unit.
[8] A secondary source is contamination caused by the presence of contaminants that have migrated outside of the waste management unit.



Pathway	EXPOSURE ROUTE	RECEPTORS: Current Industrial Worker	Future Industrial Worker	Future Excavation Worker	Future Recreational User	Future Rural Resident
Surface Soil	Ingestion	●	●	●	●	●
	Inhalation	●	●	●	●	●
	Dermal	●	●	●	●	●
	External (Radiation)	●	●	●	●	●
Subsurface Soil	Ingestion	▲	▲	●	▲	▲
	Inhalation	▲	▲	●	▲	▲
	Dermal	▲	▲	●	▲	▲
	External (Radiation)	▲	▲	●	▲	▲
Biota	Ingestion	▲	▲	▲	●	■
	Inhalation	▲	▲	▲	▲	■
	Dermal	▲	▲	▲	▲	■
	External (Radiation)	▲	▲	▲	▲	■
Groundwater (including seeps)	Ingestion	▲	▲	▲	▲	●
	Inhalation	▲	▲	▲	▲	●
	Dermal	▲	▲	▲	▲	●
	External (Radiation)	▲	▲	▲	▲	▲

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Figure 2.1 Conceptual Site Model for BGOU

Figure 2.1 is based on Figure F.1 of the *Remedial Investigation Report for the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0030&D2/R1, February (DOE 2010).

Other COCs that occur infrequently at the BGOU are nonvolatile organic chemicals such as PAHs. These COCs could drive specific response actions, but are amenable to some of the same physical treatment remedial technologies identified for radioactive/inorganic COCs, but technologies also were evaluated for remediation of these classes of contaminants.

RPOs were developed from the appropriate technology types necessary to address the physical and chemical nature of the contamination at each SWMU. Alternatives were developed by combining the appropriate RPOs to remediate the full scope of contamination at each SWMU, including, in some cases, both radioactive/inorganic and DNAPL contamination-source RPOs.

2.2 DEVELOPMENT OF RAOs

The RAOs for the BGOU FS, developed in accordance with NCP requirements, consist of site-specific goals for protecting human health and the environment (EPA 1988) and meeting ARARs (in the absence of a CERCLA waiver). The RAOs were developed from the CSM and the BHHRA results by identifying the COCs and their sources, as well as the contaminant migration pathways and exposure scenarios that the action will address.

2.2.1 Allowable Exposure Based upon Risk Assessment (Including ARARs)

ARARs include federal or more stringent state environmental or facility laws/regulations that are applicable or relevant and appropriate to the hazardous substances or circumstances at a site unless a CERCLA waiver is granted. ARARs do not include occupational safety or worker protection requirements. Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site (40 *CFR* § 300.5). Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under federal or state environmental or facility siting law that, while not applicable to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site (40 *CFR* § 300.5). In addition to ARARs, there are advisories, criteria, or guidance to be considered (TBC) for a particular release that were developed by other federal agencies or states that may be useful in developing CERCLA remedies. These are not potential ARARs, but are TBC guidance [40 *CFR* § 300.400(g)(3)]. CERCLA § 121(d)(4) provides several ARAR waiver options that may be invoked, provided that human health and the environment are protected. Additional ARAR discussion is presented in Appendix F.

ARARs typically are divided into three categories: (1) chemical-specific, (2) location-specific, and (3) action-specific. "Chemical-specific ARARs usually are health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values" [53 *FR* 51394, 51437 (December 21, 1988)]. (In the absence of chemical-specific ARARs, cleanup criteria are based upon risk calculations consistent with those used to complete the BHHRA for the BGOU SWMUs.) Location-specific ARARs generally are restrictions placed upon the concentration of hazardous substances or the conduct of activities solely because they are in special locations [53 *FR* 51394, 51437 (December 21, 1988)]. Action-specific ARARs usually are technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes or requirements to conduct certain actions to address particular circumstances at a site [53 *FR* 51394, 51437 (December 21, 1988)].

There are no chemical-specific ARARs for remediation of the contaminated soils at the source areas with identified COCs; however, soil PRGs, including PRGs for radionuclides, were developed based on both direct exposure and migration from soil to groundwater. The MCLs established in the Safe Drinking Water Act were used to back calculate soil PRGs, but are not ARARs for this source action.

2.2.2 RAOs

RAOs are goals for protection of human health and the environment. RAOs provide a general description of what a CERCLA cleanup is designed to accomplish. The BGOU FS evaluates taking actions as necessary to protect human health and the environment from the BGOU waste units and addressing potential releases from these source areas that may impact RGA groundwater or adjacent drainageways. The following general RAOs were developed:

(1) Contribute to protection of groundwater by eliminating, reducing, or controlling sources of groundwater contamination;

(2) Prevent exposure to waste and contaminated soils that present an unacceptable risk from direct contact; and

(3) Treat or remove PTW wherever practicable, consistent with 40 *CFR* § 300.430 (a)(1)(iii)(A).

The BGOU waste areas are located within the industrial area of the PGDP facility, and reasonable future use of this area is expected to remain industrial (DOE 2015). The RAOs presented in this section are relative to future industrial worker and future excavation worker receptors only. This FS evaluates alternatives designed to eliminate direct contact with wastes to ensure no risk to these future workers. Figure 2.1, Conceptual Site Model for BGOU, identifies that the surface soil exposure pathway also is complete for the current industrial worker, future recreational user, and future rural resident. While these pathways are possible, this FS considers only the reasonably anticipated future land uses, as defined in the SMP.

These general RAOs are refined further in the SWMU-specific sections of the document (Sections 5.2, 6.2, 7.2, and 8.2) to include COCs identified at each SWMU.

Where the general RAO to address PTW applies (SWMUs 2, 3, and 7), it is restated as a SWMU-specific RAO.

The SWMU-specific RAO may not fully address the general RAO for those direct contact risks that are more appropriately addressed in other programs and are not within the scope of the BGOU. Specifically, no SWMU-specific RAOs will be identified in this FS to address potential ecological impacts.

The sitewide baseline ecological risk assessment is where cumulative effects to ecological receptors will be evaluated. COPCs identified in the SERA will be incorporated into that evaluation. Most of the impacts identified in the SERAs for these SWMUs were for drainageway or surface soil samples adjacent to the burial ground areas that did not result from migration from the waste. No significant ecological risks were identified that required short-term actions at these SWMUs. In addition, addressing human health risks within the SWMU boundaries would be expected to also reduce exposures to these receptors.

2.2.3 Preliminary Remediation Goals

Consistent with Office of Solid Waste and Emergency Response (OSWER) Directive 9355.7-04, *Land Use in the CERCLA Remedy Selection Process,* DOE, EPA, and Kentucky have determined that the reasonably anticipated future use for the area of PGDP that includes the burial grounds is industrial. This future use is consistent with continued use of these SWMUs as inactive burial grounds. This FS will consider alternatives that lead to site remediation activities that are consistent with the reasonably anticipated land use (EPA 1995).

The PRGs are media-specific goals that serve as the basis for identifying and screening the treatment processes or mass removal and containment efficiencies required for the alternatives developed in Section 3. PRGs for chemicals that have the potential to impact RGA groundwater are derived differently than those to protect workers from exposure to contaminants in soil and waste.

The list of COCs from the BHHRA is reported in Section 1.3 and refined in Sections 1.5 and 1.6. In Section 1.5, the list of COCs was revised based upon consideration of uncertainties presented in the BGOU RI and BHHRA. In Section 1.6, the retained COCs were summarized and target COCs were identified. Evaluation of potential alternatives to meet the RAOs and corresponding development of soil PRGs protective of future workers or groundwater has the following additional considerations.

- The BHHRA identified risks to the future excavation worker based on contact with contaminants in surface and subsurface soils (0–16 ft). PRGs for surface soil are to be based on the future industrial worker. To meet the RAO, PRGs for the future excavation worker would be derived only for those COCs present in the surface and subsurface soil (0–16 ft bgs).

The PRG derivation, as well as the technologies/alternatives to address the potential risks from exposure pathways, is considered independently in this FS; however, the final remedy will address both pathways to meet the RAOs. Figure 2.2 highlights the potentially applicable PRGs and the implications for evaluating the depth to which these apply.

Section 2.2.3.1 provides a summary of the derivation of PRGs for protection of groundwater, which is presented in greater detail in Appendix B. Section 2.2.3.2 summarizes the PRGs for protection of workers from direct contact exposures, which are discussed in detail in Appendix C. The primary risk associated with direct contact remains associated with direct contact with buried wastes.

2.2.3.1 Soil PRGs for groundwater protection

The PRGs in soil that would be protective of groundwater are those concentrations that, if left in place at that depth, would not result in a contribution to groundwater that would cause the groundwater concentration in the RGA at the SWMU to exceed the MCL or a suitable risk-based concentration for those COCs that do not have an MCL. The soil PRGs developed in this way are protective of groundwater in the RGA found below the respective SWMU. The period of model performance was 1,000 years.

The BHHRA identified COCs for use of RGA groundwater based on risks for modeled concentrations in the RGA at the SWMU boundary. The objective of the modeling conducted for the RI was to determine if, under current conditions, existing soil contamination levels at the SWMUs within the BGOU may result in exceeding groundwater standards at particular POEs. In the FS, the objective of a remedial action is to reduce the impact to human health and the environment to acceptable levels. PRGs, as developed in Appendix B, are summarized in Table 1.22 for the target compounds. Figures showing the distribution of these COCs are presented in Appendix A.

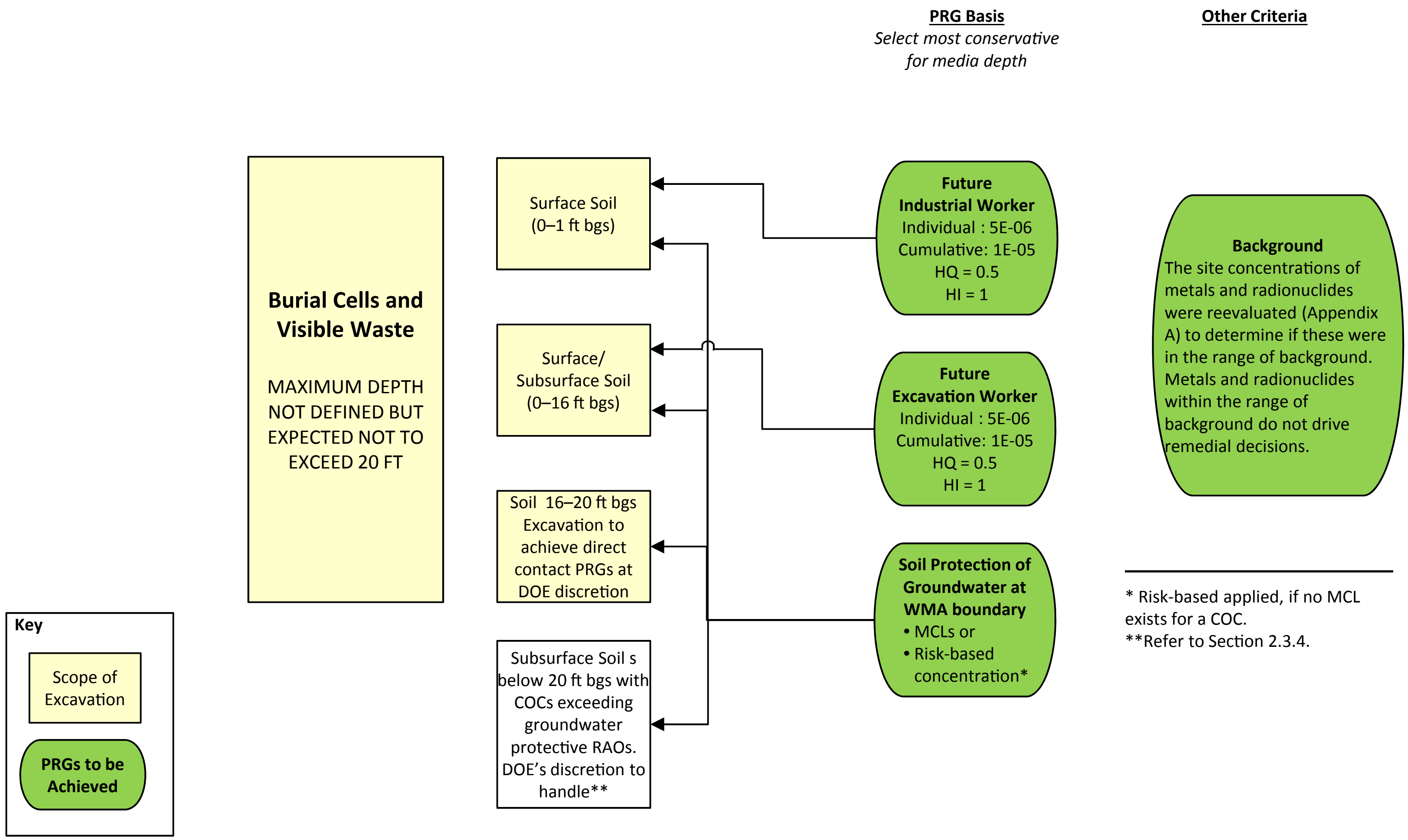

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Figure 2.2. BGOU Excavation Extent and Applicable PRGs

Groundwater concentrations used in the development of groundwater-protective soil PRGs are shown in Appendix B. The MCL established in the Safe Drinking Water Act was used as the groundwater concentration for most COCs. Where an MCL was not available for a chemical (e.g., naphthalene), a risk-based groundwater concentration was calculated based on the NAL for residential water use (see Appendix B). Additional details concerning the derivation of development of groundwater-protective soil PRGs are provided in Appendix B.

The MCL concentrations for radionuclides are given in EPA guidance (EPA 1999a). The MCL concentration for gross alpha emitters is 15 pCi/L, excluding radon and uranium, and was applied to neptunium-237 (Np-237) and plutonium-239 at SWMUs 7 and 30. The MCL concentrations for beta and photon emitters correspond to an annual radiation dose limit of 4 mrem/yr, which corresponds to (an EPA-calculated) concentration of 900 pCi/L for Tc-99 (EPA 1999a) at BGOU SWMUs. The MCL concentrations for U-234, U-235, and U-238 are 10.24, 0.466, and 9.99 pCi/L, respectively, and were applied to these isotopes at BGOU SWMUs (DOE 2013a). The same groundwater-protective PRG for soil applies to both surface and subsurface soil. COCs that were shown to be immobile by modeling reported in the RI Report do not require a groundwater protective PRG. Their MCLs are shown in Appendix B for information purposes.

2.2.3.2 PRGs for direct exposure to COCs in soil

The BGOU BHHRA identified several COCs for protection of future industrial or future excavation workers as summarized in Section 1.3.6, and refined to the COCs to be addressed in this FS in Sections 1.5 and 1.6. To meet the SWMU-specific RAO for surface soil (0–1 ft bgs), the direct contact PRG is based upon a cumulative ELCR target of 1E-05 and a cumulative HI target of 1 to both the future industrial and future excavation worker. For subsurface soil (1–16 ft bgs), the direct contact PRG is based upon a cumulative ELCR target of 1E-05 and a cumulative HI target of 1 to the future excavation worker. These targets are within EPA's generally accepted risk range. The PRGs for the COCs are summarized on Tables 1.20 and 1.21.

As shown on Tables 1.20 and 1.21, the PRGs for each COC (with the exception of PCBs) are set at one half the target cumulative ELCR and HI as follows:

- **Surface soils.** The direct contact PRGs for COCs in surface soil are protective of the future industrial worker and future excavation worker from exposure by external exposure, soil ingestion, inhalation, and dermal contact exposure routes. The future industrial worker PRGs were calculated as 5 × the industrial worker NAL for carcinogenic COCs. The NAL for carcinogenic COCs corresponds to a cancer risk of 1E-06; the resulting PRG corresponds to a cancer risk of 5E-06. For noncarcinogenic COCs, the PRG is calculated as 5 × the industrial worker NAL for noncarcinogenic COCs. The NAL for noncarcinogenic COCs corresponds to a noncancer hazard quotient of 0.1; the resulting PRG corresponds to a noncancer hazard quotient of 0.5. The lower of the two direct contact PRGs is shown for COCs having either cancer or noncancer health effects. Derivation of the future excavation worker PRGs for surface soil are explained under the subsurface soils subsection. If the direct contact PRG is less than background, then background becomes the revised PRG for surface soil.

- **Subsurface soils.** The direct contact PRGs for COCs in subsurface soil (and surface soil) that are protective of future excavation worker from exposures through external exposure, soil ingestion, inhalation, and dermal contact routes were calculated as 5 × the excavation worker NAL for carcinogenic COCs (considering an exposure duration of 5 years). The NAL for carcinogenic COCs corresponds to a cancer risk of 1E-06; the resulting PRG corresponds to a cancer risk of 5E-06. For noncarcinogenic COCs, the PRG is calculated as 5 × the NAL for noncarcinogenic COCs. The NAL for noncarcinogenic COCs corresponds to a noncancer hazard quotient of 0.1; the resulting PRG corresponds to a noncancer hazard quotient of 0.5. The lower of the two direct contact PRGs is shown for COCs having either cancer or noncancer health effects. If the direct contact PRG is less than background, then background becomes the revised PRG for subsurface soil.

PCBs were identified as COCs for industrial and future excavation workers. The 10 ppm value for PCBs in soil is the value jointly agreed upon by representatives of EPA Region 4, KDEP, and DOE in the June/July 2009 Scoping meetings. This value was considered to be sufficiently protective of potential direct contact risk that could occur at the BGOU, when used to identify potential hot spots of PCBs. This is considered protective for cumulative risks for these exposure scenarios. The 10 ppm value was not based on TSCA values, but was consistent with the risk-based clean-up value used for the Surface Water OU On-site Removal Action (i.e., 16 ppm), which was derived for industrial use and was determined to be protective for cumulative risk (DOE 2009). The final RG for PCBs protective of the future industrial and excavation worker will be presented in the ROD.

In some cases, multiple carcinogenic COCs were identified. Any sample where even one of the COCs is present at concentrations above the PRGs would require further evaluation. Using the approach for setting the PRG at half the target risk has been used at PGDP and demonstrated to achieve RAOs.

There were potential uncertainties raised regarding the identification/refinement of COCs list and the derivation of PRGs at half the target risk/HI as a guide to evaluate remedial actions. Because additional data were collected subsequent to the BHHRA for direct contact exposures, it was necessary to verify that additional chemicals that contributed to the risks/hazards are being addressed (see Section 1.5). An additional uncertainty regarded the case where multiple COCs are each present below the PRGs, but the cumulative ELCR could still exceed 1E-05 (or HI > 1). The figures shown in Appendix A include chemicals that exceed their PRGs and also identify primary contributors to the risk or hazard on a sample specific basis. In this process, the following was confirmed.

- Locations where additional chemicals identified in samples collected after the BHHRA contributed significantly to the risk (e.g., cesium-137 at SWMU 2) are shown on the figures in Appendix A. This confirmed that these were locations where the PRGs are exceeded for one or more of the target compounds, indicating that area would be addressed in the FS.

- No instances were identified where the target cumulative risk was exceeded, yet no PRG was exceeded; however, there were instances where the PRGs were exceeded but the cumulative risk at that location did not exceed the target ELCR. This suggests that the process for identifying locations requiring actions based on the PRGs is a conservative approach that will lead to a SWMU-wide cumulative ELCR that meets the RAO.

- The refinement process for the COCs eliminated a number of metals that contribute to the noncancer hazard, and additional data subsequently were obtained. It was confirmed that the HI of 1 was very rarely exceeded in any sample in any SWMU and typically HI < 3. Using current toxicity and dermal absorption factors, the potential for isolated locations exceeding an HI of 1 would be infrequent, and clearly a SWMU-wide cumulative HI (which is the RAO) would not be a factor in the decision process.

2.2.3.3 Use of PRGs for soil direct contact and the protection of groundwater

The PRGs for soil (Tables 1.20, 1.21, and 1.22) are used in Sections 5 through 8 to develop remediation alternatives for potential use at individual SWMUs. Upon completion of remedial actions at each SWMU, it will be necessary to attain the RAOs. This eventual evaluation of soil concentrations to verify attainment of RAOs will be based on the results of postremediation sampling.

The FFA parties have agreed that an excavation alternative would be conducted to 16 ft bgs, deeper if visible contamination continued to be observed. The maximum depth of an excavation was not defined, but is not expected to exceed 20 ft bgs (in general) based on available disposal records as represented in Figure 2.2. At SWMUs 2 and 7, where mobile COCs are identified, treatment options for contaminants below excavation depth are included. Assumed excavation depths are found in each SWMU-specific section (i.e., Sections 5, 6, 7, and 8) and in the cost estimates found in Appendix E.

To the extent that decisions may be affected by available resources, some of the proposed actions may need to be completed in a sequential process instead of a single action. Also, the extent of excavation may be modified, for example, to pursue COCs at concentrations above PRGs found in locations inconsistent with planning assumptions used for the excavation alternative in this FS. In this instance, additional discussion of such discretionary expansion of proposed remedial action boundaries would be undertaken with the regulators. Although postremediation sampling results cannot be predicted, it is possible that soil concentrations of COCs at a SWMU would represent cumulative ELCR or HI levels above target criteria (Figure 2.2) if all were detected at their PRG concentrations. This will need to be managed when the remedial action work plan (RAWP) is prepared. Additional discussion concerning specific SWMUs and attainment of PRGs is best postponed until the RAWP.

2.2.4 Basis for BGOU Technology Identification and Screening

The BGOU RI did not conduct intrusive sampling in the existing waste management units. As a result, specific waste characterization data are limited. Historical records and data, past observations, and waste disposal documentation referenced in the BGOU RI Report were used to supplement the RI data; the information is summarized in Section 1.4 of this FS. Information gathered or modified after approval of the BGOU RI Report is summarized in Section 1.5 of this FS. It also was necessary to make some assumptions regarding the nature, extent, and quantities of waste and waste-related contamination within the BGOU SWMUs that would require remediation. The collective body of information that forms the basis for selecting remedial alternatives and preparing cost estimates for those alternatives is summarized in Section 1.6 of this FS. The assumptions and rationale applied in developing estimates of the extent of contamination and the corresponding waste volumes are presented in the SWMU-specific sections of this FS.

2.2.4.1 PTW

The PTW acknowledged for the SWMUs included in this FS is identified in Section 1. It is EPA's expectation that PTW be treated wherever practicable [40 *CFR* § 300.430(a)(iii)(A)]. General RAO 3, which includes treatment or removal, recognizes EPA's expectation. The PTW determinations per the dispute resolution agreement are presented in Section 1.5.6 on a SWMU-specific basis (DOE 2012).

2.2.4.2 Contamination above PRGs

The data from the BGOU RI Report were evaluated to determine which BGOU SWMUs are contaminated with COCs at concentrations above their respective PRGs (DOE 2010b). A layer-by-layer, detailed comparison of the maximum concentration, mean of the detectable concentrations, and mean model concentration to the appropriate soil PRGs is made in Appendix A using the data available in the BGOU RI Report (DOE 2010b).

2.3 GENERAL RESPONSE ACTIONS

GRAs describe those actions that will satisfy the RAOs. This section develops GRAs that may be implemented individually or in combination to meet the SWMUs 2, 3, 7, and 30 RAOs. The GRAs developed for SWMUs 2, 3, 7, and 30 FS include LUCs, surface controls, monitoring, monitored natural attenuation (MNA), removal, containment, treatment, and disposal.

2.3.1 Land Use Controls

LUCs for the CERCLA sites at the PGDP BGOU as described in Section 2.4.1.1 are needed only for those alternatives that leave waste and/or contaminated soil in place at concentrations that would not allow for UU/UE.

The LUCs GRA may include engineering and physical barriers, such as fences, as well as Institutional Controls (ICs). EPA defines ICs as nonengineered instruments, such as administrative and legal controls, that help to minimize the potential for exposure to contamination and/or protect the integrity of a response action. ICs typically are designed to work by limiting land and/or resource use or by providing information that helps modify or guide human behavior at a site (EPA 2012).

2.3.2 Surface Controls

The surface controls GRA provides a physical barrier that will prevent direct contact exposure to surface soil contamination. The technology type, surface barriers, and associated process options, soil covers and riprap, provide a physical means of preventing direct contact with contaminated soils without inclusion of a low-permeable barrier.

2.3.3 Monitoring

The monitoring GRA may include both monitoring the progress of cleanup by determining the extent of contamination remaining and long-term monitoring for potential migration of wastes left in place. Monitoring alone does not meet the RAOs, but can be used in combination with other GRAs to form a remedial action.

Any alternatives that leave waste in place will incorporate monitoring to confirm that there is no unacceptable threat to groundwater or surface water from migration from SWMUs 2, 3, 7, or 30.

2.3.4 Monitored Natural Attenuation

MNA relies on natural processes to achieve site-specific remedial objectives. Processes may include physical, chemical, or biological processes that reduce the mass, toxicity, mobility, volume, or concentration of contaminants in soil and groundwater. Monitoring of contaminant concentrations and process-specific parameters to ensure protection of human health and the environment during implementation is a critical element of MNA.

EPA technical brief, "Depleted Uranium" states that, "...the use of monitored natural attenuation (MNA) may be applied as an optional process, which should be evaluated with other applicable remedies (including innovative technologies) for restoring contaminated groundwater, preventing migration of contaminant plumes, and protecting groundwater and other environmental resources" (EPA 2006b).

As the waste disposal records show that SWMUs 2, 3, 7, and 30 contain uranium contaminated scrap, MNA may contribute to meeting RAOs at these SWMUs.

2.3.5 Removal

The removal GRA involves removal of all or some buried waste and soils in close proximity to the waste. Removal would generate secondary wastes potentially requiring *ex situ* treatment and disposal or discharge. Removal can meet RAOs. An excavation alternative would be conducted to the visible limits of buried wastes. Additional soil may be removed if the confirmation sampling at the margins of the excavation indicates residual contamination present above PRG, or deeper, if visible contamination continues to be observed DOE will evaluate whether additional excavation is warranted and will consult the regulatory agencies; however, the decision about whether to conduct additional excavation below 20 ft will remain at DOE's discretion, as presented in Figure 2.2. The excavation depths used for cost estimating are discussed in the SWMU-specific sections. Lateral excavation will be bounded by sample analysis used to place sheet pile shoring prior to excavation. Placement of shoring will be determined during the RAWP. SWMU-specific excavation volumes (i.e., area and depth of potential excavations) are discussed in Sections 5, 6, 7, and 8; related information also is contained in the estimate assumption found in Appendix E. The PRGs for the future excavation worker were calculated based on a depth of 16 ft, consistent with guidance in the 2013 Risk Methods Document (DOE 2013a).

Additional excavation may be performed in pursuit of source contaminants exposed directly to area soils and/or groundwater based on the added environmental benefits of the continued action. In this instance, additional discussion of such discretionary expansion of proposed remedial action boundaries would be undertaken with the regulators.

2.3.6 Containment

The containment GRA isolates contaminated media from release mechanisms, transport pathways, and exposure routes using surface and/or subsurface barriers, thereby reducing contaminant flux and reducing or eliminating exposures to receptors. Containment can meet RAOs 1 and 2 and can help mitigate the uncertainties identified in Section 1.4.1.

2.3.7 Treatment

The treatment GRA reduces the toxicity, mobility, or volume of contaminants or contaminated media. Contaminant sources may be reduced or eliminated, and contaminant migration pathways and exposure routes may be eliminated. *In situ* methods treat contaminants and media in place without removal. *Ex situ* methods treat contaminants or media after removal. Treatment may contribute to meeting RAOs 1, 2, and 3.

2.3.8 Disposal

The disposal GRA may include land disposal of solid wastes or discharge of liquid or vapor phase effluents generated during waste treatment processes. Waste disposal for solids may include use of permitted commercial off-site disposal facilities, off-site DOE disposal facilities, or on-site facilities as available. These facilities may have regulated waste acceptance criteria (WAC).

2.4 IDENTIFICATION AND SCREENING OF TECHNOLOGY TYPES AND PROCESS OPTIONS

Table 2.1 lists the GRAs, as well as the technology types and process options contained within each GRA. Identification was based on demonstrated process efficiencies, engineering judgment, and existing policies or procedures.

Table 2.1. BGOU SWMUs 2, 3, 7, and 30 GRA, Technology Type, and Process Option Screening

Technology Type	Process Options	Description	Technology Status	Screening Comments
General Response Action—LAND USE CONTROLS				
Physical Controls	Warning Signs	Warning signs notify workers of potential hazards and restrict access.	Available	Technically implementable. Retained for possible alternative development.
	Fences	Fences restrict access to potentially hazardous areas.	Available	Technically implementable. Retained for possible alternative development.
Institutional Controls	Property Record Notice/ CERCLA Section 120(h)	Property notice that waste left in place and survey plat of its location filed at McCracken County Clerk's office. CERCLA Section 120(h) requires certain notices and covenants for transfer of federally owned property.	Available	Technically implementable. Retained for possible alternative development.
	Deed and/or Lease Restrictions	Deed and/or lease restrictions prohibiting residential development or agricultural development within the BGOU source area will be put in place contingent upon the property transfer.	Available	Technically implementable. Retained for possible alternative development.
	E/PP Program	E/PP program requires review and approval of any proposed intrusive activities to protect workers and remedy integrity.	Available	Technically implementable. Retained for possible alternative development.
	Environmental Covenant	Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer.	Available	Technically implementable. Retained for possible alternative development.
General Response Action—SURFACE CONTROLS				
Surface Barriers	Soil Cover	Monolayered cover used for waste landfill closures.	Commercially available	Technically implementable. Retained for possible alternative development.
	Riprap	Riprap is defined as a permanent, erosion-resistant ground cover of large, loose, angular stone. Its standard application is to protect slopes, stream banks, channels, or areas subject to erosion by wave action. However, it also can be used to prevent intrusion by serving as a physical impediment due to its size.	Commercially available	Technically implementable. Retained for possible alternative development.
General Response Action—MONITORING				
Soil Monitoring	Conventional Sample Collection and Analysis	Conventional collection and analysis of soil samples for physical/chemical parameters yields data that verify effectiveness of remedial action. Samples usually collected with spade, trowel, scoop, hand auger, flight auger, trier, or split-spoon (shallow sample depths assumed so that no mechanized equipment is needed).	Commercially available	Technically implementable. This technology is screened from further evaluation as a primary technology, but its use may be incidental to other GRAs such as removal.

Table 2.1. BGOU SWMUs 2, 3, 7, and 30 GRA, Technology Type, and Process Option Screening (Continued)

Technology Type	Process Options	Description	Technology Status	Screening Comments
General Response Action—MONITORING (Continued)				
Soil Monitoring (Continued)	Soil Cores	Cores may be obtained using direct push technology, hollow-stem auger, or other drilling methods. Laboratory analysis may be used on core samples to detect VOCs or other constituents.	Commercially available	Technically implementable. This technology is screened from further evaluation as a primary technology, but its use may be incidental to other GRAs such as removal.
	Membrane Interface Probe (MIP)	MIP is used for real-time VOC profiling and sampling using a heating element and gas permeable membrane. The element heats the material surrounding the probe, causing the VOCs contained in the material to vaporize. Vapors enter the probe through a gas permeable membrane and are transported through tubing to the surface by an inert carrier gas. The sample then is analyzed.	Commercially available	Technically implementable. Retained for possible alternative development.
	Soil Gas Monitoring (e.g., Gore-sorbers)	Multiple methods available to either directly collect soil gas or indirectly measure soil gas concentrations such as use of Gore-sorbers.	Commercially available	Technically implementable. Retained for possible alternative development. May also be used as a secondary technology to other GRAs.
Groundwater Monitoring	Conventional Groundwater Well Installation, Sample Collection, and Analysis	Groundwater samples can be obtained from wells completed in saturated zone using pumps, bailers, or passive samplers. Analysis can be performed on-site using field instrumentation or off-site at fixed-base laboratories.	Commercially available	Technically implementable. Retained for possible alternative development. May also be used as a secondary technology to other GRAs such as containment or treatment.
	Diffusion Bags	Semipermeable diffusion bags containing deionized water can be hung in wells to collect VOCs or other soluble contaminants. They are allowed to equilibrate with surrounding groundwater and eventually reach the same concentrations of soluble constituents. Useful in vertical profiling of contaminant distributions.	Commercially available	Technically implementable. Retained for possible alternative development.
	Borehole Fluxmeter	The passive fluxmeter (PFM) can be deployed in a well to directly measure subsurface water and contaminant flux. The interior is a matrix of hydrophobic and hydrophilic permeable sorbents that retain dissolved organic and/or inorganic contaminants present in fluid intercepted by the unit.	Commercially available	Technically implementable. Retained for possible alternative development.
	Ribbon NAPL Sampler	Direct sampling device that provides detailed depth-discrete mapping of DNAPLs in a borehole. This qualitative method is used to complement other techniques. Uses the Flexible Liner Underground Technologies, Ltd. (FLUTe) membrane system (patent pending) to deploy a hydrophobic absorbent ribbon in the subsurface. The system is pressurized against the wall of the borehole and the ribbon absorbs any NAPL that it contacts.	Commercially available	Technically implementable. Retained for possible alternative development.

Table 2.1. BGOU SWMUs 2, 3, 7, and 30 GRA, Technology Type, and Process Option Screening (Continued)

Technology Type	Process Options	Description	Technology Status	Screening Comments
General Response Action—MONITORING (Continued)				
Groundwater Monitoring (Continued)	DNAPL Interface Probe	Incorporates an infrared sensor and a conductivity sensor attached to a coaxial cable. The cable is mounted on a spool, allowing the probe to be lowered into a well. The probe emits an audible signal upon detection of differences in electrical conductivity and infrared response that occurs when the probe passes through the interface between water and an organic liquid.	Commercially available	Technically implementable. Retained for possible alternative development.
Surface Water Monitoring	Conventional Surface Water Sample Collection and Analysis	Grab samples of surface water would be collected. Analysis can be performed on-site using field instrumentation or at fixed-base laboratories.	Commercially available	Technically implementable. Retained for possible alternative development. May also be used as a secondary technology to other GRAs such as containment or treatment.
General Response Action—MONITORED NATURAL ATTENUATION				
Monitoring and Natural Processes	Soil and Groundwater Monitoring with Abiotic and Biological Processes	Natural processes including dilution, diffusion, dispersion, sorption, biodegradation, combined with monitoring.	Commercially available	Technically implementable for some COCs. Retained for possible alternative development.
General Response Action—REMOVAL				
Excavators	Backhoes and/or Trackhoes	Tracked excavators with 45-ft arms limited to approximately 30 ft bgs.	Commercially available	Technically implementable. Retained for possible alternative development.
	Vacuum Excavation, Remote Excavator	Commercial vacuum excavators used for digging small exploratory holes to assess conditions, radioactive waste cleanup.	Commercially available	Technically implementable. Retained for possible alternative development.
	Crane and Clamshell	Excavation at depths greater than 100 ft bgs possible.	Commercially available	Technically implementable. Retained for possible alternative development.
	Large Diameter Auger	Large diameter augers (~ 2–4) are used to remove soils from a vertical column. Borings can be cased to avoid sidewall collapse. Augers are capable of drilling to depths of 100 ft bgs.	Commercially available	Process option is technically implementable. Retained for possible alternative development as a delivery method of chemical reagent or biological nutrients.
Hydraulic Containment	Recharge Controls	Recharge controls can reduce facility discharges to the UCRS, promote surface water runoff, and reduce recharge of the UCRS in the BGOU TCE source areas, thereby limiting leaching of TCE from NAPL source areas and migration to the RGA.	Commercially available	Technically implementable. Retained for possible use in alternative development.

Table 2.1. BGOU SWMUs 2, 3, 7, and 30 GRA, Technology Type, and Process Option Screening (Continued)

Technology Type	Process Options	Description	Technology Status	Screening Comments
General Response Action—CONTAINMENT				
Hydraulic Containment (Continued)	Groundwater Extraction	Groundwater pumping wells create a cone of depression in the piezometric surface, causing flow to the well resulting in a capture zone.	Commercially available	Yields of wells in the UCRS are expected to be low and thus, more wells may be needed to be effective in lower permeability zones. Technically implementable. Groundwater extraction is implementable in the RGA, although hydraulic control may require pumping large volumes of water. Retained for possible alternative development as a secondary technology for other treatments.
Capping	RCRA Subtitle C Cap	Multilayered cover incorporating compacted clay and geosynthetics used for RCRA hazardous waste landfill closures.	Commercially available	Technically implementable. Retained for possible alternative development.
	KY Subtitle D Cap	Multilayered cover used for RCRA nonhazardous waste landfill closures.	Commercially available	Technically implementable. Retained for possible alternative development.
	Evapotranspiration Cover	Soil cover system using one or more vegetated soil layers to retain water until it is either transpired through vegetation or evaporated from the soil surface.	Commercially available	Not technically implementable as a stand-alone installation due to local climate conditions and existing features. This form of cover is best suited to arid climates. It is eliminated from further consideration.
	Concrete-Based Cover	Concrete cover systems may consist of a single layer of concrete pavement over a prepared subgrade to isolate contaminated soils, reduce infiltration, and provide a trafficable surface.	Commercially available	Technically implementable. Retained for possible alternative development.
	Conventional Asphalt Cover	Asphalt cover systems may consist of a single layer of bituminous pavement over a prepared subgrade to isolate contaminated soils, reduce infiltration, and provide a trafficable surface. Must be sealed and/or combined with a low-permeability membrane to reduce permeability effectively.	Commercially available	Technically implementable. Retained for possible alternative development.

Table 2.1. BGOU SWMUs 2, 3, 7, and 30 GRA, Technology Type, and Process Option Screening (Continued)

Technology Type	Process Options	Description	Technology Status	Screening Comments
General Response Action—CONTAINMENT (Continued)				
Capping (Continued)	MatCon™ Asphalt	MatCon™ asphalt has been used for Subtitle C-equivalent closures of landfills and soil contamination sites. MatCon™ is produced using a mixture of a proprietary binder and a specified aggregate in a conventional hot-mix asphalt plant.	Commercially available	Technically implementable. Retained for possible alternative development.
	Flexible Membrane	Consists of single layers of relatively impermeable polymeric plastic (HDPE and others) laid out in rolls or panels and welded together. The resulting membrane cover essentially is impermeable to transmission of water unless breached. Flexible membranes can be sealed around surface infrastructure using waterproof sealants. Must be combined with protective soil layers.	Commercially available	Technically implementable. Retained for possible alternative development.
Subsurface Horizontal Barriers	Freeze Walls	Constructed by artificially freezing the soil pore water, resulting in decreased permeability and formation of a low-permeability barrier. The frozen soil remains relatively impermeable and migration of contaminants is thereby reduced. A horizontal barrier would be constructed by installing freeze pipes through wells drilled at a 45 degree angle along the sides of an area to be contained.	Commercially available	Technically implementable, but less practical as a permanent barrier. Eliminated from alternative development.
	Jet Grouting	Grouts are injected through drill rods to reduce infiltration of water. The jetted grout mixes with the soil to form a column or panel.	Commercially available	The effectiveness of jet grouting as a horizontal barrier remains uncertain with no means to verify *in situ* results. Eliminated from possible alternative development.
	Permeation Grouting	Low-viscosity grout is injected vertically or directionally into soil at multiple locations. Establishing and verifying a continuous, effective subsurface barrier is difficult or impossible in heterogeneous and/or low-permeability soils or in the presence of subsurface infrastructure.	Commercially available	Uncertain effectiveness. Screened from possible alternative development.
Subsurface Vertical Barriers	Freeze Walls	Constructed by artificially freezing the soil pore water, resulting in decreased permeability and formation of a low-permeability barrier. The frozen soil remains relatively impermeable and migration of contaminants is thereby reduced.	Commercially available	Technically implementable, but typically used to construct a temporary vertical hydraulic barrier during construction projects. Technology less practical as a permanent barrier. Retained for possible alternative development.
	Slurry Walls	Vertically excavated trenches that are kept open are backfilled with a slurry, generally bentonite and water. Soil (often excavated material) then is mixed with bentonite and water to create a low-permeability soil-bentonite backfill.	Commercially available	Technically implementable. Retained for possible alternative development.

Table 2.1. BGOU SWMUs 2, 3, 7, and 30 GRA, Technology Type, and Process Option Screening (Continued)

Technology Type	Process Options	Description	Technology Status	Screening Comments
General Response Action—CONTAINMENT (Continued)				
Subsurface Vertical Barriers (Continued)	Sheet Piling	Long (e.g., 60 ft) structural steel sections with a vertical interlocking system that are driven into the ground to create a continuous subsurface wall. After the sheet piles have been driven to the required depth, they are cut off at the surface. The subsurface soils must be relatively homogenous (i.e., no boulders) to allow for a uniform installation.	Commercially available	Technically implementable. Retained for possible alternative development.
	Jet Grouting	This system breaks up the soil structure completely and performs deep soil mixing to create a homogeneous soil, which, in turn, solidifies. The jet grouting technique can be used regardless of soil, permeability, or grain size distribution. It is possible to apply jet grouting to most soils, from soft clays and silts to sands and gravels. Although it is possible to inject any binder, water-cement-bentonite mixtures typically are used when an impermeable vertical barrier is to be created.	Commercially available	Technically implementable. Retained for possible alternative development.
General Response Action—TREATMENT				
Biological	*In Situ* Process Options—Enhanced Biodegradation and Phytoremediation	Bioremediation techniques are destruction techniques directed toward stimulating the microorganisms to grow and use the contaminants as a food and energy source by creating a favorable environment for the microorganisms. A wide range of delivery methods can be used depending upon specific site conditions and include methods such as surface flooding, well injection, high pressure injection and soil mixing.	Commercially available	Technically implementable. Retained for possible alternative development.
	Ex Situ Process Options—Bioreactors and Constructed Wetlands	Bioremediation techniques are destruction techniques directed toward stimulating the microorganisms to grow and use the contaminants as a food and energy source by creating a favorable environment for the microorganisms.	Commercially available	Although theoretically implementable, eliminated from possible alternative development because of its reliance on extraction.
Physical/Chemical	Soil Vapor Extraction (SVE)—*In Situ*	Removal of unsaturated zone air and vapor by applying vacuum.	Commercially available	Technically implementable. Retained for possible alternative development.
	Dual-Phase Extraction—*In Situ*	Enhancement of SVE that includes extraction of groundwater and soil vapor.	Commercially available	Technically implementable. Retained for possible alternative development.
	Air Sparging—*In Situ*	Promotes volatilization of VOCs in saturated zone by injecting air. Can be combined with SVE. Can be used in conjunction with actions that lower water table such as electrical resistance heating (ERH.)	Commercially available	Technically implementable. Screened due to low soil permeability and would not effectively mitigate the risk associated with each SWMU's waste. This process option is screened from further consideration.

Table 2.1. BGOU SWMUs 2, 3, 7, and 30 GRA, Technology Type, and Process Option Screening (Continued)

Technology Type	Process Options	Description	Technology Status	Screening Comments
General Response Action—TREATMENT (Continued)				
Physical/Chemical (Continued)	Soil Flushing—*In Situ*	Promotes dissolution or desorption of VOCs in soil, may mobilize NAPLs by reducing interfacial tension. Can be applied *in situ* or *ex situ.*	Commercially available	Technically implementable. Screened because it would effectively address only a narrow range of COCs; for *in situ* treatment alternatives, a process option that addresses a broader range of COCs is needed.
	Electrokinetics—*In Situ*	Applied *in situ* as Lasagna™ process.	Commercially available	Technically implementable though large volume of waste may limit use. Retained for possible alternative development.
	Permeable Reactive Barrier—*In Situ*	PRBs are designed and constructed to permit the passage of water while immobilizing or destroying contaminants through the use of various reactive agents. PRBs may be constructed to depths of 60 ft bgs, but complexity and cost increase with depth.	Commercially available	This process option does not mitigate risk from contact with buried waste. Also, it is not technically implementable because hydraulic gradients in the UCRS are primarily downward and the construction orientation exceeds the commonly applied practical limit of the technology. This process option is screened from further consideration.
	Air Stripping—*Ex Situ*	Applied *ex situ* for secondary waste treatment.	Commercially available	Technically implementable. Retained for possible alternative development as a component of an *ex situ* treatment process train.
	Ion Exchange—*Ex Situ*	Ion exchange removes ions from the aqueous phase by exchanging cations or anions between contaminants and the exchange media. Media are typically resins made from synthetic organic materials, inorganic materials, or natural polymeric materials.	Commercially available	Technically implementable. Retained for possible alternative development as a component of an *ex situ* treatment process train.
	Granular Activated Carbon (GAC) (vapor or liquid phase) —*Ex Situ*	GAC is used for VOC removal from aqueous streams. Dissolved contaminants are removed by adsorption onto activated carbon grains.	Commercially available	Technically implementable. Retained for possible alternative development as a component of an *ex situ* treatment process train.
	Vapor Condensation	Applied *ex situ* for secondary waste off-gas treatment.	Commercially available	Technically implementable. Retained for possible alternative development as a component of an *ex situ* treatment process train.
	Deep Soil Mixing—*In Situ*	Potential adjunct technology for some *in situ* treatment, containment, or removal technologies.	Commercially available	Technically implementable. Retained for possible alternative development.

Table 2.1. BGOU SWMUs 2, 3, 7, and 30 GRA, Technology Type, and Process Option Screening (Continued)

Technology Type	Process Options	Description	Technology Status	Screening Comments
General Response Action—TREATMENT (Continued)				
Physical/Chemical (Continued)	Cement and Grouting—*In Situ*	Stabilization/solidification agents are injected at high pressure through conventional boreholes to form a grouted mass.	Commercially available	Technically implementable. Retained for possible alternative development.
	Jet Injection/Grouting—*In Situ*	Reactants are injected at high pressure through a rotating stylus as the stylus is moved vertically through the soil. The high pressure injectant will react *in situ*. If stabilization/solidification agents are injected, they will mix with the surrounding soil matrix to form a solid vertical column.	Commercially available	Technically implementable. Retained for possible alternative development.
Thermal	ERH—*In Situ*	Saturated or unsaturated soils are heated by applying current in subsurface, resulting in *in situ* steam stripping. VOCs and steam are recovered by dual phase extraction wells and treated. Can be implemented as three-phase or six-phase heating.	Commercially available	Technically implementable. Retained for possible alternative development. Most effective following removal of debris.
	Thermal Conduction Heating—*In Situ*	Saturated or unsaturated soils are heated via thermal conduction by placing heating elements in wells. VOCs and steam are recovered by dual phase extraction wells and treated.	Commercially available	Technically implementable. Retained for possible alternative development.
	Steam Stripping	Hot air or steam is injected below the contaminated zone to heat contaminated soil and thereby enhance the release of VOCs and some VOCs from the soil matrix.	Commercially available	Technically implementable. Retained for possible alternative development.
	Catalytic Oxidation—*Ex Situ*	Oxidation equipment (thermal or catalytic) can be used for destroying contaminants in the exhaust gas from air strippers and SVE systems. Applied *ex situ* for secondary vapor treatment.	Commercially available	Technically implementable. Retained for possible alternative development.
	Thermal Desorption—*Ex Situ*	Soils are heated to volatilize VOCs, which then are treated. Applied *ex situ* for excavated waste treatment.	Commercially available	Technically implementable. Retained for possible alternative development.
	Vitrification	Extremely high heat is used either *in situ* or *ex situ* to melt and glassify the contaminated media.	Limited Commercial availability	Vitrification would reduce the uncertainties associated with SWMUs 2, 3, 7, and 30 as it would reduce potential contaminant mobility and direct contact with waste. Retained for possible alternative development.
	Uranium Chip Roasting	Burns uranium chips to an oxide which is a more stable form for disposal.	Available	Technically implementable. Retained for possible alternative development.

Table 2.1. BGOU SWMUs 2, 3, 7, and 30 GRA, Technology Type, and Process Option Screening (Continued)

Technology Type	Process Options	Description	Technology Status	Screening Comments
General Response Action—TREATMENT (Continued)				
Chemical	*In Situ* Chemical Oxidation using reagents such as • Permanganate • Fenton's Reagent • Ozonation • Persulfate • Redox Manipulation • Surfactant-Enhanced *In Situ* Chemical Oxidation (ISCO)	*In situ* chemical oxidation processes involve injection of chemical compounds to oxidize organic contaminants in the subsurface.	Commercially available	Technically implementable. Retained for possible alternative development for *in situ* treatment of VOCs. This process option requires pairing with a site-appropriate delivery method.
	In Situ Reductive Reagent (Zero-Valent Iron)	*In situ* chemical reductive processes involve injection of chemical compounds that will create a reducing environment.	Commercially available	Technically implementable. Retained for possible alternative development for *in situ* treatment of VOCs, uranyl fluoride, and PCBs.
General Response Action—DISPOSAL				
Land Disposal	Off-site Permitted Disposal Facility	Shallow land burial site for LLW, MLLW, and HW disposal option.	Commercially available	Technically implementable. Retained for possible alternative development.
	Potential Disposal Unit	Planned radioactive and mixed waste on-site disposal unit.	Under consideration	Technically implementable. Retained for possible alternative development.
	PGDP C-746-U Landfill	Existing on-site nonhazardous nonradioactive waste landfill.	Available	Technically implementable. Retained for possible alternative development.
Discharge of Wastewater	Wastewater Treatment Demonstrating Compliance with ARARs	Allowed under CERCLA after treatment.	Available	Technically implementable. Retained for possible alternative development.

Note: Dark gray shading indicates the process option was screened out as not applicable or not technically implementable.

The technologies and associated process options are described in Section 2.4.1, as are their potential technical implementability. Evaluated technologies and process options that cannot be technically implemented are screened and eliminated from further consideration. In Section 2.4.2, the retained process options' effectiveness, implementability, and cost are evaluated. Finally, RPOs that will be used to develop the remedial alternatives are identified in Section 2.4.3.

2.4.1 Identification and Screening of Technologies and Process Options

The technology types and process options for each GRA are discussed in the following subsections 2.4.1.1 through 2.4.1.7. Table 2.1 summarizes the narrative discussion that follows.

In this FS, technologies and process options are evaluated for effectiveness, implementability, and cost as to how they may address the identified risk/hazards and uncertainties at the SWMUs.

Additionally, certain technologies or process options are retained as temporary or complementary actions subordinate to another retained action. For example, freeze wall is not effectively implementable as a long-term action, but is retained as a means to stabilize an excavation sidewall.

2.4.1.1 LUC technologies/process options

LUCs will be implemented at BGOU SWMUs where waste is left in place or source area-related contamination remains after active remediation that precludes UU/UE. In such cases, DOE will implement and maintain a LUC program that is protective based on current or reasonably anticipated future land use as described in the following subsections. LUCs will include institutional controls such as property record notices, the E/PP Program, physical controls (warning signs), and an Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer. Upon transfer of the property, DOE will comply with Section 120(h) of CERCLA.

The LUC implementation actions, including inspections, monitoring, and continued maintenance, will be provided in a land use control implementation plan (LUCIP) that will be prepared by DOE and submitted as a component of the RD.

In addition to LUCs selected and implemented as part of the BGOU remedy selection process, other existing DOE plant controls maintained outside of CERCLA, and that will not be a part of this remedy, currently are on-going and are discussed further in Section 1.3.1.6. Accordingly, PGDP is a federal facility with restricted access by the general public. Physical access to PGDP is prohibited by security fencing, and armed guards patrol the DOE property 24 hours per day to restrict worker entry and prevent uncontrolled access by the public/site visitors. These existing access controls are being maintained outside of the requirements of CERCLA due to the nature and security needs of the facility; nonetheless, the existing controls serve to protect against unacceptable/uncontrolled exposures.

Warning Signs. Warning signs are a physical control that will be placed at the source areas at the beginning of the remedial action to provide warning of potential contaminant exposure, will continue to be posted pending a final decision under the Comprehensive Site OU, or until such time as contaminant levels have been reduced that would allow for unrestricted use.

Fences. Fences are a physical control that may be placed at the source areas restricting access to hazardous areas.

Property Record Notice. In the event contamination and/or waste is left in place that will preclude UU/UE, a Property Record Notice (Notice) will be filed at the McCracken County Clerk's Office, in accordance with state and federal law, within 120 days of regulatory approval of the LUCIP and will remain in effect until DOE, KDEP, and EPA approve a request to modify or delete it. The Notice will include the purpose of the Notice, a brief summary of the main COCs and location of any waste remaining in-place, along with a description of the CERCLA remedial action and a DOE program contact. The Notice also will include a survey plat, accomplished by a registered land surveyor (under the direction and approval of a DOE official and consistent with applicable security requirements), that depicts the contamination and the area subject to LUCs. The Notice also will inform the reader that, upon title transfer of the property, the deed will include applicable land use restrictions and information required by CERCLA Section 120(h)(3). The Property Record Notice will alert anyone searching property records that an environmental covenant will be filed simultaneous with transfer of a fee simple interest in the property to a non-federal entity. DOE will file both the Notice and survey plat in the register of deeds (e.g., Real Estate Office) of the McCracken County Clerk.

Deed and/or Lease Restriction. For alternatives that will preclude UU/UE, DOE will implement and maintain a LUC program that includes the use of deed and/or lease restrictions that prohibit residential development or agricultural development within the BGOU source area and will be put in place contingent upon the property transfer. Deed and/or lease restriction prohibiting residential development, agricultural development, or excavation and drilling, unless written approval from DOE is obtained within the BGOU source area, will be put in place contingent on the property transfer.

Environmental Covenant. Should the Federal Government convey by deed a fee simple interest for contaminated real property at SWMUs 2, 3, 7, or 30, an environmental covenant pursuant to Subchapter 80 of *KRS* Chapter 224 will be created, granted to the holder and recorded that will contain the land use restrictions required in the Record of Decision or any amendments made thereto. The environmental covenant will impose no obligation on DOE independent of CERCLA requirements but will provide an additional means to assure the use of the property by a subsequent owner is consistent with restrictions that are established under the CERCLA remedy.

CERCLA Section 120(h). In the event that DOE should enter into any contract for the sale or transfer of any of the site, DOE will comply with the provisions found in CERCLA § 120(h) and Section XLII of the PGDP FFA pursuant to Section 120(h) of CERCLA, each deed entered into for the transfer of property is required to contain, to the extent such information is available:

- Notice of the type and quantities of hazardous substances;
- Notice of the time at which such storage, release, or disposal took place;
- Description of the remedial action taken, if any; and
- A covenant warranting that:
    - — All remedial actions necessary to protect human health and the environment with respect to any such substance remaining on the property has been taken before the date of such transfer [unless deferred under CERCLA § 120(h)(3)(c)], and
    - — Any additional remedial action found to be necessary after the date of such transfer shall be conducted by the United States.

Any necessary LUCs and their implementation will be documented in a LUCIP that would be submitted as a component of the overall RD. The frequency of monitoring, sampling, inspection, etc., will be defined in the LUCIP.

E/PP Program. The current E/PP Program with the contingent deed restriction provides a layered control for long-term effectiveness. The E/PP Program will be maintained for as long as DOE or its contractor maintain an on-site presence at the PGDP. The E/PP Program is a LUC administered by DOE's contractors at PGDP. It currently includes a specific permitting procedure (PAD-ENG-0026 or equivalent) designed to provide a common sitewide system to identify and control potential personnel hazards related to trenching, excavation, and penetration greater than 6 inches into the surface of the earth, concrete, pavement or walls, floors, and ceilings of buildings. The E/PP permits are issued by the Paducah Site's DOE Prime Contractor. The primary objective of the E/PP procedure is to provide notice of existing underground utility lines and/or other structures to the organization requesting a permit and to ensure that any E/PP activity is conducted safely and in accordance with all environmental requirements pertinent to the area.

The E/PP procedure does the following:

- Requires formal authorization (i.e., internal permits/approvals) before beginning any intrusive activities at PGDP;
- Is reviewed annually; and
- Is implemented by trained personnel knowledgeable in its requirements.

An initial draft of an E/PP is reviewed by project support groups to ensure that the latest updates in engineering drawings and utility drawings are considered prior to the issuance of an E/PP.

2.4.1.2 Surface Barriers

Soil Cover. Soil covers are intended to prevent direct contact only and promote runoff, but not provide hydraulic containment. This type of cover is effective, technically implementable, commercially available, and is retained for further consideration.

Riprap. Riprap is defined as a permanent, erosion-resistant ground cover of large, loose, angular stone. Its standard application is to protect slopes, stream banks, channels, or areas subject to erosion by wave action (http://www.mass.gov/dep/water/laws/policies.htm#storm); however, it also can be used to prevent intrusion by serving as a physical impediment due to its size.

2.4.1.3 Monitoring

Monitoring may be used in combination with other technologies to meet RAOs. Monitoring for the BGOU could include determination of soil and groundwater contaminant concentrations during remedial action as well as long-term groundwater monitoring. This technology is retained for further evaluation of process options.

2.4.1.3.1 Soil monitoring

Soil monitoring may be used before, during, and after remediation to determine extent and concentration of COCs. Collection of samples for laboratory analysis for physical/chemical parameters yields data that may be used to support RD and verify effectiveness of remedial action.

This technology will not be evaluated as a primary technology; however, it is retained for evaluation as a subordinate technology in conjunction with a primary technology.

Multiple process options are available and can be implemented during investigation or remediation on a site-specific and COC-specific basis. Specifically, conventional surface soil sample collection and analysis, soil core collection and analysis, membrane interface probe, and soil gas monitoring will be considered on a SWMU-specific basis during RAWP preparation.

2.4.1.3.2 Groundwater monitoring

Groundwater monitoring may be used in the UCRS and/or RGA saturated zones before, during, and after remediation to determine extent and concentrations of COCs. Conventional groundwater sampling consists of withdrawing a representative sample of groundwater from a well or drive point, using a variety of pump types or bailers, and analyzing the contents in a laboratory. Overall, groundwater monitoring is widely used for compliance monitoring and is effective, technically implementable, and commercially available. Groundwater monitoring for the group of SWMUs for the BGOU on the downgradient margin is not a significant challenge. However, monitoring the contribution from individual SWMUs (which are adjacent or contiguous) can be a challenge. Any monitoring systems selected would need to take into account commingled releases from adjacent units and upgradient sources. The design of any such unit would be addressed in the RD phase.

This technology is retained for further evaluation. In addition to conventional well monitoring, multiple techniques are available for consideration during the RAWP. These include the use of diffusion bags, borehole fluxmeters, ribbon nonaqueous-phase liquid (NAPL) samplers and DNAPL interface probes.

Note that the ability to implement a successful groundwater monitoring program may depend on the design and installation of additional MWs at PGDP. MW needs would be addressed during the RD process for the selected remedial alternative. The need for additional MWs is accounted for in the remedial alternative cost estimates.

2.4.1.4 Surface water sampling

Monitoring may be used after remedial action implementation to determine the degree of COC contribution, if any, of waste and impacted soils to surface water. Conventional surface water monitoring consists of analyzing grab samples using field instrumentation or at fixed-base laboratories. Overall, surface water monitoring is widely used for compliance monitoring and is effective, technically implementable, and commercially available. Monitoring of surface water at the BGOU SWMUs is not a significant challenge; however, monitoring determining the contribution of contaminants from the SWMUs (which are located in an industrial setting) can be a challenge. Any monitoring program would need to take into account comingled releases from upgradient sources. The detailed design of any such monitoring program would occur during RD. This technology is retained for further evaluation.

2.4.1.5 MNA/enhanced attenuation

Natural attenuation encompasses the naturally occurring soil and groundwater processes such as sorption, abiotic or biological degradation, and dilution, which immobilize, transform, or reduce concentrations of pollutants. Each natural attenuation process occurs under a range of conditions that must be extensively characterized and monitored over time to determine the effectiveness of the remedy. Although some natural attenuation processes may contribute to the protectiveness of the remedy, there are no additional steps that would be effective to enhance these natural processes. The sorption processes already have been estimated as part of the modeling of the impacts to groundwater. Thus, the viability of this option in a source area is uncertain.

2.4.1.6 Removal technologies

Removal, in the context of this FS, means the excavation of source materials disposed in the BGOU, as well as UCRS soils containing COCs above PRGs. The technical complexity of conventional excavation increases greatly with depths greater than about 20 ft (6 m) (Terzaghi et al. 1996), and several factors to be considered include slope stability, control of seepage, worker safety, management of excavated soil, shoring requirements, and potential for mobilization of COCs. Other removal methods could be considered in light of the potential impact of these factors.

This technology involves the use of commercially available heavy equipment to remove waste and contaminated soil. The selection of specific equipment is site specific and must consider items such as vertical and lateral extent of excavation, soil and groundwater conditions, specific hazards associated with the buried waste, site permit conditions, and potential interferences with existing utilities, infrastructure or buildings. When using conventional excavation equipment, deep excavations may require extensive terracing or elaborate shoring. Piping of groundwater and entry of heaving sands into the excavation can occur as excavation proceeds below the water table and also must be considered. Several types of excavation equipment that potentially could be used at the BGOU SWMUs are discussed later in this section.

Excavation can have a large capital cost, but low O&M cost, and may have the largest probability of achieving over 99% COC removal at smaller sites with contamination restricted to the upper 12.2 m (40 ft) of the soil (AFCEE 2000). Overall, experience has shown that excavation works best and is most cost-competitive at sites where confining layers are shallow, soil permeabilities are low, the volume of source materials is less than 5,000 m^3 (176,600 ft^3), and the contaminants do not require complex treatment or disposal (NRC 2004).

Removal technologies are combined with other GRAs such as treatment or disposal to meet RAOs. In some cases, RAOs may be met by combining selective, or hot spot, excavation with disposal, treatment, or containment GRAs.

This technology is technically implementable, is commercially available, and is retained for further evaluation.

2.4.1.6.1 Backhoes, trackhoes, and front-end loaders

Conventional excavation equipment such as backhoes, trackhoes, front-end loaders, and skid steer loaders can do an effective job of removing contaminated soil and overburden. Practical considerations regarding equipment limitations and sidewall stability can restrict the depth of excavation to a maximum of about 20 ft in a single lift. Where source zone contamination lies at greater depth, excavation can require a series of progressively deeper lifts or terraces accessed by ramps. This technique can extend the maximum depth of excavation in unconsolidated soil to over 40 ft; however, the unit cost of soil excavation increases rapidly with increasing depth of excavation. Additionally, implementation of methods to control or prevent the movement of groundwater into the excavation may be required if source removal extends below the water table. These methods are expensive and can require placement of caissons or driven sheet piling and dewatering (AFCEE 2000).

This process option is technically implementable, is commercially available, and is retained for further evaluation.

2.4.1.6.2 Vacuum excavation

Vacuum excavation can be used to remove contaminated soil to depths of about 30 ft in congested areas where access, obstructions, and buried utilities prevent safe operation of conventional excavators. A combination of high-pressure air (or water) is used to break up the soil, while a high flow vacuum removes the soil and deposits it in the vacuum truck collector body. Vacuum trucks are commercially available with capacities up to 15 yd^3. Additionally, contaminated soil and sludge can be placed directly in vacuum roll-off boxes (20 or 25 yd^3) or bags for disposal without having to decontaminate the vacuum truck.

Effective excavation can be performed as far as 300 ft from the vacuum truck, allowing work inside buildings and in highly congested areas. The high flow vacuum eliminates the need for additional dust control measures typically required during conventional excavation activities. This technology would not be effective at handling debris; thus, it would not be suitable for some of the wastes disposed of at SWMUs 2, 3, 7, and 30, but it could be used to remove soil from around the debris to expose the debris for further inspection or removal by other means.

This process option is technically implementable and is retained for further evaluation.

2.4.1.6.3 Cranes and clamshells

Cranes and clamshells often are used in deep excavations (e.g., excavation of piers, dredging, and mining). Excavation to depths of over 100 ft is achievable. Deep excavations may require elaborate shoring to prevent sidewall collapse; otherwise a bentonite slurry or biopolymer is needed to fill the excavation.

This process option is technically implementable, is commercially available, and is retained for further evaluation.

2.4.1.6.4 Large diameter auger

Large diameter augers (LDAs) can be used to effectively remove contaminated soil using a drill rig equipped with a large diameter (3 ft–10 ft) solid stem auger. LDAs can be used either cased or uncased. Casing prevents water infiltration and prevents sidewalls from sloughing to the excavation. LDA borings can reach depths of 27.4 m (90 ft) depending on the lithology and drill rig. Following excavation, holes typically are filled with flowable fill material. Conventionally, LDAs are used for source removal where standard heavy equipment is not feasible (e.g., heavily industrialized sites and/or deep contamination). Densely located subsurface utilities potentially could impact the boring spacing, and, therefore, the removal efficiency of this technology. The effectiveness of this technology partially depends on the location and spacing of the borings. The boring overlap pattern can be designed to achieve 100% removal; however, due to the amount of fill material excavated by overlapping the borings, the cost of excavation increases with the percentage of boring overlap.

This process option has limitations in the BGOU. Large debris contained in SWMUs 2, 3, 7, and 30 could cause the auger flights to bind, could cause auger refusal, and could cause equipment damage; however this process option is retained for further evaluation in conjunction with implementation of excavation technology and/or should COCs not be colocated with large debris.

2.4.1.7 Containment technologies

Containment technologies can hydraulically isolate source areas, reduce infiltration, and minimize contaminant migration. Containment technologies also can isolate contaminated media from release mechanisms, transport pathways, and exposure routes using surface and/or subsurface barriers, thereby reducing contaminant flux and reducing or eliminating exposures to receptors.

2.4.1.7.1 Hydraulic containment

Hydraulic containment involves implementing process options that either limit the potential for water to migrate through the waste or contaminated soil or limit the potential for contaminated water to enter the RGA. This technology is implementable and is retained for further evaluation.

Recharge Controls. Recharge controls can reduce facility process water discharges to the UCRS, promote surface water run-off, and reduce recharge of the source areas, thereby limiting leaching of COCs from source areas and migration to the RGA. Recharge controls options are technically implementable at present using commercially available materials and equipment. Potential recharge control options include the following:

- Identifying saturated zones in the UCRS based on past investigations and determining sources. (artificial groundwater mounding influences for the C-616 Lagoons will be considered as necessary, during RD);
- Directing water away from source areas or to storm drains;
- Eliminating surface water drainage from adjacent areas onto source areas;
- Lining ditches and culverts in the vicinity of the BGOU source areas with concrete or membranes;
- Inspecting and repairing, as needed, asphalt areas to promote runoff and minimize infiltration;
- Inspecting, clearing and repairing, as needed, discharge pipes, culverts, and storm drains; and
- Inspecting, metering, and repairing water lines in the vicinity of the BGOU source areas as needed.

This technology is implementable and is retained for further evaluation.

Groundwater Extraction. Groundwater pumping may be used to contain dissolved-phase contaminant plumes or may be used as a secondary technology to circulate or contain treatment amendments. This process option is retained for further evaluation; however, its effectiveness is dependent upon site conditions such as location of well placement.

2.4.1.7.2 Capping

The capping technology contains those process options that are designed to both prevent direct contact and significantly reduce infiltration into buried wastes through either an impermeable layer (RCRA Subtitle C or D caps, concrete based covers, conventional asphalt covers, MatCon™ asphalt, and flexible membranes) or through soil mass and vegetation (evapotranspiration cover). Capping includes RCRA Subtitle C and KY Subtitle D caps with the specified impermeable layer, which will prevent infiltration of water into the buried waste.

Of the capping process options listed below, all are intended to and will be designed to reduce recharge of precipitation through the use of a low permeable layer, except the evapotranspiration cover. The evapotranspiration cover will limit infiltration, but does so by relying on the capacity of the cover to retain moisture and then release it back to the environment through evapotranspiration.

This technology is implementable and is retained for further evaluation.

EPA (2008) identifies the following advantages and limitations of surface barriers for containment of source areas.

- Advantages of Containment
  - It is a simple and robust technology.
  - Containment typically is inexpensive compared to treatment, especially for large source areas.
  - A well-constructed containment system almost completely eliminates contaminant transport to other areas and thus prevents both direct and indirect exposures.
  - In unconsolidated soils, containment systems substantially reduce mass flux and source migration potential.
  - Containment systems can be combined with *in situ* treatment and, in some cases, might allow the use of treatments that would constitute too great a risk with respect to migration of either contaminants or reagents in an uncontrolled setting.
- Limitations of Containment
  - Containment does not reduce source zone mass, concentration, or toxicity unless it is used in combination with treatment technologies.
  - Data are not yet available concerning the long-term integrity of the different types of physical containment systems.
  - Long-term monitoring of the containment system is essential for ensuring that contaminants are not migrating.
  - Covers and alternative soil cover systems that seek to control infiltration must address the potential for freeze/thaw damage, commonly by burying the low hydraulic conductivity layer or capillary barrier under an adequately thick (predicted by frost depth of the area) surface layer of soil.

This technology is retained for further evaluation. Specific process options are described below.

Subtitle C Cap. This type of cover is designed to meet performance objectives for Subtitle C landfill closures under 40 *CFR* § 264.310. EPA guidance recommends a cover consisting of (top to bottom) an upper vegetated soil layer, a sand drainage layer, and a flexible membrane liner overlying a compacted clay barrier (EPA 1987). A gas collection layer may be included if gas-generating wastes are capped. Nominal thickness of this type of cover is 4.9 ft, and addition of grading fill would increase the thickness at the crest. A biotic layer also can be added to prevent the intrusion of roots or burrowing animals and would also deter human intrusion.

This type of cover is designed to be less permeable than the bottom liner of a Subtitle C landfill and meets the requirements of 40 *CFR* § 264.310. Other types of covers may be used if equivalent performance can be demonstrated through numerical modeling and/or site-specific large scale lysimeter studies.

This type of cover is potentially effective, technically implementable, commercially available, and is retained for further consideration. Capping, including RCRA Subtitle C and KY Subtitle D caps with the specified impermeable layer, will prevent infiltration of water into the buried waste.

Subtitle D Cap. KY Subtitle D requirements are for nonhazardous waste landfills. This type of cover is designed to meet performance objectives for a Kentucky Subtitle D Contained Landfill under 401 *KAR* 48:080. These KDEP regulations for contained landfills cap systems provide relevant and appropriate requirements for a final cover (commonly referred to as a "cap") of a landfill with industrial waste and are listed in Table F.2. The design of a landfill cover for a Subtitle D facility is generally a function of the bottom liner system or natural subsoils present. The cover will include the following components.

The components, listed from bottom to top, include the following:

- Filter fabric or other approved material;
- 12-inch sand gas venting system with a minimum hydraulic permeability of 1E-03;
- Filter fabric or other approved material;
- 18-inch clay layer with a maximum permeability of 1E-07 cm/sec;
- 12-inch drainage layer with a minimum permeability of 1E-03 cm/sec for areas of the final cap with a slope of less than 15%; and
- 36-inch vegetative soil layer.

Alternative specifications may be used if approved by KDEP and EPA through the CERCLA process, provided the alternative results in similar performance with respect to safety, stability, and environmental protection. For example, a gas venting layer may not be an appropriate design feature for installations involving inorganic waste that will not generate methane as it decomposes. Also, an alternative design may substitute a synthetic liner of 40 mil for the 18-inch clay layer.

Installation of a KY Subtitle D cap at SWMUs 2, 3, 7, and 30, which includes multilayers that are distinctly different to the natural subsoils, provides greater depth to the buried waste. These aspects (thickness and distinct properties) of the cap are expected to provide protection of individuals from inadvertent intrusion by alerting them that this is a man-made, engineered cover over something that is potentially hazardous to human health and by making it more difficult to expose the buried waste.

This type of cover is potentially effective, technically implementable, commercially available, and is retained for further consideration.

Evapotranspiration Cover. Soil cover systems use one or more vegetated soil layers to retain water until it is either transpired through vegetation or evaporated from the soil surface. These cover systems rely on the water storage capacity of the soil layer, rather than low hydraulic conductivity materials, to minimize percolation. Alternative earthen cover system designs are based on using the hydrological processes (water balance components) at a site, which include the water storage capacity of the soil, precipitation, surface runoff, evapotranspiration, and infiltration. The greater the storage capacity and evapotranspirative properties, the lower the potential for percolation through the cover system.

This type of cover is best suited to arid climates. It is therefore eliminated from further consideration.

Concrete and Asphalt-Based Covers. Concrete and asphalt covering systems may consist of a single layer of bituminous or concrete pavement over a prepared subgrade to isolate contaminated soils, reduce infiltration, and provide a trafficable surface. The asphalt surface can be sealed around infrastructure using adhesive sealants and flexible boots; however, constructability is improved by absence of surface infrastructure.

This process option is technically implementable and is retained for further evaluation.

MatCon™. MatCon™ asphalt has been used for Subtitle C-equivalent closures of landfills and soil contamination sites. MatCon™ is produced using a mixture of a proprietary binder and a specified aggregate in a conventional hot-mix asphalt plant. The EPA Superfund Innovative Technology Evaluation program evaluated MatCon™ in 2003 with respect to permeability, flexural strength, durability, and cost (EPA 2003). EPA determined that the as-built permeability of < 1E-07 cm/s was retained for at least 10 years with only minor maintenance, and MatCon™ had superior mechanical strength properties and durability.

This process option is effective, technically implementable, commercially available, and is retained for further evaluation.

Flexible Membranes. Flexible membranes are single layers of relatively impermeable polymeric plastic [high-density polyethylene (HDPE) and others]. Flexible membranes are a component of a Subtitle C cap, potentially other types of covers, and also may be used alone. Flexible membranes are laid out in rolls or panels and welded together. The resulting membrane cover essentially is impermeable to transmission of water unless breached. Flexible membranes can be sealed around infrastructure using adhesive sealants and flexible boots; however, constructability is improved by absence of surface infrastructure.

Flexible membranes must be protected from damage to remain impermeable. Flexible membranes are subject to damage and/or leakage due to puncturing or abrasion, exposure to excessive heat, freezing, temperature cycling, poor welds, tearing, shearing, ultraviolet or other radiation exposure, and chemical incompatibilities.

This technology is effective, technically implementable, commercially available, and is retained for further evaluation.

2.4.1.7.3 Subsurface horizontal barriers

Subsurface horizontal barriers potentially may limit downward migration of contaminants in infiltrating water by formation of a physical barrier to flow. Surface barriers must be implemented with subsurface barriers to avoid "bathtubbing" (i.e., infiltrating water spilling over the sides). Several types of subsurface barriers are discussed below.

Freeze Walls. Frozen barrier walls, also called cryogenic barriers or freeze walls, are constructed by artificially freezing the soil pore water, resulting in decreased permeability and formation of a low permeability barrier. The frozen soil remains relatively impermeable and migration of contaminants thereby is reduced. This technology has been used for groundwater control and soil stabilization in the construction industry and for strengthening walls at excavation sites for many years. This technology also has been identified for contamination and dust control during excavation of buried wastes.

Implementation of this technology requires installing pipes called thermoprobes into the ground and circulating refrigerant through them. As the refrigerant moves through the system, it removes heat from the soil and freezes the pore water. Implementation in arid regions requires injecting water to provide the moisture necessary to form the barrier or to repair the frozen wall. Systems can be operated actively or passively depending on air temperatures (EPA 1999b).

The thermoprobes can be placed at 45-degree angles along the sides of the area to be contained to form a V-shaped or conical barrier to provide subsurface containment. This technology is considered innovative and emerging for remediation, but is commercially available through the geotechnical construction industry.

Freeze wall containment potentially could eliminate vertical COC flux as long as the soil remains frozen and would be effective only as a temporary containment measure. The technology is not practical as a permanent hydraulic barrier system and therefore is screened from further consideration.

Jet Grouting. Grout mixtures injected at high pressures and velocities into the pore spaces of the soil or rock have been used in civil construction for many years to stabilize subgrades and reduce infiltration of water. More recently, jet grouting has been tested as a potential means of creating a subsurface horizontal barrier, without disturbing overlying soils. Grouts typically are injected through drill rods. The jetted grout mixes with the soil to form a column or panel. Jet grouting can be used in soil types ranging from gravel to clay, but the soil type can alter the diameter of the grout column. Soil properties also are related to the efficiency. For instance, jet grouting in clay is less efficient than in sand (EPA 1999).

V-shaped jet-grouted composite barriers were demonstrated at Brookhaven and the Hanford sites (Dwyer 1994) and at Fernald in 1992 (Pettit et al. 1996) in attempts to completely isolate contaminated soils in field trials. At Hanford and Brookhaven, V-shaped grouted barriers were created by injecting grout through the drill strings of rotary/percussion directional drilling rigs. Next, a waterproofing polymer (AC 400) was placed as a liner between the waste form and the cement v-trough, forming a composite barrier. Technologies to determine the continuity and impermeability of the completed barrier are unavailable; therefore, the effectiveness of the completed barriers is uncertain. This technology is screened from further consideration as a subsurface horizontal barrier.

Permeation Grout Barriers. Permeation grouting has been used extensively in construction and mining to stabilize soils and control movement of water. Low-viscosity grout is injected vertically or directionally at multiple locations into soil at sufficiently low pressure to avoid hydrofracturing while filling soil voids. Soil permeability may be reduced with minimal increase in soil volume using this method (EPA 1999).

The extent of grout permeation is a function of the grout viscosity, grout particle size, and soil particle size distribution. A variety of materials can be used in permeation grouting, and it is essential to select a grout that is compatible with the soil matrix. Particulate grouts are applicable when the soil permeability is greater than 1E-01 cm/s. Chemical grouts can be used with soil permeabilities greater than 1E-03 cm/s (EPA 1999). Permeation grouting has been tested at pilot scale, resulting in formation of subsurface layers of inconsistent coverage, thickness, and permeability.

Viscous liquid barriers are a variant of permeation grouting using low-viscosity liquids that gel after injection, forming an inert impermeable barrier. Field tests have resulted in formation of subsurface layers of inconsistent coverage, thickness, and permeability.

Permeation grouting is limited to soil formations with moderate to high permeabilities. Establishing and verifying a continuous, effective subsurface barrier is difficult or impossible in heterogeneous soils or in the presence of subsurface infrastructure. Permeation grouting is screened from further evaluation because the UCRS clays at the burial grounds have low permeability. Additionally, heterogeneity of the soils within the UCRS on the west side of PGDP (e.g., the sand layers comprising HU2) makes the efficacy of this technology difficult to verify.

2.4.1.7.4 Subsurface vertical barriers

Vertical barrier technologies can be used to isolate areas of soil contamination and to restrict groundwater flow into the contaminated area or underlying zones. Subsurface vertical barriers may be used to contain or divert contaminated groundwater flow. Subsurface vertical barrier technologies must be “keyed” into an underlying low permeability layer to avoid leakage around the barrier if complete containment is required (Deuren et al. 2002).

Given that flow is predominantly downward through the UCRS in the BGOU and that no continuous low permeability layer exists between the COC source areas and the RGA, vertical barriers are likely effective only as adjunct technologies for other primary technologies (e.g., removal). The following is a discussion of several different types of subsurface vertical barriers. This technology and associated process options are retained for further consideration.

Freeze Walls. This technology previously was evaluated as a subsurface horizontal barrier. The same principles apply as a subsurface vertical barrier, only the thermoprobes are installed vertically instead of on a 45 degree angle to prevent/contain the lateral flow of groundwater. Freeze wall containment potentially could eliminate lateral COC flux as long as the soil remains frozen and, therefore, would be effective only as a temporary containment measure. The technology is used in the construction industry to prevent the influx of groundwater into and/or stabilize the sidewalls of deep excavations. Although impractical as a permanent hydraulic barrier and therefore screened, this process option is potentially effective as an adjunct process option during excavation, is technically implementable, commercially available, and is retained for further evaluation.

Slurry Walls. Slurry walls are an established and commercially available technology. Slurry walls consist of vertically excavated trenches that are kept open by filling the trench with a low permeability slurry, generally bentonite and water. The slurry forms a very thin layer of fully hydrated bentonite that is impermeable. Soil (often excavated material) then is mixed with bentonite and water to create a soil bentonite backfill with a hydraulic conductivity of approximately 1E-07 cm/s, which is used to backfill the trench, displacing the slurry. Trench excavation is commonly completed by a backhoe with a modified boom at depths of up to 60 ft. A drag line or clam shell may be used for excavations greater than 60 ft.

Alternatively, a cement, bentonite, and water slurry that is left in the trench to harden may be used. Concrete slurry walls may have a greater hydraulic conductivity than traditional slurry walls and the excavated soil that is not used as a backfill must be disposed of properly. This technology is technically implementable, commercially available, and is retained for further evaluation.

Sheet Pilings. Sheet pilings are an established and readily available technology. Sheet pilings are long structural steel sections with a vertical interlocking system that are driven into the ground to create a continuous subsurface wall. After the sheet piles have been driven to the required depth, they are cut off at the surface. Sheet pilings are commonly used in excavations for shoring and to reduce groundwater flow into the excavation and, therefore, are a potentially useful adjunct technology for soil removal. This technology is effective, technically implementable, commercially available, and is retained for further evaluation.

Jet Grouting. Although not considered an effective horizontal subsurface barrier, jet grouting is effective as a vertical subsurface barrier. Jet grouting can be used regardless of soil type, permeability, grain size distribution, etc. In theory, it is possible to stabilize most soils from soft clays and silts to sands and gravel. Although it is possible to inject any type of binder, in practice, water/cement mixtures normally are used. Where it is required that the barrier be impermeable, water/cement/bentonite mixes are typically utilized.

A subsurface slurry wall can be formed by sequentially jet grouting adjoining columns of soil. An advantage of jet grouting over other slurry wall techniques is, it can be used to stabilize a wide range of soils ranging from gravel to heavy clays. A secondary advantage is that large diameter columns or panels can be created from relatively small diameter boreholes (http://www.recon-net.com/jet-grouting.html#jetgrouting). Waste soil and other material requiring management and disposal are less for jet grouting than for a conventional slurry wall and, therefore, jet grouting will be retained for consideration as a vertical subsurface barrier process option. This process option could be used as a secondary technology to removal to stabilize the sidewalls of an excavation.

2.4.1.8 Treatment technologies

Treatment technologies may destroy, immobilize, or render contaminants less toxic. Treatment technologies may be implemented *in situ, ex situ,* or both.

In situ treatments destroy, remove, or immobilize COCs without removing or extracting contaminated media. *In situ* treatment technologies may involve distributing fluids or gaseous amendments; applying thermal, pressure, or electrical potential gradients; manipulating subsurface conditions to promote biotic or abiotic contaminant degradation; or applying physical mixing in combination with other treatments. *Ex situ* treatments destroy, remove, or immobilize COCs after the contaminated media has been removed through excavation or extraction.

The following treatment technologies are evaluated for potential implementability at BGOU SWMUs 2, 3, 7, and 30: biological, physical/chemical, thermal, and chemical. Process options are described for each retained technology, with *in situ* process options being discussed prior to *ex situ* process options being discussed. Process options are not discussed for those technologies screened from further evaluation.

2.4.1.8.1 Biological technologies

Bioremediation techniques are destruction techniques directed toward stimulating the microorganisms to grow and use the contaminants as a food and energy source by creating a favorable environment for the microorganisms. Generally, this means providing some combination of oxygen, nutrients, and moisture, and controlling the temperature and pH. Sometimes, microorganisms adapted for degradation of the specific contaminants are applied to enhance the process (FRTR 2008). Bioremediation techniques can be applied either *in situ* or *ex situ*.

Biological processes typically are implemented at low cost. Contaminants can be destroyed, and often little to no residual treatment is required. The process does require more time, and, in the case of *in situ* applications, it is difficult to determine whether contaminants have been destroyed. Biological treatment of PAHs leaves less degradable PAHs (cPAHs) behind. These higher molecular weight cPAHs are classified as carcinogens. Also, an increase in chlorine concentration leads to a decrease in biodegradability. Some compounds, however, may be broken down into more toxic by-products during the bioremediation process (e.g., TCE to vinyl chloride). For *in situ* applications, these by-products may be mobilized to groundwater or contacted directly if no control techniques are used. This type of treatment scheme requires soil, aquifer, and contaminant characterization, and may require extracted groundwater treatment. Groundwater with low-level contamination sometimes may be recirculated through the treatment area to supply water to the treatment area (FRTR 2008).

The behavior of Tc-99 species in soil is governed by the potential of oxidation reduction chemical (redox) reactions of the soil. If sufficient reduction conditions exist, the pertechnetate ion will be reduced to insoluble oxidation states of technetium such as $TcO_2 \cdot 2H_2O$, $^{99}Tc_2S_7$ and $^{99}TcS_2$. These reduced Tc-99 species are readily sorbed by soil constituents or form complexes with organic matter and become fixed in the soil. Reduced forms of technetium are not likely to reoxidize under normal conditions. If suitable oxidation conditions exist in the soil, the pertechnetate ion will not react with soil constituents or form complexes and will be available for transport.

Soils high in organic matter are particularly effective in reducing the pertechnetate ion to insoluble forms of technetium. Reducing conditions are created by the presence of large amounts of soil bacteria and positively charged organic compounds common to these types of soils. Some soil bacteria have the ability to reduce technetium by incorporating it in their metabolic processes. The reduced technetium reacts with carboxyl, amine, hydroxyl, and sulfide groups often found in soils high in organic matter, and insoluble technetium complexes are formed. These insoluble technetium complexes have substantially reduced migration potential.

This technology is effective, technically implementable, commercially available, and is retained for further evaluation.

2.4.1.8.2 Physical/chemical technologies

Physical/chemical treatment uses the physical properties of the contaminants or the contaminated medium to destroy (i.e., chemically convert) or separate the contamination. For example, passive treatment walls separate and destroy the contaminant from *in situ* groundwater; air sparging, dual-phase extraction (DPE), fluid/vapor extraction and air stripping are separation techniques. Physical/chemical technologies also include stabilization/solidification process options.

Many physical/chemical process options primarily address groundwater either as a stand-alone remedy or as a component of a process train. This technology is retained for further evaluation because it contains cement and chemical grouting and jet grouting that could be implemented at SWMUs 2, 3, 7, and 30.

Soil Vapor Extraction—*In Situ.* Soil vapor extraction (SVE) applies a vacuum to unsaturated soils to induce the controlled flow of air through contaminated intervals, thereby removing volatile and some semivolatile contaminants from the soil. SVE can increase the rate of volatilization from DNAPL, aqueous, and sorbed VOC phases by maintaining a high concentration gradient between these phases and the air filled soil porosity.

The gas leaving the soil may be treated to recover or destroy the contaminants, depending on local and state air discharge regulations. Vertical extraction wells typically are used at depths of 5 ft or greater and have been successfully applied as deep as 300 ft. Horizontal extraction vents installed in trenches or horizontal borings can be used as warranted by contaminant zone geometry, drill rig access, or other site-specific factors. SVE is defined by EPA as a presumptive remedy for VOCs in soil (EPA 2007).

This process option is applicable for implementation at SWMUs 2, 3, 7, or 30. This technology is effective, technically implementable, commercially available, and is retained for further evaluation.

Dual-phase Extraction—*In Situ.* DPE, also known as multiphase extraction, uses a high-vacuum system to remove both contaminated groundwater and soil vapor. In DPE systems, a high-vacuum extraction well is installed with its screened section in the zone of contaminated soils and groundwater. Fluid/vapor extraction systems depress the water table and water flows faster to the extraction well. Impermeable covers often are placed over the soil surface during operations to prevent short circuiting of air flow and to increase the radius of influence of the wells. Groundwater depression pumps may be used to reduce groundwater upwelling induced by the vacuum or to increase the depth of the vadose zone. DPE was evaluated and recommended by Hightower et al. (2001) as potentially effective and implementable for remediation of DNAPL TCE in saturated conditions in the UCRS at PGDP. Potential adjunct technologies to improve performance, including fracturing, active or passive air injection, air sparging, and ozone injection, are discussed separately.

This technology is effective, technically implementable, commercially available, and is retained for further evaluation.

Air Sparging—*In Situ.* Air sparging injects air into a contaminated aquifer. Injected air traverses horizontally and vertically in channels through the soil column, creating an underground stripper that removes contaminants by volatilization. This injected air helps to volatilize the contaminants up into the unsaturated zone, where they typically are removed by an SVE system. This technology is designed to operate at high flow rates to maintain increased contact between groundwater and soil and strip more groundwater by sparging. Air sparging can act on aqueous DNAPL and sorbed phase VOCs by promoting volatilization of VOCs into an air phase, although air sparging may not effectively treat DNAPL when present in amounts significantly above residual saturation (COE 2008).

Oxygen added to contaminated groundwater and vadose zone soils also can enhance biodegradation of contaminants below and above the water table. Ozone may be generated on-site and added to air injection or sparging systems to oxidize contaminants *in situ*. This application of sparging was recommended for evaluation by Hightower et al. (2001) for remediation of TCE sources in the UCRS unsaturated zone at PGDP.

This process option is not applicable for implementation at SWMUs 2, 3, 7, and 30 because it would not effectively mitigate the risk associated with each SWMU’s waste (see Section 1.3.6). It is therefore screened from further evaluation.

Soil Flushing—*In Situ.* Soil flushing is the extraction of contaminants from soil with water or other suitable aqueous solutions. Soil flushing is accomplished by passing the extraction fluid through in-place soils using an injection or infiltration process. Extraction fluids are recovered from the underlying aquifer and, when possible, they are recycled. Many soil flushing techniques are adapted from enhanced oil recovery methods used by the petroleum industry for many years.

This process option is not applicable for implementation at SWMUs 2, 3, 7, and 30 because it would not effectively mitigate the risk associated with each SWMU’s waste (see Section 1.3.6). It is therefore screened from further evaluation.

Electrokinetics—*In Situ.* The principle of electrokinetic remediation relies upon application of a low-intensity direct current through the soil between ceramic electrodes that are divided into a cathode array and an anode array. This mobilizes charged species, causing ions and water to move toward the electrodes. Metal ions, ammonium ions, and positively charged organic compounds move toward the cathode. Anions such as chloride, cyanide, fluoride, nitrate, and negatively charged organic compounds move toward the anode. The current creates an acid front at the anode and a base front at the cathode.

Two primary mechanisms, electromigration and electroosmosis, transport contaminants through the soil toward one or the other electrodes. In electromigration, charged particles are transported through the stationary soil moisture. In contrast, electroosmosis is the movement of the soil moisture containing ions relative to a stationary charged surface. The direction and rate of movement of an ionic species will depend on its charge, both in magnitude and polarity, as well as the magnitude of the electroosmosis-induced flow velocity. Non-ionic species, both inorganic and organic, also will be transported along with the electroosmosis-induced water flow. Electrokinetics can act on aqueous, DNAPL, and sorbed-phase VOCs. Electroosmosis has been used for years in the construction industry to dewater low-permeability soils.

While this process option has been demonstrated at PGDP to be effective, technically implementable, and commercially available for remediation of VOCs in soil, it is not suitable for implementation at SWMUs 2, 3, 7, and 30 as a primary technology because of the presence of drums. Electrokinetics will be retained for technology and process options screening as a secondary means of treating VOCs after removal of buried waste.

Permeable Reactive Barrier—*In Situ.* Permeable reactive barriers (PRBs) are designed and constructed to permit the passage of water while immobilizing or destroying contaminants through the use of various reactive agents. PRBs often are used in conjunction with subsurface vertical barriers such as sheet piling to form a funnel and gate system that directs the groundwater flow through the PRB.

This process option is not applicable for implementation at SWMUs 2, 3, 7, and 30 because it would not effectively mitigate the risk associated with each SWMU's waste (see Section 1.3.6). It is therefore screened from further evaluation.

Air Stripping—*Ex Situ.* Air stripping removes volatile organics from extracted groundwater by greatly increasing the surface area of the contaminated water exposed to air. Air stripping is a presumptive technology for treatment of VOCs in extracted groundwater (EPA 1996).

Types of aeration methods include packed towers, diffused aeration, tray aeration, and spray aeration. Packed tower air strippers typically include a spray nozzle at the top of the tower to distribute contaminated water over the packing in the column, a fan to force air countercurrent to the water flow, and a sump at the bottom of the tower to collect decontaminated water. Tray aerators stack a number of perforated trays vertically in an enclosure. Air is blown upward through the perforations as water cascades downward through the trays. Aeration tanks strip volatile compounds by bubbling air into a tank through which contaminated water flows. A forced air blower and a distribution manifold are designed to ensure air-water contact.

This process option is applicable as a component of an *ex situ* water treatment system and is retained for further evaluation.

Ion Exchange—*Ex Situ.* Ion exchange removes ions from the aqueous phase by exchanging cations or anions between the contaminants and the exchange medium. Ion exchange materials may consist of resins made from synthetic organic materials that contain ionic functional groups to which exchangeable ions are attached. Resins also may be inorganic and natural polymeric materials. After the resin capacity has been exhausted, resins can be regenerated (off-site by the vendor) for reuse.

This process option is applicable as a component of an *ex situ* water treatment system and is retained for further evaluation.

Granular-Activated Carbon (Vapor Phase and Liquid Phase)—*Ex Situ.* Vapor-phase carbon adsorption removes pollutants including VOCs removed from extracted air by physical adsorption onto activated carbon grains. Carbon is "activated" for this purpose by processing the carbon to create porous particles with a large internal surface area (300 to 2,500 m^2 or 3,200 to 27,000 ft^2 per gram of carbon) that attracts and adsorbs organic molecules as well as certain metal and inorganic molecules.

Commercial grades of activated carbon are available for specific use in vapor-phase applications. The granular form of activated carbon typically is used in packed beds through which the contaminated air flows until the concentration of contaminants in the effluent from the carbon bed exceeds an acceptable level. Granular-activated carbon (GAC) systems typically consist of one or more vessels filled with carbon connected in series and/or parallel operating under atmospheric, negative, or positive pressure. The carbon then can be regenerated in place, regenerated at an off-site regeneration facility, or disposed of depending upon economic considerations.

Liquid phase GAC also is widely used for removal of VOCs including VOCs from aqueous streams, including pump-and-treat (P&T) systems. Liquid-phase carbon adsorption removes dissolved pollutants by physical adsorption onto activated carbon grains, similar to gas-phase absorption as described previously. Sizing of the GAC bed is based on effluent flow rate, face velocity, and residence time. Most GAC systems include a multiple bed configuration to optimize carbon utilization. GAC currently is used as a polishing step after air stripping at the PGDP Northwest Plume Pump-and-Treat system.

This process option is applicable as a component of an *ex situ* water treatment system and is retained for further evaluation.

Vapor Condensation. TCE and other VOCs in contaminated vapor streams can be cooled to condense the contaminants (EPA 2006c). The contaminant-laden vapor stream is cooled below the dew point of the contaminants, [e.g., below about 37.2°C (99°F) for TCE], and the condensate can be collected for recycling or disposal. Methods used to cool the vapor stream may include the use of liquid nitrogen, mechanical chilling, or a combination of the two.

Condensation systems are most often used when the vapor stream contains concentrations of contaminants greater than 5,000 ppm or when it is economically desirable to recover the organic contaminant contained in the vapor stream for reuse or recycling. Other configurations of vapor condensation include adsorbing or otherwise concentrating compounds from low-concentration vapors using another technology (e.g., GAC) and then performing condensation for recovery for disposal or recycling.

This process option is applicable as a component of an *ex situ* water treatment system and is retained for further evaluation.

Deep Soil Mixing. Deep soil mixing is a stabilization/solidification technique in which reagents, generally cement, are injected into a soil matrix and mixed *in situ*. Several types of deep soil mixing systems are commercially available, including single- and dual-auger systems. Dual-auger soil mixing involves the controlled injection and blending of reagents into soil through dual overlapping auger mixing assemblies, consisting of alternate sections of auger flights and mixing blades that rotate in opposite directions to pulverize the soil and blend in the appropriate volumes of treatment reagents. Each auger mixing assembly is connected to a separate, hollow shaft (Kelly bar) that conveys the treatment reagents to the mixing area, where the reagents are injected through nozzles located adjacent to the auger cutting edge. The mix proportions, volume, and injection pressures of the reagents are continuously controlled and monitored by an electronic instrumentation system.

Deep soil mixing is not implementable at SWMUs 3, 7, and 30 without first removing large, rigid debris known to exist at these SWMUs. This debris would interfere with the auger flights and could cause auger flights to bind, could cause auger refusal, or could cause equipment damage; however, this process option is retained for further evaluation. At SWMU 2, deep soil mixing is implementable; properly sized equipment is capable of shredding and mixing the relatively soft and unconsolidated waste in SWMU 2.

Cement and Chemical Grouting—*In Situ.* Cement grouting, also known as slurry grouting or high mobility grouting, is a grouting technique that fills pores in granular soil or voids in rock or soil with flowable particulate grouts. Depending on the application, Portland cement or microfine cement grout is injected under pressure at strategic locations either through single port or multiple port pipes. The grout particle size and soil/rock void size must be properly matched to permit the grout to enter the pores or voids. The grouted mass has an increased strength and stiffness, and reduced permeability.

Chemical grouting is a grouting technique that transforms granular soils into sandstone-like masses, by permeation with a low viscosity grout. Typically, a sleeve port pipe first is grouted into a predrilled hole. The grout is injected under pressure through the ports on the pipe. The grout permeates the soil and solidifies it into a sandstone-like mass. The grouted soil has increased strength and stiffness and reduced permeability.

In situ grouting of the SWMUs 2, 3, 7, and 30 wastes would reduce the uncertainty associated with the wastes by reducing mobility. It is commercially available and technically implementable. This process option is retained for further evaluation.

Jet Grouting—*In Situ.* Jet grouting is a grouting technique that creates *in situ* geometries of soilcrete (grouted soil), using a grouting monitor attached to the end of a drill stem. The jet grout monitor is advanced to the maximum treatment depth, at which time high velocity grout jets (and sometimes water and air) are initiated from ports in the side of the monitor. The jets erode and mix the *in situ* soil as the drill stem and jet grout monitor are rotated and raised (Hayward Baker 2014).

Jet grouting is effective across the widest range of soil types of any grouting system, including silts and most clays, although cohesionless soils typically are more erodible by jet grouting than cohesive soils.

Jet grouting the wastes at SWMUs 2, 3, 7, and 30 would reduce the uncertainty associated with the wastes by reducing mobility. This option is commercially available and is technically implementable. This process option is retained for further evaluation.

2.4.1.8.3 Thermal technologies

Thermal processes burn, decompose, or detonate contaminants (destruction); melt the contaminants (immobilization); or use heat to increase volatility of contaminants (separation). Destruction technologies include incineration, open burn/open detonation, and pyrolysis. Vitrification immobilizes inorganics and destroys some organics. Separation technologies include thermal desorption and hot gas decontamination.

Thermal treatments offer quick cleanup times, but typically are the most costly treatment group. This difference, however, is lower in *ex situ* applications than *in situ* applications. Cost is driven by energy and equipment costs and is both capital- and O&M-intensive.

This technology is technically implementable and is retained for further evaluation.

ERH—*In Situ.* ERH uses electrical resistance heaters or electromagnetic/fiber optic/radio frequency heating to increase the volatilization rate of semivolatiles and facilitate vapor extraction. The vapor extraction component of ERH requires heat-resistant extraction wells, but is otherwise similar to SVE.

Contaminants in low-permeability soils such as clays and fine-grained sediments can be vaporized and recovered by vacuum extraction using this method. Electrodes are placed directly into the soil matrix and energized so that electrical current passes through the soil, creating a resistance that then heats the soil. The heat may dry out the soil causing it to fracture. These fractures make the soil more permeable, allowing the use of SVE to remove the contaminants.

The heat created by ERH also forces trapped liquids, including DNAPLs, to vaporize and move to the steam zone for removal by SVE. ERH applies low-frequency electrical energy in circular arrays of three (three-phase) or six (six-phase) electrodes to heat soils. The temperature of the soil and contaminant is increased, thereby increasing the contaminant's vapor pressure and its removal rate. ERH also creates an *in situ* source of steam to strip contaminants from soil. Heating via ERH also can improve air flow in high moisture soils by evaporating water, thereby improving SVE performance. ERH can act on aqueous, DNAPL, and sorbed phase VOCs.

Six-phase heating (SPH) was evaluated and recommended by Hightower et al. (Hightower 2001) for TCE DNAPL contamination in the saturated and unsaturated zones of the UCRS. A pilot study using SPH subsequently was conducted at PGDP between February and September of 2003. The heating array was 30 ft in diameter and reached a depth of 99 ft bgs. Baseline sampling results showed an average reduction in soil contamination of 98% and groundwater contamination of 99% (DOE 2003b).

ERH was implemented as the C-400 IRA remedy to remove VOC contamination, primarily TCE, from subsurface soils in the vicinity of the C-400 Cleaning Building. This decision was documented in a ROD signed in August 2005.

Phase I construction began in December 2008 and was substantially complete in December 2009; at that time, start up and shakedown testing began. Testing was complete and operations commenced at the end of March 2010. Heating operations ceased (soil vapor extraction continued) at the end of October 2010, and all system operations ended on December 4, 2010.

Phase I performance assessment results support the conclusion that RAOs, as documented in the ROD, were achieved for the UCRS and upper RGA in the Phase I treatment areas.

Postoperational soil sample results show average percent reductions in TCE concentrations of 95% and 99% in the Phase I east and southwest treatment areas. Groundwater analytical results from postoperational samples show average reductions of 76% and 99% in the east and southwest areas, respectively.

Target temperatures were attained in treatment areas and depths targeted for VOC removal, indicating that the ERH design was adequate for thermal treatment of UCRS soils.

This technology is effective, technically implementable, commercially available, and is retained for further evaluation.

Thermal Conduction Heating—*In Situ.* Thermal conduction heating (TCH) is similar to ERH in that the physical processes of contaminant removal and collection are similar, but the two processes use different methods to heat the subsurface. TCH uses an array of heating elements placed in heater wells to raise the temperature of the subsurface by thermal conduction. Unlike ERH, it does not pass a current through the subsurface or rely on the electrical resistance of the soil to facilitate the heating process. TCH can generate subsurface temperatures above 100°C and is therefore effective at removing semivolatile organic compounds (SVOCs) such as PAHs, PCBs, pesticides, and dioxins. The maximum soil temperature achievable with ERH is 100°C and its application typically is limited to treatment of VOCs.

Unlike ERH, buried metal objects are not a significant limitation to the implementation of TCH, as long as the buried materials do not interfere with the construction of heater and heater/vacuum wells.

This technology is effective, technically implementable, commercially available, and is retained for further evaluation.

Steam Stripping—*In Situ.* Hot air or steam is injected below the contaminated zone to heat contaminated soil and thereby enhance the release of VOCs from the soil matrix. Desorbed or volatilized VOCs are removed through SVE (FRTR 2008). Steam injection has been used to enhance oil recovery for many years and was investigated for environmental remediation beginning in the 1980s. Approximately 10 applications of this technology for recovery of fuels, solvents, and creosote are reported in EPA 2005, detailing varied results.

This technology is effective, technically implementable, commercially available, and is retained for further evaluation.

Catalytic Oxidation—*Ex Situ.* Oxidation equipment (thermal or catalytic) can be used for destroying contaminants in the exhaust gas from air strippers and SVE systems. Thermal oxidation units typically are single chamber, refractory-lined oxidizers equipped with a propane or natural gas burner and a stack. Lightweight ceramic blanket refractory is used because many of these units are mounted on skids or trailers. Flame arrestors are installed between the vapor source and the thermal oxidizer. Burner capacities in the combustion chamber range from 0.5 to 2 million BTUs per hour. Operating temperatures range from 760° to 870°C (1,400°F to 1,600°F), and gas residence times typically are one second or less.

Catalytic oxidation units are widely used for the destruction of VOCs and numerous vendors are available. It is retained for further evaluation.

Thermal Desorption—*Ex Situ.* Thermal desorption heats wastes *ex situ* to volatilize water and organic contaminants. A carrier gas or vacuum system transports volatilized water and organics to a gas treatment system where they are collected or oxidized to CO_2 and water (FRTR 2008).

Two common thermal desorption designs are the rotary dryer and thermal screw. Rotary dryers are horizontal cylinders that can be indirect- or direct-fired. The dryer is normally inclined and rotated. Thermal screw units transport the medium through an enclosed trough using screw conveyors or hollow augers. Hot oil or steam circulates through the auger to indirectly heat the medium. Thermal desorption systems typically require treatment of the off-gas to remove particulates and destroy contaminants. Particulates are removed by conventional particulate removal equipment such as wet scrubbers or fabric filters. Contaminants may be removed through condensation followed by carbon adsorption or destroyed in a secondary combustion chamber or a catalytic oxidizer.

Most of the hardware components for thermal desorption systems are readily available off the shelf. Most *ex situ* soil thermal treatment systems employ similar feed systems consisting of a screening device to separate and remove materials greater than 5 centimeters (2 inches), a belt conveyor to move the screened soil from the screen to the first thermal treatment chamber, and a weight belt to measure soil mass. Occasionally, augers are used rather than belt conveyors, but either type of system requires daily maintenance and is subject to failures that can shut down the system.

This technology is effective, technically implementable, commercially available, and is retained for further evaluation.

Vitrification. Of all the common solidification methods, vitrification offers the greatest degree of containment. Most (but not all) of the resultant solids have an extremely low leach rate; however, the high energy demand and requirements for specialized equipment and trained personnel greatly limit the use of this method. Exposure of contaminants to the vitrification process results in several desirable results: (1) destruction of hazardous organics by pyrolytic decomposition and/or oxidation, and (2) removal (partial or fully) of low-solubility, high-volatility, and high-solubility inorganics in the residual glass product, through chemical incorporation and/or encapsulation.

In the *ex situ* method, the waste, together with other chemicals that produce the glassy product, are mixed and melted within a special furnace. Waste and glass- forming (or slag- forming) constituents are introduced into the heated zone of the furnace. These react to produce a molten mass while organic materials are decomposed or volatilized into a suitable scrubber system. The fused mass of insoluble materials can be cast into blocks or removed in a granular form depending on composition and intended disposal requirements.

In situ vitrification is another *in situ* process that uses an electric current to melt soil or other earthen materials at extremely high temperatures (1,600°C to 2,000°C or 2,900°F to 3,650°F) and thereby immobilize most inorganics and destroy organic pollutants by pyrolysis. Inorganic pollutants are incorporated within the vitrified glass and crystalline mass. Water vapor and organic pyrolysis combustion products are captured in a hood, which draws the contaminants into an off-gas treatment system that removes particulates and other pollutants from the gas. The vitrification product is a chemically stable, leach-resistant, glass and crystalline material similar to obsidian or basalt rock. The process destroys and/or removes organic materials. Radionuclides and heavy metals are retained within the molten soil (FRTR 2008).

In situ vitrification would mitigate the uncertainties associated with SWMUs 2, 3, 7, and 30 wastes by reducing mobility. It is retained for further evaluation.

Uranium Chip Roasting. Uranium chip roasting describes the process of removing the pyrophoric property of uranium by igniting the uranium chips under controlled conditions and allowing them to burn (oxidize). Should this process be implemented, air emissions equipment, such as high-efficiency particulate air filtration, would need to be integrated into the design. Uranium chip roasting was used at various DOE sites to manage site generated wastes, but is not presently commercially available. It is retained for further evaluation.

2.4.1.8.4 Chemical technologies

***In Situ* Chemical Oxidation (ISCO).** ISCO processes are *in situ* treatments whereby chemical compounds are injected to oxidize organic contaminants in the subsurface. Commercially available chemical oxidation/reduction technologies include the following:

- Permanganate
- Fenton's reagent
- Ozonation
- Persulfate
- Redox manipulation
- Surfactant-enhanced ISCO

ISCO has been used at many sites, and oxidants are available from a variety of vendors. Water-based oxidants can react directly only with the dissolved-phase of NAPL contaminants because the two will not mix. This property limits their activity to the oxidant solution/DNAPL interface; however, significant mass reduction has been reported for application of ISCO at sites with dissolved-phase VOCs and DNAPL residual ganglia (EPA 2008). Off-gas control is often important during implementation of chemical oxidation technologies.

This technology is effective, technically implementable, commercially available, and is retained for further evaluation.

Reductant (Zero-Valent Iron). ZVI is conventionally used in conjunction with a permeable reactive barrier to dechlorinate chlorinated hydrocarbons in the subsurface. However, the technology also may be applied as direct injection of particulate iron, mixing of iron with clay slurries, or incorporating micro or nanoscale ZVI into an oil emulsion prior to injection. A form of ZVI may be injected into the subsurface downgradient of the contaminant source to create a zone of treatment. This is an innovative/emerging technology that would require field demonstration prior to implementation. This technology is potentially implementable and commercially available and is retained for further evaluation.

2.4.1.9 Disposal technologies

Disposal technologies for wastes and soil produced during excavation are discussed in the following subsections.

2.4.1.9.1 Land disposal

Land disposal of buried waste and soils generated from excavation at the SWMUs will require disposal facilities to accept the waste types generated during the action. It is acknowledged that once excavation begins, sampling of uncovered buried waste would be used to definitively determine waste types and to confirm the waste meets the WAC of the receiving facility if one must be used. The following discussion presents potential on-site and off-site options for land disposal of waste materials generated during remediation of SWMUs 2, 3, 7, and 30.

On-Site Disposal. DOE has existing and available capacity for on-site disposal of nonhazardous solid wastes. The C-746-U Landfill at PGDP on DOE-owned property would be used to dispose of the nonhazardous solid wastes generated from SWMUs 2, 3, 7, and 30.

On-site disposal of waste also may be possible for additional waste types depending upon the remedy selected from a waste disposal alternatives evaluation DOE is conducting for CERCLA-derived wastes. One alternative being considered in that evaluation is the siting, design, construction, operation, closure, and postclosure of a new on-site waste disposal facility (OSWDF). This potential facility would be designed and operated to accept LLW, RCRA, TSCA, and mixed low-level waste (MLLW) and also may be designed to accept classified wastes. The CERCLA waste disposal alternative evaluation is currently in progress (an RI/FS is under development); therefore, a decision is not yet available. If a new on-site facility were selected in a ROD, then BGOU waste that met its WAC, but not that of the C-746-U Landfill, could be disposed of on-site when open and ready for disposal operations. Excavation and disposal alternatives evaluated in this FS will provide discussion of both off-site disposal and on-site disposal in a potential OSWDF for LLW, RCRA, TSCA, and MLLW. Cost for disposal of waste in a potential OSWDF also is included in Appendix E.

Off-Site Disposal. Off-site disposal currently is used by DOE for land disposal of wastes that do not meet the WAC of the on-site PGDP C-746-U Landfill. Wastes requiring off-site disposal include LLW, RCRA, TSCA, and MLLW. DOE has existing contracts with off-site commercial disposal facilities as well as access to disposal at the Nevada National Security Site (NNSS) in Mercury, NV. DOE also has established methods for packaging and transportation of waste off-site. Historically, the disposal facilities most frequently used have been Energy*Solutions* in Clive, UT, and NNSS (formerly known as the Nevada Test Site); these facilities were used as the land disposal cost basis in the FS for the excavation and disposal estimates in Appendix E. Energy*Solutions* can be reached either by rail or truck; NNSS-bound waste can be shipped only by truck. Containers typically used include gondola rail cars, intermodals, Sealand trailers, and B-25/ST-90s. Other off-site disposal facilities may be used in the future to maintain cost efficiency. One such facility is Waste Control Specialists in Andrews County, TX. Energy*Solutions* and Waste Control Specialists can receive nonclassified LLW/RCRA/TSCA/MLLW, but neither facility currently can accept depleted uranium.

Based on current restrictions for depleted uranium concentrations at both Energy*Solutions* and Waste Control Specialists facilities, it is anticipated that uranium metal (from SWMUs 2 and 3) will be disposed at the NNSS, and only uranium contaminated materials meeting the concentration restrictions will be disposed of at ES, WCS, or other DOE approved disposal facilities.

Off-site disposal costs for the FS are based on current contract rates that DOE has in place with the primary disposal facilities discussed. The main cost elements associated with off-site disposal include the cost of the containers (either purchased or rentals), transportation costs, treatment (if required), and disposal fees. The costs also are dependent on the waste type (regulatory classification) and form (i.e., soil, debris) of the waste. Disposal fees are not always based on the volume of the waste in the container. Some facilities charge by the external size of the container and other facilities use an assumed volume on the contents of the container. Disposal of classified wastes results in an increase in transportation costs.

2.4.1.9.2 Discharge of wastewater

Water collected as incidental to the implementation of an excavation alternative will be sent to a temporary water treatment unit to be installed as part of the remedial action. Based on the COCs found at SWMUs 2, 3, 7, and 30, it is anticipated that the temporary wastewater treatment unit will consist of media appropriate to remove solids and radionuclides. The used filter media would be sent to a land disposal facility or regenerated, as appropriate.

Water would be discharged from the water treatment unit to existing ditches and would exit PGDP through an existing KPDES-permitted outfall. Treated waste water would be required to meet ARARs under CERCLA for discharge of pollutants into waters of the Commonwealth. Pollutants may include VOCs, metals, and/or PCBs that could be present in extracted water from a burial ground during excavation.

It is reasonably expected that BGOU project effluent will meet all ambient water quality criteria in the receiving stream if the concentration of pollutants is at or below the Kentucky numeric water quality criteria for fish consumption specified in Table I of 401 *KAR* 10:031 § 6(1). There are no waste load allocations approved by EPA pursuant to 40 *CFR* § 130.7 for the receiving stream (Bayou Creek) that would impact effluent limits based on the numeric water quality criteria for fish consumption specified in Table I of 401 *KAR* 10:031 § 6(1).

The FFA parties have agreed to defer the establishment of radionuclide effluent limits for discharges of wastewater from this CERCLA project until the Proposed Plan and Record of Decision stage of remedy selection. Effluent limits for radionuclides will be established in accordance with CERCLA, the NCP and EPA guidance.

2.4.2 Evaluation and Screening of Representative Technologies

Technologies retained following the initial screening in Section 2.4.1 are evaluated with respect to effectiveness, implementability, and cost in Table 2.2. The objective of this evaluation is to provide sufficient information for subsequent selection of RPOs in Section 2.4.3.

Effectiveness is the most important criterion at this evaluation stage. The evaluation of effectiveness was based primarily on the following:

- The potential effectiveness of process options in handling the estimated areas or volumes of contaminated media and meeting the RAO;

- The potential impacts to worker safety, human health, and the environment during construction and implementation; and

- The degree to which the processes are proven and reliable with respect to the contaminants and conditions at the site.

The evaluation of implementability includes consideration of the following:

- The availability of necessary resources, skilled workers, and equipment to implement the technology;

- Site accessibility and interfering infrastructure;

- Potential public concerns regarding implementation of the technology; and

- The time and cost-effectiveness of implementing the technology in the physical setting associated with the waste unit.

A relative cost evaluation is provided in Table 2.2 for comparison among technologies. Relative capital and O&M costs are described as high, medium, or low. Capital costs for the technologies evaluated tend to increase with increasing complexity and number of process unit operations. O&M costs are estimated to be lower when an alternative may meet PRGs and reduce or eliminate the need for long-term monitoring.

While it is understood that monitoring will be needed for as long as there is a potential for a completed exposure pathway between COPCs and receptors, a technology that leaves waste in place is assumed for estimating purposes to have a 1,000-year long-term monitoring groundwater program that is moderate in cost when considered from a present value perspective, but high in cost when considered in terms of an actual or escalated cost evaluation. These costs are based on references applicable to the particular process option, prior estimates, previous experience, and engineering judgment. The costs are not intended for budgeting purposes. Additionally, a LUC program will be implemented to assure that a containment remedy controls direct contact over the long-term protection of human health and the environment.

Table 2.2. Evaluation of SWMUs 2, 3, 7, and 30 Technology Types and Process Options

Technology Type	Process Option	Effectiveness			Implementability		Relative Cost	
		Long-Term Effectiveness	Short-Term Effectiveness	Demonstrated Effectiveness and Reliability	Technical	Administrative	Capital	O&M
General Response Action—LAND USE CONTROLS								
Institutional Controls	E/PP Program	Moderate—effective for as long as DOE or its contractor maintain an on-site presence at the PGDP	High—effective at preventing worker exposure	High—already implemented	High—already implemented	High—already implemented	Low	Low
	Property Record Notice	Moderate—relies on continued future implementation	High—effective for preventing groundwater and property use	High to moderate	High	High	Low	Low
	CERCLA Section 120(h)	Moderate—relies on continued future implementation	High—effective for preventing groundwater and property use	High to moderate	High	High	Low	Low
	Deed and/or Lease Restrictions	Moderate—relies on continued future implementation	High—effective for preventing groundwater and property use	High to moderate	High	High	Low	Low
	Environmental Covenant	Moderate—relies on continued future implementation	High—effective for preventing groundwater and property use	High to moderate	High	High	Low	Low
Physical Controls	Warning Signs	Moderate—prevents and controls access; does not reduce contaminant levels	High—effective at preventing worker exposure	High—already implemented; requires inspections and maintenance	High—already implemented	High—already implemented	Low	Low
	Fences	Moderate—prevents and controls access; does not reduce contaminant levels	High—effective at preventing worker exposure	High—requires inspections and maintenance	High	High	High	High

Table 2.2. Evaluation of SWMUs 2, 3, 7, and 30 Technology Types and Process Options (Continued)

Technology Type	Process Option	Effectiveness			Implementability		Relative Cost	
		Long-Term Effectiveness	Short-Term Effectiveness	Demonstrated Effectiveness and Reliability	Technical	Administrative	Capital	O&M
General Response Action—SURFACE CONTROLS								
Surface Barriers	Soil Cover	High	High—effective at preventing worker exposure	High	High	High	Moderate	Moderate
	Riprap	High	High	High	High	High	Moderate	Moderate
General Response Action—MONITORING								
Soil Monitoring	Conventional Sample Collection and Analysis	N/A—only considered as subordinate technology during remediation	High—effective at defining contamination and guiding excavation	High	High	High	Moderate	N/A
	Soil Cores	N/A—only considered as subordinate technology during remediation	High—effective at defining contamination and guiding excavation	High	High	High	Moderate	N/A
	Membrane Interface Probe	N/A—only considered as subordinate technology during remediation	High—effective at defining contamination and guiding excavation	Moderate—can be difficult to calibrate MIP readings to analytical data	High	Moderate	Low	N/A
	Soil Gas Monitoring (e.g., Gore-sorbers)	N/A—only considered as subordinate technology during investigation	High—effective for qualitatively detecting VOCs	High for qualitative data only	High	High	Low	N/A
Groundwater Monitoring	Conventional Groundwater Well Installation, Sample Collection, Analysis	High—sampling can continue for many years	High—can be installed quickly	High	High	High	Moderate	Low
	Diffusion Bags	High—sampling can continue for many years	High—can be installed quickly	High	High	High	Moderate	Low

Table 2.2. Evaluation of SWMUs 2, 3, 7, and 30 Technology Types and Process Options (Continued)

Technology Type	Process Option	Effectiveness			Implementability		Relative Cost	
		Long-Term Effectiveness	Short-Term Effectiveness	Demonstrated Effectiveness and Reliability	Technical	Administrative	Capital	O&M
General Response Action—MONITORING (Continued)								
Groundwater Monitoring (Continued)	Borehole Fluxmeter	High	High	Moderate	Moderate	Moderate	Moderate	Low
	Ribbon NAPL Sampler	N/A—only considered as subordinate technology during investigation	High	High for qualitative data only	High	High	Moderate	Low
	DNAPL Interface Probe	N/A—only considered as subordinate technology during investigation	High	High	High	High	Low	Low
Surface Water Monitoring	Conventional Surface Water Monitoring	N/A—only considered as subordinate technology during investigation	High	High	High	High	Low	Low
General Response Action—MONITORED NATURAL ATTENUATION								
Monitoring and Natural Processes	Soil and Groundwater Monitoring with Abiotic and Biological Processes	Low for uranium	High	Low for uranium	High	Low	Low	Moderate
General Response Action—REMOVAL								
Excavators	Backhoes/ Trackhoes	High—remove source to 15–20 ft bgs with conventional equipment. Deeper excavations possible, but with added complexity	Moderate—risks to workers in excavation	High	High	High	Low	Low

Table 2.2. Evaluation of SWMUs 2, 3, 7, and 30 Technology Types and Process Options (Continued)

Technology Type	Process Option	Effectiveness			Implementability		Relative Cost	
		Long-Term Effectiveness	Short-Term Effectiveness	Demonstrated Effectiveness and Reliability	Technical	Administrative	Capital	O&M
General Response Action—REMOVAL (Continued)								
Excavators (Continued)	Vacuum Excavation, Remote Excavator	High—remove source to 9.14 to 12.2 m (30–40 ft) bgs	Low—work may be hampered by metal debris or other large pieces	Low—because of the scrap and metal debris found at these SWMUs	Low—because of the scrap and metal debris found at these SWMUs	High	Moderate	Moderate
	Crane and Clamshell	High—remove source to > 30 m (100 ft) bgs	Moderate—more technically complex; hoisting and rigging concerns	High	Moderate	Moderate	High	High
	Large Diameter Auger	High—remove sources to > 30 m (100 ft) bgs	Low—generates significant quantities of cuttings in order to achieve auger overlap	High	Low when debris is present or subsurface conditions are not well defined	Moderate	Moderate	Moderate
General Response Action—CONTAINMENT								
Hydraulic Containment	Recharge Controls	Moderate	High	High	High	High	Low	Moderate
	Groundwater Extraction	Moderate	High	High	Moderate	High	High	Moderate
Capping	RCRA Subtitle C Cap	Moderate	High	High	Moderate	High	High—complex construction	Moderate—ongoing maintenance & monitoring required
	KY Subtitle D Cap	Moderate	High	High	Moderate	High	High	Moderate
	Concrete-Based Cover	Low—prone to cracking	High	Low—prone to cracking	Moderate	High	High	High
	Conventional Asphalt Cover	Low—relatively permeable	High	Low—relatively permeable	High	High	Low	Moderate

Table 2.2. Evaluation of SWMUs 2, 3, 7, and 30 Technology Types and Process Options (Continued)

Technology Type	Process Option	Effectiveness			Implementability		Relative Cost	
		Long-Term Effectiveness	Short-Term Effectiveness	Demonstrated Effectiveness and Reliability	Technical	Administrative	Capital	O&M
General Response Action—CONTAINMENT (Continued)								
Capping (Continued)	MatCon™ Asphalt	Moderate	High	Moderate	Moderate—proprietary vendor technology	High	Moderate	Moderate
	Flexible Membrane	Moderate	High	Moderate–must be protected from damage	Moderate	High	Moderate	Moderate—ongoing maintenance and monitoring required
Subsurface Vertical Barriers	Freeze Walls	Low for permanent installation	High	Low—few long-term applications, but effectively used as a temporary measure in construction industry to stabilize excavation sidewalls	Low	High	High	High—energy and refrigerant costs
	Slurry Walls	Potentially high	Low—intrusive and requires adequate space to implement	Moderate	Low	High	High	Moderate
	Sheet Piling	Low for permanently reducing groundwater flow	Moderate to high—installation may contact waste depending upon placement	High	High	High	High	None
	Jet Injection Grouting	Potentially high	Moderate—installation may contact waste and generate some residuals for management	Moderate—difficult to verify results	Moderate	Low	High	Low

Table 2.2. Evaluation of SWMUs 2, 3, 7, and 30 Technology Types and Process Options (Continued)

Technology Type	Process Option	Effectiveness			Implementability		Relative Cost	
		Long-Term Effectiveness	Short-Term Effectiveness	Demonstrated Effectiveness and Reliability	Technical	Administrative	Capital	O&M
General Response Action—TREATMENT								
Biological	*In Situ* Process Options—Enhanced Biodegradation	High for VOCs, but not other COCs	High	Moderate	Moderate	High	Moderate	Low
Physical/ Chemical	Soil Vapor Extraction—*In Situ*	High	High	Moderate	Moderate	Low	High	Low
	Dual-Phase Extraction—*In Situ*	High	High	Moderate	Moderate	Low	High	Low
	Electrokinetics—*In situ*	High	Moderate	Moderate	Moderate	Moderate	High	Low
	Air Stripping—*Ex Situ*	High	High	High	High	Moderate	Moderate	Moderate—ongoing energy costs
	Ion Exchange—*Ex Situ*	High	High	High	High	High	Low	Moderate—ongoing secondary waste treatment and disposal costs
	Granular Activated Carbon (Vapor or Liquid Phase)—*Ex Situ*	High	High	High	High	High	Low	High—ongoing carbon replacement cost
	Vapor Condensation	High	High	High	Moderate	Moderate	High	High

Table 2.2. Evaluation of SWMUs 2, 3, 7, and 30 Technology Types and Process Options (Continued)

Technology Type	Process Option	Effectiveness			Implementability		Relative Cost	
		Long-Term Effectiveness	Short-Term Effectiveness	Demonstrated Effectiveness and Reliability	Technical	Administrative	Capital	O&M
General Response Action—TREATMENT (Continued)								
Physical/ Chemical (Continued)	Deep Soil Mixing—*In Situ*	Potentially high—can treat all VOC phases and other contaminants	Moderate	High—if soil conditions and COCs well understood; Low—if large debris is present	Moderate—buried materials must be cleared from treatment area	Moderate	High	Varies depending on application
	Cement and Grouting—*In Situ*	Low to moderate	Low to mode ate	Low	Low—poor performance in heterogeneous and low conductivity soils	Low	High	Low
Physical/ Chemical (Continued)	Jet Grouting—*In Situ*	Moderate—to high when used as a reagent delivery method	Moderate	Moderate	Moderate—injection may be hampered by debris and repositioning may be necessary	Moderate	Moderate	Moderate
Thermal	Electrical Resistance Heating—*In Situ*	High	High	Moderate	Moderate	Low	High	None
	Thermal Conduction Heating—*In Situ*	High	High	Moderate	Moderate	Low	High	None
	Steam Stripping	High	High	Moderate	Moderate	Low	High	None
	Catalytic Oxidation—*Ex Situ*	High	High	Moderate	Moderate	Low	High	None

Table 2.2. Evaluation of SWMUs 2, 3, 7, and 30 Technology Types and Process Options (Continued)

Technology Type	Process Option	Effectiveness			Implementability		Relative Cost	
		Long-Term Effectiveness	Short-Term Effectiveness	Demonstrated Effectiveness and Reliability	Technical	Administrative	Capital	O&M
General Response Action—TREATMENT (Continued)								
Thermal (Continued)	Thermal Desorption—*Ex Situ*	High	Moderate—soil must be excavated	High	High	Moderate—air emissions	High	High energy costs during implementa-tion; none after completion
	Vitrification	High	High	Moderate	Moderate	Low	High	Very high energy costs during implementa-tion; none after completion
	Uranium Chip Roasting	High	Moderate—potential for worker exposure to Uranium and other contaminants	High	Moderate	Moderate	Moderate	Moderate
Chemical	*In Situ* Oxidative Reagents	Uncertain in UCRS due to low permeability, heterogeneity, and variable saturation	Moderate	Moderate	Moderate	Moderate	Moderate	Moderate—may require continued injection
	In Situ Reductive Reagents	Moderate	Moderate	Moderate	Moderate	Low	Moderate	None
General Response Action—Disposal								
Land Disposal	Off-Site Permitted Disposal Facility	High	Moderate—long-distance transportation required	High	High	High	High	None
	Potential Disposal Unit	High	High	High	Moderate	Moderate	Low	None

Table 2.2. Evaluation of SWMUs 2, 3, 7, and 30 Technology Types and Process Options (Continued)

Technology Type	Process Option	Effectiveness			Implementability		Relative Cost	
		Long-Term Effectiveness	Short-Term Effectiveness	Demonstrated Effectiveness and Reliability	Technical	Administrative	Capital	O&M
General Response Action—Disposal (Continued)								
Land Disposal (Continued)	PGDP C-746-U Landfill	High	High	High	High	High	Low	None—long-term monitoring and maintenance not paid by program
Discharge of Wastewater	Wastewater Treatment Demonstrating Compliance with ARARs	High	Moderate	High	High	Moderate	Moderate	Moderate—monitoring required

2.4.3 Representative Process Options

Table 2.3 shows the RPOs that were selected to be included in alternative development based on the implementability screening and effectiveness evaluation performed in Sections 2.4.1 and 2.4.2, respectively. The selected RPOs were determined to be the most potentially effective and implementable of the process options considered for each technology type. The RPOs were selected as needed to formulate the remedial alternatives that are appropriate for each SWMU, as presented in Section 3. Not all technologies or process options were developed into components of remedial alternatives. The representative process provides a basis for developing performance specifications during preliminary design; however, the specific process actually used to implement the remedial action at a site will be selected in the ROD.

In some cases, more than one RPO was selected for a technology type; this was done, for example, when two or more process options were considered to be sufficiently different in their performance such that one would not adequately represent the other.

Table 2.3. Selection of Representative Process Options

General Response Actions	Technology Type	Representative Process Options	Basis for Selection
Land Use Controls	Institutional Controls	Property record notice, contingent deed and/or lease restriction, CERCLA Section 120(h), E/PP Program, Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer	Effective and implementable. Low cost.
Land Use Controls	Physical Controls	Signs	Effective and implementable. Low cost.
		Fences	Effective and implementable. High to moderate cost.
Surface Controls	Surface Barriers	Riprap	Provides effective protection from intrusion.
		Soil cover	Mitigates direct contact risk.
Monitoring	Groundwater Monitoring	Conventional sampling and analysis from MWs. Potential exists for installation of additional MWs	Effective and implementable for monitoring. Moderate cost.
Monitoring	Surface Water Monitoring	Conventional sampling and analysis	Effective and implementable for monitoring. Low cost.
Removal	Excavators	Backhoes, trackhoes	Demonstrated effectiveness to depths of 20 ft bgs; technically implementable at BGOU source areas. Moderate cost.
Containment	Hydraulic Containment	Groundwater extraction	Technically implementable. Groundwater extraction is implementable in the RGA, although hydraulic control may require pumping large volumes of water. Retained for possible alternative development as a supporting technology for other treatments. Moderate cost.
Containment	Capping	Landfill covers (including Subtitle C and D caps)	Implementable and prevents direct contact and migration of residual contamination not effectively removed/destroyed by other means. Moderate cost.

Table 2.3. Selection of Representative Process Options (Continued)

General Response Actions	Technology Type	Representative Process Options	Basis for Selection
Containment	Subsurface Vertical Barriers	Sheet pile	Sheet pile is selected as a complementary process option to excavation, not as a permanent installation. Moderate cost.
Containment	Subsurface Vertical Barriers	Slurry wall	Slurry wall is selected as a complementary process option to capping to prevent lateral migration from the unit within the UCRS. Moderate cost.
Treatment	Physical/Chemical	Air stripping (*ex situ*), ion exchange (*ex situ*), GAC (*ex situ*)	Implementable if paired with another technology, such as groundwater extraction (e.g., P&T). Moderate cost.
Treatment	Biological	*In situ* enhanced biodegradation	Implementable and will provide some protection to groundwater if paired with a surface barrier to prevent infiltration. Low cost.
Treatment	Physical/Chemical	Dual-phase extraction—*in situ*; deep soil mixing, jet grouting	Implementable and will provide some protection to groundwater if paired with a surface barrier to prevent infiltration. Moderate cost.
Treatment	Thermal	Electrical resistance heating—*in situ*	Implementable and will provide some protection to groundwater if paired with a surface barrier to prevent infiltration. High cost.
Treatment	Chemical	ZVI	Implementable and will provide some protection to groundwater if paired with a surface barrier to prevent infiltration. Moderate cost.
Disposal	Land Disposal	Off-site disposal	Effective and implementable as an adjunct technology for soil removal. High cost.
		Potential disposal unit	Effective as an adjunct technology for soil removal. Not currently implementable. Low cost.
		C-746-U on-site landfill	Effective and implementable for nonhazardous nonradioactive wastes, currently available. Wastes must meet WAC, including for PCBs. Low cost.
Disposal	Discharge of Wastewater	Wastewater treatment demonstrating compliance with ARARs	Effective and implementable for treated groundwater. Moderate cost.

3. DEVELOPMENT AND SCREENING OF GENERAL ALTERNATIVES

3.1 INTRODUCTION

The general alternatives developed and screened in this section offer a range of remedial alternatives that meet the goals of the FS. The screened general alternatives are refined in the SWMU-specific sections (Sections 5-8) by evaluating and selecting SWMU-specific RPOs based on SWMU-specific conditions.

The general alternatives were formulated to create responses that vary in the methods and degree of attainment of RAOs, the degree of reduction in toxicity, mobility, or volume; implementability; effectiveness; and cost in order to meet EPA's expectation that an FS for source control actions provides, "A range of alternatives in which treatment that reduces the toxicity, mobility, or volume of the hazardous substances, pollutants, or contaminants is a principal element" [40 *CFR* § 300.430(e)(3)].

The historically demonstrated effectiveness of combined technologies was used to identify candidate alternatives. Media interactions, including effects of source actions on RGA groundwater during implementation, also were considered.

These general alternatives are developed and discussed with the assumption that each could be applied to the various BGOU SWMUs as presented; however, decision makers could select portions of different alternatives at individual SWMUs, depending on additional evaluation, including public response to the proposed plan. Sufficient information is provided to allow for this type of alternative selection in the proposed plan and ROD.

3.2 CRITERIA FOR THE DEVELOPMENT OF REMEDIAL ALTERNATIVES

The purpose of the FS and the overall remedy selection process is to identify remedial actions that, at a minimum, eliminate, reduce, or control risks to human health and the environment and also meet ARARs. The national program goal of the FS process, as defined in the NCP, is to select remedies that are protective of human health and the environment, that maintain protection over time, and that minimize untreated waste. The NCP defines certain expectations for developing remedial action alternatives to achieve these goals.

3.3 DEVELOPMENT OF GENERAL ALTERNATIVES

The GRAs and technologies retained for further evaluation in Section 2 have been combined to form six general remedial alternatives. Effectiveness, implementability, and cost are the balancing criteria that were used to guide the development of these alternatives. The developed alternatives are summarized in Table 3.1, and Table 3.2 summarizes how these alternatives address COCs at SWMUs 2, 3, 7, and 30 and PTW identified in SWMUs 2, 3, and 7. A remedial design support investigation (RDSI) is included for each action alternative (with the exception of General Alternative 2) in anticipation that additional information will be required to support technology sizing, design, and optimization for any remedy selected. All alternatives that leave waste or contamination in place (above UU/UE levels) will include LUCs and monitoring to manage protection of human health and the environment.

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Table 3.1. Development of General Alternatives for PGDP BGOU Source Areas

	General Alternative 1	General Alternative 2	General Alternative 3	General Alternative 4	General Alternative 5	General Alternative 6
	No Action	**Limited Action (LUCs and Monitoring)**	**Containment, Surface Controls, LUCs, and Monitoring**	***In Situ* Source Treatment, Containment, Surface Controls, LUCs, and Monitoring**	**Excavation and Disposal, Treatment, and LUCs**	**Targeted Excavation and Disposal, Containment, Surface Controls, Treatment, LUCs, and Monitoring**
Primary Elements	No Action	LUCs • Physical Controls • Administrative Controls Monitoring • Groundwater Monitoring	Containment • Caps • Hydraulic Isolation Surface Controls • Surface Barriers LUCs • Physical Controls • Administrative Controls Monitoring • Groundwater Monitoring	Treatment • Biological • Physical/Chemical • Thermal • Chemical Containment • Caps • Hydraulic Isolation Surface Controls • Surface Barriers LUCs • Physical Controls • Administrative Controls Monitoring • Groundwater Monitoring	Removal • Excavation Disposal • Landfill Disposal Treatment • Biological • Physical/Chemical • Thermal • Chemical LUCs • Physical Controls • Administrative Controls Monitoring • Groundwater Monitoring	Removal • Excavation Disposal • Landfill Disposal Containment • Caps • Hydraulic Isolation Surface Controls • Surface Barriers Treatment • Biological • Physical/Chemical • Thermal • Chemical LUCs • Physical Controls • Administrative Controls Monitoring • Groundwater Monitoring

Table 3.2. Estimated Effectiveness of General Alternatives in Addressing COCs and PTW

		General Alternative 1[a] No Action	General Alternative 2[a] Limited Action (LUCs and Monitoring)	General Alternative 3[a] Containment, Surface Controls, LUCs, and Monitoring	General Alternative 4[a] *In Situ* Source Treatments,[b] Containment, Surface Controls, LUCs, and Monitoring	General Alternative 5[a] Excavation and Disposal,[c] Treatment, and LUCs	General Alternative 6[a] Targeted Excavation and Disposal,[c] Containment, Surface Controls, Treatment, LUCs, and Monitoring
PTW							
Direct Contact	Uranium solids (including PTW)	No	Yes. Addresses direct contact through LUCs, but does not reduce toxicity, mobility, or volume.	Yes. Addresses direct contact through LUCs and cap, but no reduction of toxicity, mobility, or volume.	Yes. Addresses direct contact through LUCs and cap, and reduces mobility through *in situ* treatment.	Yes	Yes. Addresses direct contact through LUCs and cap, but no reduction of toxicity, mobility, or volume.
	PCBs > 500 ppm[d]	No	No	Yes, if cap meets criteria in 40 *CFR* § 264.310(a).	Yes, if cap meets criteria in 40 *CFR* § 264.310(a).	Yes	Yes, if cap meets criteria in 40 *CFR* § 264.310(a).
Mobile Constituents	Uranyl fluoride PTW	No	Limited. (Some effectiveness due to existing SWMU 3 leachate collection and treatment and minimal risk of uranium exposure via air because of existing soil cover.)	Yes. Hydraulic isolation can be evaluated on a SWMU-specific basis as a means of capturing mobile constituents before they leave the unit.	Yes. Reduces mobility of uranyl fluoride through treatment.	Yes	Yes. Hydraulic isolation can be evaluated on a SWMU-specific basis as a means of capturing mobile constituents before they leave the unit.
	TCE, DCE (DNAPL/soil source, including PTW)	No	No	At SWMU 2, hydraulic isolation can be evaluated on a SWMU-specific basis as a means of capturing mobile constituents before they leave the unit. At SWMU 7, hydraulic isolation would have limited benefit based on presumed TCE distribution in the UCRS.	Yes. VOC toxicity, mobility, and volume reduced through treatment.	Yes	Yes. Some source material can be removed by excavation with hydraulic containment included as a means of capturing mobile constituents before they leave the unit.
LLTW							
Direct Contact	PCBs (> 10 but < 50 ppm)	No	Yes. LUCs are considered sufficient per 40 *CFR* § 761.61.	Yes	Yes	Yes	Yes
	PCBs (> 50 but less than 100 ppm) PCBs (> 100 ppm but less than 500 ppm)	No	No	Yes, if cap meets criteria in 40 *CFR* § 264.310(a).	Yes, if cap meets criteria in 40 *CFR* § 264.310(a).	Yes	Yes, if cap meets criteria in 40 *CFR* § 264.310(a).
	Metals (other than uranium)	No	Yes, but no significant potential for reduction in toxicity, mobility, or volume.	Yes, but no significant potential for reduction in toxicity, mobility, or volume.	Yes	Yes	Yes, through soil removal, LUCs, and a cap.
	Np-237 + daughters	No	Yes	Yes	Yes	Yes	Yes, through soil removal, LUCs, and a cap.
	Uranium-234, 235/236, 238 + daughters	No	Yes	Yes	Yes	Yes	Yes, through soil removal, LUCs, and a cap.
	Total PAHs	No	Yes	Yes	Yes	Yes	Yes, through soil removal, LUCs, and a cap.
	Uranium (metal)	No	Yes	Yes	Yes	Yes	Yes, through soil removal, LUCs, and a cap.
Mobile Constituents	Metals (other than uranium)	No	No significant potential for reduction in toxicity, mobility, or volume.	Yes, if hydraulic containment is included.	Yes	Yes	Yes, through soil removal, and a cap.
	Tc-99	No	No significant potential for reduction in toxicity, mobility, or volume.	Yes, if hydraulic containment is included.	Yes	Yes	Yes, through soil removal, and a cap.
	TCE, DCE, vinyl chloride (non-DNAPL)	No	No significant potential for reduction in toxicity, mobility, or volume.	Yes, if hydraulic containment is included.	Yes	Yes	Yes, through soil removal, and a cap.

[a] Alternatives are presented in a general format and will be developed into SWMU-specific alternatives in subsequent sections.
[b] *In situ* treatment could include a number of technologies as discussed in SWMU-specific sections.
[c] Disposal could include consolidation and/or segregation of contaminated materials with either no treatment or on-site treatment of excavated material and then disposal on-site or off-site in approved disposal facility designed to receive specific waste.
[d] SWMU 2 potentially contains PCBs > 500 ppm (DOE 2012).

Soil PRGs were developed (Section 1.6) to be protective of groundwater (Table 1.22) and direct contact with soils (Tables 1.20 and 1.21). Table 3.2 summarizes how alternatives address those COCs and how the alternatives address the PTW identified in SWMUs 2, 3, and 7.

The final determination of successful remediation will be based on a demonstration that the target concentrations for COCs have been met. Target concentrations are those concentrations that meet acceptable risk criteria for the specific COCs present incorporating all the risk/hazard control elements of the alternative. They differ from PRGs in that they consider the cumulative risk of actual COCs present in samples at time of sampling and the realistic exposure scenarios to be allowed at the site.

In order to develop remedial costs for each alternative, assumptions were made about the area, depth, and volume of the contaminant source areas. These assumptions are based on the available characterization data and site history. Assumptions regarding each SWMU's disposal history including area, depth, and volume are captured in Section 1.3.3. Assumptions regarding specific areas, depths, and volumes of treatment, removal, or containment are found in the SWMU-specific sections of this FS, as well as in the cost estimates found in Appendix E.

3.4 GENERAL ALTERNATIVES FOR BGOU SOURCE AREAS

3.4.1 General Alternative 1—No Action

Formulation of a No Action alternative is required by the NCP [40 *CFR* § 300.430(e)(6)]. The No Action alternative serves as a baseline for evaluation of other remedial action alternatives and is retained throughout the FS process. As defined in CERCLA guidance actions taken to reduce exposure, such as site fencing, are not included as a component of the No Action alternative (EPA 1988). Alternative 1 includes no actions and no costs.

3.4.2 General Alternative 2—Limited Action (LUCs and Monitoring)

This alternative eliminates direct contact risk via LUCs and recognizes the role played by the existing surface soil in preventing direct contact with the waste and contaminated materials. This alternative also may eliminate risk from exposure to groundwater through the use of LUCs. Monitoring mitigates the uncertainties associated with managing risks associated with exposure to groundwater by monitoring any changes in SWMU status or condition that may warrant an additional response or action.

The following GRAs, technologies, and process options, as applicable, are identified as integral components of Alternative 2.

General Response Action	Technologies	Process Options
Monitoring	Groundwater Monitoring	Conventional groundwater monitoring to be defined based on SWMU-specific conditions
Land Use Controls	Physical Controls	To be defined based on SWMU-specific conditions
	Administrative Controls	To be defined based on SWMU-specific conditions

Additionally, Alternative 2 can be described as including the following components:

- RD,
- Monitoring, and
- LUCs.

3.4.2.1 Remedial design

A SWMU-specific RD will be performed. This design will evaluate existing data to define the limits of waste placement or the SWMU boundary as necessary to develop LUCs. The need for and placement of additional MWs will be identified to document the continuing protectiveness of the remedy.

3.4.2.2 Groundwater and surface water monitoring

The groundwater monitoring program is expected to incorporate sampling of upgradient and downgradient wells, screened in the RGA, followed by analyses for SWMU-related analytes. A general description of the groundwater monitoring objectives, schedules, reporting requirements, sampling strategies, technologies, and personnel necessary to ensure remedy effectiveness is presented in the SWMU-specific sections.

Surface water monitoring may be needed to assess surface water impacts to adjacent surface water ditches. SWMU-specific monitoring details will be developed in the RD. As additional impacts to ditches adjacent to these SWMUs are identified, they will be evaluated.

3.4.2.3 LUCs

All alternatives that leave waste or contamination in place above UU/UE levels will include LUCs. The specific LUCs described in Section 2.4.1.1 will be evaluated for effectiveness, implementability, and cost in the SWMU-specific sections of this report for inclusion on a SWMU-specific basis.

3.4.3 General Alternative 3—Containment, Surface Controls, LUCs, and Monitoring

This alternative will evaluate means to effectively prevent contamination from migrating to the RGA or surface water and will evaluate means to prevent direct contact with waste or contaminated soils.

Under this alternative, a cap (RCRA Subtitle C or KY Subtitle D cap) will be designed and installed to prevent direct contact and significantly reduce infiltration of precipitation into buried waste.[9] Other containment technologies, such as hydraulic isolation, including vertical subsurface barriers and groundwater extraction, will be evaluated for inclusion on a SWMU-specific basis. Additionally, surface controls and LUCs will be evaluated for inclusion on a SWMU-specific basis.

The following general response actions, technologies, and process options, as applicable, are identified as integral components of Alternative 3.

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[9] In the case of SWMU 3, the alternative accepts credit for the existing RCRA Subtitle C cap.

General Response Action	Technologies	Process Options
Containment	Caps	KY Subtitle D or RCRA Subtitle C cap
	Hydraulic Isolation*	To be evaluated on SWMU-specific conditions
Surface Controls	Surface Barriers*	Riprap or soil cover
Monitoring	Groundwater Monitoring	Conventional groundwater monitoring to be defined based on SWMU-specific conditions
	Surface Water Monitoring	Conventional surface water monitoring to be defined based on SWMU-specific conditions
Land Use Controls	Physical Controls	To be evaluated based on SWMU-specific conditions
	Administrative Controls	To be evaluated on SWMU-specific conditions

*To be evaluated for inclusion based on SWMU-specific conditions.

This alternative includes the following as necessary:

- RDSI;
- RD;
- Cap construction;
- Hydraulic isolation implemented based on SWMU-specific considerations;
- Surface controls evaluated based on SWMU-specific conditions;
- Groundwater and surface water monitoring; and
- LUCs.

3.4.3.1 Remedial design site investigation

Engineering data will be collected to support technology sizing, design, and optimization of the containment system and will be performed, as necessary, during the RD in accordance with the RAWP.

An RDSI for Alternative 3 would focus on aspects of groundwater monitoring, such as adequacy of existing groundwater wells and the design of additional groundwater wells, if needed. It also would need to include confirmation of waste placement locations and topographic and drainage considerations that are needed for cap and/or hydraulic isolation components. The RDSI also may include further investigation of surface soils outside the containment area for potential consolidation under the cap. Any additional information needed to implement surface controls would be captured for cap design.

3.4.3.2 Remedial design

A SWMU-specific RD will be performed. This design will evaluate existing information, as necessary, to design the containment remedy. This design also will incorporate information necessary to develop LUCs. The need for and placement of additional MWs will be identified to document the continuing protectiveness of the remedy.

3.4.3.3 Cap construction

Either a KY Subtitle D or RCRA Subtitle C cap, as described in Section 2.4.1.7.2, would be constructed over the waste.

Decay of in-place uranium eventually will generate radium and subsequently radon gas; however, the half-life of the uranium decay is very long. All radon isotopes have a short half-life and low potential for vapor migration from affected areas. These conditions support a determination that specific radon mitigation measures are not required for these burial grounds. Further, the rapid dispersion of radon in the atmosphere and the absence of buildings located on or adjacent to the SWMU where radon could accumulate, the barrier provided by a cap, and radon's rapid decay minimize exposure hazards. Any subsequent modification to the cap (including the installation of buildings) should consider the potential for impacts from radon. Radon modeling will be conducted during the remedial design phase for any remedy that involves capping of low level waste that might emit radon at SWMU 2 or SWMU 3, and the modeling should be consistent with the modeling performed for the OSWDF project or new technologies and/or methodologies agreed to by the FFA parties.

3.4.3.4 Hydraulic isolation

In addition to a cap, the additional containment technologies vertical subsurface barriers (e.g., slurry walls) and hydraulic isolation (e.g., groundwater extraction) will be evaluated for application on a SWMU-specific basis to isolate lateral and downward vertical contaminant migration from the SWMU.

3.4.3.5 Surface controls

Surface controls, which have the primary purpose of providing a physical barrier that will prevent direct contact exposure to surface soil contamination or underlying waste, will be evaluated based on SWMU-specific conditions. The cap described in the previous section would prevent direct contact with contaminants. Also, LUCs would ensure protectiveness. In the event that additional surface controls are required, the RPO for surface controls would be riprap.

3.4.3.6 Groundwater and surface water monitoring

A groundwater monitoring program will be implemented to support performance monitoring of Alternative 3 (the containment remedy). A general description of the groundwater monitoring objectives, schedules, reporting requirements, sampling strategies, technologies, and personnel necessary to ensure remedy effectiveness is presented in the SWMU-specific sections.

Surface water monitoring would be evaluated during the RD, but is not anticipated because the specified cap would be constructed of clean soil, and cap installation would eliminate a surface water exposure pathway.

3.4.3.7 LUCs

All alternatives that leave waste or contamination in place above UU/UE levels will include LUCs. The specific LUCs described in Section 2.4.1.1 will be evaluated for effectiveness, implementability, and cost in the SWMU-specific sections of this report for inclusion on a SWMU-specific basis.

3.4.4 General Alternative 4—*In Situ* Source Treatment, Containment, Surface Controls, LUCs, and Monitoring

Alternative 4 is the same as Alternative 3 with the addition of *in situ* source treatment and associated postremediation sampling. The *in situ* treatment will be used to address in-place wastes and/or contaminated media.

Upon completion of the source treatment, a cap would be installed over the waste area and the containment technologies vertical subsurface barriers (e.g., slurry walls), and hydraulic isolation (e.g., groundwater extraction) will be evaluated for inclusion on a SWMU-specific basis to isolate lateral and downward vertical contaminant migration from the SWMU. Other containment technologies and hydraulic isolation may be implemented based on SWMU-specific considerations. The final physical installations would be the placement of surface controls and any signs.

Excavation to remove buried construction rubble, debris, or metallic waste that could interfere with the installation or operation of the source treatment system is not planned. Should any incidental removal be needed to implement the treatment, it will be identified in the RD. Excavated material will be managed and/or disposed of properly in accordance with its composition and degree of contamination, if any.

The following GRAs, technologies, and process options, as applicable, are identified as integral components of Alternative 4.

General Response Action	Technologies	Process Options
Treatment	As described in Section 3.4.4.3	
Containment	Caps	KY Subtitle D or RCRA Subtitle C cap
	Hydraulic Isolation*	To be evaluated on SWMU-specific conditions
Surface Controls	Surface Barriers*	Riprap or soil cover
Monitoring	Groundwater Monitoring	Conventional groundwater monitoring to be defined based on SWMU-specific conditions
	Surface Water Monitoring	Conventional surface water monitoring to be defined based on SWMU-specific conditions
Land Use Controls	Physical Controls	To be evaluated based on SWMU-specific conditions
	Administrative Controls	To be evaluated on SWMU-specific conditions

*To be evaluated for inclusion based on SWMU-specific conditions.

This alternative includes the following:

- RDSI;
- RD;
- Installation of *in situ* source treatment;
- Postremediation sampling;
- Cap construction;
- Hydraulic isolation implemented based on SWMU-specific considerations;
- Surface controls evaluated based on SWMU-specific conditions;
- Groundwater monitoring and surface water monitoring; and
- LUCs.

3.4.4.1 Remedial design site investigation

The RDSI for Alternative 4 would be similar to that for Alternative 3 except that it would be augmented to define the extent of waste(s) or contamination to be treated. Engineering data collection to support technology sizing, design, and optimization will be performed, as necessary, during the RD in accordance with the RAWP.

3.4.4.2 Remedial design

A SWMU-specific RD will be performed for this remedial alternative. This design will evaluate existing information, as necessary, to design the treatment system, containment system, and LUCs. The need for and placement of additional MWs to support either performance monitoring or extended monitoring will be identified. The SWMU-specific alternative evaluation will consider the uncertainties and assumptions inherent in this alternative and how the implementation and performance of the alternative would be affected by changes to the assumptions.

3.4.4.3 *In situ* source treatment

One or more of these RPOs may be used to reduce toxicity, mobility, and/or volume of the COCs. These RPOs will be evaluated further based on SWMU-specific conditions for effectiveness, implementability, and cost and will result in a treatment process option(s) selected to be included in the SWMU-specific alternatives, as appropriate.

Section 2.4 of this document identified *in situ* treatment RPOs, which are shown in Table 3.3.

Table 3.3. Selection of Representative Process Options

General Response Action	Technology Type	Representative Process Options	Basis for Selection
Treatment	Biological	*In Situ* Enhanced Biodegradation	Implementable and will provide some protection to groundwater if paired with a surface barrier to prevent infiltration. Low cost.
Treatment	Physical/Chemical	Dual-phase Extraction—*In Situ*, Cement and Chemical Grouting	Implementable and will provide some protection to groundwater if paired with a cap to prevent infiltration. Moderate cost.
Treatment	Thermal	Electrical Resistance Heating—*In Situ*	Implementable and will provide some protection to groundwater if paired with a cap to prevent infiltration. Note: ERH may not be appropriate for some buried waste.
Treatment	Chemical	ZVI—*In Situ*	Implementable and will provide some protection to groundwater if paired with a cap to prevent infiltration. Moderate cost.

3.4.4.4 Postremediation sampling

Confirmatory sampling in the treatment area may be utilized to determine treatment effectiveness in achieving PRGs and documenting residual contaminant concentrations. A postremediation/confirmation sampling plan will be prepared during RAWP development. Postremediation sampling will vary with the applied technology and also with the process monitoring.

3.4.4.5 Cap construction

A cap will be constructed at the unit, as summarized for Alternative 3 (see Section 3.4.3.3), and as specified in the SWMU-specific discussions later in this document.

3.4.4.6 Hydraulic isolation

The need to hydraulically isolate waste and impacted soil following treatment will be evaluated on a SWMU-specific basis as summarized for Alternative 3 (see Section 3.4.3.4).

3.4.4.7 Surface controls

The need for surface controls will be evaluated on a SWMU-specific basis as summarized above for Alternative 3 (see Section 3.4.3.5).

3.4.4.8 Groundwater and surface water monitoring

Groundwater monitoring and surface monitoring programs will be implemented to support performance monitoring, as summarized for Alternative 3 (see Section 3.4.3.6).

3.4.4.9 LUCs

All alternatives that leave waste or contamination in place above UU/UE levels will include LUCs. The specific LUCs described in Section 2.4.1.1 will be evaluated for effectiveness, implementability, and cost in the SWMU-specific sections of this report for inclusion on a SWMU-specific basis.

3.4.5 General Alternative 5—Excavation and Disposal, Treatment, and LUCs

Alternative 5 includes excavating wastes and associated affected soils for disposal. This alternative also includes *in situ* treatment if either of the following situations is presented.

- RGs were not met during excavation because mobile COCs have migrated below the maximum excavation depth (20 ft bgs).
- The RDSI determines that mobile COCs, such as TCE, were not codisposed of with the solid wastes and that treatment outside the waste area is preferable to excavation based on effectiveness, implementability, and cost.

Monitoring of groundwater should not be necessary once the buried wastes and subsurface soils are removed.

All alternatives that leave waste or contamination in place above UU/UE levels will include LUCs. The specific LUCs identified in Section 2.4.1.1 will be evaluated for inclusion based on effectiveness, implementability, and cost. LUCs will be evaluated because UU/UE conditions may not be met.

Because SWMU-specific conditions differ, as described in Section 1, SWMU-specific excavation, *ex situ* treatment, packaging, and disposal details will be presented in the SWMU-specific sections of this report, as applicable. The following sections describe the excavation process in a general manner while highlighting some important SWMU-specific concerns.

The following GRAs, technologies, and process options, as applicable, are identified as integral components of Alternative 5.

General Response Action	Technologies	Process Options
Removal	Excavators	Backhoes/trackhoes
Disposal	Landfill Disposal*	To be evaluated on waste stream specific conditions
Treatment	See Table 3.3	
Land Use Controls	Physical Controls	To be evaluated based on SWMU-specific conditions
	Administrative Controls	To be evaluated on SWMU-specific conditions

*Wastes may require *ex situ* treatment prior to disposal to meet the disposal facility's WAC. Specific treatment process options will be discussed on a SWMU-specific basis.

This alternative includes the following:

- RDSI;
- RD;
- Shoring (based on SWMU-specific evaluation);
- Excavation;
- Treatment or disposal of residual groundwater as necessary;
- Postexcavation sampling and analysis;
- Treat waste and soil on- or off-site, if necessary, for WAC compliance;
- Transport and dispose of waste;
- Backfill to meet final design requirements and contours;
- Installation of *in situ* source treatment; and
- LUCs.

3.4.5.1 Remedial design site investigation

The RDSI for Alternative 5 would be similar to that for Alternatives 3 and 4; greater emphasis would be placed on defining the extent of waste(s) or contamination so that treatment processes can be designed. Additionally, waste samples would be collected to support the design of *ex situ* treatments and to ensure the treated wastes would meet the WAC of the disposal facilities. Engineering data collection to support technology sizing, design, and optimization will be performed, as necessary, during the RD in accordance with the RAWP.

As necessary, the RDSI will include updating the geophysical survey to ensure that the bounds of the waste area are well understood. For SWMU 2, where excavation is anticipated to extend to 20 ft bgs and engineered shoring will be necessary to avoid interferences with SWMU 3 (the capped C-404 Landfill), borings will be placed around the perimeter of the planned excavation and samples collected and analyzed for COCs. If COCs are found below RGs, then the lateral limits of excavation will be defined by the boring locations. If COCs are found above RGs, then borings will be stepped out and sampling repeated.

3.4.5.2 Remedial design

A SWMU-specific RD will be performed. This design will evaluate existing information, as necessary, to design the excavation, any *in situ* or *ex situ* treatment, and LUCs.

This alternative anticipates that the scale and scope of an RD will depend on SWMU-specific conditions and will be discussed in the SWMU-specific sections of this report. Additionally, the SWMU-specific alternative evaluation will consider the uncertainties and assumptions inherent in this alternative and how the alternative would be affected by changes to the assumptions and uncertainties.

3.4.5.3 Shoring

Because some of the SWMUs are located in areas of PGDP with limited accessibility, shoring, such as sheet piles, may be required to excavate the waste cell material to the anticipated depth. If shoring is determined to be necessary in the RAWP, a comprehensive shoring system will be designed based on the maximum anticipated excavation depth at the SWMU in question. The cost estimate assumes sheet piling will be used as the method of shoring. This system, to be designed as part of the RDWP, is expected to include interlocking sheet pile and may include drilled tie-back anchors, which will extend through the sheet pile to the surrounding soil.

Installation of shoring around the perimeter of the waste will be performed prior to beginning excavation. During excavation, dewatering would be required to remove groundwater trapped within the confines of the sheet piles. Discharge of collected water is discussed in Section 2.4.1.7.2.

Where shoring is not deemed necessary to implement an excavation, excavation will be performed in a safe manner to include sloping or benching of sidewalls to meet health and safety requirements.

3.4.5.4 Excavation

The excavation alternative includes the removal of waste and associated affected soils. Excavation will progress until visible wastes have been removed and the appropriate PRGs are met up to a maximum depth of 20 ft bgs, assumed excavation depths for each unit are contained in the SWMU-specific sections as shown in Figure 2.2.

The methods of waste excavation, staging, *ex situ* treatment as necessary, and loading are complex and site specific; therefore, a general approach is presented in this section with limited SWMU-specific detail. A number of factors and variables are considered part of the general excavation approach including, but not limited to, site controls and monitoring; dewatering; controls for fugitive emissions; weather protection; combustibles monitoring; and fire suppression. Additional detailed description of the excavation methodology will be presented in the SWMU-specific sections of this document and in the estimating assumptions included in Appendix E, as appropriate.

(1) The waste material will be excavated with conventional heavy equipment, such as trackhoes and backhoes/loaders. The maximum planned depth of excavation using such equipment is approximately 20 ft bgs. This conventional equipment will be limited by its own design or by the design depth of the shoring.

(2) Depending on how the material is to be characterized to meet the disposal facility WAC, the waste and soil either will be temporarily staged at the PGDP, loaded into trucks or trailers, or loaded directly into waste containers. The material may be segregated based on physical, chemical, and radioactive characteristics, as determined by field observation, testing, and monitoring, to facilitate meeting the WAC of the disposal facilities.

(3) The waste and soil will be treated, as necessary, to meet disposal facility's WAC requirements. Waste may be temporarily stored for the purpose of treatment in containers such as 208-liter (55-gal) drums; 1,325-liter (350-gal polyliners); 1,585-kg (3,500-lb) steel boxes; or 10-m^3 (25-yd^3) roll-off containers. The wastes will be stored in compliance with ARARs. Temporary storage would occur only as long as needed to facilitate the characterization and treatment processes required to allow disposal.

(4) If the material is determined by analytical testing to be nonhazardous, does not exceed the target concentrations, and meets PGDP guidance for clean backfill (PRS 2010), it will be set aside and considered for use as backfill for the BGOU project or for other projects. If the material meets criteria for fill at the C-746-U Landfill (or the potential OSWDF) it may be set aside and used as fill for these units. These procedures will be documented in the RAWP.

(5) Waste and soil will be treated to meet WAC requirements. Any pyrophoric uranium encountered during excavation would be treated through solidification/stabilization prior to disposal. Soils containing organic contaminants (e.g., VOCs or PCBs) that exceed land disposal restrictions may be subjected to off-site treatment prior to disposal. Specific treatment assumptions and details are provided in the SWMU-specific sections of this report as applicable.

(6) Waste and contaminated soil will be loaded into the proper shipping container and transported for treatment or disposal.

(7) As required by the RAWP and associated site-specific health and safety plan (HASP), airborne emissions containment and monitoring may be implemented. The HASP will also evaluate methods to control fugitive dust emissions and ensure waste transportation does not allow contaminants to leave the site.

At SWMUs 2 and 7, mobile COCs are anticipated to be encountered below 20 ft bgs; therefore, the excavation alternative also includes *in situ* treatment.

Equipment and Preparation. Excavation of contaminated soil and the removal of buried waste (including waste present in drums and other types of packaged debris) can be accomplished using conventional excavation techniques and equipment. Excavation equipment typically will consist of a trackhoe, rubber-tired backhoe, and/or front-end loader. Where pyrophoric uranium may be present, the excavator bucket will be equipped with teeth fabricated from material that minimizes spark-potential, thereby mitigating the potential of igniting hydrogen that could be generated through hydrolysis.

If intact drums are found, they may be removed with a drum grappler and placed directly into overpacks. The management of the excavation will be detailed in the RAWP. Drums not placed into an overpack will be evaluated to determine whether the drum should be opened and its contents transferred to another container or treated with foam or other fixing agent. As specified in the to-be-developed RAWP, other waste, such as decayed drums, packaging, and soil will either be direct loaded into trucks, staged within the excavation, or be placed in dewatering roll-off containers to minimize retention of free liquids with the excavated material.

Drums that still are intact will be removed from the excavation individually in order to minimize exposure to workers and the environment. Site controls will be utilized for both intact and degraded drums, as specified in the HASP. Standard fire prevention and suppression techniques will be used.

Pyrophoric Uranium Waste (SWMU 2 Only). Excavation activities will be performed in accordance with a HASP designed for handling pyrophoric uranium. The excavation and handling of this uranium presents challenges for the remedial action contractor. Detailed information regarding handling of uranium waste will be provided in the RAWP.

Uranium will undergo combustion if the oxide layer on the fines is disturbed in the presence of air and the rate of heat production by the self-sustaining chemical reaction (oxidation) exceeds the rate of the heat loss to the surroundings. Any type of handling has the potential to disturb the oxide layer. In the absence of a flammable or combustible material, the combustion of these types of materials resembles smoldering and produces a heavy smoke that likely would settle in the immediate vicinity. Typically, this type of event may be managed by covering the material with soil to allow the combustion to self-extinguish.

Dust emissions from excavation can be controlled by foam and/or water-based spray solutions.

Water generally is acceptable for use as an extinguishing or cooling agent for fires involving uranium; however, the preferred extinguishing agent is a sodium chloride-based powder such as MET-L-X. This dry powder is noncombustible and does not produce secondary fires as a result of its application to burning metal. Sodium chloride-based extinguishers and sodium chloride-based powder will be available at the site. Soil may be placed over a fire to cut off oxygen supply and extinguish the fire.

Uranium metal will need to be treated prior to disposal as required by the WAC of the receiving facility. During this treatment process, the above listed methods may be used to extinguish any fires that may occur. Additionally, other DOE sites have used a mineral oil misting spray to coat exposed metal surfaces and prevent fires. Additional detail regarding *ex situ* treatment can be found in the SWMU-specific section.

Secondary Waste. Secondary waste, such as PPE and spent bag filters, generated as part of the proposed action, will be characterized based on process knowledge and radiological screening. High-efficiency particulate air filters (if any are used) may contain low levels of radioactivity and will be managed on-site until they can be appropriately disposed of. Wastes or contaminated media identified as nonradiological and nonhazardous will be disposed of in the PGDP C-746-U Landfill, if they meet the WAC. Wastes or contaminated media identified as hazardous or low-level/low-level mixed will be stored on-site pending shipment to an appropriate disposal facility.

Wastes will be managed, recycled, treated, and/or disposed of in accordance with ARARs.

On-Site Storage. Waste may be temporarily stored in containers for the purpose of dewatering or treatment. The wastes will be stored on-site in compliance with ARARs. Temporary storage will occur only as long as needed to get the wastes/media through the treatment process(es), and then the treated waste/media would be sent for disposal.

3.4.5.5 Treatment or disposal of residual groundwater

There may be contaminated groundwater entering the excavation. If groundwater enters the excavation during or after removal of waste and contaminated soils, the groundwater will be treated and/or disposed of appropriately based on the nature of the contamination and the levels present in the groundwater.

Depending upon SWMU-specific considerations, an on-site wastewater treatment unit may be required or water may be transported to the existing on-site water treatment facility at the Northwest Plume. SWMU-specific dewatering assumptions will be detailed in the SWMU-specific sections of this report and in Appendix E.

3.4.5.6 Postexcavation sampling and analysis

Several types of sampling and analysis efforts may be performed during the excavation phase. As required, samples will be collected to support identification of disposal options and verify that the excavated materials meet the disposal facility's WAC requirements. Periodic sampling and analysis may occur throughout the course of excavating the SWMU to monitor progress. Excavation will continue to the desired depth or until contaminants above the target concentrations no longer are encountered. A final set of samples may be collected from the bottom of the excavation to confirm that the contaminants above the target concentrations have been removed. Sidewall samples will be collected if sheet-pile walls are not installed. The RAWP will summarize whether/how the excavation will be backfilled.

3.4.5.7 Treatment of waste and soil for WAC compliance

Excavated soils/wastes may be treated on-site or off-site at a commercial facility as needed to meet the WAC of the disposal facility. On-site treatment would be done in containers, tanks, temporary units, and/or corrective action management units (CAMUs) in accordance with ARARs. Treatment of hazardous waste is necessary to meet LDR treatment standards or alternatively CAMU treatment standards, if sent to a designated CAMU. Specific treatment assumptions and details are provided in the SWMU-specific sections of this report as applicable**.**

3.4.5.8 Transportation and disposal

The exact mode of transportation will be chosen based on material characteristics and disposal facility requirements. The shipping container requirements and transportation method(s) will be described in detail in the RAWP. It is anticipated that the wastes will be transported either by rail cars in appropriate containers or by truck.

Assumptions regarding transportation and disposal can be found in the SWMU-specific sections of this report and in Appendix E. Appendix E contains tables detailing the estimated quantities and disposition pathways for excavation-related wastes.

Because an evaluation of the feasibility of constructing an on-site disposal facility for CERCLA waste is underway, two sets of excavation cost estimates have been developed. One set assumes disposal at off-site federal and commercial facilities. The other set assumes use of the on-site disposal facility, as well as off-site federal and commercial facilities. Both sets of cost estimates assume use of the existing C-746-U Landfill for wastes assumed to meet the facility WAC.

3.4.5.9 Backfill

Upon completion of excavation and receipt of confirmatory postremediation sample results, fill material compatible with the final site use may be placed in the excavation. Drainage structures may need to be installed in the excavation prior to backfill. Alternatively, the SWMU may be re-graded to support future uses (e.g., as wetlands, as staging areas for soil borrow for the on-site cell, as staging areas for soils for the C-746-U Landfill).

If backfilled, the fill material will be placed in the excavation in lifts and compacted, as described in the RAWP. The excavation will be backfilled and graded to return the location to its original condition. If confirmed clean, soil from the upper layer of each SWMU that has been set aside will be combined with soil from elsewhere on the facility. All clean backfill material used will be confirmed clean prior to placement, in accordance with DOE protocol (PRS 2010). The cost estimate for this alternative assumes clean soil is obtained from off-site sources to be used for backfill.

3.4.5.10 Implement *in situ* treatment to address mobile COCs

This treatment alternative anticipates that RGs may not be met by excavation alone. Section 2 identified RPOs that could be used to treat residual contamination following backfill or contamination not colocated with waste. These RPOs are the same as identified in Table 3.3 and will be evaluated based on SWMU-specific conditions in the SWMU-specific sections of this report.

3.4.5.11 LUCs

Excavation and subsequent treatment will meet RGs (as applicable). LUCs are included as a remedy component in the event UU/UE is not attained; if UU/UE is attained, then LUCs would not be necessary. LUCs will be evaluated in the SWMU-specific sections of this report with specific LUCs being incorporated in the SWMU-specific alternatives carried forward to detailed analysis.

3.4.6 General Alternative 6—Targeted Excavation and Disposal, Containment, Surface Controls, Treatment, LUCs, and Monitoring

Alternative 6 employs targeted excavation and disposal of waste to provide more active remediation than is available through containment. Targeted excavation will address portions of the SWMU where the disposal of highly mobile waste has been documented. Targeted excavation will be conducted on buried waste to a maximum depth of 20 ft bgs. Following targeted excavation, Alternative 6 relies on containing the remaining wastes to protect human health or the environment from contact with those areas not excavated.

Alternative 6 reduces risk to receptors by removing COCs that have the greatest potential for risk under certain contaminant exposure and migration pathways and controlling direct contact by removal, containment, and LUCs. The containment components include installing a cap and hydraulic isolation, as appropriate, to limit direct contact and prevent infiltration of precipitation. Groundwater and surface water monitoring will be continued as necessary to monitor the effectiveness of the remedy.

Details for each element of the alternative are presented below. The cover system design also could include a surface barrier (riprap).

The following GRAs, technologies, and process options, as applicable, are identified as integral components of Alternative 6.

General Response Action	Technologies	Process Options
Removal	Excavators	Backhoes/trackhoes
Disposal	Landfill Disposal*	To be evaluated on waste stream specific conditions
Treatment	See Table 3.3	
Containment	Caps	KY Subtitle D or RCRA Subtitle C cap
	Hydraulic Isolation	To be evaluated on SWMU-specific conditions
Surface Controls	Surface Barriers	Riprap or soil cover
Monitoring	Groundwater Monitoring	Conventional groundwater monitoring to be defined based on SWMU-specific conditions
	Surface Water Monitoring	Conventional surface water monitoring to be defined based on SWMU-specific conditions
Land Use Controls	Physical Controls	To be evaluated based on SWMU-specific conditions
	Administrative Controls	To be evaluated on SWMU-specific conditions

*Wastes may require *ex situ* treatment prior to disposal to meet the disposal facility's WAC. Specific treatment process options will be discussed on a SWMU-specific basis.

The alternative includes the following:

- RDSI;
- RD (including identification of disposal facilities and WACs of disposal facilities);
- Shoring (based on SWMU-specific evaluation);
- Excavation of mobile waste source material;
- Treat or dispose of removed water, as necessary;
- Postexcavation sampling and analysis;
- Treat the waste and soil on-or off-site, if necessary, for WAC compliance;
- Transport and dispose of waste;
- Backfill to meet final design requirements and contours;
- Installation of *in situ* source treatment;
- Cap construction;
- Hydraulic isolation implemented based on SWMU-specific considerations;
- Surface controls evaluated based on SWMU-specific conditions;
- Install wells and monitor; and
- LUCs.

3.4.6.1 Remedial Design Site Investigation

Because Alternative 6 includes both containment and excavation components, the RDSI would include the tasks described for Alternatives 3, 4, and 5 (see Sections 3.4.3.1, 3.4.4.1, and 3.4.5.1).

3.4.6.2 Remedial design

Because Alternative 6 includes both containment and excavation components, the RD would include the tasks described for Alternatives 3, 4, and 5 (see Sections 3.4.3.2, 3.4.4.2, and 3.4.5.2).

3.4.6.3 Shoring

Targeted excavation expected to extend to the bottom of the waste or affected media to a depth no greater than 20 ft bgs, as described for Alternative 5 (see Section 3.4.5.3). Because of the limited area, depth, and desire to limit the volume of nontargeted wastes disturbed, shoring would be installed prior to excavation to isolate the wastes targeted for removal.

3.4.6.4 Excavation of mobile wastes

Excavation and disposal will be performed in a manner similar to that described for Alternative 5 (see Section 3.4.5.4), but adjusted to target individual COCs present in smaller areas as described in the SWMU-specific RAWP.

3.4.6.5 Dewatering

It is anticipated that the excavation process would result in the need for dewatering. Water may be the result of precipitation or from infiltrating groundwater. A general description of dewatering is found for Alternative 5 in Section 3.4.5.5. SWMU-specific water management details are found in the SWMU-specific sections of this report, as applicable.

3.4.6.6 Postexcavation sampling and analysis

Postexcavation sampling and analysis would be required to document conditions and determine if mobile COCs have migrated below the waste and, if so, to determine the extent of subsequent *in situ* treatment that would be required. A general description of dewatering is found for Alternative 5 in Section 3.4.5.6.

3.4.6.7 Treatment

As described for Alternative 5 in Section 3.4.5.7, waste and contaminated soil may need treatment to meet the receiving facility's WAC. Specific treatment assumptions and details are provided in the SWMU-specific sections of this report as applicable.

3.4.6.8 Transport and dispose of waste

Waste will be transported and disposed of as summarized for Alternative 5 (see Section 3.4.5.8).

3.4.6.9 Backfill

The excavation will be backfilled as summarized for Alternative 5 (see Section 3.4.5.9).

3.4.6.10 Implement treatment remedy

As with Alternative 5, it is recognized that mobile wastes may have migrated below the unit and post-excavation treatment may be required. As with Alternative 5, the selected treatment remedy is dependent upon SWMU-specific conditions, and treatment details are reserved for the SWMU-specific sections of this report.

3.4.6.11 Cap construction

Because excavation would occur only in those areas where the disposal of highly mobile waste is documented, this alternative would include placement of a cap over the remaining waste. The cap will be constructed as described for Alternative 3 in Section 3.4.3.3. Features of this system would be selected based on SWMU-specific conditions, but would include a cap. Hydraulic isolation, including vertical subsurface barriers and groundwater extraction also may be included based on SWMU-specific conditions.

3.4.6.12 Hydraulic isolation

Under the targeted excavation alternative, removal would occur in those areas where the disposal of highly mobile waste is documented. This alternative would include hydraulic isolation as described for Alternative 3 in Section 3.4.3.4. Hydraulic isolation features would be selected based on SWMU-specific conditions, but vertical subsurface barriers, and groundwater extraction would be evaluated.

3.4.6.13 Surface controls

The need for surface controls will be evaluated on a SWMU-specific basis as summarized for Alternative 3 (see Section 3.4.3.5).

3.4.6.14 Groundwater and surface water monitoring

A groundwater monitoring program will be implemented to support performance monitoring of Alternative 6, the targeted excavation/cover remedy. This program is expected to be of a level comparable to that described for Alternative 2 in Section 3.4.2.2.

Depending upon the treatment selected, the type of cap selected, and the potential for SWMU-related impacts to surface water, a surface water monitoring program may be implemented for this alternative. This program is expected to be of a level comparable to that described for Alternative 2 in Section 3.4.2.2.

3.4.6.15 LUCs

All alternatives that leave waste or contamination in place above UU/UE levels will include LUCs. One or more LUCs, as described in Section 2.4.1.1 would be implemented for units where waste or contamination remains in place that precludes unrestricted use.

3.5 ADDRESSING DATA GAPS

There are some remedy-specific and SWMU-specific uncertainties that have been identified during the FS process. Specific uncertainties, technologies affected, and the general approach for addressing the specific uncertainties are presented in Table 3.4.

Table 3.4. Summary of Uncertainties, Affected Technologies, and Approaches to Address the Uncertainties

Uncertainty	Affected Technology(ies)	Approach(es) to Address Uncertainty
Presence of DNAPL (speculated but not confirmed)	*In situ* treatments: ERH, ZVI, *in situ* bioremediation, and DPE	• Resolve uncertainty through RDSI. • Flexible design to address DNAPL, if present. • Install MWs or other process monitoring points to monitor remedial progress. • Remedies that leave waste in place include hydraulic isolation. • Excavation alternatives include treatment component to address DNAPL.
Depth and Extent of DNAPL/High Concentration Source Areas	*In situ* treatments: ERH, ZVI application, *in situ* bioremediation, and DPE	• Resolve uncertainty through RDSI. • Flexible design to address DNAPL if present. • Install MWs or other process monitoring points to monitor remedial progress. • Remedies that leave waste in place include hydraulic isolation. • Excavation alternatives include treatment component to address DNAPL.
PCB Concentrations in SWMU 2 Waste	• Excavation and disposal • Capping • Stabilization	• The presence and prevalence of PCBs has not been established. • There are no readily verifiable "*in situ"* treatment technologies that will address high concentration PCBs effectively if present at PTW levels in SWMU 2 wastes because the PCBs were co-disposed of with uranium in drums. • PCB mobility can be reduced through *in situ* stabilization.

Table 3.4. Summary of Uncertainties, Affected Technologies, and Approaches to Address the Uncertainties (Continued)

Uncertainty	Affected Technology(ies)	Approach(es) to Address Uncertainty
Pyrophoric Uranium	• Excavation and disposal • *In situ* stabilization • Surface barriers	• The amount of pyrophoric uranium remaining in SWMU 2 has not been established. • Although there are some treatment technologies that will effectively address the pyrophoricity, none will affect the continued presence of elemental uranium. • The potential for inadvertent intrusion can be mitigated through caps, surface barriers, and LUCs.
Groundwater Elevation	• Excavation and shallow treatments • Hydraulic isolation	• The depth to water and the thickness of unsaturated soil influences the evaluation of excavation and shallow soil treatments and the need for groundwater infiltration control. • Hydraulic isolation can lower the depth to water, thus removing the waste from water. • The groundwater elevation measurements from UCRS wells in the BGOU will be used to identify gaps that may be filled with additional monitoring points.
Treatability Tests	*In situ* treatments: ERH, ZVI application, *in situ* bioremediation, and DPE	• No treatability tests are specifically planned as part of the alternatives presented in this FS. It is recognized that, depending upon selected technology, some limited bench or treatability tests may be performed to support the RD.

3.6 DEVELOPMENT AND SCREENING OF ALTERNATIVES

The general alternatives developed thus far in Section 3 are screened using the process described by EPA (EPA 1988) and the NCP to reduce the number of general alternatives and specific elements carried forward to detailed analysis. Defined alternatives are evaluated against the three broad criteria: effectiveness, implementability, and cost. See Tables 3.5, 3.6, 3.7, and 3.8 for alternatives screening for each SWMU. A summary of the alternatives carried forward for each SWMU is presented in Table 3.9.

In the SWMU-specific sections (Sections 5–8) of this FS, the retained alternatives are further refined into SWMU-specific alternatives by evaluating the associated RPOs identified in Section 3 for application on a SWMU-specific basis. The RPOs will be evaluated based on effectiveness, implementability, and cost with the most feasible RPOs retained for incorporation into a SWMU-specific alternative that will be subjected to detailed and comparative analysis based on conditions present at each SWMU.

Table 3.5. SWMU 2 Alternative Screening

Alternative	Effectiveness	Implementability	Cost	Screening Rationale
1	Low	N/A	None	**Retained**: (Serves as a baseline for evaluation of other remedial action alternatives.)
2	Low	High	Capital cost—Low O&M—Low	**Screened**: Low effectiveness; alternative does not contribute to protection of groundwater or treat/remove PTW.
3	Low	Moderate to Low	Capital cost—Low O&M—High	**Retained**
4	Moderate to High	Moderate to High	Capital cost—Moderate O&M—High	**Retained**
5	High	Moderate	Capital cost—High O&M—Low	**Retained**
6	Moderate	Moderate	Capital cost—Moderate O&M—High	**Retained**

Table 3.6. SWMU 3 Alternative Screening

Alternative	Effectiveness	Implementability	Cost	Screening Rationale
1	Low	N/A	None	**Retained**: (Serves as a baseline for evaluation of other remedial action alternatives.)
2	Low	High	Capital cost—Low O&M—Moderate	**Screened**: Low effectiveness; alternative does not contribute to protection of groundwater or treat/remove PTW.
3	High/Moderate	High	Capital cost—Moderate O&M—Moderate	**Retained**
4	N/A	N/A	N/A	**Screened**: *In situ* treatment component would destroy the existing cap, so Alternative 3 (containment) or Alternative 5 (full excavation) is better suited for SWMU 3.
5	High	Moderate	Capital cost—High O&M—Low	**Retained**
6	N/A	N/A	N/A	**Screened**: Targeted excavation component would destroy the existing cap, so Alternative 3 (containment) or Alternative 5 (full excavation) is better suited for SWMU 3.

Table 3.7. SWMU 7 Alternative Screening

Alternative	Effectiveness	Implementability	Cost	Screening Rationale
1	Low	N/A	None	**Retained**: (Serves as a baseline for evaluation of other remedial action alternatives.)
2	Low	High	Capital cost—Low O&M—Low	**Screened**: Low effectiveness; alternative does not contribute to protection of groundwater or treat/remove PTW.
3	Low	Low	Capital cost—Low O&M—High	**Screened**: Containment component (cap) would not be highly effective for TCE PTW, so Alternative 4 (treatment of TCE and containment of burial cell wastes) is better suited for SWMU 7.
4	High	Moderate to High	Capital cost—Moderate O&M—High	**Retained**
5	High	Moderate	Capital cost—High O&M—Low	**Retained**
6	Low	Low	Capital cost—Moderate O&M—Low	**Screened**: Targeted/partial excavation of the burial cells is unnecessary since there is no PTW, and the depth of the TCE PTW (i.e., possibly as deep as 60 ft bgs) exceeds the practical limits of standard excavating equipment; so Alternative 4 (treatment of TCE and containment of burial cell wastes) or Alternative 5 (full excavation of the burial cells and treatment of TCE) is better suited for SWMU 7.

Table 3.8. SWMU 30 Alternative Screening

Alternative	Effectiveness	Implementability	Cost	Screening Rationale
1	Low	N/A	Low	**Retained**: (Serves as a baseline for evaluation of other remedial action alternatives.)
2	Low	High	Capital cost—Low O&M—Low	**Screened**: Low effectiveness; alternative does not contribute to protection of groundwater.
3	High	High	Capital cost—Moderate O&M—Low	**Retained**
4	N/A	N/A	N/A	**Screened**: *In situ* treatment component (in conjunction with a containment component) is unnecessary for SWMU 30, so Alternative 3 (containment without *in situ* treatment) is better suited for SWMU 30.
5	High	High	Capital cost—Low O&M—Low	**Retained**
6	N/A	N/A	N/A	**Screened**: Targeted/partial excavation of the contaminated wastes/soils is unnecessary since there is no PTW; so Alternative 5 (full excavation of the burial cells) is better suited for SWMU 30.

Table 3.9. BGOU Remedial Alternative Summary by SWMU

Alternative Number/Description		SWMU			
		2	3	7	30
1	**No Action**	X	X	X	X
2	**Limited Action (LUCs and Monitoring)**				
3	**Containment, Surface Controls, LUCs, and Monitoring:** • Recognizes existing Subtitle C cap at SWMU 3.	X	X		X
4	***In Situ* Source Treatment, Containment, Surface Controls, LUCs, and Monitoring**	X		X	
5	**Excavation and Disposal, Treatment, LUCs, and Monitoring:** • Includes treatment beneath excavation as applicable. • Monitoring of groundwater should not be necessary once the buried wastes and subsurface soils are removed. • Attainment of UU/UE would preclude the need for LUCs. • Includes evaluation of disposal off-site and at a potential WDF.	X	X	X	X
6	**Targeted Excavation and Disposal, Containment, Surface Controls, Treatment, LUCs, and Monitoring:** • Includes treatment beneath excavation as applicable. • Includes evaluation of disposal off-site and at a potential WDF. Mitigates the uncertainty of the buried waste through excavation. It also allows for implementation of a contingent treatment remedy should one be necessary.	X			

4. DETAILED AND COMPARATIVE ANALYSES OF ALTERNATIVES

In Section 3, a range of remedial alternatives was developed and then screened consistent with EPA/540/G-89/004. The alternatives carried forward for SWMU-specific analysis are shown in Table 3.9 Detailed analysis at each individual SWMU occurs in the SWMU-specific Sections 5, 6, 7, and 8. The purpose and approach for performing the detailed analysis are discussed here in Section 4. Results of the detailed analysis form the basis for comparing alternatives. The general approach for performing the comparative analysis also is presented in Section 4. The SWMU-specific comparative analyses of each alternative retained for consideration are presented in SWMU-specific Sections 5, 6, 7, and 8. The results of the detailed and comparative analyses ultimately will be used for preparing the Proposed Plan for BGOU SWMUs 2, 3, 7, and 30.

4.1 DETAILED ANALYSIS

4.1.1 Approach to the Detailed Analysis

The remedial action alternatives developed in Section 3 and retained after screening are analyzed in detail against the nine CERCLA threshold, balancing, and modifying criteria outlined in 40 *CFR* § 300.430(e)(9)(iii). This analysis forms the basis for selecting a final remedial action. The intent of this analysis is to present sufficient information for selection of an appropriate remedy.

4.1.2 Overview of the CERCLA Evaluation Criteria

The CERCLA evaluation criteria include technical, administrative, and cost considerations; compliance with specific statutory requirements; and state and community acceptance. Overall protection of human health and the environment and compliance with ARARs (in the absence of a CERCLA waiver) are categorized as threshold criteria that any viable alternative must meet. The balancing criteria upon which the detailed analysis is primarily based include long-term effectiveness and permanence; reduction of toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. Both state acceptance and community acceptance are considered modifying criteria and are evaluated following a public comment period on the proposed plan, as well as when a final decision is made and the ROD is prepared. Each criterion is described below.

4.1.2.1 Overall protection of human health and the environment (threshold criterion)

Alternatives will be assessed to determine whether they can adequately protect human health and the environment in both the short- and long-term. Alternatives must protect human health and the environment from unacceptable risks posed by contaminants present at the BGOU source areas by eliminating, reducing, or controlling exposures as established during the development of RAOs consistent with 40 *CFR* § 300.430(e)(2)(I). Overall protection of human health and the environment draws on the assessments of the other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs (in the absence of a CERCLA waiver).

4.1.2.2 Compliance with ARARs (threshold criterion)

ARARs include substantive federal or more stringent state environmental or facility siting laws/regulations. They do not include occupational safety or worker radiation protection requirements. Additionally, per 40 *CFR* § 300.400(g)(3), other advisories, criteria, or guidance may be considered in determining remedies (TBC category). CERCLA § 121(d)(4) provides several ARAR waiver options that may be invoked, provided that human health and the environment are protected. Activities conducted on-site must comply with the substantive, but not administrative, requirements. Administrative requirements include applying for permits, recordkeeping, consultation, and reporting. Activities conducted off-site must comply with both the substantive and administrative requirements of applicable laws. Measures required to meet ARARs will be incorporated into the design phase and implemented during the construction and operation phases of the remedial action.

ARARs typically are divided into three categories: (1) chemical-specific, (2) location-specific, and (3) action-specific. Chemical-specific ARARs provide health- or risk-based concentration limits or discharge limitations in various environmental media (i.e., surface water, groundwater, soil, or air) for specific hazardous substances, pollutants, or contaminants. Location-specific ARARs establish restrictions on permissible concentrations of hazardous substances or establish requirements for how activities will be conducted because they are in special locations (e.g., floodplains or historic districts). Action-specific ARARs include operation, performance, and design of the preferred alternative based on waste types and/or media to be addressed and removal/remedial activities to be implemented.

Alternatives are assessed to determine whether they meet ARARs identified for each alternative. If ARARs will not be met at the end of an action, an evaluation will occur to determine when a basis exists for invoking one of the ARAR waivers cited in 40 *CFR* § 300.430(f)(l)(ii)(c) that are listed as follows:

(1) The alternative is an interim measure and will become part of a total remedial action that will attain the federal or state ARARs.

(2) Compliance with the requirement will result in greater risk to human health and the environment than other alternatives.

(3) Compliance with the requirement is technically impracticable from an engineering perspective.

(4) The alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method or approach.

(5) With respect to a state requirement, the state has not consistently applied, or demonstrated the intention to consistently apply, the promulgated requirement in similar circumstances at other remedial actions within the state.

An alternative must meet this threshold criterion (or obtain a CERCLA waiver) to be eligible for selection. The ARARs in this FS are tailored to the scope of the FS, which does not include groundwater or surface water remediation. ARARs for each of the remedial alternatives retained for detailed and comparative analysis at one or more of the SWMUs are listed in Appendix F.

4.1.2.3 Long-term effectiveness and permanence (balancing criterion)

Long-term effectiveness and permanence are an assessment of the risk remaining at the site after RAOs have been met and the effectiveness and reliability of controls required to manage the risk posed by untreated waste or treatment residuals. Alternatives will be assessed for the long-term effectiveness and permanence they afford, along with the degree of certainty that the alternative will prove successful. These are factors that may be considered in this assessment:

- The magnitude of residual risk from untreated waste or treatment residuals remaining at the conclusion of the remedial activities, including their volume, toxicity, and mobility.

- The adequacy and reliability of controls such as containment systems necessary to manage treatment residuals and untreated waste. For example, this factor addresses uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the potential need to replace technical components of the alternative, such as a cover or treatment system; and the potential exposure pathways and risks posed should the remedial action need replacement.

- The ability of controls to prevent treatment residuals and untreated waste from serving as a continuing source of contamination to groundwater, such that groundwater quality cannot be restored throughout the plume.

4.1.2.4 Reduction of toxicity, mobility, or volume through treatment (balancing criterion)

The degree to which the alternatives employ treatment or recycling that reduces toxicity, mobility, or volume will be assessed, including how the treatment is used to address the principal threats posed by the release sites. Factors that will be considered, as appropriate, include these:

- Treatment or recycling processes that the alternatives employ and the materials that they will treat;

- The amount of hazardous substances, pollutants, or contaminants that will be destroyed or recycled;

- The degree of expected reduction in toxicity, mobility, or volume of the waste because of the treatment or recycling and the specification of which reductions are occurring;

- The degree to which the treatment is irreversible;

- The type and quantity of residuals that will remain following treatment, taking into consideration the persistence, toxicity, mobility, and propensity to bioaccumulate such hazardous substances and their constituents; and

- The degree to which treatment reduces the inherent hazards posed by the principal threats at the release sites.

4.1.2.5 Short-term effectiveness (balancing criterion)

Short-term effects during implementation of the remedial action will be assessed, including the following:

- Short-term risks that might be posed to the community;
- Potential risks or hazards to workers and the effectiveness and reliability of protective measures;
- Potential environmental effects and the effectiveness and reliability of mitigative measures; and
- Time until protection is achieved.

4.1.2.6 Implementability (balancing criterion)

The ease or difficulty of implementing the alternatives will be assessed by considering the following types of factors, as appropriate:

- Technical feasibility, including the technical difficulties and unknowns associated with constructing and operating the technology, reliability of the technology, ease of undertaking additional remedial actions, and ability to monitor the effectiveness of the remedy;

- Administrative feasibility, including the availability of treatment, storage, and disposal capacity; and

- Availability of required materials and services.

4.1.2.7 Cost (balancing criterion)

Supporting calculations for conceptual designs including cost estimates are provided in Appendix E. These are the types of costs assessed:

- RD and construction documentation costs, including RD, construction management and oversight, RD and remedial action document preparation, project/program management and oversight, and reporting costs;

- Construction costs, including capital equipment, general and administrative costs, and construction subcontract fees;

- Operating and maintenance costs;

- Equipment replacement costs; and

- Surveillance and monitoring costs.

EPA guidance distinguishes between scope contingency and bid contingency costs (EPA 2000). Scope contingency costs represent risks associated with incomplete design and include contributing factors such as limited experience with technologies, additional requirements because of regulatory or policy changes, and inaccuracies in defining quantities or characteristics. Bid contingency costs are unknown costs at the time of estimate preparation that become known as remedial action construction proceeds. They represent reserves for quantity overruns, modifications, change orders, and claims during construction. Although EPA guidance allows for contingency based on the complexity and size of the project and the inherent uncertainties related to the remedial technologies, scope contingency was applied to the excavation alternative cost estimates prepared for this FS.

Life-cycle costs are presented as Net Present Worth, and in escalated dollars, for capital, O&M, and periodic costs for each alternative. Escalation was applied as directed by DOE Order 430.1A, "Life Cycle Asset Management." Guidance was provided by DOE, Office of Project Assessment, "FY 2011 Field Budget Call: Escalation Rates."

Detailed total costs for implementing each alternative at the appropriate BGOU source areas are presented in Appendix E. Summary costs for implementing each alternative at the individual source areas are presented in the sections for the individual SWMUs that follow.

The alternative cost estimates are for comparison purposes only and are not intended for budgetary, planning, or funding purposes. Estimates were prepared to meet the -30% to +50% range of accuracy recommended in CERCLA guidance (EPA 1988).

4.1.2.8 State acceptance (modifying criterion)

This assessment evaluates the technical and administrative issues and concerns KDEP may have regarding each of the alternatives. This criterion will be addressed in the proposed plan and ROD after KDEP comments on the FS are received.

4.1.2.9 Community acceptance (modifying criterion)

This assessment evaluates the issues and concerns the public may have regarding each of the alternatives. This criterion will be addressed in the ROD after public comments on the proposed plan are received.

4.1.3 Federal Facility Agreement and NEPA

Additional requirements considered in this FS include the specific requirements of the FFA and NEPA, consistent with the DOE's Secretarial Policy Statement on NEPA in June of 1994 (DOE 1994a).

4.1.3.1 Otherwise required permits under the FFA

When DOE proposes a response action, Section XXI of the FFA further requires that DOE identify each state and federal permit that otherwise would have been required in the absence of CERCLA Section 121(e)(1) and the NCP. DOE identifies the permits that otherwise would be required, the standards, requirements, criteria, or limitations necessary to obtain such permits and provide an explanation of how the proposed action will meet the standards, requirements, criteria, or limitations identified.

An evaluation of alternatives presented in the FS determined that the otherwise required permits may include the KPDES permit; the RCRA Treatment, Storage, and Disposal Facility permit; and the Solid Waste Landfill permit. Jurisdictional wetlands have been identified on PGDP and will be delineated, as necessary, prior to a remedial action.

PGDP currently operates under KPDES Permit No. KY0004049, Hazardous Waste Facility Operating Permit No. KY8-890-008-982, and Solid Waste Permit No. SW07300014, SW07300015, SW07300045. The substantive requirements of the otherwise required permits are identified in the ARARs provided for each alternative. A list of ARARs is provided in Appendix F.

4.1.3.2 NEPA values

The following NEPA values also are considered in this FS to the extent practicable, consistent with DOE policy.

- Land use
- Air quality and noise
- Geologic resources and soils
- Water resources
- Wetlands and floodplains
- Ecological resources
- T&E species
- Migratory birds
- Cultural and archeological resources
- Socioeconomics, including environmental justice and transportation

Alternatives selected for detailed analysis would have no identified short-term or long-term impacts on geological resources, migratory birds, cultural resources, or socioeconomics. Upon final selection of the alternative, the absence of any short- and long-term impacts to these values will be verified.

No long-term impacts to air quality or noise would result from implementation of the remedial action alternatives evaluated. Remedial actions should not result in generation of air pollutants above regulatory limits, and noise levels should be similar to current background levels.

None of the remedial alternatives would have any impacts on geologic resources, and construction activities would have only short-term impacts on soils. Site clearing, excavation, grading, and contouring would alter the topography of the construction area, but the geologic formations underlying those sites should not be affected. Construction would disturb existing soils, and some topsoil might be removed in the process. Soil erosion impacts during construction would be mitigated through the use of best management practices control measures (e.g., covers and silt fences). No conversion of prime farmland soils is expected to occur. Surface soil quality may improve for all alternatives except for No Action. Any alternative that would create disturbances also would include restoration to these areas.

None of the activities associated with the remedial alternatives would be conducted within a floodplain. Wetlands were identified during the 1994 COE environmental investigation for the area surrounding PGDP. This investigation identified five acres of potential wetlands inside the fence at PGDP (COE 1994). The COE made the determination that these areas are jurisdictional wetlands (COE 1995).

As stated in the ARARs, construction activities must avoid or minimize adverse impacts on wetlands and act to preserve and enhance their natural and beneficial values. These applicable requirements include avoiding construction in wetlands, avoiding (to the extent practicable) long- and short-term adverse impacts to floodplains and wetlands, avoiding degradation or destruction of wetlands, and avoiding discharge of dredge and fill material into wetlands. In addition, the protection of wetlands shall be incorporated into all planning documents and decision making as required by 10 *CFR* § 1022.3.

No long- or short-term impacts have been identified to archeological or cultural resources. Executive Order 12898, "Federal Actions to Address Environmental Justice in Minority Populations and Low Income Populations," requires agencies to identify and address disproportionately high and adverse human health or environmental effects their activities may have on minority and low-income populations. There is a disproportionately high percentage of minority and low-income populations within 50 miles of the PGDP site (DOE 2004), but because there are no potential impacts from these alternatives, there would be no disproportionate or adverse environmental justice impacts to these populations associated with these alternatives.

No long- or short-term adverse transportation impacts are expected to result from implementation of these remedial alternatives. During construction activities there would be a slight increase in the volume of truck traffic in the vicinity of the BGOU SWMUs, but the affected roads are capable of handling the additional truck traffic. Any wastes transferred off-site or transported in commerce along public rights-of-way will meet the packaging, labeling, marking, manifesting, and applicable placarding requirements for hazardous materials at 49 *CFR* Parts 107, 171-174, and 178; however, transport of wastes along roads within the PGDP site that are not accessible to the public would not be considered "in commerce."

In addition, CERCLA § 121(d)(3) provides that the off-site transfer of any hazardous substance, pollutant, or contaminant generated during CERCLA response actions be sent to a treatment, storage, or disposal facility that complies with applicable federal and state laws and has been approved by the EPA for acceptance of CERCLA waste. Accordingly, DOE will verify with the appropriate EPA regional contact that any needed off-site facility is acceptable for receipt of CERCLA wastes before transfer.

4.1.3.3 Natural Resources Damage Assessment

The alternatives evaluated are acceptable because they are anticipated to have beneficial impact, and they are not expected to cause any further injury to a natural resource through their implementation than already might exist.

4.2 COMPARATIVE ANALYSIS

The SWMUs 2, 3, 7, and 30 remedial action alternatives are subjected to comparative analysis to identify the relative advantages and disadvantages of each so that the key tradeoffs that risk managers must balance can be identified. The comparative analysis provides a measure of the relative performance of the alternatives against each evaluation criterion.

Alternatives are compared based on two of the three CERCLA categories including threshold criteria and primary balancing criteria. The third category, modifying criteria, including state and community acceptance, will not be addressed until the proposed plan has been issued for public review. These modifying criteria will be addressed in the ROD responsiveness summary, which will be prepared following the public comment period.

Threshold criteria are of greatest importance in the comparative analysis because they reflect the key statutory mandates of CERCLA, as amended. The threshold criteria that any viable alternative must meet are as follows:

- Overall protection of human health and the environment, and
- Compliance with ARARs (in the absence of a CERCLA waiver).

The primary balancing criteria to which relative advantages and disadvantages of the alternatives are compared include the following:

- Long-term effectiveness and permanence;
- Reduction of toxicity, mobility, or volume through treatment;
- Short-term effectiveness;
- Implementability; and
- Cost.

The first and second balancing criteria address the statutory preference for treatment as a principal element of the remedy and the bias against off-site land disposal of untreated material. Together with the third and fourth criteria, they form the basis for determining the general feasibility of each potential remedy. The final criterion addresses whether the costs associated with a potential remedy are proportional to its overall effectiveness, considering both the cleanup period and O&M requirements during and following cleanup, relative to other alternatives. Key tradeoffs among alternatives most frequently will relate to one or more of the balancing criteria.

The comparative analyses for remedial alternatives are presented in the SWMU-specific sections that follow.

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5. SWMU 2

Previous sections of this document present a framework that collects sitewide information and uses it to formulate a general approach to developing alternatives to address the COCs present in BGOU SWMUs 2, 3, 7, and 30. This framework also discusses key elements of the alternatives that are used as a basis for technology screening and development of SWMU-specific alternatives. This section (Section 5) of the document develops the candidate alternatives for SWMU 2 by expanding the general alternatives to address SWMU-specific conditions.

Section 5.1 presents SWMU-specific history and background, including a discussion of COCs summarized in Section 1.6 of this report. Section 5.2 presents SWMU-specific RAOs that were developed from the general RAOs in Section 2.2.2. Section 5.3 refines the general alternatives that were developed in Section 3.4 into SWMU-specific alternatives; this includes a detailed screening of the RPOs from Section 3 from effectiveness, implementability, and cost to identify SWMU-specific RPOs and define each SWMU-specific remedial alternative. Section 5.4 presents the individual detailed analysis for each SWMU-specific alternative using the nine CERCLA criteria. Finally, Section 5.5 presents the comparative analysis of the SWMU-specific alternatives.

5.1 SWMU 2 HISTORY AND BACKGROUND

SWMU 2 encompasses an area of approximately 59,000 ft^2 and is located within the west-central portion of the PGDP secured area. The C-749 Uranium Burial Ground is located in the northern half of SWMU 2 and encompasses an area of approximately 32,000 ft^2, with approximate dimensions of 160 ft by 200 ft. Records indicate that when the burial ground was in use, cells were excavated to an estimated depth of 7 to 17 ft. After the burial ground no longer was in use, the area was covered with a 6-inch thick clay cap and an 18-inch thick soil layer covered with vegetation (DOE 1995). Figure 5.1 illustrates the documented disposal at SWMU 2 (Union Carbide 1975).

SWMU 2 was used from 1951 to 1977 for the disposal of uranium and uranium-contaminated wastes. Disposal records for SWMU 2 indicate that 270 tons of uranium, 59,000 gal of oils, and 450 gal of TCE were disposed of in the unit (DOE 1999). Other wastes at the unit consist of 35 30-gal drums of uranyl fluoride. Disposal records indicate that uranium containing drummed wastes buried in the unit consist primarily of uranium metal from machine shop turnings, shavings, and sawdust. The most likely scenario is that the buried uranium is in the metallic state or is coated with uranium (IV) oxide. Neither of these forms of uranium is very susceptible to leaching. The kinetics of dissolution of the buried metal and uranium (IV) oxide is affected by the amount of oxygen present in the subsurface in proximity to the waste. According to the RI Report, occasionally underground fires were reported as a result of oxidation of pyrophoric uranium metal, but no documentation of these fires is available; no subsidence has been observed as a result of volume reductions due to the fires (DOE 2010b).

In August 1984, cell 9 was excavated with the intent of removing TCE in the soil or drums due to concern about the integrity of TCE-containing drums (15 30-gal drums = 450 gal) reportedly disposed of in this area. It is reported that during excavation, 4 30-gal drums (one of these drums contained a uranium and TCE sludge and the others were of such poor integrity that the contents could not be ascertained) and 35 55-gal drums (30 of these drums contained uranium sludges, not TCE; one drum contained TCE sludge; and the rest were of such poor integrity their contents could not be ascertained) were recovered. The 30-gal and 55-gal drums containing TCE sludge were placed in overpacks for proper disposal (Ashburn 1984). The remaining excavated materials were returned to the cell and covered with soil; the

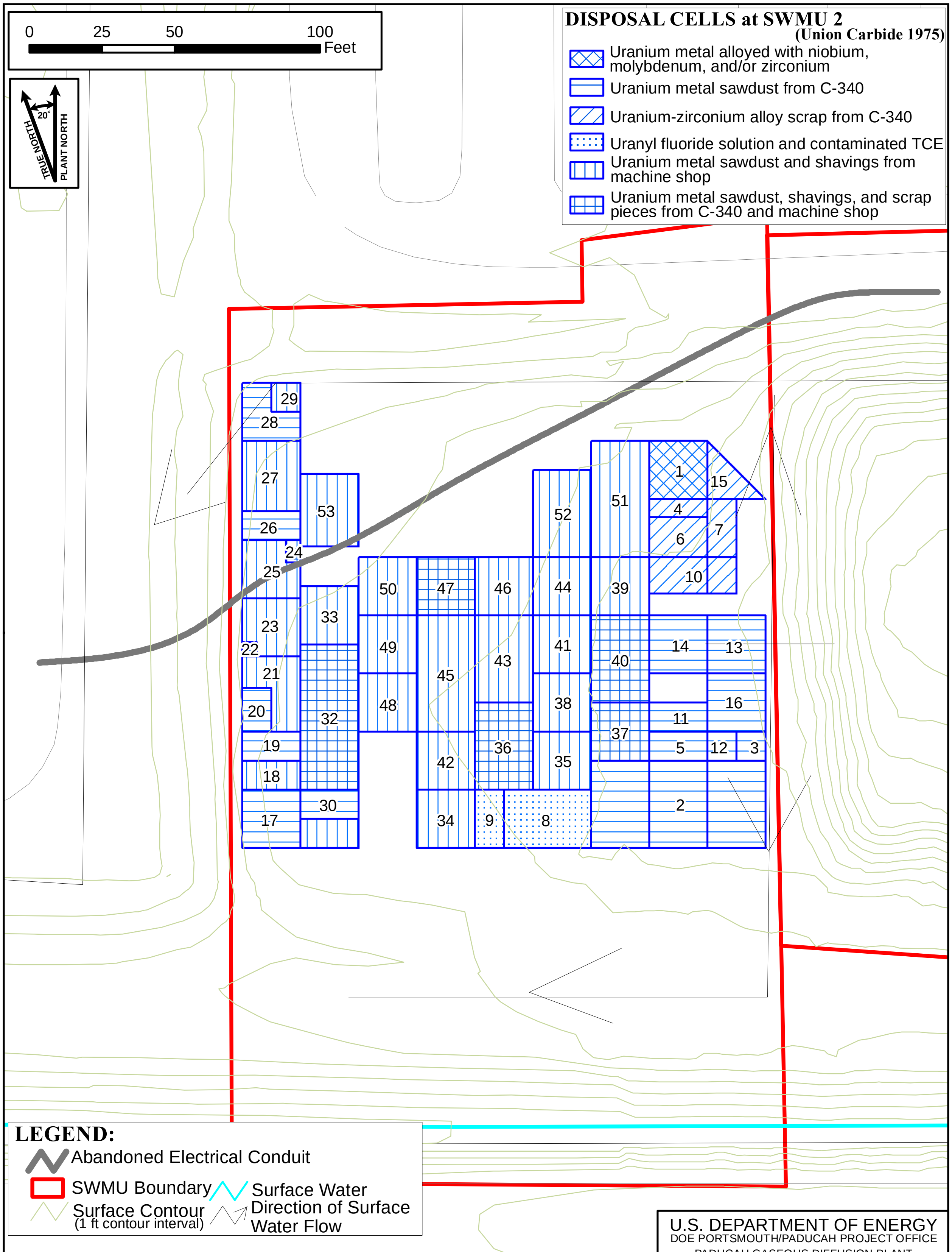

Figure 5.1. SWMU 2 Historical Layout

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sludge from the recovered drums contains TCE, uranium, and PCBs. The current condition of drums buried in SWMU 2 is unknown. The integrity of drums observed during the 1984 investigation was highly variable and seemed to be dependent on whether the drums were plastic-lined (i.e., drums lined with plastic were in good condition; while those that were not lined in plastic were highly deteriorated) (Ashburn 1984).

5.1.1 Nature and Extent of Contamination

This summary of nature and extent reflects the BGOU RI (DOE 2010b). Additional information can be found in Sections 1.5 and 1.6 of this report.

The BGOU RI reviewed both data collected during the RI along with historical data (DOE 2010b). The RI Report states that the most prevalent metals detected above background level in subsurface soil samples at SWMU 2 are arsenic, thallium, and uranium. Arsenic was detected above the screening levels throughout the depth of the angled borings (60 ft) installed during the RI. The areas that exceed the background level for metals are in the shallow soils on the eastern side of the SWMU and an isolated area at 45 ft bgs on the western side (i.e., the 60 ft sample at this location was less than background). Because this is a relatively small SWMU, these two zones may be connected spatially. The highest concentrations of uranium were found at shallow depths on the western side of the burial ground. TCE and its degradation products, *cis*-1,2-DCE and vinyl chloride, were detected at high levels (140 mg/kg, 130 mg/kg, and 1.4 mg/kg, respectively) at a depth of 12 ft bgs on the eastern side of the burial unit. Although PCBs were suspected to be associated with the waste buried in SWMU 2, PCBs were detected above 1 ppm in only one subsurface soil sample below a depth of 6 ft (the approximate depth of the top of buried waste). The highest activities of the uranium isotopes were found at shallow depths on the western side of the burial ground. The distribution of the uranium isotopes is very similar to that of naturally-occurring uranium.

Groundwater sample collections were attempted at the two angled borings installed at SWMU 2 as part of the BGOU RI; however, none were collected (even where the UCRS is saturated, the low hydraulic conductivity of the unit restricts groundwater yield). A review of historical data indicates uranium and the uranium isotopes exceeded screening criteria in the horizon of the burial cells. Additionally, beryllium, manganese, and vanadium, TCE and its degradation products, and uranium isotopes occurred at levels that exceeded historical RI screening criteria throughout the UCRS interval below the waste pits.

The RGA groundwater samples contained several metals that exceeded RI screening criteria, including beryllium, iron, manganese, uranium, vanadium (also identified as UCRS contaminants), arsenic, and cadmium. TCE was the most widely detected organic contaminant in RGA groundwater at SWMU 2. Another VOC, 1,1-DCE, showed high levels in one RGA historical boring. RGA groundwater samples from one historical location contained U-234 above screening criteria; samples from two historical locations contained U-238 above screening criteria. Note: These chemicals are summarized from the BGOU RI Report (DOE 2010b).

PTW. Review of the SWMU 2 waste disposal history suggests the presence of a number of source materials of concern, including some identified as PTW.

- Approximately 270 tons of uranium (e.g., shavings and sawdust packed in oil) disposed of in burial pits at SWMU 2;

- Buried drums of uranium-contaminated TCE and any high soil concentrations of TCE present under and adjacent to the drums;

- Buried drums (thirty-five 30-gal drums documented) of uranyl fluoride solution and high soil concentrations of uranyl fluoride solution present under and adjacent to the drums;

- High concentrations of TCE and *cis*-1,2-DCE (a toxic degradation product of TCE) in soil on the eastern side of SWMU 2; and

- There is the potential that the 59,000 gal of oil with which the uranium was packaged in drums contains PCBs concentrations greater than 500 ppm considering sample results of 7,900 ppm PCB from a drum excavated from SWMU 2 (Ashburn 1984). Under EPA guidance, PCBs greater than 500 ppm generally are considered PTW. Absent additional characterization (sampling and analysis) of the buried waste, it is uncertain whether PCBs are widely present at SWMU 2 at levels greater than 500 ppm. The 59,000 gal of oil could contain PCBs in excess of 500 ppm and thus be considered PTW.

Radionuclides. Consistent with the presence of source materials, uranium isotopes frequently were detected above background and risk-based concentrations in soils (see Appendix A, Figures A.1 and A.2). The sediment sample, SWMU 2-15, is from an area addressed in the SWOU, thus, sediments in this location have been addressed as part of the SWOU on-site actions.

Because small pieces of uranium metal may be pyrophoric (spontaneously burn in air), operating practices of that time required placing the material in drums and submerging the material in petroleum-based oil and synthetic oil to avoid contact with air. It is possible that the oils used may have included some PCB-contaminated oils. Such oils are resistant to chemical and biological degradation and from leaching by percolating waters. In addition, oils, as they slowly degrade, consume oxygen, which lowers the ORP. Under such conditions, uranium dissolution is negligible (ORNL 1998).

PCBs. The sludge in drums recovered in the 1984 excavation of cell 9 contained PCBs (1,500 to 7,900 mg/kg); however, other portions of the source material (not associated with cell 9) at SWMU 2 may contain PCBs. PCBs were detected in several soil samples, occasionally exceeding the NAL (see Figures A.1 and A.2); however, detections at these locations do not correlate with a buried PCB in oil source. The maximum concentration in soil was below 10 mg/kg. Any soils or wastes with PCB concentrations at or greater than 50 ppm would be regulated for disposal as TSCA PCB waste if generated by the response action.

Solvents. The waste unit disposal summary indicates drums containing TCE were disposed of in the SWMU at cells 8 and 9. TCE and its degradation products, *cis*-1,2-DCE and vinyl chloride, were detected at high levels (140 mg/kg, 130 mg/kg, and 1.4 mg/kg, respectively) at a depth of 12 ft bgs on the eastern side of the burial unit and within Burial Cell 6 (See Figure A.3); however, this area is not the area where the TCE drums were dispositioned. The concentration of 140 mg/kg is below the soil saturation concentration (C_{sat}) of 690 mg/kg that is used to estimate the presence of a solvent phase. TCE was detected in soil at 9 additional locations with concentrations from 0.0021 mg/kg to 0.0428 mg/kg. TCE was the most widely detected organic contaminant in RGA groundwater at SWMU 2; however, there is an upgradient contribution to the RGA TCE concentrations. The hydrogeological assessment of the SWMUs 2 and 3 areas (PRS 2007a) determined that an upgradient source is responsible for some if not all of the TCE levels in the area. It is difficult to separate any potential impacts to the RGA from SWMU 2 due to the migration of contamination from upgradient areas. Based upon the disposal information and the sampling data, the PTW-level TCE sources are limited to cells 6, 8, and 9; however, the lateral and vertical extent of PTW beyond these cells has not been delineated.

Disposal records for SWMU 2 indicate drums containing TCE were historically disposed of in this unit. Depending on the originating source, the TCE could be a listed hazardous waste with one or more waste codes (F001, F002, or U228) and/or be a characteristic hazardous waste (D040), if generated by the response action. Given the historical uses of TCE at PGDP, TCE, TCE-contaminated soils, and TCE-contaminated debris (e.g., drums, PPE) likely would be considered characteristic and/or listed RCRA hazardous wastes until such time as a "contained-in" determination has been made, and/or a "contaminated with" determination has been made. In addition, drums and/or containers that have been emptied in accordance with 40 *CFR* 261.7 also are not hazardous waste.

Technetium-99. No documentation of Tc-99 disposal at SWMU 2 exists; however, during the years of feed plant operation from 1953 to 1964 and from 1968 intermittently through 1977, recycled uranium feed material from nuclear reactors was reprocessed through the feed plant, resulting in the introduction of reactor-produced radioactive impurities, such as Tc-99, into the enrichment process. It is possible that a portion of the uranium-contaminated wastes disposed of in burial grounds at PGDP contains Tc-99 from reprocessing activities (DOE 1994b); however, Tc-99 is not a target compound at SWMU 2 based on soil data. It was identified as having the potential to impact groundwater, but the modeled concentrations did not exceed the MCL. More importantly, it was detected above background in only 3 surface samples (maximum concentration of 14.6 pCi/g), and was not found above background in 57 subsurface soil samples, suggesting no evidence of a release from SWMU 2.

Arsenic. Arsenic above background concentrations poses a potential direct contact risk as well as a potential concern for migration to groundwater. The distribution of arsenic at SWMU 2 is shown on Figures A.1 to A.3. Depending upon the levels of arsenic, the soil and/or debris in the burial grounds could be RCRA characteristic hazardous waste.

5.1.2 Risk Summary

This risk summary reflects the summary presented in the BGOU RI (DOE 2010b). Additional information can be found in Sections 1.5 and 1.6 of this report.

The primary threat from SWMU 2 is associated with direct contact exposure to buried wastes.

Unacceptable direct contact risks to industrial workers exposed to SWMU 2 soils were identified in the BGOU RI BHHRA (DOE 2010b). The COCs include arsenic, uranium-235, and uranium-238. The BHHRA identified the COCs based on samples collected to depths of 8 ft, so this evaluation presents COCs for both surface and subsurface soils. The WAG 22 RI Addendum stated that under an uncontrolled excavation scenario, the risk of worker radiation doses that exceed DOE occupational radiation protection standards is very high (DOE 1994b). The half-life for U-238 is approximately 4.5 billion years. The decay chain for U-238 includes U-234, Th-230, and radium-226.

The BGOU RI BHHRA also identified COCs present in soil that may migrate to the RGA at levels that would limit future residential use. These COCs were reviewed and the list refined (see Sections 1.5.4 and 1.6.2).

Additional data collected after the WAG 22 RI Addendum BHHRA that were summarized in the BGOU RI were included in a review to address uncertainties (see Sections 1.5.4 and 1.6.2). Figures A.1 (surface soil) and Figure A.2 (subsurface soils) in Appendix A of this FS identify where COCs are present that contribute to an unacceptable risk.

Drainageways are present adjacent to this waste unit. As illustrated on Figure A.1, sediments from locations west of the site have been remediated as part of the SWOU. Contaminants found in other drainageways are not associated with SWMU 2 and will be managed as part of the SWOU.

The SERA identified COPCs in surface soils. Actions taken to address human health in this FS will reduce potential exposures to these COPCs. Residual risks will be evaluated in a future sitewide ecological risk assessment.

5.1.3 Hydrogeological Interpretation

The study area geology and hydrogeology is summarized below, as documented in the BGOU RI (DOE 2010b). Because SWMUs 2 and 3 are adjacent to each other, their hydrogeological interpretation is discussed as one.

Stratigraphy. The burial cells of SWMU 2 are excavated into the HU1 loess member (silt with some clay) of the UCD. Some waste cells likely extend to near the base of the HU1 unit, at a depth of 18.5 ft. The underlying HU2 interval consists of upper and lower sand and gravel horizons, separated by an intervening clayey silt unit, to a depth of 40 ft. A 9-ft thick silty clay interval (HU3) separates the HU2 sand and gravel horizons from the basal HU4 sand and the sands and gravels of the Lower Continental Deposits (HU5). SWMU 3 rests upon the top of the UCD.

UCRS Groundwater Flow and Hydraulic Potential. The SWMU 2 Data Summary and Interpretation Report (DOE 1997a) documents the depth and gradient of the water table using measurements from shallow MWs and piezometers. Four rounds of measurements of water level during a one-week period in August 1996, consistently demonstrate that the water table occurred within 10 ft of land surface, sloping toward a ditch on the west side. With water at this depth, much of the buried waste at SWMU 2 would be saturated. The westward slope of the water table below SWMU 2 indicates that the water table would be at a similar depth beneath SWMU 3, except for the presence at SWMU 3 of a Subtitle C cap and leachate collection and treatment system that limits infiltration to the UCRS.

The parameters governing the groundwater flow paths are the higher hydraulic conductivity corridors in the RGA marked by the Southwest Plume and the Northwest Plume to the south and north of SWMU 3, respectively, and the RGA potentiometric surface, which declines to the north. Edges of the Southwest Plume and Northwest Plume approximate boundaries of higher hydraulic conductivity in the HU5 sediments, through which the majority of groundwater flow occurs. Pumping tests of the RGA in the area of the main contaminant plumes on-site (Terran 1992; LMES 1996) have determined the representative hydraulic conductivity to be 1,200 to 1,300 ft/day, which contrasts with the hydraulic conductivity of the RGA beneath SWMU 3, measured as 100 ft/day in a previous pumping test (Terran 1990).

RGA Groundwater Flow and Hydraulic Potential. The northward groundwater flow beneath SWMU 3 is an intermediate flow path between the hydraulic conductivity “expressways” delineated by the Southwest Plume (to the south of SWMU 3) and the Northwest Plume (to the north of SWMU 3) and is related to seasonal variations in potentiometric head.

Average RGA groundwater flow velocity in the areas of the contaminant plumes is commonly 1 to 3 ft/day. Hydraulic potential gradients to the north and to the west are commonly similar in the SWMU 3 area. The northward groundwater flow rate beneath SWMU 3 is likely 0.1 to 0.3 ft/day, in step with the order-of-magnitude reduction in hydraulic conductivity beneath SWMU 3.

5.2 SWMU-SPECIFIC RAOs

RAOs that are specific to SWMU 2 were developed based on the findings and observations from the BGOU RI Report. The SWMU-specific RAOs are directed toward conditions related to the waste materials and affected soils, the surface soils, and the subsurface soils at the SWMU.

The burial cells contain hazardous materials, some of which are considered PTW. In addition, impacts in soils have been identified that pose unacceptable risks to future industrial and future excavation workers and may migrate to RGA groundwater at levels that would limit future residential use.

SWMU-Specific RAO for Protection of Groundwater. Contribute to the protection of groundwater by eliminating, reducing, or controlling sources of groundwater contamination (see Section 1.6 for target COCs) that could result in an exceedance in RGA groundwater of the MCL (or risk-based concentration for residential use of groundwater in the absence of an MCL).

SWMU-Specific RAO for Protection of Direct Contact with Waste. Prevent exposure to waste that exceeds target cumulative ELCRs and cumulative noncancer HIs for the future industrial and future excavation worker receptors. The acceptable cumulative risk levels for this RAO are defined as follows:

- Waste: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future excavation worker [considering a five-year exposure based on the outdoor worker scenario in the 2013 Risk Methods Document (DOE 2013a)].

SWMU-Specific RAO for Protection of Direct Contact with Contaminated Soils. Prevent exposure to contaminated soils that exceeds target cumulative ELCRs and cumulative noncancer HIs for the future industrial and future excavation worker receptors. The acceptable cumulative risk levels for this RAO are defined as follows:

- Surface Soil: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future industrial worker.

- Surface and Subsurface Soil: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future excavation worker [considering a five-year exposure based on the outdoor worker scenario in the 2013 Risk Methods Document (DOE 2013a)].

SWMU-Specific RAO for PTW. Treat or remove PTW wherever practicable, consistent with 40 *CFR* § 300.430 (a)(1)(iii)(A).

The PRGs identified for target compounds in soil to be addressed in this FS for protection of groundwater and direct contact at SWMU 2 are listed in Table 5.1.

Table 5.1. PRGs for SWMU 2

COC	Units	PRG for Surface Soil[a]	PRG for Subsurface Soil[b]	PRG for Subsurface Soil for Groundwater Protection[c]
cis-1,2-DCE	mg/kg	N/A	1.19E+00	1.19E+00
TCE	mg/kg	N/A	1.03E-01	1.03E-01
Total PCBs	mg/kg	N/A	1.00E+01[d]	1.00E+01[d]
Arsenic	mg/kg	1.69E+01	1.04E+01	1.69E+01
Uranium	mg/kg	N/A	4.31E+02	7.83E+02
Tc-99	pCi/g	N/A	2.12E+01	2.12E+01
U-234	pCi/g	3.06E+02	2.18E+02	4.88E+06
U-235	pCi/g	9.20E+00	1.21E+01	5.07E+04
U-238	pCi/g	3.74E+01	4.53E+01	2.64E+02

N/A = not applicable, these analytes are not COCs for the referenced media for SWMU 2.
[a] PRGs for surface soil are taken from Table 1.21 of this report.
[b] PRGs for subsurface soil are taken from Table 1.22 of this report.
[c] PRGs for subsurface soil for groundwater protection are taken from Table 1.23 of this report.
[d] Determined during June 2009 BGOU FS scoping meeting.

Locations where these PRGs are exceeded in soil are shown on figures in Appendix A. These PRGs will not be applied at sediment locations that are being addressed as part of the SWOU.

5.3 DEVELOPMENT OF SWMU-SPECIFIC ALTERNATIVES

General alternatives were assembled and screened in Section 3. This section further refines those general alternatives brought forward for specific application at SWMU 2, then proceeds to detailed and comparative analysis of the SWMU-specific alternatives using the nine CERCLA criteria.

The general alternatives retained in Section 3 for SWMU 2 are shown in Table 5.2.

Table 5.2. SWMU 2 Retained General Alternatives

Alternative Number/Description	
1	**No Action**
3	**Containment, Surface Controls, LUCs, and Monitoring**
4	***In Situ* Source Treatment, Containment, Surface Controls, LUCs, and Monitoring**
5	**Excavation and Disposal, Treatment, and LUCs**
6	**Targeted Excavation and Disposal, Containment, Surface Controls, Treatment, LUCs, and Monitoring**

For each GRA or technology identified in a general alternative, corresponding technologies and/or process options will be evaluated against the criteria of effectiveness, implementability, and cost for inclusion in a SWMU-specific alternative.

5.3.1 Alternative 1—No Action

The No Action alternative is defined in accordance with CERCLA and provides a baseline to which other alternatives can be compared. Under this alternative, no action would be taken to implement remedial activities for SWMU 2 or to reduce the potential hazard to human or ecological receptors. Alternative 1 does not address PTW or any of the COCs identified in SWMU 2 soils that pose an unacceptable risk under some future use scenarios because no action is taken.

5.3.2 Alternative 3—Containment, Surface Controls, LUCs, and Monitoring

Alternative 3 will evaluate means to contain waste and contaminated soil in place effectively and limit direct contact through the use of caps, surface controls, and LUCs.

Under this alternative, a cap (RCRA Subtitle C or KY Subtitle D cap) will be designed and installed to prevent direct contact and significantly reduce infiltration of precipitation into buried wastes. Other containment technologies, such as hydraulic isolation, including vertical subsurface barriers and groundwater extraction, are evaluated for inclusion. Additionally, surface controls, monitoring, and LUCs are evaluated.

The results of the SWMU-specific evaluation and a summary of the SWMU-specific alternative are shown in Section 5.3.2.5.

5.3.2.1 Containment

General Alternative 3 identified containment as a GRA. Caps, subsurface vertical barriers, and hydraulic containment are containment technologies for which RPOs are evaluated for inclusion into a SWMU 2-specific alternative.

5.3.2.1.1 Caps

Effectiveness. Both the RCRA Subtitle C and KY Subtitle D caps are identified as RPOs. Both of these "caps" are effective at preventing surface water from migrating to the underlying waste. The RCRA Subtitle C cap (as recommended in EPA guidance) includes a 24-inch low permeable soil layer and a 20-mil geosynthetic membrane, which make it a more robust cap than the KY Subtitle D cap (EPA 1991b).

Installation of a RCRA Subtitle C and KY Subtitle D cap, which includes multilayers that are distinctly different from the natural subsoils, provides greater depth to the buried waste. These aspects (thickness and distinct properties) of the cap are expected to provide protection of individuals from inadvertent intrusion by alerting them that this is a man-made, engineered cover over something that is potentially hazardous to human health and by making it more difficult to expose the buried waste.

As stated in Section 3.4.3.3, radon modeling will be conducted during the remedial design phase for any remedy that involves capping of low level waste that might emit radon at SWMU 2, and the modeling should be consistent with the modeling performed for the OSWDF project or new technologies and/or methodologies agreed to by the FFA parties.

Implementability. Both the RCRA Subtitle C and KY Subtitle D caps use similar construction means and methods and are both highly implementable at SWMU 2. The design of either cap can accommodate the placement of the separate surface barrier.

Cost. RCRA Subtitle C cap is somewhat more costly to install due to its increased low permeable layer thickness and the inclusion of a defined geosynthetic membrane. Long-term maintenance costs are equal for both caps.

Based on the evaluation factors of effectiveness, implementability, and cost; and in consideration that Alternative 3 leaves principal threat wastes in place, the RCRA Subtitle C cap will be the RPO for caps for SWMU-specific alternatives developed from General Alternative 3 at SWMU 2.

It is anticipated that surface soils that exceed RGs located outside the cap area would be excavated and consolidated on the RCRA Subtitle C cap area prior to cap placement. Any such excavation would be identified in the RAWP. Corner markers would be placed identifying the edge of the cap.

5.3.2.1.2 Subsurface vertical barriers

Effectiveness. Both sheet pile and slurry walls were identified as RPOs for the subsurface vertical barriers technology. The intent of the subsurface vertical containment in Alternative 3 at SWMU 2 is to assist in hydraulically isolating the waste that will remain contained at SWMU 2. A properly constructed soil-bentonite slurry wall has superior long-term effectiveness over a sheet pile installation which can leak through the joints and will eventually corrode.

Implementability. Both installation of sheet pile and a slurry wall are implementable at SWMU 2. The design of either would need to consider the location of the adjacent SWMU 3 which includes an existing Subtitle C cap.

Cost. Installation of a slurry wall at SWMU 2 is estimated to be somewhat more expensive than installation of sheet pile. Additionally, given the long-term nature of the SWMU-2 COCs, a sheet pile wall is subject to corrosion and would need periodic replacement whereas a slurry wall is a permanent feature with no maintenance or replacement required.

Based on the evaluation factors of effectiveness, implementability, and cost; a slurry wall will be the RPO for subsurface vertical barriers for SWMU-specific alternatives developed from General Alternative 3 at SWMU 2 because of its superior long-term effectiveness.

5.3.2.1.3 Hydraulic isolation

Groundwater extraction is the sole process option for containment (hydraulic isolation). Groundwater extraction would be effective and is implementable at SWMU 2 as a means of lowering the water table within the disposal area such that waste is no longer located in water. The implementability of groundwater extraction would be increased if paired with a cap and subsurface vertical barrier to minimize precipitation and groundwater infiltration. Groundwater extraction would require long-term monitoring to ensure that isolation is maintained.

5.3.2.2 Surface controls

Section 2.4.3 identifies soil covers and riprap as RPOs.

Because this alternative includes a RCRA Subtitle C cap and LUCs to ensure protectiveness, no additional surface controls are necessary. Surface controls are evaluated for use in the event DOE transfers the property.

Effectiveness. Riprap is differentiated from soil covers in that the riprap can be sized large enough (e.g., boulders) so as not to be man-portable and therefore cannot readily be removed without the use of heavy equipment. Riprap may be left uncovered to provide a striking contrast to the surrounding area as a warning, or it may be covered with a vegetative cover.

Assuming surface controls would be placed over a RCRA Subtitle C cap to provide long-term protection after DOE transfers the property, riprap (with or without a vegetative cover) would increase the thickness of the cap. Riprap could be used to protect the RCRA Subtitle C cap and prevent biointrusion into the buried waste.

Implementability. Both soil and riprap are readily available in the local market and placement of each is readily implementable. Riprap would need to be placed on a bedding material (smaller aggregate) to slow infiltration. There is little difference in the long-term implementability between covers (vegetative) and riprap (exposed). A soil cover would need mowing to maintain the vegetative cover while the exposed riprap would need periodic weeding to inhibit plant ingrowth.

Cost. Riprap is a somewhat more expensive product to initially install, but it is not prohibitively expensive compared to soil cover. It is estimated that maintenance costs are equal.

Based on the evaluation factors of effectiveness, implementability, and cost; and in consideration that Alternative 3 leaves a large mass of uranium PTW in place (an estimated 270 tons), riprap will be the

RPO for the surface controls for SWMU 2-specific alternatives developed from General Alternative 3. Compared to a soil cover, the riprap barrier is more effective when placed over the RCRA Subtitle C cap, but the riprap barrier would be more expensive than a soil cover.

5.3.2.3 Land use controls

Consistent with Section 2.4.1, LUCs will be implemented at BGOU SWMUs where waste is left in place or source area-related contamination at concentrations above RGs remains after active remediation that precludes UU/UE conditions.

Section 2.4.1.1 identifies the following LUCs to be evaluated on SWMU-specific and alternative-specific bases. This evaluation for SWMU 2, Alternative 3 is as follows.

Warning Signs. Warning signs provide a highly effective means to warn of the hazards of potential contaminant exposure. An initial sign installation is highly implementable; however, a drawback to signs is that they can be removed or defaced by vandals. This drawback negatively affects both the effectiveness and implementability of signs, but can be mitigated by constructing signs of vandal resistant materials and that can be affixed to supporting structures in a manner so as to make them not readily removable by vandals. Overall, warning signs are viewed as having high effectiveness, high implementability at a low cost.

Fences. Fences can be an effective LUC to prevent access or intrusion and are also highly implementable as a first installation; however, as with signs, fences require significant long-term maintenance at a significant cost in order to ensure adequate long-term effectiveness. Also, fences can be readily defeated by an intruder with common hand tools. While the pairing of fence and warning signs does offer a minimal increase in effectiveness, it does not offset the increased cost due to long-term maintenance that a fence requires.

Because this alternative includes a RCRA Subtitle C cap and LUCs, the addition of fences is unnecessary. For these reasons, fences will not be incorporated as a LUC in Alternative 3 at SWMU 2.

E/PP Program. The E/PP Program is a LUC administered by DOE's contractors at PGDP. It is an effective LUC for controlling potential personnel hazards related to trenching, excavation, and penetration greater than 6 inches into the earth, concrete, pavement or walls, floors, and ceilings of buildings. This program will be maintained for as long as DOE or its contractor maintain an on-site presence at the PGDP. The E/PP Program has proved to be highly implementable and at a low cost.

Property Record Notice, Deed and/or Lease Restrictions, and Environmental Covenant. These administrative controls are described in Section 2.4.1.1, and all are effective means of ensuring protection under the reasonably anticipated industrial future land use. These proprietary controls help ensure the land use remains industrial. Additionally, any land use change would be identified through the five-year review process, per CERCLA 121(c), and DOE would be required to take appropriate measures to ensure the continued protection of human health and the environment under the changed land use. These administrative LUCs are highly implementable and at a low cost.

Based on an evaluation of effectiveness, implementability and cost, Alternative 3 at SWMU 2, which leaves waste in place, will include the following LUCs as described in Section 2.4.1.1. Specific implementation details would be further defined in the LUCIP.

- Warning signs
- E/PP Program
- Property record notices
- Deed and/or lease restrictions (contingent upon transfer)
- Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer
- CERCLA 120(h)

These administrative and physical controls together provide enhanced protection and afford a layered strategy that provides protection in different ways. Fences are not included as a LUC for this alternative at SWMU 2 because they offer limited additional effectiveness at increased cost.

5.3.2.4 Monitoring

Conventional sampling and analysis of MWs is the identified RPO for the monitoring technology. This process option is an effective means of monitoring to assure that protection of human health and the environment is maintained by the remedy.

The following paragraphs identify the objectives, schedules, reporting requirements, sampling strategies, and technologies for the groundwater monitoring program to ensure remedy effectiveness (DOE 1998c).

Objective. The objective of groundwater monitoring would be to detect and characterize any releases of hazardous constituents from the SWMU that may adversely impact the uppermost aquifer. This is sometimes referred to as detection monitoring. Samples would be collected periodically from the MW and analyzed for specific indicator parameters and any other waste constituents or reaction products that could indicate that a release might have occurred.

Monitoring Schedule/Frequency. If this alternative is selected, semiannual monitoring would occur through the first five years of remedy implementation. After the first five years, monitoring frequency at these wells could be reduced to annually, provided no indication of potential adverse environmental impacts to groundwater were detected.

Reporting Requirements. Results of SWMU 2 groundwater monitoring will be reported twice annually in the FFA Semiannual Report. These results will be evaluated for the triggers described below every five years in the CERCLA five-year review.

Sampling Strategy—Monitoring Locations. One upgradient RGA MW and three downgradient MWs would be sufficient to monitor for releases. The cost estimates assume construction of four new monitoring wells.

Sampling Strategy—Analytical Parameters. At a minimum, SWMU 3 MWs would be monitored for the COCs for the protection of groundwater determined in the FS. These contaminants are listed in Table 5.1 of this FS. Nationally recognized methods, where applicable (e.g., SW-846, ASTM), would be used to analyze the groundwater samples.

Sampling Strategy—Monitoring Triggers. The following triggers may be used to determine whether adverse environmental impacts to groundwater associated with this SWMU have occurred.

- A statistically significant trend of any of the COCs or a significant change to other monitored parameters (e.g., pH, dissolved oxygen) within an individual MW.

- An increase in downgradient MW results above upgradient MW results (i.e., a statistically significant increase in the downgradient levels of any of the monitored constituents when compared to the upgradient levels).

Technologies. Standard technologies would be used to collect the groundwater samples and transport them to a suitable laboratory. As previously stated, nationally recognized methods would be used to analyze the groundwater samples. It is anticipated that surface soils that exceed RGs located outside the cap area would be excavated and consolidated under the RCRA Subtitle C cap prior to cap placement. The excavation and consolidation of surface soils exceeding the RGs under the cap would eliminate the need for subsequent surface water monitoring.

5.3.2.5 Summary of SWMU-specific alternative

Table 5.3 identifies and summarizes the features that will be included for Alternative 3 at SWMU 2.

Alternative 3 satisfies the first RAO and contains waste in place. Potential for impacts to groundwater is mitigated through containment.

Table 5.3. SWMU 2, Alternative 3 Components

General Response Action	Technologies	RPOs
Containment	Caps	RCRA Subtitle C cap
	Hydraulic Isolation	Slurry wall Groundwater extraction
Surface Controls	Surface Barriers	Riprap Soil Cover
Monitoring	Groundwater Monitoring	Conventional groundwater monitoring
LUCs	Physical Controls	Warning signs
	Administrative Controls	• E/PP Program • Property record notices • Deed and/or lease restrictions contingent upon transfer • CERCLA 120(h) • Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer

- A slurry wall would be placed around the disposal area to eliminate lateral groundwater movement through the UCRS either outward from the disposal area to the ditch south of SWMU 2 or inward from the ditch to the disposal area. The RDSI would use geoprobe equipment to place sample collection borings along the sides of the waste area to ensure that RGs are met at the slurry wall boundary and that all waste would be contained within the slurry wall.

- Dewatering wells would be placed within the boundary of the slurry walls at the UCRS at the HU2/HU3 interface to lower the water level so that the waste is no longer in water.

- The cap, slurry wall, and groundwater extraction system would work together to isolate the waste hydraulically.

- Separate RGA groundwater MWs would monitor remedy effectiveness outside of the containment structure.

Alternative 3 satisfies the second RAO. The potential for direct contact would be mitigated through layered controls.

- Contaminated surface soils outside the cap area would be consolidated under the cap prior to cap placement. The RDSI would include surface soil sampling to characterize the shallow soils (within the SWMU, but outside the burial pit footprint) to identify the soils that exceed RGs.

- The RCRA Subtitle C cap would form a barrier to prevent infiltration and also to mitigate intrusion.

- Physical LUCs would provide warning at the site, and administrative LUCs would provide warning and mitigate potential exposure.

- Riprap would be placed over the RCRA Subtitle C cap.

Regarding the third RAO, Alternative 3 does not include treatment or removal of PTW.

Additional details used for cost estimating purposes are presented in Table 5.4 and Appendix E.

5.3.3 Alternative 4—*In Situ* Source Treatment, Containment, Surface Controls, LUCs, and Monitoring

Alternative 4 is the same as Alternative 3, with the addition of *in situ* source treatment and associated postremediation sampling.

5.3.3.1 Containment

Because Alternatives 3 and 4 rely on containment in largely the same manner, the evaluation of containment process options is the same for both alternatives. However, to summarize, the process options to be assembled into SWMU 2-specific Alternative 4 include a RCRA Subtitle C cap, slurry walls, and groundwater extraction.

5.3.3.2 Surface controls

Because Alternatives 3 and 4 rely on containment and surface controls in the same manner, the evaluation of surface controls process options is the same for both alternatives; therefore, SWMU 2-specific Alternative 4 includes a riprap layer for the same reasons derived in Section 5.3.2.2.

5.3.3.3 Treatment

General Alternative 4 identifies treatment as a GRA. Table 5.5 identifies the RPOs from their respective technologies.

Table 5.4. SWMU 2, Alternative 3 Key Cost Drivers and Key Assumptions

CAPITAL COSTS
Hydraulic Isolation • Slurry Wall — Soil-bentonite slurry wall — Keyed into HU3 at approximately 40 ft bgs — Assumed dimensions of the 4 walls to enclose the SWMU (200 ft in length × 3-ft wide × 40-ft deep) • Groundwater Removal System — Assumes four dewatering wells within slurry wall screened at HU2/HU3 interface — Wells pumped to a 1,000-gal holding tank — Assumed disposal at C-612 for 30 years — Assumed off-site disposal beyond 30 years at 1,000 gal per year
Surface Soil Consolidation at the Cap Area • Assumes 25% of SWMU area not under the cap (3,637 ft^2 of 14,588 ft^2) will be excavated to 2 ft bgs and placed at the cap area prior to cap construction • Total volume = 270 yd^3
Cap Construction • Assumed cap area = 44,000 ft^2 • RCRA Subtitle C cap layers consist of — Base (Leveling) Layer—6-inch thick — Low Permeable Soil layer—24-inch thick compacted clay — Geomembrane—40-mil HDPE — Granular Drainage Layer—1-ft thick — Geotextile Filter Fabric — Protective Soil Layer—2-ft thick soil layer • Four corner markers
Riprap • 6 inches bedding material underlying • 2-ft thick layer of 18 inch to 24 inch nominally graded stone
ANNUAL COSTS
• Operation and Maintenance — Inspection—Quarterly — Remove weeds—Semiannually — Collect and dispose of groundwater from storage tank—Annually — Replace groundwater extraction pumps—Every 5 years — Replace signs—Every 30 years — Replace dewatering system above ground components—Every 50 years — Replace dewatering wells—Every 100 years • Groundwater Monitoring — Monitor 4 wells semiannually for 5 years — Assume annual monitoring of same wells after 5 years • Five-Year Review

Table 5.5. General Alternative 4, Treatment RPOs

Technology	RPOs	Comments
Physical/Chemical	• Air stripping (*ex situ*) • Ion exchange (*ex situ*) • Granulated activated carbon (*ex situ*)	These components will be evaluated together as the *ex situ* components of a conventional P&T system.
Physical/Chemical	• DPE (*in situ*) • Deep soil mixing (*in situ*) • Jet grouting (*in situ*)	N/A
Biological	Enhanced biodegradation	N/A
Thermal	ERH	N/A
Chemical	ZVI	N/A

5.3.3.3.1 Pump-and-treat

In its conventional use, P&T systems are installed to capture contaminated groundwater *in situ* and treat the water *ex situ*. Also, in its conventional use, a P&T system would be most applicable with wells installed in the RGA such as the P&T system installed for the Northwest Plume.

Effectiveness. A P&T system at SWMU 2 would be effective only at capturing the more mobile COCs at SWMU 2 (TCE and uranyl fluoride) prior to migrating from the unit to the RGA. P&T would not be an effective means for treating the less mobile COCs at the unit.

Implementability. P&T has been implemented at PGDP and would be readily implementable at SWMU 2.

Cost. Given that Alternative 3 already relies on groundwater extraction for dewatering purposes as a component of hydraulic isolation, the value of installing an additional P&T system is not considered cost-effective. Additionally, any P&T system installed at SWMU 2 may have to operate for an extensive period, incurring substantial long-term costs.

Because of the limited effectiveness to treat nonmobile COCs, overlap with groundwater extraction, and high long-term costs, installing a P&T system at SWMU 2 will not be included as a remedy component for Alternative 4.

The *ex situ* treatment components, however, would be effective when paired with groundwater extraction, and these treatment components are assumed to be available in the near term at C-612, as associated with the Northwest Plume Pump-and-Treat system. In the long-term, it is assumed that C-612 would not be operating, and the limited groundwater collected through hydraulic isolation would be shipped off-site for disposal. Specific cost assumptions are included in Appendix E.

5.3.3.3.2 Dual-phase extraction

Effectiveness. DPE, as a component of ERH, has proved effective for remediating TCE within the UCRS at PGDP as evidenced by the C-400 project. The vapor extraction component of DPE would not be an effective means of remediating other nonvolatile COCs at SWMU 2 such as PCBs and uranyl fluoride; however, those COCs could be captured effectively by the groundwater extraction component of the dual-phase system. DPE would not treat uranium metal in a manner to reduce its toxicity, mobility, or volume.

As stated above, DPE is a component of ERH and has been paired with ground heating (through ERH) to form a remedial action at the C-400 site at PGDP. Because the C-400 remedial action included heating, TCE was volatilized, extracted, and subsequently treated *ex situ*, and the remediation was completed in months. Without a heating component, the effectiveness of DPE is reduced and the treatment time is significantly increased.

Implementability. DPE has been implemented at PGDP when paired with ERH and would be implementable at SWMU 2.

Cost. As with P&T, DPE does not have a cost effective application at SWMU 2.

5.3.3.3.3 Deep soil mixing (solidification/stabilization)

Effectiveness. As applied at SWMU 2, deep soil mixing would involve injecting chemical/cement or bentonite slurry into the waste and underlying soil through a rotating large diameter auger or mixer. This method would mix the waste, contaminated soil, and uncontaminated soil effectively with the reagent forming a monolithic block with a reduced mobility. *In situ* solidification/stabilization has been used to treat both organic and inorganic hazardous waste constituents.

Implementability. Disposal records indicate that uranium-containing drummed wastes buried in the unit consist primarily of uranium metal from the machine shop turnings, shavings, and saw dust. These wastes still may be pyrophoric. Auger mixing of these soils will disturb any unoxidized uranium leaving it susceptible to a pyrophoric reaction. This reaction may cause localized heating, but the reaction would be limited by the oxygen available. A large pyrophoric event is not possible due to the limited oxygen. Additionally, the reaction would be well contained due to the depth of the waste.

Disposal records do not indicate that debris, including concrete or structural steel was placed in the unit. It is anticipated that the disposed uranium may have agglomerated together. However, any agglomerated uranium or remaining drums would be readily shredded and mixed by properly sized equipment.

The implementability of deep soil mixing would be limited to the waste area because mixing below the waste may provide a means for metallic uranium, (which would be more dense than the stabilization slurry) to migrate to lower depths within the stabilization slurry column.

Deep soil mixing (solidification/stabilization) is a well-recognized treatment method. While the cost of initial treatment is higher than other methods evaluated, there are no long-term operational costs.

Because of its ability to treat all COCs at SWMU 2 effectively by reducing mobility, deep soil mixing will be incorporated into a SWMU 2-specific alternative.

Cost. Deep soil mixing is not prohibitively expensive. Additionally, deep soil mixing techniques could be used to install the containment slurry wall prior to waste mixing. This would eliminate the cost of mobilizing specific slurry-wall equipment.

Because of its effectiveness to limit the mobility of all COCs and PTW at SWMU 2, solidification/stabilization (deep soil mixing) will be incorporated into a SWMU 2-specific Alternative 4.

5.3.3.3.4 Jet grouting

Jet grouting can be used to inject treatment reagents into a soil matrix in a manner similar to deep soil mixing; however, jet grouting does so at high pressures that destroy the existing soil matrix creating slurry of existing soil and reagent, which generally is cement and/or bentonite.

Effectiveness. One of the identified limitations of deep soil mixing is that uranium metal could migrate downward through the slurry matrix; therefore, it would be limited to the depth of the existing waste. Jet grouting would be effective to treat underlying contamination. Jet grouting involves drilling a pilot hole in which the jet grouting annulus is inserted causing minimal disruption of the waste and allowing for jet grouting to treat mobile COCs in the UCRS below the waste without the concern for uranium migration.

Unlike soil mixing in which full mixing can be assured within the diameter of the mixing apparatus, jet grouting relies on pressure to force slurry into the soil matrix, and the diameter of the soil column is not dictated by a physical measure such as an auger. This limitation could be overcome by using horizontal or angled drilling methods to verify adequate treatment coverage.

Implementability. Jet grouting is implementable within HU2. It would be less implementable in HU3 because of the higher clay content.

Cost. Jet grouting is not prohibitively expensive.

Jet grouting will be retained as an adjunct process option for combination with deep soil mixing and as a means of delivering chemical treatment reagents below the SWMU 2 waste.

5.3.3.3.5 *In situ* enhanced biodegradation

Effectiveness. *In situ* enhanced bioremediation could be an effective means to treat some of the less mobile COCs at SWMU 2. Given the uncertainty associated with the drum integrity of the drummed uranyl fluoride and the uncertainties of the volume of remaining TCE, *in situ* enhanced bioremediation would not be an effective treatment for these mobile wastes. These mobile wastes could migrate from the unit prior to sufficient residence time in the treatment area. This is particularly true for the uranyl fluoride, if the drums have not previously ruptured.

Implementability and Cost. *In situ* enhanced biodegradation is implementable at a low cost.

While *in situ* enhanced bioremediation is the RPO, considerable uncertainty remains as to its effectiveness as applied to SWMU 2. It will therefore not be incorporated into a SWMU-specific alternative at SWMU 2.

5.3.3.3.6 Electrical resistance heating

Effectiveness. ERH is the RPO for thermal technologies. *In situ* thermal treatments are best suited for the treatment of VOCs; however, they also have been used to treat PCBs *in situ*. *In situ* thermal technologies would not be effective to treat inorganic wastes such as uranium metal or uranyl fluoride. Additionally, *in situ* thermal technologies would not mitigate the uncertainty associated with drum condition. Any drums that remain intact likely would not be treated.

Implementability. Due to interferences with drums or metal debris at SWMU 2, ERH is not readily implementable except for contaminated soil found under the source term. Other process options, such as thermal conductive heating or steam injection could be implemented in the source zone, but do not overcome the uncertainties associated with intact drums.

Cost. The cost of ERH or other thermal treatments is high.

Because of the uncertainty of intact drums at SWMU 2 and because of the presence of nonvolatile COCs for which ERH, conductive, or stream injection would be ineffective, these heating treatments will not be incorporated into a SWMU 2-specific alternative.

5.3.3.3.7 ZVI

Effectiveness. Chemical treatment at SWMU 2**,** for which ZVI is the RPO, would focus on uranyl fluoride immobilization and TCE destruction. ZVI was selected as the RPO largely because of its success at treating COCs at other sites. Based upon the results of the RDSI, which will better define contamination extent and concentration, the determination could be made to proceed with ZVI injection, use of another chemical reagent, or a combination of both. For example, ZVI may be considered most effective to destroy TCE at cell 6, while phosphate injection may be considered most effective to immobilize uranyl fluoride at cells 8 and 9. Chemical injection would be in solution form, and jet injection would be the selected delivery mechanism. Treatment column spacing, column depth, and injection rates would be identified during the RAWP based on RDSI results.

5.3.3.3.8 Treatment summary

Based on an evaluation of effectiveness, implementability and cost, two treatment process options will be assembled into general Alternative 4 at SWMU 2. These process options include deep soil mixing and ZVI. Additionally, jet grouting will be included as a means of delivering stabilization/solidification reagents or other chemical reagents to areas below the waste.

5.3.3.4 Land use controls

Alternative 4 at SWMU 2 leaves waste in place. Because Alternatives 3 and 4 rely on containment and LUCs in the same manner, the evaluation of LUC process options is the same for both alternatives; therefore, SWMU 2-specific Alternative 4 will include the following LUCs for the same reasons derived in Section 5.3.2.3.

- Warning signs
- E/PP Program
- Property record notices
- Deed and/or lease restrictions (contingent upon transfer)
- Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer
- CERCLA 120(h)

These administrative and physical controls together provide enhanced protection and afford a layered strategy that provides protection in different ways.

5.3.3.5 Monitoring

Conventional sampling and analysis from MWs is the identified RPO for the monitoring technology. This process option is an effective means of monitoring to assure that protection of human health and the environment is maintained by the remedy.

5.3.3.6 Summary of SWMU-specific alternatives

Based upon the evaluation of process options for effectiveness, implementability, and cost, specific to SWMU 2, the following SWMU-specific alternatives have been assembled and will be brought forward for detailed analysis at SWMU 2. No further screening of alternatives is necessary because the alternative screening was performed following the assembly of General Alternatives in Section 3.

Alternative 4 contains two treatment options: stabilization/solidification and chemical injection. These options are identified/designated as shown below using "SS" to denote the stabilization/solidification option and "CI" to denote the chemical injection option.

- Alternative 4 (SS)—Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring

- Alternative 4 (CI)—Containment, Chemical Injection, Surface Controls , LUCs, and Monitoring

Tables 5.6 and 5.7 identify the key features of these SWMU-specific alternatives.

Table 5.6. Alternative 4 (SS) Components

General Response Action	Technologies	RPOs
Containment	Caps	RCRA Subtitle C cap
	Hydraulic Isolation	Slurry wall Groundwater extraction
Treatment	Physical Chemical	Deep soil mixing and jet grouting
Surface Controls	Surface Barriers	Riprap
Monitoring	Groundwater Monitoring	Conventional groundwater monitoring
LUCs	Physical Controls	Warning signs
	Administrative Controls	• E/PP Program • Property record notices • Deed and/or lease restrictions (contingent upon transfer) • CERCLA 120(h) • Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer

Table 5.7. Alternative 4 (CI) Components

General Response Action	Technologies	RPOs
Containment	Caps	RCRA Subtitle C cap
	Hydraulic Isolation	Slurry wall Groundwater extraction
Treatment	Chemical	ZVI
Surface Controls	Surface Barriers	Riprap
Monitoring	Groundwater Monitoring	Conventional groundwater monitoring
LUCs	Physical Controls	Warning signs
	Administrative Controls	• E/PP Program • Property record notices • Deed and/or lease restrictions (contingent upon transfer) • Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer

Alternatives 4 (SS) and 4 (CI) contain waste in place and satisfy the first RAO. Potential contamination of groundwater is mitigated through containment.

- A slurry wall would be placed around the disposal area to eliminate lateral groundwater movement through the UCRS either outward from the disposal area to the ditch south of SWMU 2 or inward from the ditch to the disposal area. In order to properly locate this slurry wall, an investigation will be conducted to ensure that the proposed slurry wall alignment falls outside of the waste area. The investigation will use geoprobe equipment to place borings along the sides of the waste area to ensure that RGs are met at the slurry wall boundary.

- Dewatering wells would be placed within the boundary of the slurry walls at the UCRS at the HU2/HU3 interface to lower the water level so that the waste is no longer in water.

- The cap, slurry wall, and groundwater extraction system would work together to hydraulically isolate the waste. Through groundwater extraction, the waste would be removed from being located in groundwater.

- Separate RGA groundwater MWs located outside the slurry wall would monitor remedy effectiveness.

- Alternative 4 (SS) also would mitigate the potential for contamination of groundwater through stabilization/solidification, which will reduce mobility through the waste.

Alternatives 4 (SS) and 4 (CI) satisfy the second RAO. The potential for direct contact would be mitigated through layered controls.

- Contaminated surface soils outside the cap area would be consolidated under the cap prior to cap placement. The RDSI would include surface soil sampling to characterize the shallow soils (within the SWMU, but outside the burial pit footprint) to identify the soils that exceed RGs.

- The RCRA Subtitle C cap would form a barrier to prevent infiltration and to mitigate intrusion.

- Physical LUCs would provide warning at the site, and administrative LUCs would provide warning and mitigate potential exposure.

- Riprap would be placed over the RCRA Subtitle C cap.

Regarding the third RAO, Alternative 4 (SS), which reduces mobility through stabilization/solidification, satisfies the third RAO by treating all PTW wherever practicable, consistent with 40 *CFR* § 300.430 (a)(1)(iii)(A). Alternative 4 (CI), partially satisfies the third RAO by treating PTW in cells 6, 8, and 9, but does not satisfy the third RAO for PTW (uranium metal or potential PCBs) situated in other cells.

Additional details used for cost estimating purposes are presented in Table 5.8, Table 5.9, and Appendix E.

Table 5.8. SWMU 2, Alternative 4 (SS) Key Cost Drivers and Key Assumptions

CAPITAL COSTS
Stabilization/Solidification • **Stabilize waste area using deep soil mixing to 20 ft bgs** — Treat volume of 24,000 yd^3 (160 ft × 200 ft × 20-ft deep) • **Chemical injection using jet grouter below cells 6, 8 and 9** — Cell 6—Assume 20 ft × 20 ft area—Treated from 20 ft to 60 ft bgs — Cells 8 and 9—Assume 20 ft × 40 ft area—Treated from 20 ft to 60 ft bgs
Hydraulic Isolation • Slurry Wall — Soil-bentonite slurry wall — Keyed into HU3 at approximately 40 ft bgs — Assumed dimensions of the 4 walls to enclose the SWMU (200 ft in length × 3-ft wide × 40-ft deep) • Groundwater Removal System — Assumes four dewatering wells within slurry wall screened at HU2/HU3 interface — Wells pumped 1,000-gal holding tank — Assumed disposal at C-612 for 30 years — Assumed off-site disposal beyond 30 years at 1,000 gal per year
Surface Soil Consolidation at the Cap Area • Assumes 25% of SWMU area not under the cap (3,637 ft^2 of 14,588 ft^2) will be excavated to 2 ft bgs and placed at the cap area prior to cap construction • Total volume = 270 yd^3

Table 5.8. SWMU 2, Alternative 4 (SS) Key Cost Drivers and Key Assumptions (Continued)

CAPITAL COSTS (CONTINUED)
Cap Construction • Assumed cap area = 44,000 ft^2 • RCRA Subtitle C cap layers consist of — Base (Leveling) Layer—6-inch thick — Low Permeable Soil layer—24-inch thick compacted clay — Geomembrane—40 mil HDPE — Granular Drainage Layer—1-ft thick — Geotextile Filter Fabric — Protective Soil Layer—2-ft thick soil layer — Four corner markers
Riprap • 6 inch bedding material underlying • 2-ft thick layer of 18 inches to 24 inches nominally graded stone
ANNUAL COSTS
• Operation and Maintenance — Inspection—Quarterly — Remove weeds—Semiannually — Collect and dispose of groundwater from storage tank—Annually — Replace groundwater extraction pumps—Every 5 years — Replace signs—Every 30 years — Replace dewatering system above ground components—Every 50 years — Replace dewatering wells—Every 100 years • Groundwater Monitoring — Monitor 4 wells semiannually for 5 years — Assume annual monitoring of same wells after 5 years • Five-Year Review

Table 5.9. SWMU 2, Alternative 4 (CI) Key Cost Drivers and Key Assumptions

CAPITAL COSTS
Chemical Injection • **Chemical injection using deep soil mixing to 20 ft bgs** — Cell 6—Assume 20 ft × 20 ft area—Treated from surface to 20 ft bgs — Cells 8 and 9—Assume 20 ft × 40 ft area—Treated from surface to 20 ft bgs. • **Chemical injection using jet grouter below cells 6, 8 and 9** — Cell 6—Assume 20 ft × 20 ft area—Treated from 20 ft to 60 ft bgs — Cells 8 and 9—Assume 20 ft × 40 ft area—Treated from 20 ft to 60 ft bgs.

Table 5.9. SWMU 2, Alternative 4 (CI) Key Cost Drivers and Key Assumptions (Continued)

CAPITAL COSTS (CONTINUED)
Hydraulic Isolation • Slurry Wall — Soil-bentonite slurry wall — Keyed into HU3 at approximately 40 ft bgs — Assumed dimensions of the 4 walls to enclose the SWMU (200 ft in length × 3-ft wide × 40-ft deep) • Groundwater Removal System — Assumes four dewatering wells within slurry wall screened at HU2/HU3 interface — Wells pumped 1,000 gal holding tank — Assumed disposal at C-612 for 30 years — Assumed off-site disposal beyond 30 years at 1,000 gal per year
Surface Soil Consolidation at the Cap Area • Assumes 25% of SWMU area not under the cap (3,637 ft^2 of 14,588 ft^2) will be excavated to 2 ft bgs and placed at the cap area prior to cap construction • Total volume = 270 yd^3
Cap Construction • Assumed cap area = 44,000 ft^2 • RCRA Subtitle C cap layers consist of — Base (Leveling) Layer—6-inch thick — Low Permeable Soil layer—24-inch thick compacted clay — Geomembrane—40-mil HDPE — Granular Drainage Layer—1-ft thick — Geotextile Filter Fabric — Protective Soil Layer—2-ft thick soil layer • Four corner markers
Riprap • 6 inch bedding material underlying • 2-ft thick layer of 18 inches to 24 inches nominally graded stone
ANNUAL COSTS
• Operation and Maintenance — Inspection—Quarterly — Remove weeds—Semiannually — Collect and dispose of groundwater from storage tank—Annually — Replace groundwater extraction pumps—Every 5 years — Replace signs—Every 30 years — Replace dewatering system above ground components—Every 50 years — Replace dewatering wells—Every 100 years • Groundwater Monitoring — Monitor 4 wells semiannually for 5 years — Assume annual monitoring of same wells after 5 years • Five-Year Review

5.3.4 Alternative 5—Excavation and Disposal, Treatment, and LUCs

General Alternative 5 assembles RPOs primarily from the Removal, Treatment, and Disposal GRAs. *In situ* treatment process options are evaluated and would be implemented if RGs are not met through excavation and disposal alone. *Ex situ* treatment also is evaluated to treat waste in accordance with ARARs prior to disposal, should they not meet the disposal facility's WAC. Finally, LUCs are evaluated and would be implemented if excavation and *in situ* treatment do not result in UU/UE conditions.

5.3.4.1 Removal

The use of conventional excavation equipment such as backhoes and trackhoes is the RPO for the removal GRA at SWMU 2. Equipment would be fitted with nonsparking buckets to prevent the ignition of hydrogen that may have built up in buried containers. This equipment is effective, implementable, and cost effective for application at SWMU 2. Due to the proximity of SWMU 2 to SWMU 3, it is anticipated that shoring will be used to stabilize the excavation. While sheet pile is identified as a containment process option, it is not a permanent feature of the remedial action and therefore not separately evaluated here. Shoring would be designed in the RAWP. Sheet pile shoring is assumed for estimating purposes.

If postexcavation sampling shows contamination at concentrations above RGs below the excavation, other removal process options, such as auger removal, could be evaluated to remove COCs selectively as an alternative to treatment. This method of removal was used for removal of TCE at a DOE site in Pinellas, FL. If postexcavation sampling indicates that contamination above RGs extends only slightly beyond 20 ft bgs, then additional excavation to address this contamination also may be implemented at DOE's discretion. For estimating purposes, excavation to 20 ft bgs has been assumed.

5.3.4.2 Treatment (*in situ*)

The practical depth of conventional excavation is limited to 20 ft due to cost considerations involved with more elaborate shoring systems that would be required to excavate deeper than 20 ft bgs. It is recognized that, while waste is not anticipated to be found below 20 ft bgs, the CSM is that drums have released their contents, and contaminants have migrated vertically down to a degree that RGs cannot be met through excavation alone. Because of this, treatment of the soils below the bottom of the excavation is anticipated and included as part of Alternative 5.

The COCs targeted for treatment are the mobile COCs, uranyl fluoride, and TCE. The less mobile pyrophoric uranium and PCBs would be remediated through excavation and disposal. Therefore, the primary difference between the treatment evaluation conducted in Section 5.3.3.3 and an evaluation for postexcavation treatment process options is that the uncertainty associated with the physical waste properties will have been resolved through removal. That is, interferences due to metal items disposed of at SWMU 2 will have been removed and no longer would serve as an impediment to treatment methods.

Enhanced biodegradation and ERH (or other thermal process options) would be effective means to treat TCE alone located below cell 6, but would not be effective to treat both TCE and uranyl fluoride at cells 8 and 9. Because it would not be cost effective to employ multiple treatment methods, those methods that would not be effective at treating both TCE and uranyl fluoride will be screened on the basis of effectiveness and cost.

Stabilization/solidification could be used; however, it is not preferred because it only stabilizes the TCE and does not destroy it.

Chemical injection will be assembled into Alternative 5. Chemical injection can be an effective means to treat mobile COCs at SWMU 2 and provides the greatest flexibility to account for uncertainties such as treatment volume and COC concentration. For example, injection of (nano or micro) ZVI may be appropriate for treatment (destruction) of residual TCE, while injection of phosphate may be appropriate for treatment (stabilization) of residual uranyl fluoride. The addition of amendments (e.g., apatite or phosphate solutions) stabilizes uranium in soils and groundwater through the formation of relatively insoluble uranium phosphate solids. Precipitation of uranium to the phosphate form leaves uranium highly insoluble and essentially inert chemically (EPA 2006b).

5.3.4.3 Treatment (potentially pyrophoric uranium)

This *ex situ* treatment is considered a secondary process to excavation. That is, *ex situ* treatment will be performed only if the waste and contaminated soil are excavated. Excavated soils/wastes may be treated on-site or off-site at a commercial facility as needed to meet the WAC of the disposal facility. On-site treatment would be done in containers, tanks, temporary units, and/or CAMUs in accordance with ARARs. Treatment of hazardous waste is necessary to meet LDR treatment standards or alternatively CAMU treatment standards, if sent to a designated CAMU.

Assumptions have been made regarding the waste streams that would be generated from the excavation of SWMU 2 wastes and contaminated soils. These waste streams and associated volumes are presented in Appendix E. Notably, it is estimated that 9,881 bcy of waste and associated soil removed incidental to the waste will require stabilization for the characteristic of ignitability prior to disposal.

The following discussion evaluated the relative effectiveness, implementability, and cost of on-site vs. off-site treatment.

5.3.4.3.1 Off-Site Treatment

In 2002, Perma-Fix Environmental Services Inc., completed a First Article Test 31.79—3 to treat DOE's existing nationwide inventory of pyrophoric radioactive metal wastes (Crocker et al. 2006). Two additional full-scale treatment projects also were performed between 2003 and 2004. Chemical contaminants included mineral oil, PCBs, numerous volatile and SVOCs and toxic metals.

Effectiveness. The measure of effectiveness for treatment is the ultimate ability to meet the selected disposal site's WAC. In this case, because of the volume of uranium, it is assumed that treated waste would be disposed of either at NNSS or at a potential CERCLA OSWDF.

Off-site treatment is effective. Perma-Fix Environmental Services, Inc., has successfully treated waste with the same COCs as at SWMU 2 to meet LDR and WAC requirements; therefore, this process would be described as highly effective.

Implementability. The off-site treatment process is also highly implementable; however, waste would need to be managed in compliance with U.S. Department of Transportation requirements that pyrophoric materials be shipped in an inert atmosphere. This can be done by flooding containers with an inert gas prior to shipment.

Cost. Off-site stabilization is very high cost; however, the costs are somewhat variable based on the volume treated. While the amount of pyrophoric uranium remaining is an uncertainty, it is assumed for estimating purposes that all uranium metal will be treated as pyrophoric.

5.3.4.3.2 On-site stabilization

Effectiveness. On-site stabilization was the selected treatment method planned for potentially pyrophoric uranium (in the event it was found) at DOE's Fernald site. This method involved physical inspection and separation of agglomerated uranium into smaller pieces followed by cement stabilization.

Implementability. On-site stabilization would be highly implementable, although the pyrophoric nature of uranium metal chips and shavings is recognized as impacting implementability. Chemical and radiological concerns can be mitigated through proven industrial safety methods. On-site stabilization also mitigated the need for separate processes to be established to ship nonstabilized uranium for treatment.

The methods analyzed to stabilize uranium on-site for pyrophoricity using cement grout is a method similar to that used at DOE's Fernald site.

On-site treatment would be done in accordance with ARARs in containers, tanks, temporary units, and/or CAMUs. Soil and metal packaged at the excavation site will be placed in a stabilization area. In the first treatment step, drums would be emptied onto a sorting table. Large agglomerated pieces of uranium would be manually broken apart using nonsparking hand tools. Inerting materials, such as mineral oil would be gently sprayed onto the metal to form a light coating. Sand also will be available to smother the metal and prevent exposure to oxygen. Alternatively, a glovebox in which a low oxygen environment was maintained could be used to size reduce large uranium agglomerations.

After sizing, the metal, associated soil and cement grout would be mixed in a concrete mixer drum. Once satisfactorily mixed, the slurry would be dumped into "half high" waste boxes with a capacity of approximately 35 ft^3. Assuming a slurry matrix density of 200 lb per ft^3, the mass of the loaded container would be 7,600 lb, which is less than the containers 9,000 lb capacity.

It is assumed that *ex situ* uranium stabilization also would result in lowering PCB concentrations in PCB-contaminated soil to below 500 ppm.

Cost. On-site treatment costs are high, and significant fixed mobilization costs exist which would be incurred regardless of the volume treated. While the amount of pyrophoric uranium remaining is an uncertainty, it is assumed for estimating purposes that all uranium metal will be treated as pyrophoric. Using this assumption as a cost basis significantly favors on-site treatment.

Because both on-site and off-site treatments are effective and implementable, cost becomes a driving consideration and, therefore, this alternative will include on-site stabilization as the RPO.

5.3.4.4 Disposal

Both on-site and off-site disposal of excavated waste and contaminated soils were identified as RPOs for the subsurface vertical barriers technology. Additionally, the existing C-746-U Landfill was identified as a RPO for nonhazardous wastes that meet the C-746-U Landfill WAC (including authorized limits).

Use of the C-746-U Landfill is an effective location for disposal of nonhazardous wastes that meet the WAC and its use is evaluated. Additionally, both off-site and on-site disposal can be equally effective disposal means for the wastes generated through an excavation alternative.

The off-site waste disposal currently is implementable. Based on process knowledge of the SWMU 2 waste and industry practices for disposal of such wastes, it is assumed that all SWMU 2 generated wastes would meet the WAC of either a commercial landfill or a federally owned facility such as NNSS. The on-site disposal process option would be implementable only if an on-site facility is available at the time of excavation. Regarding cost, disposing of wastes on-site would be significantly cheaper than off-site disposal.

Based on the evaluation factors of effectiveness, implementability, and cost, this FS will carry forward both the off-site and on-site disposal process options, with the assumption that both process options would be paired with use of the C-746-U Landfill. For estimating purposes, it will be assumed that off-site wastes will be transported to NNSS for disposal. It is recognized that disposal at an on-site cell would be implementable only should one be constructed.

Appendix E includes detailed assumptions regarding the volume and treatment and disposition pathways for all excavation-driven waste associated with this alternative.

5.3.4.5 Land use controls

Consistent with Section 2.4.1, LUCs will be implemented at BGOU SWMUs where waste is left in place or source area-related contamination at concentrations above RGs remains after active remediation that precludes unrestricted use. LUCs may be necessary at SWMU 2 if postexcavation treatment does not allow for UU/UE use. This could occur if chemical treatment of uranyl fluoride is used to limit its mobility, leaving a nonmobile, but still radioactive component at the SWMU.

Section 2.4.1.1 identifies the following LUCs to be evaluated on SWMU-specific and alternative-specific bases. This evaluation for SWMU 2, Alternative 5 is as follows.

Warning Signs. Warning signs provide a highly effective means to warn of the hazards of potential contaminant exposure. An initial sign installation is highly implementable; however, a drawback to signs is that they can be removed or defaced by vandals. This drawback negatively affects both the effectiveness and implementability of signs, but can be mitigated by constructing signs of vandal-resistant materials that can be affixed to supporting structures in a manner so as to make them not readily removable by vandals. Overall, warning signs are viewed as having high effectiveness and high implementability at a low cost.

Fences. Because this alternative includes removal of the buried wastes and LUCs (if UU/UE is not achieved), the addition of fences is unnecessary. Fences will not be incorporated as a LUC in Alternative 5 at SWMU 2.

E/PP Program. The E/PP Program is a LUC administered by DOE's contractors at PGDP. It is an effective LUC for controlling potential personnel hazards related to trenching, excavation, and penetration greater than 6 inches into the earth, concrete, pavement or walls, floors, and ceilings of buildings. This program will be maintained for as long as DOE or its contractor maintain an on-site presence at the PGDP. The E/PP Program has proved to be highly implementable and at a low cost.

Property Record Notice, Deed and/or Lease Restrictions, and Environmental Covenant. These administrative controls are described in Section 2.4.1.1, and all are effective means of ensuring protection under the reasonably anticipated industrial future land use. These proprietary controls help ensure the land use remains industrial. Additionally, any land use change would be identified through the five-year review process, per CERCLA 121(c), and DOE would be required to take appropriate measures to ensure the continued protection of human health and the environment under the changed land use. These administrative LUCs are highly implementable and at a low cost. Property record notices would not be necessary because the waste will be removed.

LUCs Summary. Alternative 5 at SWMU 2, which removes the source term to a depth of 20 ft bgs, but may leave treated underlying, nonmobile LLW in place, will include the following LUCs:

- Deed and/or lease restrictions (contingent upon transfer)
- Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer
- CERCLA 120(h)

These administrative and physical controls together provide enhanced protection and afford a layered strategy that provides protection in different ways. Specific implementation details would be defined further in the LUCIP.

5.3.4.6 Summary of SWMU-specific alternative

Based upon the evaluation of process options for effectiveness, implementability, and cost specific to SWMU 2, the following SWMU-specific alternative has been assembled and will be brought forward for detailed analysis at SWMU 2. No further screening of alternatives is necessary because the alternative screening was performed following the assembly of General Alternatives in Section 3.

- Excavation, Treatment, Disposal, and LUCs

Table 5.10 identifies the key features of the SWMU-specific alternative Excavation, Treatment, Disposal, and LUCs.

While not specifically identified in this FS as a separate alternative, disposal costs also will be evaluated assuming that an OSWDF is available for use.

Alternative 5 satisfies the first RAO. The potential for contamination of groundwater is mitigated through both removal and subsequent treatment of residual COCs, if necessary.

Alternative 5 satisfies the second RAO and mitigates the potential for direct contact through removal. If UU/UE is not achieved, then deed and/or lease restrictions would be implemented (contingent upon property transfer) and an Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer.

Alternative 5 satisfies the third RAO. The potential for contamination of groundwater is mitigated through both removal and subsequent treatment of residual COCs, if necessary. Alternative 5 would treat COCs below the excavation, if necessary, and it also would treat wastes to the degree necessary to meet WAC requirements for disposal.

Table 5.10. Alternative 5 Components

General Response Action	Technologies	RPOs
Removal	Excavators	Backhoes/trackhoes
Disposal	Landfill Disposal	Disposal based on waste stream specific conditions, but will include off-site and on-site disposal facilities
Treatment	Chemical Injection	ZVI (for treating TCE) Phosphate (for treating uranyl fluoride)
LUCs	Administrative Controls	• E/PP Program • Deed and/or lease restrictions (contingent upon transfer) • Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer

Additional details used for cost estimating purposes are presented in Table 5.11 and Appendix E.

Table 5.11. SWMU 2, Alternative 5 Key Cost Drivers and Key Assumptions

CAPITAL COSTS
Shoring • **Install four sided sheet pile box around waste** — Shoring area defined through waste area perimeter sampling using geoprobe — 800 LF of sheet pile wall estimated — Assume sheet pile driven to 40 ft bgs — Design would accommodate two access/egress ramps
Excavation • Dewatering — Mobilize five frac tanks and temporary water treatment plant • Excavation — Assumes excavation area of 210 ft × 180 ft excavated to 20 ft depth — Total excavation equals 28,000 bcy — Waste selectively excavated to minimize treatment — Assumes 10% of drums are intact and oils are recovered • Treatment, Transportation, and Disposal Summary — Treat uranium metal and associated soil on-site using cement stabilization (Uranium metal and associated soil may also be contaminated with PCB oils) — Treat uranyl fluoride waste and contaminated soil on-site using cement stabilization — Treat TCE contaminated soils off-site at commercial vendor — Off-site treatment of PCB oils > 500 ppm

Table 5.11. SWMU 2, Alternative 5 Key Cost Drivers and Key Assumptions (Continued)

Transportation and Disposal Volumes (assuming OSWDF not available)			
Waste Stream	**Volume**	**Treatment Anticipated**	**Disposal Pathway(s)**
Surface soil and subsurface soil located above the waste	11,760 yd^3	No	C-746-U Landfill
Potentially pyrophoric uranium metal and incidental soils	6,448 yd^3	Yes; On-site concrete stabilization	NNSS—ship via truck
PCB-contaminated soils (> 50 ppm < 500 ppm)	19,551 yd^3	No	Off-site commercial disposal—ship via rail
TCE-contaminated soil	462 yd^3	Yes; Off-site (vacuum thermal desorption) at commercial facility	Off-site commercial disposal—ship via truck
Uranyl fluoride-contaminated soils	231 yd^3	Yes; On-site concrete stabilization	Off-site commercial disposal—ship via truck
PCB oils > 500 ppm	5,982 gal	Yes; Off-site commercial alternate thermal treatment	Off-site commercial treatment— ship via tanker truck
Transportation and Disposal Volumes (assuming OSWDF available)			
Waste Stream	**Volume (*In Situ*)**	**Treatment Anticipated**	**Disposal Pathway(s)**
Surface soil and subsurface soil located above the waste	11,760 yd^3	No	C-746-U Landfill
Potentially pyrophoric uranium metal and incidental soils	6,448 yd^3	Yes; On-site concrete stabilization	OSWDF, transported in ½-high boxes on flatbed truck
PCB-contaminated soils (> 50 ppm < 500 ppm)	19,551 yd^3	No	OSWDF
TCE-contaminated soil	462 yd^3	Yes; Off-site (vacuum thermal desorption) at commercial facility	Off-site commercial disposal—ship via truck
Uranyl fluoride-contaminated soils	231 yd^3	Yes; On-site concrete stabilization	OSWDF
PCB oils > 500 ppm	5,982 gal	Yes; off-site commercial alternate thermal treatment	Off-site commercial treatment— ship via tanker truck
Treatment • Treat two waste areas using chemical injection subsequent to excavation • Each area assumed to be 50 ft × 50 ft or 2,500 ft^2 • Treatment assumed from bottom of excavation (20 ft bgs) to 60 ft bgs			
Backfill • Assumes off-site commercial backfill source imported, placed, and compacted			
ANNUAL COSTS			
Five-Year Review			

5.3.5 Alternative 6—Targeted Excavation, Treatment, Disposal, Containment, Surface Controls, LUCs, and Monitoring

Alternative 6, as applies to SWMU 2, removes the known PTW located in cells 6, 8, and 9. In doing so, the known mobile PTW, TCE and uranyl fluoride, either will be removed through excavation or treated, should RGs not be met through excavation. Additionally, remaining waste and contaminated soil would be contained in place using the features described in Alternative 4, described in Section 5.3.2.2.

5.3.5.1 Removal

The use of conventional excavation equipment such as backhoes and trackhoes is the RPO for the removal GRA at SWMU 2. This equipment is effective, implementable, and cost effective for application at SWMU 2. Due to the proximity of SWMU 2 to SWMU 3, it is anticipated that shoring, such as sheet pile, will be used to stabilize the excavation. Sheet pile is identified as a containment process option, it is not a permanent feature of the remedial action and therefore not separately evaluated here.

5.3.5.2 Treatment (removed waste and contaminated soil)

It is estimated that approximately 1,500 lcy will require treatment because of TCE and/or uranyl fluoride prior to disposal. Based on waste records, pyrophoric metals are not expected to be excavated during implementation of Alternative 6. Because of the limited volume of soil to be treated and the high initial mobilization and capital costs associated with on-site treatment, the SWMU-2 specific Alternative 6 will assume off-site treatment.

However, excavated soils/wastes may be treated on-site or off-site at a commercial facility as needed to meet the WAC of the disposal facility. On-site treatment would be done in containers, tanks, temporary units, and/or CAMUs in accordance with ARARs. Treatment of hazardous waste is necessary to meet LDR treatment standards or alternatively CAMU treatment standards, if sent to a designated CAMU.

5.3.5.3 Disposal

The SWMU 2-specific alternatives resulting from the evaluation of General Alternative 6 at SWMU 2 will evaluate on-site disposal and off-site disposal in conjunction with use of the C-746-U Landfill in a manner similarly described in Section 5.3.4.4 for Alternative 5.

5.3.5.4 Treatment (contingent *in situ*)

SWMU 2-specific alternative or treatment for mobile COCs located below the waste will include chemical injection the for same reasons as for Alternative 5.

5.3.5.5 Containment

Because Alternative 6 relies on containment in the same manner as Alternatives 3 and 4, the evaluation of containment process options is the same for these alternatives; therefore, SWMU 2-specific Alternative 6 includes the following containment features.

- RCRA Subtitle C cap
- Hydraulic containment
  - Groundwater extraction
  - Slurry wall

5.3.5.6 Surface controls

Because Alternative 6 relies on surface controls in the same manner as Alternatives 3 and 4, the evaluation of surface controls process options is the same for these alternatives; therefore, SWMU 2-specific Alternative 6 includes a riprap layer for the same reasons derived in Section 5.3.2.2.

5.3.5.7 Land use controls

Alternative 6 at SWMU 2 leaves waste in place. Because Alternative 6 relies on containment and LUCs in the same manner as Alternatives 3 and 4, the evaluation of LUC process options is the same for these alternatives; therefore, SWMU 2-specific Alternative 6 will include the following LUCs for the same reasons derived in Section 5.3.2.3.

- Warning signs
- E/PP Program
- Property record notices
- Deed and/or lease restrictions (contingent upon transfer)
- Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer
- CERCLA 120(h)

These administrative and physical controls together provide enhanced protection and afford a layered strategy that provides protection in different ways.

5.3.5.8 Monitoring

Conventional sampling and analysis from MWs is the identified RPO for the monitoring technology. This process option is an effective means of monitoring that protection of human health and the environment is maintained by the remedy.

5.3.5.9 Summary of SWMU-specific alternative

Based upon the evaluation of process options for effectiveness, implementability, and cost specific to SWMU 2, the following SWMU-specific alternatives have been assembled and will be brought forward for detailed analysis at SWMU 2. No further screening of alternatives is necessary because the alternative screening was performed following the assembly of General Alternatives in Section 3.

- Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring

Table 5.12 identifies the key features of the SWMU-specific alternative Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring.

While not specifically identified in this FS as a separate alternative, disposal costs also will be evaluated assuming that an OSWDF is available for use.

Table 5.12. Alternative 6 Components

General Response Action	Technologies	RPOs
Removal	Excavators	Backhoes/trackhoes
Disposal	Landfill Disposal	Disposal based on waste stream specific conditions. Excavated soils/wastes may be treated on-site or off-site at a commercial facility as needed to meet the WAC of the disposal facility.
Treatment	Chemical Injection	ZVI (for treating TCE) Phosphate (for treating uranyl fluoride)
Containment	Caps	RCRA Subtitle C cap
	Hydraulic Isolation	Slurry wall Groundwater extraction
Surface Controls	Surface Barriers	Riprap
Monitoring	Groundwater Monitoring	Conventional groundwater monitoring
LUCs	Administrative Controls	• E/PP Program • Property record notices • Deed and/or lease restrictions (contingent upon transfer) • Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer

Alternative 6 satisfies the first RAO and removes or treats the known mobile COCs at SWMU 2. Potential for contamination to groundwater posed by the remaining waste also is mitigated through containment.

- A slurry wall would be placed around the disposal area to eliminate lateral groundwater movement through the UCRS either outward from the disposal area to the ditch south of SWMU 2 or inward from the ditch to the disposal area. In order to properly locate this slurry wall, an investigation will be conducted to ensure that the proposed slurry wall alignment falls outside of the waste area. The investigation will use geoprobe equipment to place borings along the sides of the waste area to ensure that RGs are met at the slurry wall boundary.

- Dewatering wells would be placed within the boundary of the slurry walls at the UCRS at the HU2/HU3 interface to lower the water level so that the waste no longer is in water.

- The cap, slurry wall, and groundwater extraction system would work together to isolate the waste hydraulically. Through groundwater extraction, the waste would be removed from being located in groundwater.

- Separate RGA groundwater MW would monitor remedy effectiveness.

- Alternative 6 also would mitigate risk to groundwater through treatment (ZVI) below/under the burial cells, which will destroy TCE and immobilize uranyl fluoride.

Alternative 6 satisfies the second RAO. It includes removal of some wastes, but contains most waste in place. For waste remaining in place, the potential for direct contact would be mitigated through layered controls.

- Contaminated surface soils outside the cap area would be consolidated under the cap prior to cap placement. The RDSI would include surface soil sampling to characterize the shallow soils (within the SWMU, but outside the burial pit footprint) to identify the soils that exceed RGs.

- Physical LUCs would provide warning at the site, and administrative LUCs would provide warning and mitigate potential exposure.

- Riprap would be placed over the RCRA Subtitle C cap.

Regarding the third RAO, Alternative 6, partially satisfies the third RAO by treating PTW in cells 6, 8, and 9, but does not satisfy the third RAO for PTW (uranium metal or potential PCBs) present in other cells.

Additional details used for cost estimating purposes are presented in Table 5.13 and Appendix E.

Table 5.13. SWMU 2, Alternative 6 Key Cost Drivers and Key Assumptions

<table>
<tr><th colspan="4">CAPITAL COSTS</th></tr>
<tr><td colspan="4">Shoring
• Install three sided sheet pile box around waste
— In the northeast corner (cell 6), shore 40 ft by 60 ft area with shored ramp exiting to the north
— In the south-central area (cells 8 and 9) shore 20 ft by 40 ft area with shored ramp exiting to the south
— Assume sheet pile driven to 40 ft bgs</td></tr>
<tr><td colspan="4">Excavation
• Dewatering
— Mobilize two frac tanks and temporary water treatment plant
• Excavation
— Excavate cells 8 and 9 to 20 ft bgs
— Excavate cell 6 shored area to 20 ft bgs
• Treatment, Transportation, and Disposal Summary
— Treat uranium metal and associated soil on-site using cement stabilization (uranium metal and associated soil also may be contaminated with PCB oils)
— Treat uranyl fluoride contaminated soil on-site, using cement stabilization
— Treat TCE contaminated soils off-site at commercial vendor
— Off-site treatment of PCB oils > 500 ppm</td></tr>
<tr><td colspan="4">Transportation and Disposal Volumes (assuming OSWDF not available)</td></tr>
<tr><th>Item</th><th>In Situ Volume</th><th>Disposal Pathway</th><th>Resulting Treatment and/or Disposal Volume</th></tr>
<tr><td>Overburden and Ramps</td><td>2,605 bcy</td><td>Haul in trucks to existing C-746-U Landfill</td><td>3,126 lcy</td></tr>
<tr><td>TCE contaminated waste at cells 8 and 9</td><td>385 bcy</td><td>Package and ship for off-site thermal treatment and disposal</td><td>462 lcy</td></tr>
<tr><td>Incidental removal of cells 1, 4, 6, 7, 10, and 15)</td><td>1,158 bcy</td><td>Package in B-25 boxes and ship for off-site commercial disposal</td><td>1,385 lcy</td></tr>
</table>

Table 5.13. SWMU 2, Alternative 6 Key Cost Drivers and Key Assumptions (Continued)

Transportation and Disposal Volumes (assuming OSWDF available)

Item	***In Situ* Volume**	**Disposal Pathway**	**Resulting Treatment and/or Disposal Volume**
Overburden and Ramps	2,605 bcy	Haul in trucks to existing C-746-U Landfill	3,126 lcy
Item	***In Situ* Volume**	**Disposal Pathway**	**Resulting Treatment and/or Disposal Volume**
TCE contaminated waste at cells 8 and 9	385 bcy	Package and ship for off-site thermal treatment and disposal	462 lcy
Incidental removal of cells 1, 4, 6, 7, 10, and 15)	1,158 bcy	Haul in trucks to WDF for disposal	1,385 lcy

Hydraulic Isolation

- Slurry Wall
  - Soil-bentonite slurry wall
  - Keyed into HU3 at approximately 40 ft bgs
  - Assumed dimensions of the 4 walls to enclose the SWMU (200 ft in length × 3-ft wide × 40-ft deep)
- Groundwater Removal System
  - Assumes four dewatering wells within slurry wall screened at HU2/HU3 interface
  - Wells pumped to a 1,000 gal holding tank
  - Assumed disposal at C-612 for 30 years
  - Assumed off-site disposal beyond 30 years at 1,000 gal per year

Surface Soil Consolidation at the Cap Area

- Assumes 25% of SWMU area not under the cap (3,637 ft^2 of 14,588 ft^2) will be excavated to 2 ft bgs and placed at the cap area prior to cap construction
- Total volume = 270 yd^3

Cap Construction

- Assumed cap area = 44,000 ft^2
- RCRA Subtitle C cap layers consist of
  - Base (Leveling) Layer—6-inch thick
  - Low Permeable Soil layer—24-inch thick compacted clay
  - Geomembrane—40 mil HDPE
  - Granular Drainage Layer—1-ft thick
  - Geotextile Filter Fabric
  - Protective Soil Layer—2-ft thick soil layer
  - Four corner markers

Riprap

- 6 inch bedding material underlying
- 2-ft thick layer of 18 inches to 24 inches nominally graded stone

***In Situ* Treatment**

- Treat two waste areas using chemical injection subsequent to excavation
- Each area assumed to be 50 ft × 50 ft or 2,500 ft^2
- Treatment assumed from bottom of excavation (20 ft bgs) to 60 ft bgs

Backfill

- Assumes off-site commercial backfill source imported, placed, and compacted

Table 5.13. SWMU 2, Alternative 6 Key Cost Drivers and Key Assumptions (Continued)

ANNUAL COSTS
• Operation and Maintenance — Inspection—Quarterly — Remove weeds—Semiannually — Collect and dispose of groundwater from storage tank—Annually — Replace groundwater extraction pumps—Every 5 years — Replace signs—Every 30 years — Replace dewatering system above ground components—Every 50 years — Replace dewatering wells—Every 100 years • Groundwater Monitoring — Monitor 4 wells semiannually for 5 years — Assume annual monitoring of same wells after 5 years • Five-Year Review

5.3.6 Summary of SWMU 2-Specific Alternatives

Table 5.14 identifies the key features of each SWMU 2-specific alternative that will undergo detailed analysis.

Table 5.14. SWMU 2-Specific Alternative Key Features

Alternative	Name	Key Features
1	No Action	• No action
3	Containment, Surface Controls, LUCs, and Monitoring	• RCRA Subtitle C cap • Vertical hydraulic isolation walls • Groundwater extraction • Riprap • Monitoring • LUCs
4 (SS)	Containment, Stabilization/Solidification, Surface Controls, LUCs and Monitoring	• RCRA Subtitle C cap • Riprap • Vertical isolation walls • Cement and chemical grouting • Groundwater extraction • Monitoring • LUCs
4 (CI)	Containment, Chemical Injection, Surface Controls, LUCs and Monitoring	• Subtitle C cap • Riprap • Vertical Isolation walls • Chemical injection (ZVI) • Groundwater extraction • Monitoring • LUCs

Table 5.14. SWMU 2-Specific Alternative Key Features (Continued)

Alternative	Name	Key Features
5	Excavation and Disposal, Treatment, and LUCs	• Installation of sheet pile delineating excavation bounds • Excavation of buried waste materials and affected soils to a maximum of 20 ft bgs • Post remediation sampling and analysis • WAC sampling and analysis • *Ex situ* waste treatment (as needed) to meet WAC requirements • Waste disposal* • Chemical treatment below excavation if RGs are not met — Cell 6—TCE — Cell 8—uranyl fluoride — Cell 9—TCE • Backfill excavation • LUCs (if UU/UE not achieved)
6	Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring	• Installation of sheet pile delineating excavation bounds • Excavation of cells 6, 8 and 9 to a maximum of 20 ft bgs • Post remediation sampling and analysis • WAC sampling and analysis • *Ex situ* waste treatment (as needed) to meet WAC requirements • Waste disposal* • Chemical treatment below excavation if RGs are not met — Cell 6—TCE — Cell 8—uranyl fluoride — Cell 9—TCE • Backfill excavation • RCRA Subtitle C cap • Vertical hydraulic isolation walls • Groundwater extraction • Riprap • Monitoring • LUCs

*Alternatives 5 and 6 will develop cost estimates and evaluate the impacts of an OSWDF being available for use at PGDP.

5.4 DETAILED ANALYSIS OF ALTERNATIVES

In this section each of the SWMU-specific alternatives is analyzed against the CERCLA evaluation criteria. Overall protection of human health and the environment and compliance with ARARs are threshold criteria. The remaining five criteria are balancing criteria.

5.4.1 Alternative 1—No Action

The No Action alternative is defined in accordance with CERCLA and provides a baseline to which other alternatives can be compared. Under this alternative, no action would be taken to implement remedial activities for SWMU 2 or to reduce the potential hazard to human or ecological receptors. Alternative 1 does not address PTW or any of the COCs identified in SWMU 2 soils that pose an unacceptable risk under some future use scenarios because no action is taken.

5.4.1.1 Overall protection of human health and the environment

Alternative 1 does not meet the threshold criterion of protection of human health and the environment under some future use conditions because wastes are left in place and the plant controls maintained outside of CERCLA are not permanent. This alternative would not be protective of groundwater under some future use scenarios. None of the PTW is treated by this alternative.

5.4.1.2 Compliance with ARARs

Although no ARARs have been identified for Alternative 1, compliance with ARARs has not been evaluated, given that this alternative does not meet the other threshold criterion.

5.4.1.3 Long-term effectiveness and permanence

Alternative 1 provides no long-term effectiveness or permanence because there is no mechanism to maintain or extend site controls maintained outside of CERCLA. Future leaching of contaminants to the RGA may result in concentrations above their MCL or risk-based value without being detected because there is no provision for monitoring the RGA in the vicinity of SWMU 2. Alternative 1 leaves the risk or hazard from direct contact with radioactive, inorganic, VOCs, or PCBs at current levels at the SWMU. The alternative does not provide any long-term remedy to manage residual risk at this SWMU.

5.4.1.4 Reduction of toxicity, mobility, or volume through treatment

Alternative 1 does not reduce toxicity, mobility, or volume through treatment.

5.4.1.5 Short-term effectiveness

No actions would be implemented under Alternative 1; therefore, no risks associated with remediation would be incurred by site workers, the public, or the environment. There would be no change to existing conditions. RAOs would not be met due to implementation of this remedy.

5.4.1.6 Implementability

The No Action alternative can be implemented readily. If future remedial action is necessary, this alternative would not impede its implementation.

The ongoing public awareness program would require regular coordination with DOE, KY, and possibly with other governmental agencies.

5.4.1.7 Cost

The preliminary cost estimates for Alternative 1 serve as a baseline for comparison of the other remedial alternatives. These cost estimates are based upon FS-level scoping and are intended to aid with selection of a preferred alternative. There are no capital or O&M costs associated with Alternative 1.

5.4.2 Alternative 3—Containment, Surface Controls, LUCs, and Monitoring

Alternative 3 is described in Section 5.3.2.5 with additional implementation data included in Appendix E. In summary, this alternative contains the waste. The alternative prevents direct contact with waste and contaminated soil through the placement of a RCRA Subtitle C cap and LUCs. Riprap would be placed over the RCRA Subtitle C cap. The waste also is isolated hydraulically via the Subtitle C cap, vertical slurry walls, and groundwater extraction. Through continued operation of the groundwater extraction system, the water table within the slurry walls will be lowered so that the waste is out of water. Finally, groundwater will be periodically sampled to monitor the remedy.

An interim ROD (signed in 1995) to install a cap to limit infiltration of water was cancelled because the RD investigation showed that the waste at SWMU 2 was mostly saturated, and a cap would not be effective in reducing infiltration. Alternative 3 supplements the cap selected in the 1995 ROD with the addition of vertical isolation walls to reduce lateral infiltration and groundwater extraction to lower the water table in the hydraulically isolated area.

5.4.2.1 Overall protection of human health and the environment

Alternative 3 would meet this threshold criterion of protection of human health and the environment. The RCRA Subtitle C cap provides a physical barrier between receptors and contaminated surface soils, waste, and contaminated subsurface soil, thus preventing direct contact and the associated risk. The cap provides a direct reduction in mobility of surface contamination and a reduction in migration of subsurface vadose zone contamination by preventing infiltration. The vertical subsurface barrier (slurry wall) and groundwater extraction would further eliminate, reduce, or control migration of contaminants to the RGA, and the slurry wall would eliminate potential horizontal migration to the ditch located south of SWMU 2. LUCs would be layered to ensure protectiveness. Riprap would be placed over the RCRA Subtitle C cap.

5.4.2.2 Compliance with ARARs

Alternative 3 would meet this threshold criterion for SWMU 2.

Action-specific ARARs for this alternative are summarized in Appendix F.

No chemical-specific ARARs have been identified.

A wetlands assessment would be performed prior to remedy implementation. Although it is not anticipated, if an action should involve discharge of dredge or fill material into waters of the United States, including jurisdictional wetlands, potential location-specific ARARs are summarized in Appendix F.

5.4.2.3 Long-term effectiveness and permanence

Alternative 3 would be moderately effective regarding to long-term effectiveness and permanence. It would limit exposure to surface and subsurface contamination and minimize the contribution of contaminants to the RGA; however, waste and associated risk would remain at the unit. LUCs would protect current and future receptors (Section 2.4.1.1). The integrity of the Subtitle C cap will be maintained.

The degree of long-term effectiveness and permanence is dependent upon construction materials; appropriate materials would be selected as part of the RD activities. Long-term O&M of the groundwater extraction system and surface cap would be required.

This remedy relies on the soundness of the HU3 layer to act as an aquitard to effectively contain mobile COCs from migrating to the RGA. There is empirical evidence, through existing groundwater plumes, that the HU3 has not been an effective aquitard across PGDP. Ultimately, the long-term effectiveness of preventing mobile COCs from migrating to the RGA is the continued lowering of the water table through groundwater extraction.

Uncertainty exists as to the condition of the drums disposed of at SWMU 2, and it is not known if all drums have breached. This uncertainty is managed by the inclusion of groundwater extraction that would capture COCs migrating down vertically from the unit.

Magnitude of Residual Risk. This alternative effectively manages direct contact risk by extending the depth from the surface to the buried waste. Signs and the multilayer cap also inform the intruder of the potential dangers associated with direct contact to the waste and contaminated soil.

The potential for a pyrophoric event at SWMU 2 is minimized in Alternative 3 by not bringing the uranium metal waste to the surface for treatment or repackaging, which could potentially result in small fires requiring control measures. Assuming the uranium metal is not fully oxidized (e.g., sawdust, shavings, etc.), a pyrophoric event could occur during excavation of or contact with the waste; therefore, the pyrophoric nature of uranium metal can be managed through containment in Alternative 3.

Additionally, the CSM for SWMU 2 identifies that waste, including uranium metal, presently may be under water. Since uranium metal potentially exists under water, its reaction with water is important in evaluating long-term stability for Alternative 3. The reaction of uranium metal with water has been documented historically. Delegard and Schmidt in *Uranium Metal Reaction Behavior in Water, Sludge, and Grout Matrices* provided information related to the reaction of uranium metal in water, sludge, and grout (DOE 2008b). The Delegard and Schmidt report indicates the oxidation/corrosion of uranium metal by its reaction with water potentially can generate hydrogen during the handling of waste and grout, and this potentially could create a flammable atmosphere. The reaction of uranium metal with water proceeds through a uranium hydride that can sequester part of the hydrogen. Under anoxic condition the reaction of uranium metal with water produces heat, uranium dioxide (UO_2) and hydrogen more rapidly than under oxic conditions. Table 3.3 in the BGOU RI provides dissolved oxygen and oxidation/reduction data showing the UCRS is oxic at SWMU 2 (DOE 2010b). However, since the majority of these measurements at SWMU 2 are outside the disposal area and additional data suggest possible anoxic conditions, the potential does exist for the presence of localized anoxic environments within the disposal area waste cells and the development of anoxic conditions subsequent to the implementation of Alternative 3.

Uncertainties associated with potential horizontal migration to the ditch south of SWMU 2 are resolved through installation of a slurry wall.

Finally, this remedy includes groundwater monitoring, which will monitor remedy effectiveness at preventing COC migration to the RGA.

Need for Five-Year Review. Because this remedy will not result in UU/UE conditions, five-year reviews will be required to ensure that the remedy remains protective.

Adequacy and Reliability of Controls. The physical and administrative controls listed in this remedy are adequate to meet threshold criteria. The physical controls to protect from direct contact require a low degree of maintenance to maintain adequacy. However, a higher degree of long-term O&M of the groundwater extraction system would be required.

5.4.2.4 Reduction of toxicity, mobility, or volume through treatment

Alternative 3 includes only minimal treatment to reduce mobility, toxicity, or volume through treatment. Treatment is accomplished only for mobile COCs collected through groundwater extraction.

PTW. The PTW identified at SWMU 2 would be impacted only minimally through treatment and would remain in place.

5.4.2.5 Short-term effectiveness

The short-term effectiveness of Alternative 3 is high because it largely leaves waste undisturbed.

Protection of Community during Remedial Actions. Implementation of Alternative 3 has low potential for impact to the community during remedial action.

Protection of Workers during Remedial Actions. Implementation of Alternative 3 has low potential for remediation worker exposure to surficial soil contamination at concentrations above RGs and residual subsurface contamination at concentrations above RGs through construction of a slurry wall and cover. Exposure to contaminated surface soils, subsurface soils, and groundwater during environmental sampling is also low. Potential exposure pathways include inhalation of dust containing surficial soils, dermal contact with surficial and subsurface soils, exposure to external penetrating radiation associated with buried waste, and dermal contact with contaminated groundwater.

Environmental Impacts. No ecological impacts at the BGOU are anticipated under this alternative. The BGOU is located at an active operational facility already disturbed by construction and operational activities and does not support any unique or significant ecological resources. No known archaeological or historical sites or T&E species would be impacted by this alternative. Risk assessment and mitigation of potential risks for ecological receptors in nearby drainage ditches are within the scope of the Surface Water OU.

Time Frame to Achieve Protectiveness. Protectiveness will be achieved when each component of Alternative 3 is completed. Implementation of Alternative 3 would take less than one year from field mobilization.

5.4.2.6 Implementability

Implementation of the remedial action components of Alternative 3 is technically feasible, and the alternative consists of demonstrated technologies, standard construction methods, materials, and equipment that are available from vendors and contractors.

Ability to Construct and Operate Technology. All construction components of Alternative 3 are highly implementable consisting of demonstrated technologies and standard construction methods, materials and equipment; therefore, this alternative is highly implementable in the short term. This alternative relies on continued operation of a groundwater extraction system into the foreseeable future, however, to ensure that mobile COCs (e.g., uranyl fluoride, TCE) do not migrate from the unit.

Reliability of Technology. All of the technologies employed in Alternative 3 are highly reliable.

Ease of Undertaking Additional Remediation. The presence of the Subtitle C cap and riprap could impede additional remediation should it be undertaken (e.g., would increase the cost of a future excavation, etc.), but they would not prevent additional remediation.

Monitoring Considerations. As indicated in Chapter 3, SWMU 2 is located over a contaminant plume (i.e., the PGDP Southwest Plume), so there would be impediments to the evaluation of groundwater monitoring data. Statistical evaluations and trending would be used to identify any groundwater impacts that may be attributable to SWMU 2.

Coordination with Other Agencies. The means and methods for coordinating with other agencies are established in the PGDP FFA. This remedy would not require involvement of new agencies.

Availability of Equipment and Specialists. All equipment and specialists are readily available.

5.4.2.7 Cost

Consistent with EPA guidance (EPA 2000), the cost estimates in this FS consist of a 1,000-year period due to the nature of the contaminants, including long-lived radionuclides. Net present value/worth cost estimates are presented for the individual and comparative analysis of alternatives and for remedy selection (EPA 1988). The real discount rate has been obtained from Office of Budget and Management (OMB) guidance (reference Appendix C in OMB circular A-94). In addition, nondiscounted cost estimates (i.e., capital and average annual O&M) are presented for comparison purposes only.

Net Present Worth Cost	$21,788,000
Nondiscounted Cost	
• Capital Cost	$11,255,000
• Average Annual O&M Cost	$125,900

5.4.3 Alternative 4 (SS)—Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring

Alternative 4 (SS) is described in Section 5.3.3.6 with additional implementation data included in Appendix E. This alternative builds upon the containment features of Alternative 3 by adding treatment of the SWMU 2 wastes and contaminated soil by stabilization/solidification through deep soil mixing and jet grouting to reduce mobility.

5.4.3.1 Overall protection of human health and the environment

Alternative 4 (SS) would meet this threshold criterion for SWMU 2. The RCRA Subtitle C cap provides a physical barrier between receptors and contaminated surface soils, thus preventing direct contact and the associated risk. The cap provides a direct reduction in mobility of surface contamination and a reduction in migration of subsurface vadose zone contamination by preventing infiltration. Construction of a vertical subsurface barrier (slurry wall) prevents migration of contaminants to the RGA and would eliminate potential horizontal migration to the ditch located south of SWMU 2. LUCs provide additional protection against exposure. Riprap would be placed over the RCRA Subtitle C cap.

Waste mobility is decreased through solidification/stabilization (cement/bentonite injection). Two injection methods are identified. Deep soil mixing will be used to 20 ft bgs, and jet injection will be used below that level. Further, groundwater extraction would further mitigate the uncertainties by removing the stabilized waste from the water table. Stabilization and groundwater extraction are paired as a layered approach to prevent COC migration to the RGA.

5.4.3.2 Compliance with ARARs

Alternative 4 (SS) would meet this threshold criterion for SWMU 2.

Action-specific ARARs for this alternative are summarized in Appendix F. No chemical-specific ARARs have been identified.

A wetlands assessment would be performed prior to remedy implementation. Although it is not anticipated, if an action should involve discharge of dredge or fill material into waters of the United States, including jurisdictional wetlands, potential location-specific ARARs are summarized in Appendix F.

5.4.3.3 Long-term effectiveness and permanence

Alternative 4 (SS) would have a moderate to high effectiveness in regard to long-term effectiveness and permanence. It would limit exposure to surface and subsurface contamination and minimize the contribution of contaminants to the RGA; however, waste and associated risk would remain at the unit. LUCs would protect current and future receptors (Section 2.4.1.1). The integrity of the Subtitle C cap will be maintained.

This remedy relies in part on the soundness of the HU3 layer to act as an aquitard to contain mobile COCs from migrating to the RGA effectively. There is empirical evidence, through existing groundwater plumes, that the HU3 has not been an effective aquitard across PGDP. However, this alternative stabilizes the waste, which will lessen COC mobility; therefore, the degree to which the HU3 layer and groundwater extraction is relied upon to ensure long-term effectiveness is lessened.

Uncertainty exists as to the condition of the drums disposed of at SWMU 2 and it is not known if all drums have breached. Any intact drums would be breached *in situ* (subsurface) by the deep soil mixing equipment. Mechanically breaching any intact drums *in situ* during the stabilization/solidification process, which would treat (stabilize) the contents would address this uncertainty and ensure that all drummed wastes are treated. The stabilization/solidification reagents would be injected in slurry form, and this will mitigate the potential for spark generation during mixing of the subsurface wastes. Also, this uncertainty is managed by treatment of all wastes within the unit and the inclusion of groundwater extraction, which would capture COCs should they migrate down vertically from the unit.

Magnitude of Residual Risk. This alternative effectively manages direct contact risk by extending the depth from the surface to the buried waste. Signs and the multilayer cap inform the potential intruder of the potential dangers associated with direct contact to the waste and contaminated soil.

Uncertainties associated with potential horizontal migration to the ditch south of SWMU 2 are resolved through installation of a slurry wall.

Finally, this remedy includes groundwater monitoring that will monitor remedy effectiveness at preventing COC migration to the RGA.

Need for Five-Year Review. Because this remedy will not result in UU/UE conditions, five-year reviews will be required to ensure that the remedy remains protective.

Adequacy and Reliability of Controls. The physical and administrative controls listed in this remedy are adequate to meet threshold criteria. The physical controls to protect from direct contact require little to no maintenance to maintain adequacy. However, a higher degree of long-term O&M of the groundwater extraction system would be required.

5.4.3.4 Reduction of toxicity, mobility, or volume through treatment

Alternative 4 (SS) will reduce the mobility of wastes and impacted soil through treatment. Waste would be stabilized *in situ* through use of pozzolonic agents such as cement and bentonite to significantly lessen groundwater and therefore COC mobility. This alternative anticipates two different delivery methods.

Deep soil mixing would be used in the upper 20 ft bgs so that uranium does not substantially migrate vertically downward through the slurry mix. This would be followed by jet injection of stabilizing agents to immobilize lower lying contamination at concentrations above RGs. Additionally, the groundwater extraction system would include treatment of extracted groundwater.

PTW. All PTW identified at SWMU 2 would be stabilized only *in situ* and mobility would be reduced. Additionally, through physical action, potentially pyrophoric uranium would be dispersed laterally in the soil mixing column, thus eliminating the potential for a significant pyrophoric event.

5.4.3.5 Short-term effectiveness

The short-term effectiveness of Alternative 4 (SS) is high because treatment occurs *in situ*. The risks from any such contact can be mitigated through implementing safe work practices.;

Protection of Community during Remedial Actions. Implementation of Alternative 4 (SS) has low potential for impact to the community during remedial action.

Protection of Workers during Remedial Actions. Implementation of Alternative 4 (SS) has low to moderate potential for remediation worker exposure to contamination during solidification/stabilization and slurry wall construction. Exposure to contaminated surface soils, subsurface soils, and groundwater during environmental sampling is also low. Potential exposure pathways include inhalation of dust containing surficial soils, dermal contact with surficial and subsurface soils, exposure to external penetrating radiation associated with buried waste, and dermal contact with contaminated soil and groundwater. These potential exposure pathways can be mitigated through the use of safe work practices.

Environmental Impacts. No ecological impacts at the BGOU are anticipated under this alternative. BGOU is located at an active operational facility already disturbed by construction and operational activities and does not support any unique or significant ecological resources. No known archaeological or historical sites or T&E species would be impacted by this alternative. Risk assessment and mitigation of potential risks for ecological receptors in nearby drainage ditches are within the scope of the Surface Water OU.

Time Frame to Achieve Protectiveness. Protectiveness will be achieved when each component of Alternative 4 (SS) is completed. Implementation of Alternative 4 (SS) would take less than two years from start of field mobilization.

5.4.3.6 Implementability

Implementation of the remedial action components of Alternative 4 (SS) is evaluated as high. The alternative consists of demonstrated technologies, standard construction methods. Materials and equipment are available from vendors and contractors. Some concern exists over the potential for auger refusal should dense agglomerations of uranium exist, but properly sized equipment should be able to mitigate this uncertainty.

Ability to Construct and Operate Technology. All construction components of Alternative 4 (SS) are highly implementable, consisting of demonstrated technologies and standard construction methods, materials and equipment; therefore, this alternative is highly implementable in the short term. This alternative relies on continued operation of a groundwater extraction system into the foreseeable future to ensure that mobile COCs (e.g., uranyl fluoride, TCE) do not migrate from the unit.

Stabilization is a proven treatment technology. No record exists of large metal debris or concrete in SWMU 2. Equipment selection will need to accommodate the drums or drum shards that may remain and also the high density uranium that will add rotational resistance to the equipment greater than soil alone.

Reliability of Technology. All of the technologies employed in Alternative 4 (SS) are highly reliable. Periodic maintenance and component replacement of the groundwater extraction system will be required to ensure long-term system reliability.

Ease of Undertaking Additional Remediation. None of the treatment technologies employed in Alternative 4 (SS) would significantly impede additional remediation. *In situ* stabilization of the potentially pyrophoric uranium would ease excavation, should it someday be undertaken. The presence of the Subtitle C cap and riprap could impede additional remediation should it be undertaken (e.g., would increase the cost of a future excavation, etc.), but they would not prevent additional remediation.

Monitoring Considerations. As indicated in Chapter 3, SWMU 2 is located over a contaminant plume (i.e., the PGDP Southwest Plume), so there would be impediments to the evaluation of groundwater monitoring data. Statistical evaluations and trending would be used to identify any groundwater impacts that may be attributable to SWMU 2.

Coordination with Other Agencies. The means and methods for coordinating with other agencies are established in the PGDP FFA. This remedy would not require involvement of new agencies.

Availability of Equipment and Specialists. All equipment and specialists are readily available.

5.4.3.7 Cost

Consistent with EPA guidance (EPA 2000), the cost estimates in this FS consist of a 1,000-year period due to the nature of the contaminants, including long-lived radionuclides. Net present value/worth cost estimates are presented for the individual and comparative analysis of alternatives and for remedy selection (EPA 1988). The real discount rate has been obtained from OMB guidance (reference Appendix C in OMB circular A-94). In addition, nondiscounted cost estimates (i.e., capital and average annual O&M) are presented for comparison purposes only.

Net Present Worth Cost	$31,755,000
Nondiscounted Cost	
• Capital Cost	$21,222,000
• Average Annual O&M Cost	$125,900

5.4.4 Alternative 4 (CI)—Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring

Alternative 4 (CI) is described in Section 5.3.3.6 with additional implementation data included in Appendix E. This alternative builds upon the containment features of Alternative 3, by adding treatment of the SWMU 2 wastes and contaminated soil through chemical injection.

5.4.4.1 Overall protection of human health and the environment

Alternative 4 (CI) would meet this threshold criterion for SWMU 2. The RCRA Subtitle C cap provides a physical barrier between receptors and contaminated surface soils, thus preventing direct contact and the associated risk. The cap provides a direct reduction in mobility of surface contamination and a reduction in migration of subsurface vadose zone contamination by preventing infiltration. Construction of a vertical subsurface barrier (slurry wall) prevents migration of contaminants to the RGA and would eliminate potential horizontal migration to the ditch located south of SWMU 2. LUCs are layered to ensure protectiveness. Riprap would be placed over the RCRA Subtitle C cap.

ZVI is the selected treatment RPO and would be targeted to cells 6, 8, and 9. ZVI would treat VOC PTW at SWMU 2 and be protective of groundwater for VOCs. ZVI also has been shown to reduce uranium mobility. As discussed in Section 5.4.4.3, "Long-term effectiveness and permanence," other chemical treatments, such as phosphate, should be considered and analyzed through bench-scale testing. Through bench-scale testing, COC specific reagents can be identified such as ZVI for TCE and phosphate for uranium. Both reagents can be delivered using the jet injection.

5.4.4.2 Compliance with ARARs

Alternative 4 (CI) would meet this threshold criterion for SWMU 2.

Action-specific ARARs for this alternative are summarized in Appendix F.

No chemical-specific ARARs have been identified.

A wetlands assessment would be performed prior to remedy implementation. Although it is not anticipated, if an action should involve discharge of dredge or fill material into waters of the United States, including jurisdictional wetlands, potential location-specific ARARs are summarized in Appendix F.

5.4.4.3 Long-term effectiveness and permanence

This alternative is designed to provide protection against exposure to waste, surface soils, and subsurface soil, primarily through the installation and maintenance of a RCRA Subtitle C cap and LUCs. Riprap would be placed over the RCRA Subtitle C cap. This alternative also treats mobile PTW. The long-term effectiveness and permanence of this alternative for VOC source remediation is high; however, the alternative does not intend to treat the less mobile COCs uranium (metal) or PCBs.

The long-term effectiveness and permanence of chemical treatment of uranium is not well understood. ZVI has been used in multiple applications to immobilize uranium. ZVI's use in permeable reactive barriers has been summarized as follows, "Overall, these results strongly support the case for using conventional ZVI as an effective reductant for radionuclides, such as uranium. Thus, the potential for iron nanoparticles is considerable. Extensive research is ongoing, including studies on formulation of the iron nanoparticles, delivery vehicles and methods of *in situ* stabilization." http://www.epa.gov/radiation/docs/cleanup/nanotechnology/chapter-2-zero-valent.pdf

Additionally, specific geochemical conditions have proved to be effective at limiting uranium mobility. For example, "It should be noted that +6 form (uranyl ion) can be adsorbed on clays and organic compounds and later "eluted" or displaced by other cations. However, many organic materials reduce the uranyl ions to the +4 forms which are not likely to be eluted, though they might be subsequently reoxidized and made soluble.…Although it is known that organic matter is a sink for uranium in soils and sediments, the actual mechanism of the process is still unclear" (EPA 2006b).

With regard to phosphase: "The addition of amendments (e.g., apatite or phosphate solutions) stabilizes uranium in soils and groundwater through the formation of relatively insoluble uranium-phosphate solids. Grouting or capping of contaminated soils and sediments may also be used to stabilize uranium contamination at concentrations above RGs in place….Precipitation of uranium to the phosphate form leave uranium highly insoluble and essentially inert chemically. Even ingestion would not result in much uranium retention in the body. Nevertheless, most methods for screening for uranium would show that the uranium was still present, and it may be difficult to be sure that the uranium found by screening is effectively stabilized as the phosphate" (EPA 2006b).

Given the previous discussion and the elemental nature of uranium, there is some uncertainty as to the very long-term effectiveness and permanence of this alternative, and additional study would need to be completed to determine the potential effects of the current geochemical conditions, the effects of the commingled oils (carbon source), and uranium and the effects of lowering the water table through groundwater extraction.

Uncertainty exists as to the condition of the drums disposed of at SWMU 2, and it is not known if all drums have breached. Mechanically breaching any intact drums *in situ* during the chemical injection process, which would treat (immobilize) the contents, would address this uncertainty and ensure that all drummed wastes are treated. The chemical injection reagents would be injected in slurry form, and this will mitigate the potential for spark generation during mixing of the subsurface wastes. Also, this uncertainty is managed by the inclusion of groundwater extraction, which would capture COCs migrating down vertically from the unit.

Magnitude of Residual Risk. This alternative effectively manages direct contact risk by extending the depth from the surface to the buried waste. Signs and the multilayer cap inform the potential intruder of the potential dangers associated with direct contact to the waste and contaminated. Mobile COCs are destroyed (TCE) or immobilized (uranyl fluoride) through chemical injection.

Uncertainties associated with potential horizontal migration to the ditch south of SWMU 2 are resolved through installation of a slurry wall.

This remedy relies in part on the soundness of the HU3 layer to act as an aquitard to effectively contain mobile COCs from migrating to the RGA. There is empirical evidence, through existing groundwater plumes, that the HU3 has not been an effective aquitard across PGDP. Because contaminants would be destroyed (TCE) or immobilized (uranyl fluoride), the potential for COCs to migrate from the unit to the RGA is reduced significantly. Also, the slurry walls and dewatering/extraction components would reduce the potential for contaminants to mobilize below the HU3 layer. These components (contaminant destruction/immobilization and dewatering/extraction) would reduce the magnitude of residual risk.

Finally, this remedy includes groundwater monitoring, which will monitor remedy effectiveness at preventing COC migration to the RGA.

Need for Five-Year Review. Because this remedy will not result in UU/UE conditions, five-year reviews will be required to ensure that the remedy remains protective.

Adequacy and Reliability of Controls. The physical and administrative controls listed in this remedy are adequate to meet threshold criteria. The physical controls to protect from direct contact require a low degree of maintenance to maintain adequacy. However, a higher degree of long-term O&M of the groundwater extraction system would be required.

5.4.4.4 Reduction of toxicity, mobility, or volume through treatment

Alternative 4 (CI) will destroy TCE DNAPL/sources and other VOCs present at the site. Uranyl fluoride would be treated with ZVI or other reagents, such as phosphate, to reduce mobility. PCBs and uranium metal are not treated. The presence of a Subtitle C cap will reduce water infiltration into the burial unit, limiting the potential for migration of mobile contaminants. Additionally, groundwater extraction will lower the water level in the UCRS and ensure that waste is not submerged in groundwater. Captured groundwater will be treated *ex situ* if necessary and discharged in accordance with ARARs.

Alternative 4 (CI) also includes groundwater extraction at the HU2-HU3 interface. Treatment is accomplished only for mobile COCs collected as part of the groundwater extraction.

PTW. This alternative only targets mobile PTW, TCE and uranyl fluoride, for treatment. Uranium metal and PCBs remain untreated.

5.4.4.5 Short-term effectiveness

The short-term effectiveness of Alternative 4 (CI) is high because treatment occurs *in situ*. The risks from any such contact can be mitigated through implementing safe work practices.

Protection of Community during Remedial Actions. Implementation of Alternative 4 (CI) has low potential for impact to the community during remedial action.

Protection of Workers during Remedial Actions. Implementation of Alternative 4 (CI) has low to moderate potential for remediation worker exposure to contamination during chemical injection and slurry wall construction. Exposure to contaminated surface soils, subsurface soils, and groundwater during environmental sampling is also low. Potential exposure pathways include inhalation of dust containing surficial soils, dermal contact with surficial and subsurface soils, exposure to external penetrating radiation associated with buried waste, and dermal contact with contaminated groundwater. These potential exposure pathways can be mitigated through the use of safe work practices.

Environmental Impacts. No ecological impacts at the BGOU are anticipated under this alternative. The BGOU is located at an active operational facility already disturbed by construction and operational activities and does not support any unique or significant ecological resources. No known archaeological or historical sites or T&E species would be impacted by this alternative. Risk assessment and mitigation of potential risks for ecological receptors in nearby drainage ditches are within the scope of the Surface Water OU.

Time Frame to Achieve Protectiveness. Protectiveness will be achieved when each component of Alternative 4 (CI) is completed. Implementation of Alternative 4 (CI) would take less than two years from start of field mobilization.

5.4.4.6 Implementability

Implementation of the remedial action components of Alternative 4 (CI) is evaluated as high. The alternative consists of demonstrated technologies and standard construction methods. Materials and equipment are available from vendors and contractors.

Ability to Construct and Operate Technology. All construction components of Alternative 4 (CI) are highly implementable consisting of demonstrated technologies and standard construction methods, materials and equipment; therefore, this alternative is highly implementable in the short term. This alternative relies on continued operation of a groundwater extraction system into the foreseeable future to ensure that mobile COCs (e.g., uranyl fluoride, TCE) do not migrate from the unit.

Reliability of Technology. All of the chemical delivery technologies employed in Alternative 4 (CI) are highly reliable. Periodic maintenance and component replacement of the groundwater extraction system will be required to ensure long-term system reliability. As explained in Section 5.4.4.3, the long-term effectiveness and permanence of chemical treatment is not well understood, and a level of uncertainty exists as to ZVI's ability to treat uranyl fluoride and Tc 99.

Ease of Undertaking Additional Remediation. None of the treatment technologies employed in Alternative 4 (CI) would impede additional remediation. The presence of the Subtitle C cap and riprap could impede additional remediation should it be undertaken (e.g., would increase the cost of a future excavation, etc.), but they would not prevent additional remediation.

Monitoring Considerations. As indicated in Chapter 3, SWMU 2 is located over a contaminant plume (i.e., the PGDP Southwest Plume), so there would be impediments to the evaluation of groundwater monitoring data. Statistical evaluations and trending would be used to identify any groundwater impacts that may be attributable to SWMU 2.

Coordination with Other Agencies. The means and methods for coordinating with other agencies are established in the PGDP FFA. This remedy would not require involvement of new agencies.

Availability of Equipment and Specialists. All equipment and specialists are readily available.

5.4.4.7 Cost

Consistent with EPA guidance (EPA 2000), the cost estimates in this FS consist of a 1,000-year period due to the nature of the contaminants, including long-lived radionuclides. Net present value/worth cost estimates are presented for the individual and comparative analysis of alternatives and for remedy selection (EPA 1988). The real discount rate has been obtained from OMB guidance (reference Appendix C in OMB circular A-94). In addition, nondiscounted cost estimates (i.e., capital and average annual O&M) are presented for comparison purposes only.

Net Present Worth Cost	$25,568,000
Nondiscounted Cost	
• Capital Cost	$15,035,000
• Average Annual O&M Cost	$125,900

5.4.5 Alternative 5—Excavation and Disposal, Treatment, and LUCs

Alternative 5 is described in Section 5.3.4.7, with additional implementation data included in Appendix E. It includes excavation of buried materials and associated affected soils to a depth of 20 ft; waste disposal characterization sampling; treatment of excavated wastes; excavation pit dewatering; and packaging, transporting, and disposing of wastes in accordance with the WAC of the to-be-selected disposal facilities. Wastes containing uranium metal will be stabilized on-site using concrete prior to disposal.

This alternative also anticipates that mobile COCs have migrated below the practical maximum depth of excavation; therefore, excavation alone will not result in RG attainment in some subsurface soils that currently lie below waste areas. Because of this, treatment through chemical injection is included as a remedy component. Also, because cleanup will be to RGs, a deed restriction contingent on property transfer that restricts residential use would be required if the remedy does not support UU/UE.

Excavated soils/wastes may be treated on-site or off-site at a commercial facility as needed to meet the WAC of the disposal facility. On-site treatment would be done in containers, tanks, temporary units, and/or CAMUs in accordance with ARARs. Treatment of hazardous waste is necessary to meet LDR treatment standards or alternatively CAMU treatment standards, if sent to a designated CAMU.

5.4.5.1 Overall protection of human health and the environment

Alternative 5 would meet this threshold criterion. Potential short-term risks to remediation workers due to direct contact with the waste material and inhalation hazards are significantly greater for this alternative than for any of the other alternatives. In addition, potential risks to the public and the environment, as a result of potential shipping and handling concerns, should be considered for off-site shipments. These potential impacts on the public are reduced greatly for disposal in a potential OSWDF.

Waste and contaminated soils would be removed from the SWMU and disposed of in one or more appropriate disposal facilities, including a potential OSWDF, thus meeting RAOs for waste in the former burial cells. Additional treatment or excavation may be necessary to provide protection from mobile contaminants remaining below the excavation depth of 20 ft should they be identified during the course of excavation.

5.4.5.2 Compliance with ARARs

Alternative 5 would meet this threshold criterion for SWMU 2.

Action-specific ARARs for this alternative are summarized in Appendix F.

No chemical-specific ARARs have been identified.

A wetlands assessment would be performed prior to remedy implementation. Although it is not anticipated, if an action should involve discharge of dredge or fill material into waters of the United States, including jurisdictional wetlands, potential location-specific ARARs are summarized in Appendix F.

5.4.5.3 Long-term effectiveness and permanence

Excavation eliminates on-site contaminant migration, since no wastes or associated contaminated soils would remain in the SWMU; therefore, this alternative offers a high degree of risk reduction, effectiveness, and permanence. Excavated materials will be treated to meet the WAC of the disposal facility.

Alternative 5 would eliminate unacceptable threats from direct contact with wastes, surface soils, or subsurface soils. Alternative 5 eliminates uncertainties associated with the source term.

Magnitude of Residual Risk. This alternative will remove waste and contaminated soil up to 20 ft bgs. If the remedy does not support UU/UE, a deed restriction contingent on property transfer that restricts residential use would be required.

Need for Five-Year Review. This remedy may not result in UU/UE conditions. If not, five-year reviews will be required to ensure that the remedy remains protective.

Adequacy and Reliability of Controls. The administrative LUCs listed in this remedy are adequate to meet threshold criteria. No physical controls are included in the alternative because waste and contaminated soil will be removed to a depth of up to 20 ft bgs. Administrative controls will prevent unauthorized use, if necessary.

5.4.5.4 Reduction of toxicity, mobility, or volume through treatment

Some reduction of toxicity, mobility, and/or volume will be achieved through postexcavation waste stabilization that will be required to meet the receiving facilities' WAC requirements. Additionally, this alternative anticipates subsequent postexcavation treatment of COCs that have migrated below the waste.

PTW. All identified PTW will be removed or treated.

5.4.5.5 Short-term effectiveness

The RAOs for SWMU 2 would be achieved immediately following completion of excavation and disposal activities. Excavation, treatment, and disposal of residuals could be accomplished in approximately three years, but may necessitate an additional period of time if deeper sources of contaminants are identified during the RD or remedial action.

Protection of Community during Remedial Actions. Short-term risks to the community resulting from excavation activities at the SWMU are expected only as they relate to transport of excavated materials to off-site disposal locations. This risk would be reduced greatly by disposing of waste in a potential OSWDF.

Because this alternative exposes uranium metal to air, there is potential for a pyrophoric event. Exposure to the community or adverse environmental impact due to such an event is limited. These pyrophoric events can be readily smothered by a soil covering. Additionally, the fume will have limited mobility in the air because of its density.

Protection of Workers during Remedial Actions. There is some limited potential for pyrophoric uranium at SWMU 2 to combust, creating short-term health concerns for remediation workers, the surrounding community, and the environment. Implementation of Alternative 5 would incorporate measures to prevent or mitigate such an event. Short-term exposures of workers to COCs could occur during implementation of Alternative 5. Worker risks are not expected to exceed acceptable limits because these activities will be conducted under an approved HASP; therefore, risks from handling waste/contaminated soils would be mitigated through adherence to health and safety protocols.

Excavation and disposal would be conducted by trained personnel in accordance with work planning documents to maintain a work environment that minimizes injury or exposure to risks to human health or the environment.

Environmental Impacts. No ecological impacts at the BGOU are anticipated under this alternative. The BGOU is located at an active operational facility already disturbed by construction and operational activities and does not support any unique or significant ecological resources. No known archaeological or historical sites or T&E species would be impacted by this alternative.

Time Frame to Achieve Protectiveness. Protectiveness will be achieved when each component of Alternative 5 is completed. Implementation of Alternative 5 would take less than three years from field mobilization.

5.4.5.6 Implementability

Ability to Construct and Operate Technology. Alternative 5 is technically and administratively feasible and implementable. The equipment and technologies associated with implementation of this alternative have been proven to be feasible technically and are available from contractors or vendors. The implementability of construction-related activities during excavation and backfilling at SWMU 2 subject to Alternative 5 is very similar to that carried out routinely at other sites, so it is considered high. Likewise, sampling, analysis, transportation, and disposal at an approved location are performed routinely and, if properly implemented, are proven to be safe. Some excavated waste materials and affected soils may be radioactive, PCB contaminated, or mixed. On-site treatment processes would comply with ARARs.

Reliability of Technology. All of the technologies employed in Alternative 5 are highly reliable.

Ease of Undertaking Additional Remediation. None of the technologies employed in Alternative 5 would impede additional remediation.

Monitoring Considerations. Monitoring during excavation will follow proven industrial hygiene and environmental monitoring practices. Monitoring of groundwater should not be necessary once the buried wastes and subsurface soils are removed.

Coordination with Other Agencies. The means and methods for coordinating with other agencies are established in the PGDP FFA. This remedy would not require involvement of new agencies.

Availability of Equipment and Specialists. All equipment and specialists are readily available.

5.4.5.7 Cost

Consistent with EPA guidance (EPA 2000), the cost estimates in this FS consist of a 1,000-year period due to the nature of the contaminants, including long-lived radionuclides. Net present value/worth cost estimates are presented for the individual and comparative analysis of alternatives and for remedy selection (EPA 1988). The real discount rate has been obtained from OMB guidance (reference Appendix C in OMB circular A-94). In addition, nondiscounted cost estimates (i.e., capital and average annual O&M) are presented for comparison purposes only.

The following costs are estimated for Alternative 5. The first set of costs assumes that an OSWDF will not be available for disposal of SWMU 2 waste. The second set of costs assumes that an OSWDF would be available.

	Without OSWDF Available	With OSWDF Available
Net Present Worth Cost	$100,721,000	$57,572,000
Nondiscounted Cost		
• Capital Cost	$99,832,000	$56,683,000
• Average Annual O&M Cost	$10,000	$10,000

5.4.6 Alternative 6—Targeted Excavation, Treatment, Disposal, Containment, Surface Controls, LUCs, and Monitoring

Alternative 6 is described in Section 5.3.5.9 with additional implementation data included in Appendix E. This alternative would involve the removal of wastes and contaminated soils associated with the mobile constituents disposed in SWMU 2—cell 6 (soils with high TCE concentrations), cell 8 (uranyl fluoride drums), and cell 9 (TCE drums)—followed by covering the remaining wastes with a Subtitle C cap. The 270 tons of uranium PTW would remain along with as much as 59,000 gal of oil that contains PCB PTW.

5.4.6.1 Overall protection of human health and the environment

Alternative 6 would meet this threshold criterion. Waste and contaminated soil from cells 6, 8, and 9 would be removed physically from the SWMU, treated as necessary to meet WAC requirements of the selected disposal facility, and disposed of in one or more appropriate disposal facilities, including a potential OSWDF. The RCRA Subtitle C cap provides a physical barrier between receptors and contaminated surface soils, waste, and contaminated subsurface soil, thus preventing direct contact and the associated risk. The cap provides a direct reduction in mobility of surface contamination and a reduction in migration of subsurface vadose zone contamination by preventing infiltration. The integrity of the Subtitle C cap will be maintained. For estimating purposes, the cap is assumed to have the same dimensions as the Alternatives 3 and 4 cap. Construction of a vertical subsurface barrier (slurry wall) and groundwater extraction would prevent further migration of contaminants to the RGA, and the slurry wall would eliminate potential horizontal migration to the ditch located south of SWMU 2. If DNAPL is present in sufficient quantities to overcome capillary pressure, it would be contained or captured. LUCs are layered to ensure protectiveness. Riprap would be placed over the RCRA Subtitle C cap.

This alternative also anticipates that excavation alone will not result in RG attainment in some subsurface soils currently below waste areas. Because of this, treatment through chemical injection below the excavated cells, as needed, is included as a remedy component.

5.4.6.2 Compliance with ARARs

Alternative 6 meets this threshold criterion for SWMU 2.

Action-specific ARARs for this alternative are summarized in Appendix F.

No chemical-specific ARARs have been identified.

A wetlands assessment would be performed prior to remedy implementation. Although it is not anticipated, if an action should involve discharge of dredge or fill material into waters of the United States, including jurisdictional wetlands, potential location-specific ARARs are summarized in Appendix F.

5.4.6.3 Long-term effectiveness and permanence

Selective excavation removes mobile waste constituents. This activity, when combined with containment using a Subtitle C cap, provides moderate to high long-term effectiveness and permanence. Postexcavation treatment processes manage or remove hazardous characteristics or destroy the COCs in the excavated material.

Risks associated with direct contact with wastes, surface soils, and subsurface soils would be eliminated since the primary source and associated contaminated soils would be covered or removed. Alternative 6 reduces uncertainties associated with these soils in terms of continued contributions to the hydrogeological system by removal of mobile contaminants.

Magnitude of Residual Risk. This alternative effectively manages direct contact risk by extending the depth from the surface to the buried waste. Signs and the multilayer cap inform the intruder of the potential dangers associated with direct contact to the waste and contaminated soil through physical and administrative LUCs.

Uncertainties associated with potential horizontal migration to the ditch south of SWMU 2 are resolved through installation of a slurry wall.

Finally, this remedy includes groundwater monitoring, which will monitor remedy effectiveness at preventing COC migration to the RGA.

Need for Five-Year Review. Because this remedy will not result in UU/UE conditions, five-year reviews will be required to ensure that the remedy remains protective.

Adequacy and Reliability of Controls. The physical and administrative controls listed in this remedy are adequate to meet threshold criteria. The physical controls to protect from direct contact require a low degree of maintenance to maintain adequacy. However, a higher degree of long-term O&M of the groundwater extraction system would be required.

5.4.6.4 Reduction of toxicity, mobility, or volume through treatment

This alternative selectively removes mobile contaminants, thus reducing or eliminating the toxicity, mobility, and volume of contaminants from the unit. The extracted contaminants are treated prior to disposal in a manner that meets the WAC of the disposal facility. Chemical injection would be employed to treat COCs below the level of excavation at the targeted excavation locations (cells 6, 8, and 9).

PTW. This alternative includes excavation of wastes and contaminated soils to meet RGs at cells 6, 8, and 9. Only PTW at cells 6, 8 and 9 would be removed or treated. All other SWMU 2 PTW would remain in place untreated.

5.4.6.5 Short-term effectiveness

Protection of Community during Remedial Actions. Short-term risks to the community resulting from excavation activities at SWMU 2 would not be expected; however, there is a slim potential that excavation workers would encounter pyrophoric uranium at SWMU 2 that may combust, creating health concerns for remediation workers, the surrounding community, and the environment. Cells 6, 8, and 9 are not known to contain pyrophoric uranium. Implementation of Alternative 6 would incorporate measures to prevent or mitigate such an event. Alternative 6 includes a potential risk to the community from transportation of the LLW or hazardous wastes/liquids to off-site disposal and/or treatment facilities.

Protection of Workers during Remedial Actions. Short-term exposures of workers to COCs could occur during implementation of Alternative 6. Risks from handling waste/contaminated soils would be mitigated through adherence to health and safety protocols. To protect workers, PPE, ambient conditions monitoring, and decontamination protocols would be used in accordance with an approved, site-specific HASP.

Excavation and disposal would be conducted by trained personnel in accordance with standard radiological, engineering, and operational procedures, documented safety analyses, HASPs, and safe work practices to maintain a work environment that minimize injury or exposure to risks to human health or the environment.

Environmental Impacts. No ecological impacts at the BGOU are anticipated under this alternative. The BGOU is located at an active operational facility already disturbed by construction and operational activities and does not support any unique or significant ecological resources. No known archaeological or historical sites or T&E species would be impacted by this alternative.

Time Frame to Achieve Protectiveness. Protectiveness will be achieved when each component of Alternative 6 is completed. Implementation of Alternative 6 would take less than three years from field mobilization.

5.4.6.6 Implementability

Alternative 6 is technically and administratively feasible and implementable. The equipment and technologies associated with implementation of this alternative have been proven to be feasible technically and are available from contractors or vendors. The implementability of construction-related activities during excavation and surface cover construction at SWMU 2 subject to Alternative 6 is very similar to that carried out routinely at other sites, so it is considered high. Likewise, sampling, analysis, transportation, and disposal at an approved location are performed routinely and, if properly implemented, are proven to be safe. Some excavated waste materials and affected soils may be radioactive, PCB contaminated, or mixed. Treatment of wastes with multiple regulatory classifications is more complex and may require more than one treatment process to make the waste suitable for transportation and/or land disposal. On-site treatment processes would comply with ARARs.

An option for disposal of waste and residuals at a potential OSWDF was considered under Alternative 6. The primary difference would be the elimination of waste leaving PGDP, related off-site transportation issues, and the cost for disposal. This will be further considered should this alternative be implemented and there is an OSWDF at time of implementation.

Ability to Construct and Operate Technology. The equipment and technologies associated with implementation of this alternative have been proven to be feasible technically and are available from contractors and vendors.

As described in Section 5.3.5 and in Appendix E, the cells 1, 4, 7, 10, and 15 also would be excavated incidental to the cell 6 excavation. This area would be isolated using sheet pile prior to excavation on the east, south, and west sides of the excavation. In a separate installation, sheet pile would be used to isolate cells 8 and 9. This approach relies on the accuracy of disposal records and assumes that disposal grids were honored during placement in order to place sheet pile around the targeted waste.

The results of a 1984 excavation to recover drummed TCE results in an uncertainty to this assumption.

During the 1984 excavation of cell 9, it was expected to find fifteen 30-gal drums of contaminated TCE. Instead, four 30-gal drums of TCE were found along with approximately thirty-five 55-gal drums. Thirty plastic-lined drums were of good integrity and contained uranium-contaminated sludge. The remaining, approximately five, drums could not be analyzed. Also, one 55-gal, plastic-lined drum containing TCE sludge was uncovered.

The location of the other eleven 30-gal drums of TCE solution is unknown, but the drums are presumed to be in area 8. It also is presumed that the thirty-five 55-gal drums uncovered in cell 9 reflect the thirty-five 30-gal drums of uranyl fluoride solution identified in the disposal records.

Reliability of Technology. All of the technologies employed in Alternative 5 are highly reliable.

Ease of Undertaking Additional Remediation. None of the technologies employed in Alternative 6 would impede additional remediation.

Monitoring Considerations. As indicated in Chapter 3, SWMU 2 is located over a contaminant plume (i.e., the PGDP Southwest Plume), so there would be impediments to the evaluation of groundwater monitoring data. Statistical evaluations and trending would be used to identify any groundwater impacts that may be attributable to SWMU 2.

Coordination with Other Agencies. The means and methods for coordinating with other agencies are established in the PGDP FFA. This remedy would not require involvement of new agencies.

Availability of Equipment and Specialists. All equipment and specialists are readily available.

5.4.6.7 Cost

Consistent with EPA guidance (EPA 2000), the cost estimates in this FS consist of a 1,000-year period due to the nature of the contaminants, including long-lived radionuclides. Net present value/worth cost estimates are presented for the individual and comparative analysis of alternatives and for remedy selection (EPA 1988). The real discount rate has been obtained from OMB guidance (reference Appendix C in OMB circular A-94). In addition, nondiscounted cost estimates (i.e., capital and average annual O&M) are presented for comparison purposes only.

The following costs are estimated for Alternative 6. The first set of costs assumes that an OSWDF will not be available for disposal of SWMU 2 waste. The second set of costs assumes that an OSWDF would be available.

	Without OSWDF Available	With OSWDF Available
Net Present Worth Cost	$41,114,000	33,875,000
Nondiscounted Cost		
• Capital Cost	30,581,000	23,342,000
• Average Annual O&M Cost	$125,900	$125,900

5.5 COMPARATIVE ANALYSIS OF ALTERNATIVES

Table 5.15 summarizes the detailed analysis conducted in Section 5.4. Table 5.16 provides a comparative analysis for source area alternatives for SWMU 2.

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Table 5.15. Summary of SWMU 2 Detailed Analysis

	Alternative 1	Alternative 3	Alternative 4 (SS)	Alternative 4 (CI)	Alternative 5	Alternative 6
Criteria	**No Action**	**Containment, Surface Controls, LUCs, and Monitoring**	**Containment, Stabilization/ Solidification, Surface Controls, LUCs, and Monitoring**	**Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring**	**Excavation and Disposal, Treatment, and LUCs**	**Targeted Excavation, Treatment, Disposal, Containment, Surface Controls, LUCs, and Monitoring**
Overall Protection of Human Health and the Environment	Does not meet the threshold criterion.	Meets the threshold criterion.	Meets the threshold criterion.	Meets the threshold criterion.	Meets the threshold criterion.	Meets the threshold criterion.
Compliance with ARARs	No ARARs identified.	Meets the threshold criterion.	Meets the threshold criterion.	Meets the threshold criterion.	Meets the threshold criterion.	Meets the threshold criterion.
• Action-Specific ARARs	None	Alternative can meet all ARARs.	Alternative can meet all ARARs.	Alternative can meet all ARARs.	Alternative can meet all ARARs.	Alternative can meet all ARARs.
• Chemical-Specific ARARs	None	None identified.	None identified.	None identified.	None identified.	None identified.
• Location-Specific ARARs	None	Wetlands survey will be performed. If wetlands are found, then location-specific ARARs will be met.	Wetlands survey will be performed. If wetlands are found, then location-specific ARARs will be met.	Wetlands survey will be performed. If wetlands are found, then location-specific ARARs will be met.	Wetlands survey will be performed. If wetlands are found, then location-specific ARARs will be met.	Wetlands survey will be performed. If wetlands are found, then location-specific ARARs will be met.
Long-Term Effectiveness and Permanence						
• Magnitude of Residual Risk	No action is taken therefore, no change in residual risk.	Direct contact risk is mitigated through increased depth to waste and LUCs. Potential for pyrophoric event diminishes over time because of oxidation. Protection of groundwater relies on continued monitoring to ensure protectiveness.	Direct contact risk is mitigated through increased depth to waste and LUCs. Uranium remains, but the potential for a pyrophoric event further reduced through stabilization. Protection of groundwater is ensured through stabilization/solidification, but relies on continued monitoring to ensure protectiveness.	Direct contact risk is mitigated through increased depth to waste and LUCs. Potential for pyrophoric event diminishes over time because of oxidation. Bench scale testing required better understanding geochemistry and identifying specific reagents.	Any residual direct contact risk due to remaining contamination at concentrations above RGs is managed through LUCs.	Direct contact risk is mitigated through increased depth to waste and LUCs. Potential for pyrophoric event diminishes over time because of oxidation. Bench scale testing required better understanding geochemistry and identifying specific reagents.
• Need for Five-Year Review	None	Five-year review needed.	Five-year review needed.	Five-year review needed.	Five-year review will be needed if UU/UE conditions are not met	Five-year review needed.
• Adequacy and Reliability of Controls	None	The physical controls to protect from direct contact require little to no maintenance to maintain adequacy. However, a higher degree of long-term O&M of the groundwater extraction system would be required. Relies on continuation of LUCs selected as part of the CERCLA remedy.	The physical controls to protect from direct contact require little to no maintenance to maintain adequacy. However, a higher degree of long-term O&M of the groundwater extraction system would be required. Relies on continuation of LUCs selected as part of the CERCLA remedy.	The physical controls to protect from direct contact require little to no maintenance to maintain adequacy. However, a higher degree of long-term O&M of the groundwater extraction system would be required. Relies on continuation of LUCs selected as part of the CERCLA remedy.	Relies on continuation of LUCs selected as part of the CERCLA remedy should UU/UE conditions not be met.	The physical controls to protect from direct contact require little to no maintenance to maintain adequacy. However, a higher degree of long-term O&M of the groundwater extraction system would be required. Relies on continuation of LUCs selected as part of the CERCLA remedy.
Reduction of Toxicity, Mobility, or Volume through Treatment	None	Treatment of extracted groundwater only. No treatment or removal of PTW.	Mobility of all COCs and PTW reduced through stabilization. Extracted groundwater also treated.	Treatment targeted to the mobile COCs/PTW (TCE and uranyl fluoride). Extracted groundwater also treated.	Removed waste will be treated as needed to meet the receiving facilities' WAC requirements. Treatment below excavation targets mobile COCs/PTW (TCE and uranyl fluoride) that may have migrated from the unit. PTW will be removed.	Removed waste will be treated as needed to meet the receiving facilities' WAC requirements. Treatment below excavation targets mobile COCs/PTW (TCE and uranyl fluoride) that may have migrated from the unit.

Table 5.15. Summary of SWMU 2 Detailed Analysis (Continued)

	Alternative 1	Alternative 3	Alternative 4 (SS)	Alternative 4 (CI)	Alternative 5	Alternative 6
Criteria	**No Action**	**Containment, Surface Controls, LUCs, and Monitoring**	**Containment, Stabilization/ Solidification, Surface Controls, LUCs, and Monitoring**	**Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring**	**Excavation and Disposal, Treatment, and LUCs**	**Targeted Excavation, Treatment, Disposal, Containment, Surface Controls, LUCs, and Monitoring**
Short-Term Effectiveness						
• Protection of Community during Remedial Actions	None	No significant impact to the community.	No significant impact to the community.	No significant impact to the community.	No significant impact to the community.	No significant impact to the community.
• Protection of Workers during Remedial Actions	None	Risks to workers largely due to heavy equipment operations associated with monitoring well installation. Risks can be mitigated through work control practices such as training, administrative controls, physical controls, and PPE.	Risk to workers largely due to heavy equipment operations associated with monitoring well installation and cover construction. Risk can be mitigated through work control practices such as training, administrative controls, physical controls, and PPE.	Risk to workers largely due to heavy equipment operations associated with monitoring well installation and cover construction. Risks can be mitigated through work control practices such as training, administrative controls, physical controls, and PPE.	Risk to workers largely due to heavy equipment operations associated with excavation. This alternative does place workers in contact with waste and contaminated soil during excavation, *ex situ* treatment, and waste packaging. Risks can be mitigated through work control practices such as training, administrative controls, physical controls, and PPE.	Risk to workers largely due to heavy equipment operations associated with excavation. This alternative does place workers in contact with waste and contaminated soil during excavation, *ex situ* treatment, and waste packaging. Risks can be mitigated through work control practices such as training, administrative controls, physical controls, and PPE.
• Environmental Impacts	None	No significant environmental impacts.	No significant environmental impacts.	No significant environmental impacts.	No significant environmental impacts.	No significant environmental impacts.
• Time Frame to Achieve Protectiveness	N/A	Less than one year from field mobilization.	Less than two years from field mobilization.	Less than two years from field mobilization.	Less than three years from field mobilization.	Less than two years from field mobilization.
Implementability						
• Ability to Construct and Operate Technology	N/A	All construction means and methods are proven technologies. Monitoring will follow established PGDP practices.	All construction means and methods are proven technologies and routinely used at other DOE sites as well as in private industry.	All construction means and methods are proven technologies and routinely used at other DOE sites as well as in private industry.	All construction means and methods are proven technologies and routinely used at other DOE sites as well as in private industry.	All construction means and methods are proven technologies and routinely used at other DOE sites as well as in private industry. Uncertainty as to ability to install sheet piling to isolate targeted wastes.
• Reliability of Technology	N/A	Technologies implemented are highly reliable and in common use.	Technologies implemented are highly reliable and in common use.	Technologies implemented are highly reliable and in common use.	Technologies implemented are highly reliable and in common use.	Technologies implemented are highly reliable and in common use.
• Ease of Undertaking Additional Remediation	N/A	Subtitle C cap and riprap could impede additional remediation should it be undertaken, but they would not prevent additional remediation.	Subtitle C cap and riprap could impede additional remediation should it be undertaken, but they would not prevent additional remediation.	Subtitle C cap and riprap could impede additional remediation should it be undertaken, but they would not prevent additional remediation.	None of the technologies employed would impede additional remediation.	None of the technologies employed would impede additional remediation.
• Monitoring Considerations	N/A	SWMU 2 is located over the Southwest Plume, so there would be impediments to the evaluation of groundwater monitoring data.	SWMU 2 is located over the Southwest Plume, so there would be impediments to the evaluation of groundwater monitoring data.	SWMU 2 is located over the Southwest Plume, so there would be impediments to the evaluation of groundwater monitoring data.	Monitoring of groundwater should not be necessary once the buried wastes and subsurface soils are removed.	SWMU 2 is located over the Southwest Plume, so there would be impediments to the evaluation of groundwater monitoring data.
• Coordination with Other Agencies	Agency coordination will follow FFA. No new agencies involved.	Agency coordination will follow FFA. No new agencies involved.	Agency coordination will follow FFA. No new agencies involved.	Agency coordination will follow FFA. No new agencies involved.	Agency coordination will follow FFA. No new agencies involved.	Agency coordination will follow FFA. No new agencies involved.
• Availability of Equipment and Specialists	N/A	All equipment and specialists are readily available.	All equipment and specialists are readily available.	All equipment and specialists are readily available.	All equipment and specialists are readily available.	All equipment and specialists are readily available.

Table 5.15. Summary of SWMU 2 Detailed Analysis (Continued)

	Alternative 1	Alternative 3	Alternative 4 (SS)	Alternative 4 (CI)	Alternative 5	Alternative 6
Criteria	**No Action**	**Containment, Surface Controls, LUCs, and Monitoring**	**Containment, Stabilization/ Solidification, Surface Controls, LUCs, and Monitoring**	**Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring**	**Excavation and Disposal, Treatment, and LUCs**	**Targeted Excavation, Treatment, Disposal, Containment, Surface Controls, LUCs, and Monitoring**
Cost						
• Net Present Worth Cost	$0	$21,788,000	$31,755,000	$25,569,000	$100,721,000	$41,114,000
Nondiscounted Cost • Capital Cost • Average Annual O&M Cost	$0 $0	$11,255,000 $125,900	$21,222,000 $125,900	$15,036,000 $125,900	$99,832,000 $10,000	$30,581,000 $125,900
Costs Assuming Presence of an OSWDF						
• Net Present Worth Cost	$0	N/A	N/A	N/A	$57,572,000	$33,875,000
Nondiscounted Cost • Capital Cost • Average Annual O&M Cost	$0 $0	N/A	N/A	N/A	$56,683,000 $10,000	$23,342,000 $125,900

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Table 5.16. SWMU 2 Comparative Analysis

Criteria	Analysis
Overall Protection of Human Health and the Environment	• The No Action alternative does not meet the overall protection criterion. • All action alternatives meet the overall protection criterion.
Compliance with ARARs	
• Action-Specific ARARs	• No ARARs are identified for the No Action alternative. • All action alternatives can meet ARARs.
• Chemical-Specific ARARs	• No chemical-specific ARARs are identified for any of the alternatives.
• Location-Specific ARARs	• Implementation of all action alternatives will require that a wetlands survey be performed; if wetlands are found, then location-specific ARARs will be met.
Long-Term Effectiveness and Permanence	
• Magnitude of Residual Risk	• Alternative 5 provides the greatest degree of residual risk reduction by removing the buried wastes and contaminated soils that exceed RGs and by using chemical injection to treat the soils below/under the burial cells. Chemical injection would destroy TCE and immobilize uranyl fluoride. • Alternative 6 provides less residual risk reduction than Alternative 5 by removing a portion of the buried wastes (i.e., the burial cells containing the known, mobile, PTW TCE and uranyl fluoride from cells 6, 8 and 9); by using chemical injection to treat the soils below/under the burial cells; and by leaving the remaining buried waste and contaminated soils in place and mitigating risks to groundwater and direct contact with a Subtitle C cap. ZVI injection would destroy TCE and immobilize uranyl fluoride. • Alternatives 4 (SS) and 4 (CI) provide less residual risk reduction than Alternatives 5 and 6 by leaving the buried waste and contaminated soils in place and mitigating risks to groundwater and direct contact with a Subtitle C cap and by treating the soils below/under the burial cells. • Alternative 3 provides the least residual risk reduction by leaving the buried waste and contaminated soils in place and mitigating risks to groundwater and direct contact with a Subtitle C cap (with no excavation and no *in situ* treatment). • Cleanup will achieve RGs. If Alternative 5 does not support UU/UE, then a deed restriction would be implemented (contingent on property transfer) that restricts residential use. Alternatives 3, 4 (SS), 4 (CI), and 6 will not support UU/UE; LUCs would be implemented to restrict certain uses to ensure the remedy remains protective, and groundwater monitoring would be conducted.
• Need for Five-Year Review	• Alternative 5 removes waste; therefore, five-year reviews will be required if the remedy does not support UU/UE. • Alternatives 3, 4 (SS), 4 (CI), and 6 contain waste in place, and will not support UU/UE; therefore, five-year reviews would be necessary.
• Adequacy and Reliability of Controls	• Alternative 5 removes waste to meet RGs; if this alternative does not support UU/UE, then a deed restriction would be implemented (contingent on property transfer) that restricts residential use. • Alternatives 3, 4 (SS), 4 (CI), and 6 leave waste in place and therefore rely on LUCs to a greater degree than does Alternative 5.

Table 5.16. SWMU 2 Comparative Analysis (Continued)

Criteria	Analysis
Reduction of Toxicity, Mobility, or Volume through Treatment	• Alternative 4 (SS) stabilizes all wastes through the injection of cement grout in overlapping columns to form a monolithic block. While this will not destroy the COCs present, it will severely limit their mobility thus mitigating risk to the RGA. Alternative 4 (SS) meets the statutory preference for treatment because all waste in the disposal area will be treated through stabilization/solidification. • Alternative 4 (CI) targets the mobile COCs for chemical injection. It does not, however, reduce the toxicity, mobility or volume of PCBs or uranium metal. Alternative 4 (CI), partially meets the statutory preference for treatment because only the mobile wastes at cells 6, 8 and 9 would be treated. • Alternatives 3, 4 (SS), 4 (CI), and 6 include groundwater extraction which will mitigate the potential for COCs migrating to the RGA and provide a treatment of extracted groundwater. • Alternatives 5 and 6 remove waste and treatment will be performed if necessary to meet the WAC of the receiving facilities. If treatment is required, then these alternatives would meet the statutory preference for treatment. • Alternatives 1 and 3 do not include treatment, so they do not meet the statutory preference for treatment.
Short-Term Effectiveness	
• Protection of Community during Remedial Actions	• None of the alternatives present significant impact to the community.
• Protection of Workers during Remedial Actions	• Alternatives 3, 4 (SS), and 4 (CI) leave waste in place and do not place workers in contact with waste or contaminated soil. Protection of workers during implementation of these alternatives would largely entail protection against the physical hazards largely associated with heavy equipment operations during cap construction. Also, protection of workers during implementation of Alternatives 4 (SS) and 4 (CI) would entail protection against the chemical hazards associated with the treatment chemicals plus physical hazards associated with delivery/placement of the treatment phase. All of these hazards can be mitigated through work control practices such as engineering controls, physical controls, administrative controls, training, and PPE. • Alternatives 5 and 6 include excavation of the buried wastes and contaminated soils. Protection of workers during implementation of these alternatives is more complex because workers could be exposed during excavation and waste handling activities, but these hazards can be mitigated through work control practices such as engineering controls, physical controls, administrative controls, training, and PPE. Protection of workers during implementation of these alternatives also would entail protection against the physical hazards largely associated with heavy equipment operations.
• Environmental Impacts	• None of the action alternatives present significant environmental impacts.
Implementability	
• Ability to Construct and Operate Technology	• All construction means and methods are proven technologies and routinely used at other DOE sites as well as in private industry. The following process options have been implemented at PGDP: ERH, P&T, capping, monitoring, and LUCs.
• Reliability of Technology	• The evaluated technologies are highly reliable and in common use.

Criteria	Analysis
• Ease of Undertaking Additional Remediation	• Alternative 5 removes waste, so any additional remediation activities would not be impacted. • All other alternatives leave buried waste and contaminated soil in place, so any additional remediation activities may be impacted by the presence of the waste/contaminants and/or the cap and riprap; but they would not prevent additional remediation.
• Monitoring Considerations	• There are no impediments to monitoring; however, all action alternatives recognize the difficulties and limitations of monitoring in comingled plume conditions that exist at SWMU 2.
• Coordination with Other Agencies	• Agency coordination with EPA and KY will follow the FFA. No new agencies will be involved.
• Availability of Equipment and Specialists	• All equipment and specialists are commercially available.
Cost	The following analysis is based on the net present value costs (EPA 1988) for 1,000 years (EPA 2000). • The cost for Alternative 3 ($22M) is less than the costs for the other alternatives. • The costs for Alternative 4 (SS) ($32M) and Alternative 4 (CI) ($26M) are less than the costs for Alternative 5 ($100M) and Alternative 6 ($41M) without an OSWDF available. • The costs for Alternative 4 (SS) ($32M) and Alternative 4 (CI) ($26M) are less than the costs for Alternative 5 ($58M) and Alternative 6 ($34M) if an OSWDF is available. With or without an OSWDF available, the capital costs for Alternative 3, Alternative 4 (SS), and Alternative 4 (CI) are less than the capital costs for Alternative 5 and Alternative 6, but the average annual O&M costs for Alternative 5 are less than the average annual O&M costs for the other alternatives.

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6. SWMU 3

Previous sections of this document present a framework that collects sitewide information and uses it to formulate a general approach to developing alternatives to address the COCs present in BGOU SWMUs 2, 3, 7 and 30. This framework also discusses key elements of the alternatives that are used as the basis for technology screening and development of SWMU-specific alternatives. This section (Section 6) of the document develops the candidate alternatives for SWMU 3 by expanding the general alternatives to address SWMU-specific conditions.

Section 6.1 presents SWMU-specific history and background including a discussion of COCs summarized in Section 1.6 of this report. Section 6.2 presents SWMU-specific RAOs that were developed from the general RAOs in Section 2.2.2. Section 6.3 refines the general alternatives that were developed in Section 3.4 into SWMU-specific alternatives; this includes a detailed screening of the RPOs from Section 2 for effectiveness, implementability, and cost to identify SWMU-specific RPOs and define each SWMU-specific remedial alternative. Section 6.4 presents the individual detailed analysis for each SWMU-specific alternative using the nine CERCLA criteria. Finally, Section 6.5 presents the comparative analysis of the SWMU-specific alternatives.

6.1 SWMU 3 HISTORY AND BACKGROUND

The C-404 Low-Level Radioactive Waste Burial Ground (SWMU 3) is 1.2 acres located in the west-central portion of the secured area. The unit originally was constructed as a rectangular, aboveground surface impoundment measuring 387 ft by 137 ft, with a floor area of approximately 53,000 ft^2. The floor of the surface impoundment was constructed of well-tamped earth and clay dikes to a height of 6 ft. The C-404 impoundment was designed with an overflow weir at its southwest corner. From the weir, the surface impoundment effluent flowed west in a ditch (not the NSDD) and eventually discharged through what is now KPDES Outfall 015. Figure 6.1 shows C-404 along with a schematic of this design. Historical effluent/leachate discharges later were rerouted to the NSDD via what is now an abandoned pipeline.

SWMU 3 operated as a surface impoundment from approximately 1952 until early 1957. During this time, all influents to the impoundment originated from C-400. In 1957, the C-404 surface impoundment was converted to a solid WDF for solid uranium-contaminated wastes. The waste consists of uranium precipitated from aqueous solutions, UF_4, uranium metal, uranium oxides, degreasing sludge, and radioactively contaminated trash. There are no records documenting the cleanout of sludges and sediments from the pond when it was converted to a landfill. When the C-404 impoundment was converted into a disposal facility, a sump was installed at the weir. Leachate was pumped from the sump through an underground transfer line. The transfer line discharged into a northeast-southwest ditch just east of C-404. From this ditch (which was addressed as part of the SWOU on-site project), the leachate flowed into the NSDD. NSDD historically carried PGDP effluents north to Little Bayou Creek. The date of termination of the leachate discharge through the underground transfer line into the NSDD has not been determined. It is known that, prior to landfill closure in 1986, this underground transfer line to the NSDD was not in operation and leachate from the C-404 Landfill was being collected in the sump for treatment at the C-400-D Lime Precipitation Unit in the C-400 Facility. At some time following closure of the C-404 Landfill, treatment of leachate from C-404 at C-400 was discontinued, and treatment of the leachate was transferred to the C-752 Remedial Action Waste Holding Facility. Some of the constituents found in the leachate and their ranges have included fluoride (4.8–10 mg/L), TCE (ND–0.3 mg/L), PCBs (0.41–1.18 μg/L), Np-237 (0.42-11.7 pCi/L), Tc-99 (90.6–365 pCi/L), U-234 (66–3,390 pCi/L), U-235 (156–1,050 pCi/L), and U-238 (2,160-37,900 pCi/L).

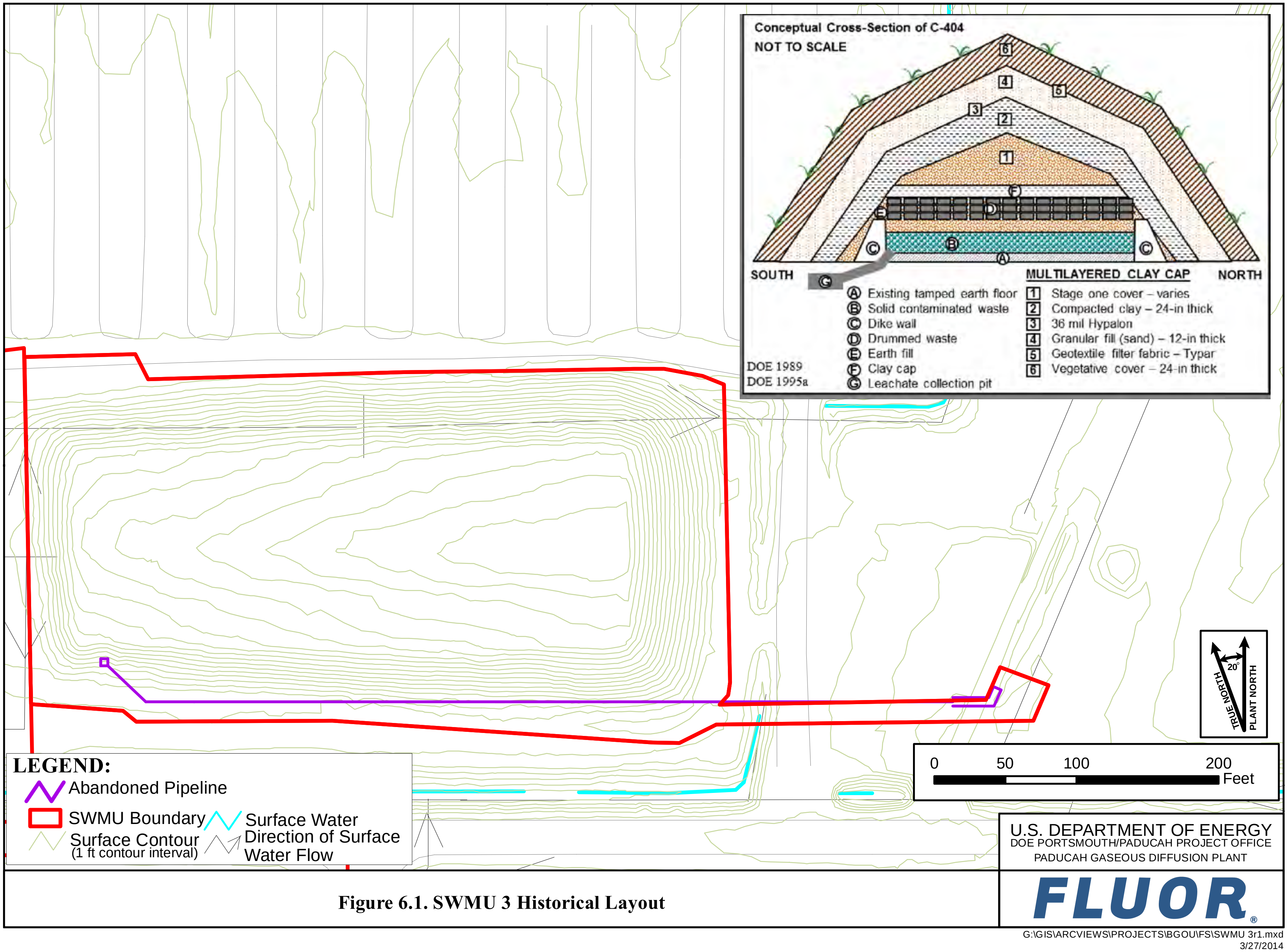

Figure 6.1. SWMU 3 Historical Layout

The upper tier of waste within C-404 contains drummed waste similar to that collected in the impoundment plus smelter furnace liners and drums of extraction-procedure, characteristically hazardous, waste [RCRA waste codes D006 (for cadmium), D008 (for lead), and D010 (for selenium)]. The drums of characteristically hazardous waste were produced in C-400 during treatment of wastes including sodium bisulfate solution, hydrochloric acid, chromic acid, nickel stripper solution, miscellaneous acids and alkalis, and aqueous solutions containing metals. A partial clay cap was installed on the eastern end of the landfill in 1982 (DOE 1987). Subsequently, the entire unit was covered with a Subtitle C cap; thus, the SWMU 3 unit is an abovegrade unit.

6.1.1 Nature and Extent of Contamination

This summary of nature and extent reflects the BGOU RI (DOE 2010b). Additional information can be found in Sections 1.5 and 1.6 of this report.

SWMU 3 extends to the area under the cap within the former surface impoundment area that received the wastes plus the pipeline which carried effluent to a ditch adjacent to the waste unit.

The source area of SWMU 3 contains approximately 6,615,000 lb of uranium-contaminated waste that has been identified as PTW. No other wastes have been identified as PTW at SWMU 3. The historical record is inconclusive about whether pyrophoric uranium is present in SWMU 3. The total volume is approximately 260,000 ft^3. Some uranium-contaminated waste also may be contaminated with TCE, radionuclides, and metals. In 1986, the disposal of waste at C-404 Landfill was halted, and a portion of the disposed of waste was found to be RCRA-hazardous [i.e., the gold dissolver precipitate that was disposed in the C-404 Landfill was determined to be a "characteristic" hazardous waste based on extraction procedure (EP) toxicity for cadmium (D006), lead (D008), and selenium (D010)]. The landfill was covered with a RCRA multilayered cap and certified closed in 1987. It currently is regulated under RCRA as a land disposal unit and compliance is monitored under a RCRA postclosure permit issued in 1992. The closure plan requires continued groundwater monitoring (DOE 1989). A permit modification was submitted in May 2008, revising the MW network for the unit to add a new upgradient well, MW420 (DOE 2008a). MW420 is screened in the upper RGA. The permit conditions are summarized in Appendix G.

No surface soil samples were collected from the surface of the Subtitle C cap. Presumably clean materials were used to construct the cap; however, subsequent to the construction of the cap, radiological surveys of adjacent roadways revealed contamination. In response to these survey results, additional gravel has been added to the roadways to prevent vehicles from spreading contamination. Though it has not been surveyed, radiological technicians have posted the cap as a radiological area as a result of elevated readings on the gravel roads and pads adjacent to the cap. In 2011, a water sample originating from a cap drain pipe was collected and analyzed for approximately 190 constituents (VOAs, SVOAs, metals, radionuclides, and PCBs). Eleven constituents were detected by the analyses; all but one (U-238) fell below the NFA threshold of a preliminary human health risk screening. Though the sample was not collected as part of an approved work plan and the manner in which it was collected made it susceptible to cross contamination, the presence of elevated levels of U-238 creates an element of uncertainty as to the nature and extent of contamination in the cap.

Subsurface soil samples collected from angled borings beneath the unit indicate the presence of U-238 and U-234 above background in a few locations. Uranium and uranium isotopes were not detected above background in any samples below 20 ft.

For UCRS groundwater, RI and historical data identified levels of metals (arsenic, iron, lead, manganese, molybdenum, or uranium), TCE, Tc-99, and U-238 that exceed screening criteria at all sampling locations

(DOE 2010b). Any releases to subsurface soils and groundwater may be related to past uses of the unit as a surface impoundment or as the current RCRA-regulated landfill.

The BGOU RI found RGA groundwater contaminants exceeding screening levels for SWMU 3 are metals (arsenic, iron, manganese, and uranium); organics (1,1-DCE, chloroform, and TCE); and radionuclides (U-234 and U-238).

URGA well MW420 (background) is the only URGA well with Tc-99 levels above the minimum detectable activity. The absence of Tc-99 in downgradient RGA wells demonstrates that the C-404 Landfill is not a source of statistically quantifiable levels of Tc-99. Note: UCRS wells MW85, MW88, MW91, and MW94 have detectable levels of Tc-99; only MW91 has a Tc-99 level greater than 900 pCi/L.

Dissolved-phase contamination with TCE is present in UCRS groundwater at SWMU 3 above MCLs. There are no disposal records of TCE disposal at SWMU 3, and leachate collection records do not indicate the continued presence of TCE DNAPL or high concentration TCE in soils at SWMU 3. Note that there are uncertainties associated with the leachate's origin (see Section 1.5.7).

The hydrogeological assessment of SWMUs 2 and 3 that was completed as part of the BGOU RI (PRS 2007a) documents that an upgradient source accounts for the high TCE concentrations in RGA groundwater. Because the 1,1-DCE detects occurred only in upgradient wells, it also appears to be related to an upgradient source.

Groundwater monitoring under the RCRA permit for the unit, however, has shown statistically significant increases of TCE above background in one of three downgradient compliance wells in the upper RGA (MW84). C-404 Landfill Source Demonstration, Paducah Gaseous Diffusion Plant, Paducah, Kentucky (PRS 2007b), related the increase in TCE levels to trends in the Southwest Plume and does not indicate that SWMU 3 is the contributor.

The 1987 *Closure Plan* (KY/B-257) and 1989 *Post-Closure Permit Application* (KY/H-35) for the C-404 Low-Level Radioactive Waste Burial Ground both contain a detailed inventory of the waste types placed in the unit based on documented disposal records available at the time. According to these documents, the gold dissolver precipitate that was disposed in the C-404 Landfill was determined to be a "characteristic" hazardous waste based on EP toxicity for cadmium (D006), lead (D008), and selenium (D010). The *Post-Closure Permit Application* further states that no evidence of disposal of trichloroethylene (TCE) or other similar organic chemicals was identified based on interviews and reviewed records. However, low concentrations of TCE have historically been detected in the leachate collected from the C-404 leachate collection sump. A later study, the 2005 *Regulatory Analysis on Application of the Headworks Exemption to Uranium Precipitate Waste* (BJC/PAD-732), involved worker interviews conducted at that time, one of which indicated that one option historically used for disposing of the C-400 degreaser sludge included placing it in steel drums and taking it to the C-409 Facility where the TCE was evaporated and the remaining drummed sludge was reportedly disposed at the C-404 Landfill. TCE degreaser sludge would be considered a F001 listed hazardous waste. Given the historical uses of TCE at PGDP, TCE, TCE-contaminated soils, and TCE-contaminated debris (e.g., drums, PPE) likely would be considered characteristic and/or listed RCRA hazardous wastes until such time as a "contained-in" and/or a "contaminated with" determination has been made. In addition, drums and/or containers that have been emptied in accordance with 40 *CFR* 261.7 also are not hazardous waste.

6.1.2 Risk Summary

This risk summary reflects the summary presented in the BGOU RI (DOE 2010b). Additional information can be found in Sections 1.5 and 1.6 of this report.

Sections 1.5 and 1.6.3 outline the potential risks posed by contaminants detected in soil that must be addressed in this FS, as developed through a review of the BGOU RI BHHRA and COCs, refining these as appropriate, and addressing uncertainties with a review of data collected subsequent to completion of the BHHRA. The BGOU RI BHHRA for SWMU 3 summarized the WAG 22 BHHRA, which evaluated risks using combined data from SWMUs 2 and 3. In addition, the WAG 22 BHHRA identified the COCs based on samples collected to depths of 8 ft, so these would be considered COCs for both surface and subsurface soils.

The primary threat from the SWMU is associated with the potential for risk to persons who may be exposed to waste. Although unacceptable direct contact risks were identified for industrial workers exposed to affected soils in the combined SWMU 2 and SWMU 3 BHHRA, a review of the current data shows the concentrations of these radionuclides in soils at SWMU 3 are much lower than at SWMU 2 and the unacceptable direct contact risks accrue to SWMU 2. Target COCs for direct contact include metals and uranium isotopes.

The BGOU RI BHHRA also identified COCs that may migrate to the RGA at levels that would limit future residential use. These were reviewed and the list refined (see Sections 1.5.4 and 1.6.3).

6.1.3 Hydrogeological Interpretation

The study area geology and hydrogeology are summarized below, as documented in the BGOU RI (DOE 2010b). Because SWMUs 2 and 3 are adjacent to each other, their hydrogeological interpretation is discussed as one.

Stratigraphy. The burial cells of SWMU 3 are constructed immediately above the HU1 loess member (silt with some clay) of the UCD. This is different from conditions at SWMU 2 where the burial cells were excavated into HU1. Although SWMU 3 is constructed above HU1, some waste cells in SWMU 2 likely extend to near the base of the HU1 unit, at a depth of 18.5 ft. The underlying HU2 interval consists of upper and lower sand and gravel horizons, separated by an intervening clayey silt unit, to a depth of 40 ft. A 9-ft thick silty clay interval (HU3) separates the HU2 sand and gravel horizons from the basal HU4 sand and the sands and gravels of the LCD (HU5).

UCRS Groundwater Flow and Hydraulic Potential. The SWMU 2 Data Summary and Interpretation Report (DOE 1997) documents the depth and gradient of the water table in the vicinity of SWMU 3 using measurements from shallow MWs and piezometers. Four rounds of measurements of water level during a one-week period in August 1996 consistently demonstrate that the water table occurred within 10 ft of land surface, sloping toward a ditch on the west side. RCRA compliance monitoring for SWMU 3 indicates differing conditions at SWMU 3—gradients vary but are net northward. The depth to water typically is greater than 10 ft bgs. Because SWMU 3 is an aboveground facility with a Subtitle C cap, the actual saturation level within the waste is unknown, and there are uncertainties associated with (1) the integrity of the existing Subtitle C cap, (2) the integrity of the clay bottom liner (i.e., the well-tamped clay floor that served as the floor of the former surface impoundment), and (3) the integrity of the concrete leachate collection sump/pit (see Section 1.5.7 and Section 1.6.3.2).

RGA Groundwater Flow and Hydraulic Potential. The BGOU RI includes a hydrogeological assessment of SWMU 3 (PRS 2007a), which documents the primary groundwater pathways in the RGA.

Contaminant trends associated with the Southwest Plume demonstrate convincingly that the dominant groundwater pathway immediately south of SWMU 3 is to the north/northwest, in agreement with the larger Southwest Plume trend, which passes beneath the south end of SWMU 2. Beneath SWMU 3, the groundwater pathway veers northward.

The governing parameters determining the groundwater flow paths are the higher hydraulic conductivity corridors in the RGA marked by the Southwest Plume and the Northwest Plume to the south and north of SWMU 3, respectively, and the RGA potentiometric surface, which declines to the north. Edges of the Southwest Plume and Northwest Plume approximate boundaries of higher hydraulic conductivity in the HU5 sediments, through which the majority of groundwater flow occurs. Pumping tests of the RGA in the area of the main contaminant plumes on-site (Terran 1992; LMES 1996) have determined the representative hydraulic conductivity to be 1,200 to 1,300 ft/day, which contrasts with the hydraulic conductivity of the RGA beneath SWMU 3, measured as 100 ft/day in a previous pumping test (Terran 1990).

The northward groundwater flow beneath SWMU 3 is an intermediate flow path between the hydraulic conductivity "expressways" delineated by the Southwest Plume (to the south of SWMU 3) and the Northwest Plume (to the north of SWMU 3) and is related to seasonal variations in potentiometric head.

Average RGA groundwater flow velocity in the areas of the contaminant plumes is commonly 1 to 3 ft/day. Hydraulic potential gradients to the north and to the west are commonly similar in the SWMU 3 area. The northward groundwater flow rate beneath SWMU 3 is likely 0.1 to 0.3 ft/day, in step with the order-of-magnitude reduction in hydraulic conductivity beneath SWMU 3.

6.2 SWMU-SPECIFIC RAOs

RAOs that are specific to SWMU 3 were developed based on the findings and observations from the BGOU RI Report. The SWMU-specific RAOs are directed toward conditions related to the waste materials and affected soils, the surface soils, and the subsurface soils at the SWMU.

Approximately 6,615,000 lb of uranium-contaminated waste and wastes in buried drums represent a principal threat should exposure occur. Uranium found at SWMU 3 is unlikely to pose a threat to underlying soil and groundwater due to its relative immobility and the collection of leachate. Note that there are uncertainties associated with (1) possible radiological contamination of the surface soil at SWMU 3, (2) the integrity of the existing Subtitle C cap, (3) the integrity of the clay bottom liner (i.e., the well-tamped clay floor that served as the floor of the former surface impoundment), and (4) the integrity of the concrete leachate collection sump/pit (see Section 1.5.7, Table 1.13, Section 1.6.3.1, and Section 1.6.3.2).

SWMU-Specific RAO for Protection of Groundwater. Contribute to the protection of groundwater by eliminating, reducing, or controlling sources of groundwater contamination (see Section 1.6 for target COCs) that could result in an exceedance in RGA groundwater of the MCL (or risk-based concentration for residential use of groundwater in the absence of an MCL).

SWMU-Specific RAO for Protection of Direct Contact with Waste. Prevent exposure to waste that exceeds target cumulative ELCRs and cumulative noncancer HIs for the future industrial and future excavation worker receptors. The acceptable cumulative risk levels for this RAO are defined as follows:

- Waste: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future excavation worker [considering a five-year exposure based on the outdoor worker scenario in the 2013 Risk Methods Document (DOE 2013a)].

SWMU-Specific RAO for Protection of Direct Contact with Contaminated Soils. Prevent exposure to contaminated soils that exceeds target cumulative ELCRs and cumulative noncancer HIs for the future industrial and future excavation worker receptors.[11] The acceptable cumulative risk levels for this RAO are defined as follows:

- Surface Soils: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future industrial worker [considering default exposure in the 2013 Risk Methods Document (DOE 2013a)].

- Surface and Subsurface Soil: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future excavation worker [considering a five-year exposure duration based on the outdoor worker scenario in the 2013 Risk Methods Document (DOE 2013a)].

SWMU-Specific RAO for PTW. Treat or remove PTW wherever practicable, consistent with 40 *CFR* § 300.430 (a)(1)(iii)(A).

PRGs were developed consistent with the approach described in Section 2.

The PRGs identified for target compounds to be addressed in this FS for protection of groundwater and direct contact at SWMU 3 are listed in Table 6.1. No surface soil samples were collected from the top of the cap; therefore, an uncertainty remains as to the risk posed by direct contact with the surface soil.

Table 6.1. Soil PRGs for SWMU 3

COC	Units	PRG for Surface Soil[a]	PRG for Subsurface Soil[b]	PRG for Subsurface Soil for Groundwater Protection[c]
cis-1,2-DCE	mg/kg	N/A	1.19E+00	N/A
TCE	mg/kg	N/A	1.03E-01	1.03E-01
Total PCBs	mg/kg	N/A	1.00E+01[d]	N/A
Arsenic	mg/kg	1.69E+01	1.04E+01	1.69E+01
Uranium	mg/kg	N/A	4.31E+02	7.83E+02
Tc-99	pCi/g	N/A	2.12E+01	2.12E+01
U-234	pCi/g	3.06E+02	2.18E+02	4.88E+06
U-235	pCi/g	9.20E+00	1.21E+01	5.07E+04
U-238	pCi/g	3.74E+01	4.53E+01	2.64E+02

N/A = not applicable, these analytes are not COCs for the referenced media for SWMU 3.
[a] PRGs for surface soil are taken from Table 1.21 of this report.
[b] PRGs for subsurface soil are taken from Table 1.22 of this report.
[c] PRGs for subsurface soil for groundwater protection are taken from Table 1.23 of this report.
[d] Determined during June 2009 BGOU FS scoping meeting.

Locations where these PRGs are exceeded are shown on figures in Appendix A (A.4, A.5, and A.6).

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[11] No surface soil data were collected at the waste unit. The surface samples in the discharge ditch are evaluated separately in Section 1.5.

6.3 DEVELOPMENT OF SWMU-SPECIFIC ALTERNATIVES

General alternatives were assembled and screened in Section 3. This section further refines those general alternatives brought forward for specific application at SWMU 3. It then proceeds to detailed and comparative analysis of the SWMU-specific alternatives using the nine CERCLA criteria.

The general alternatives retained in Section 3 are shown in Table 6.2.

Table 6.2. SWMU 3 Retained General Alternatives

Alternative Number/Description	
1	No Action
3	Containment, Surface Controls, LUCs, and Monitoring
5	Excavation, Disposal, Treatment, and LUCs

For each GRA or technology identified in a general alternative, corresponding technologies and/or process options will be evaluated against the criteria of effectiveness, implementability, and cost for inclusion in a SWMU-specific alternative.

6.3.1 SWMU 3 Ditch

When the C-404 impoundment was converted into a disposal facility, a sump was installed where the weir had been. Leachate was pumped from the sump through an underground transfer line. The transfer line discharged into a northeast-southwest ditch just east of C-404. From this ditch, the leachate flowed into the NSDD. The date of termination of the leachate discharge through the underground transfer line into the NSDD has not been determined. It is known that, prior to landfill closure in 1986, this underground transfer line to the NSDD was not in operation, and leachate from the C-404 Landfill was being collected in the sump for treatment at the C-400-D Lime Precipitation Unit in the C-400 Facility. At some time following closure of the C-404 Landfill, treatment of leachate from C-404 at C-400 was discontinued, and treatment of the leachate was transferred to the C-752 Remedial Action Waste Holding Facility.

This ditch was included in SWMU 3 in a revision to the SWMU Assessment Report in 2003. The ditch, as identified in the SWMU Assessment Report, was sampled as part of the BGOU RI. The location of the ditch has since been questioned, and the ditch is no longer included in this FS. The ditch was investigated and addressed as part of the SWOU On-site project. A new revised SWMU Assessment Report has been submitted.

6.3.2 Alternative 1—No Action

The No Action alternative is defined in accordance with CERCLA and provides a baseline to which other alternatives can be compared. Under this alternative, no action would be taken to implement remedial activities for SWMU 3 or to reduce the potential hazard to human or ecological receptors. Alternative 1 does not address PTW or any of the COCs identified in SWMU 3 soils that pose an unacceptable risk under some future use scenarios because no action is taken.

Alternative 1 recognizes that there is a Subtitle C cap present on SWMU 3 and that leachate currently is collected from a leachate pit and treated as needed prior to discharge/disposal. Note that there are uncertainties associated with the efficacy of the leachate pit (see Section 1.5.7). This alternative has no provisions to ensure continued leachate collection or cap maintenance; thus, this alternative does not meet the threshold criterion of protection of human health and the environment.

6.3.3 Alternative 3—Containment, Surface Controls, LUCs, and Monitoring

Alternative 3 will evaluate means to effectively contain waste and contaminated soil in place and limit direct contact through the use of caps, surface controls, and LUCs.

As applied at SWMU 3, this alternative recognizes the existing RCRA Subtitle C cap and leachate pit that currently prevent direct contact with the waste and significantly reduce infiltration of precipitation into buried wastes. Additionally, surface controls, monitoring, and LUCs will be evaluated.

Uncertainties. As previously stated, there are uncertainties associated with (1) possible radiological contamination of the surface soil on/in the existing RCRA Subtitle C cap, (2) the integrity of the existing Subtitle C cap, (3) the integrity of the clay bottom liner (i.e., the well-tamped clay floor that served as the floor of the former surface impoundment), and (4) the integrity of the concrete leachate collection sump/pit (see Section 1.5.7, Table 1.13, Section 1.6.3.1, and Section 1.6.3.2). Figure 6.2 illustrates these uncertainties.

In order to address these uncertainties, Alternative 3 will include a Remedial Design Site Investigation (RDSI) to evaluate each uncertainty. The RDSI activities will include a radiological survey and/or soil sampling to assess the cap contamination, an evaluation of performance data to determine the degree to which the cap may be leaking, additional groundwater elevation studies to determine if groundwater is intruding into the waste through the clay bottom liner, and a detailed evaluation of the sump/pit to determine if it is leaking.

As part of the RDSI, an Engineering Evaluation will be conducted to evaluate impacts of the riprap on the integrity and performance of the existing RCRA Subtitle C cap. The Engineering Evaluation also will consider the RDSI data to determine if additional measures need to be implemented to address any/all of the uncertainties. Additional measures to address the uncertainties may include additional cover over the existing cap to address radiological contamination, additional liners over the existing cap to prevent rain water infiltration, slurry walls to prevent groundwater intrusion through the clay bottom liner, and/or lining or replacement of the sump/pit to prevent leakage.

If it is determined that the SWMU 3 cap is radiologically contaminated and has caused surficial/shallow radiological contamination beyond the SWMU 3 administrative boundary, then this contamination will be addressed by Alternative 3.

6.3.3.1 Containment

General Alternative 3 identified containment as a GRA. Caps, subsurface vertical barriers, and hydraulic containment are containment technologies for which RPOs are evaluated for inclusion into SWMU 3-specific alternatives.

6.3.3.1.1 Caps

Effectiveness. Both the RCRA Subtitle C and KY Subtitle D caps are identified as RPOs. Both of these “caps” are effective at preventing surface water from migrating to the underlying waste. The RCRA Subtitle C cap, as recommended in EPA guidance, includes a 24-inch low permeable soil layer and a 20-mil geosynthetic membrane, which make it a more robust cap than the KY Subtitle D cap (EPA 1991b).

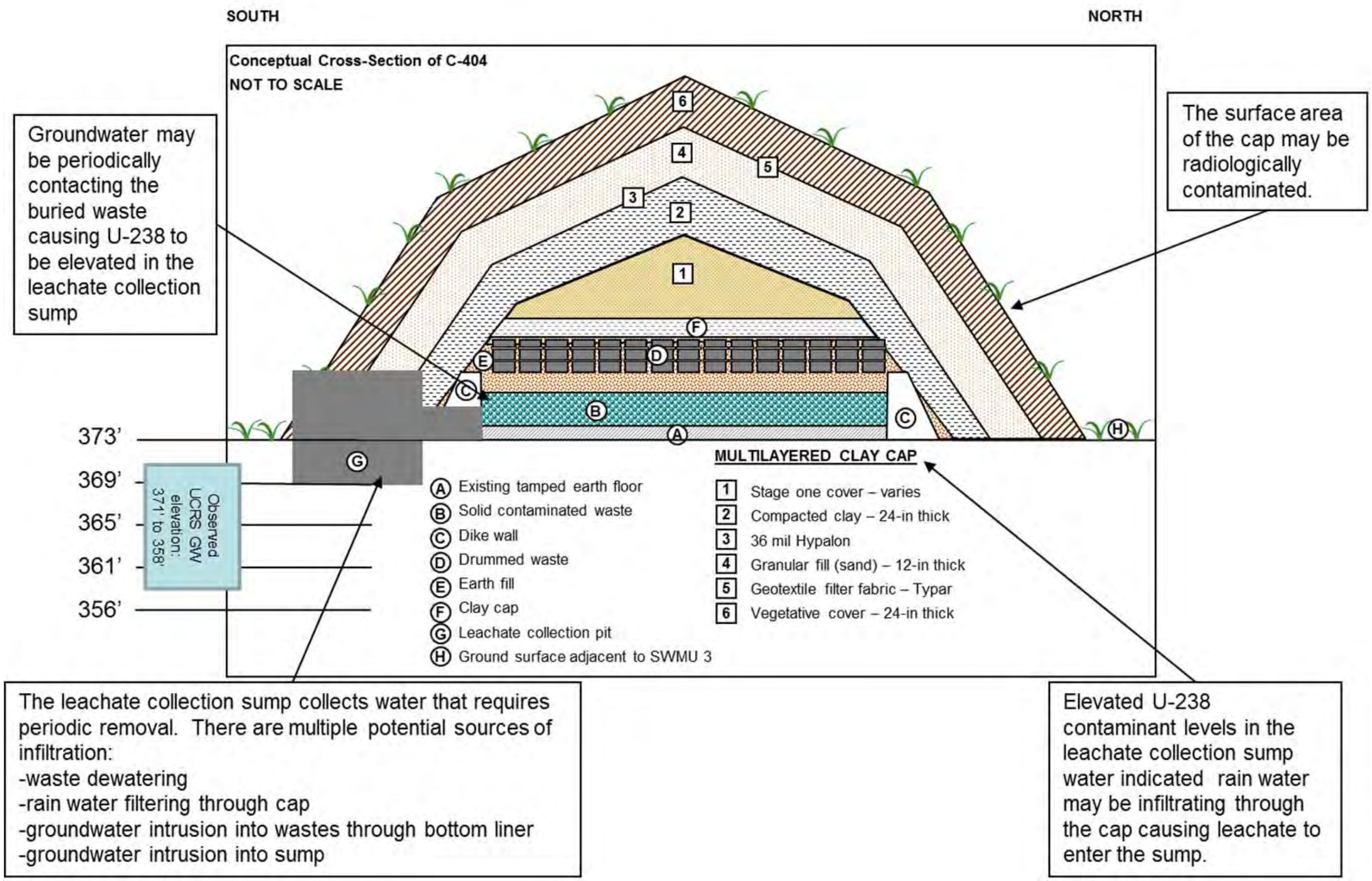

Figure 6.2. Identified Uncertainties with SWMU 3, Alternative 3

The existing RCRA Subtitle C cap at SWMU 3, which includes multilayers that are distinctly different from the natural subsoils, provides greater depth to the buried waste. These aspects (thickness and distinct properties) of the cap are expected to provide protection of individuals from inadvertent intrusion by alerting them that this is a man-made, engineered cover over something that is potentially hazardous to human health and by making it more difficult to expose the buried waste.

As stated in Section 3.4.3.3, radon modeling will be conducted during the remedial design phase for any remedy that involves capping of low level waste that might emit radon at SWMU 3, and the modeling should be consistent with the modeling performed for the OSWDF project or new technologies and/or methodologies agreed to by the FFA parties.

Implementability. Both the RCRA Subtitle C and KY Subtitle D caps use similar construction means and methods and are both highly implementable at SWMU 3. The design of a KY Subtitle D cap can accommodate the placement of the separate surface barrier. The design of the existing RCRA Subtitle C cap also can accommodate a riprap cover.

Cost. There is no additional cost associated with the RCRA Subtitle C cap installation because it is an existing feature. Long-term maintenance costs are equal for both caps.

Based on the evaluation factors of effectiveness, implementability, and cost, this alternative will recognize the existing RCRA Subtitle C cap present over SWMU 3 as the RPO for the surface barriers for SWMU-specific alternatives developed from General Alternative 3 at SWMU 3. Corner markers would be placed identifying the edge of the cap.

6.3.3.1.2 Subsurface vertical barriers

SWMU 3 is an aboveground feature with an existing RCRA Subtitle C cap that prevents water infiltration through the waste. Installation of a subsurface vertical barrier would not be effective and does not improve protection of human health and the environment. Because of this, an evaluation of subsurface barriers will not be performed.

6.3.3.1.3 Hydraulic isolation

Groundwater extraction is the sole process option for containment (hydraulic isolation). Because SWMU 3 originally was constructed as a surface impoundment, the contained wastes are above groundwater. Groundwater extraction would not improve protection of human health and the environment. Because of this, an evaluation of hydraulic isolation will not be performed.

6.3.3.2 Surface controls

Section 2.4.3 identifies soil covers and riprap as RPOs.

Because this alternative includes the existing RCRA Subtitle C cap and LUCs to ensure protectiveness, no additional surface controls are necessary. Surface controls are evaluated for use in the event DOE transfers the property.

Effectiveness. Riprap is differentiated from soil covers in that the riprap can be sized large enough (e.g., boulders) so as not to be man-portable and, therefore, cannot be removed readily without the use of heavy equipment. Riprap may be left uncovered to provide a striking contrast to the surrounding area as a warning, or it may be covered with a vegetative cover.

Assuming surface controls would be placed over a RCRA Subtitle C cap to provide long-term protection after DOE transfers the property, riprap (with or without a vegetative cover) would increase the thickness of the cap. Riprap could be used to protect the RCRA Subtitle C cap and prevent biointrusion into the buried waste.

Implementability. Both soil and riprap are readily available in the local market, and placement of each is readily implementable. Riprap would need to be placed on a bedding material (smaller aggregate) to slow infiltration to avoid eroding the existing soil. There is little difference in the long-term implementability between covers (vegetative) and riprap (exposed). A soil cover would need mowing to maintain the vegetative cover while the exposed riprap would need periodic weeding to inhibit plant ingrown.

Cost. Riprap is a somewhat more expensive product to install initially, but it is not prohibitively expensive as compared to soil cover. It is estimated that maintenance costs are equal.

Based on the evaluation factors of effectiveness, implementability, and cost, and in consideration that Alternative 3 leaves a large mass of uranium PTW in place (an estimated 3,200 tons), riprap will be the RPO for the surface controls for SWMU 3-specific alternatives developed from General Alternative 3. Compared to a soil cover, a riprap barrier is more effective when placed over the RCRA Subtitle C cap, but the riprap barrier would be more expensive than a soil cover.

6.3.3.3 Land use controls

Consistent with Section 2.4.1, LUCs will be implemented at BGOU SWMUs where waste is left in place or source area-related contamination at concentrations above RGs remains after active remediation that precludes UU/UE conditions.

Section 2.4.1.1 identifies the following LUCs to be evaluated on SWMU-specific and alternative-specific bases. This evaluation for SWMU 3, Alternative 3 is as follows.

Warning Signs. Warning signs provide a highly effective means to warn of the hazards of potential contaminant exposure. An initial sign installation is highly implementable; however, a drawback to signs is that they can be removed or defaced by vandals. This drawback negatively affects both the effectiveness and implementability of signs, but can be mitigated by constructing signs of vandal-resistant materials and that can be affixed to supporting structures in a manner that makes them not readily removable by vandals. Overall, warning signs are viewed as having high effectiveness, and high implementability at a low cost.

Fences. Fences can be an effective LUC to prevent access or intrusion and also are highly implementable as a first installation; however, as with signs, fences require significant long-term maintenance at a significant cost in order to ensure adequate long-term effectiveness. Fences also can be defaced easily by an intruder with common hand tools. While the pairing of fences and warning sign does offer a minimal increase in effectiveness, it does not offset the increased cost due to long-term maintenance that a fence requires.

Because this alternative includes a RCRA Subtitle C cap and LUCs, the addition of fences is unnecessary. For these reasons, fences will not be incorporated as a LUC in Alternative 3 at SWMU 3.

E/PP Program. The E/PP Program is a LUC administered by DOE's contractors at PGDP. It is an effective LUC for controlling potential personnel hazards related to trenching, excavation, and penetration greater than 6 inches into the earth, concrete, or pavement, or walls, floors, and ceilings of buildings. This program will be maintained for as long as DOE or its contractor maintain an on-site presence at the PGDP. The E/PP Program has proved to be highly implementable and at a low cost.

Property Record Notice, Deed and/or Lease Restrictions, and Environmental Covenant. These administrative controls are described in Section 2.4.1.1, and all are effective means of ensuring protection under the reasonably anticipated industrial future land use. These proprietary controls help ensure the land use remains industrial. Additionally, any land use change would be identified through the five-year review process, per CERCLA 121(c), and DOE would be required to take appropriate measures to ensure the continued protection of human health and the environment under the changed land use. These administrative LUCs are highly implementable and at a low cost.

Alternative 3 at SWMU 3, which leaves waste in place, will include the following LUCs, as described in Section 2.4.1.1. Specific implementation details would be defined further in the LUCIP.

- Warning signs
- E/PP Program
- Property record notices
- Deed and/or lease restrictions (contingent upon transfer)
- Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer
- CERCLA 120(h)

These administrative and physical controls together provide enhanced protection and afford a layered strategy that provides protection in different ways. Fences are not included as a LUC for this alternative at SWMU 3 because they offer limited additional effectiveness at increased cost.

6.3.3.4 Monitoring

Conventional sampling and analysis of MWs is the identified RPO for the monitoring technology. This process option is an effective means of monitoring that assures protection of human health and the environment is maintained by the remedy.

The following paragraphs identify the objectives, schedules, reporting requirements, sampling strategies, and technologies for the groundwater monitoring program to ensure remedy effectiveness (DOE 1998c).

Objective. The objective of groundwater monitoring would be to detect and characterize any releases of hazardous constituents from the SWMU that may impact the uppermost aquifer adversely. This is sometimes referred to as detection monitoring. Samples would be collected periodically from the MWs and analyzed for specific indicator parameters and any other waste constituents or reaction products that could indicate a release might have occurred.

Monitoring Schedule/Frequency. Semiannual monitoring would occur during the first five years of remedy implementation. After the first five years, monitoring frequency could be reduced to annually, provided no indication of potential adverse environmental impacts to groundwater were detected.

Reporting Requirements. Results of SWMU 3 groundwater monitoring will be reported twice annually in the FFA Semiannual Report. These results will be evaluated for the triggers described below every five years in the CERCLA Five-Year Review.

Sampling Strategy—Monitoring Locations. One upgradient RGA MW and three downgradient RGA MWs would be sufficient to monitor for releases. The cost estimates assume construction of four new monitoring wells.

Sampling Strategy—Analytical Parameters. At a minimum, SWMU 3 MWs would be monitored for the COCs for the protection of groundwater determined in the FS. These contaminants are listed in Table 6.1 of this FS. Nationally recognized methods, where applicable (e.g., SW-846, ASTM), would be used to analyze the groundwater samples.

Sampling Strategy—Monitoring Triggers. The following triggers may be used to determine whether adverse environmental impacts to groundwater associated with this SWMU have occurred.

- A statistically significant trend of any of the COCs or a significant change to other monitored parameters (e.g., pH, dissolved oxygen) within an individual MW.

- An increase in downgradient MW results above upgradient MW results (e.g., a statistically significant increase in the downgradient levels of any of the monitored constituents when compared to the upgradient levels).

Technologies. Standard technologies would be used to collect the groundwater samples and transport them to a suitable laboratory. As previously stated, nationally recognized methods would be used to analyze the groundwater samples.

6.3.3.5 Summary of SWMU-specific alternative

Table 6.3 identifies and summarizes the features that will be included for Alternative 3 at SWMU 3.

Table 6.3. SWMU 3, Alternative 3 Components

General Response Action	Technologies	RPOs*
Containment	Caps	RCRA Subtitle C cap
Surface Controls	Surface Barriers	Riprap
Monitoring	Groundwater Monitoring	Conventional groundwater monitoring
LUCs	Physical Controls	Warning signs
	Administrative Controls	• E/PP Program • Property record notices • Deed and/or lease restrictions (contingent upon transfer) • CERCLA 120(h) • Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer

* Note: Alternative 3 also will include RDSI and Engineering Study to address uncertainties.

Alternative 3 satisfies the first RAO and contains waste in place. Risk to groundwater also is mitigated through containment.

- The RCRA Subtitle C cap and clay bottom liner (i.e., well-tamped clay floor that served as the floor of the former surface impoundment) are present to isolate the waste, above the water table. Because the amount of leachate or its origin cannot be verified with existing information (e.g., if and how much groundwater is in the leachate), the efficacy of the RCRA Subtitle C cap and clay bottom liner (i.e., well-tamped clay floor that served as the floor of the former surface impoundment) cannot be calculated with certainty. As described in Section 6.3.3, there are uncertainties associated with (1) possible radiological contamination of the surface soil on/in the existing RCRA Subtitle C cap, (2) the integrity of the existing Subtitle C cap, (3) the integrity of the clay bottom liner (i.e., the well-tamped clay floor that served as the floor of the former surface impoundment), and (4) the integrity of the concrete leachate collection sump/pit. An RDSI will be conducted to assess the uncertainties, and an Engineering Study will be conducted to ensure the uncertainties are addressed properly.

- RGA groundwater MWs would monitor remedy effectiveness.

Alternative 3 satisfies the second RAO. The potential for direct contact would be mitigated through layered controls.

- The RCRA Subtitle C cap forms a barrier to prevent infiltration, and it also mitigates intrusion. As described in Section 6.3.3, there are uncertainties associated with (1) possible radiological contamination of the surface soil on/in the existing RCRA Subtitle C cap, and (2) the integrity of the existing Subtitle C cap. An RDSI will be conducted to assess the uncertainties, and an Engineering Study will be conducted to determine whether interim measures need to be implemented for the cap to support the riprap and to ensure the uncertainties are addressed properly. If it is determined that the SWMU 3 cap is radiologically contaminated and has caused surficial/shallow radiological contamination beyond the SWMU 3 administrative boundary, then this contamination will be addressed by Alternative 3.

- Physical LUCs would provide warning at the site, and administrative LUCs would provide warning and mitigate potential exposure.

- Riprap would be placed over the RCRA Subtitle C cap.

Regarding the third RAO, Alternative 3 does not include treatment or removal of PTW.

Additional details used for cost estimating purposes are presented in Table 6.4 and Appendix E.

Table 6.4. SWMU 3, Alternative 3 Key Cost Drivers and Key Assumptions

CAPITAL COSTS	
Riprap Placement • Place geotextile • Place 6-inch layer of bedding material • Place 2-ft thick layer of 18-inch to 2-ft nominal graded stone	
Quantity Summary	
Item	**Quantity**
Total SWMU area	126,758 ft^2
Assumed riprap area	135,000 ft^2
Geotextile (riprap area × 10% waste)	148,500 ft^2
Bedding material [(riprap area × .5 ft)/27 × 1.5 ton/yd^3 × 1.10% for waste]	4,125 tons
Riprap [(Riprap area × 2 ft)/27 × 1.5 ton/yd^3 × 1.10% for waste]	16,500 tons
ANNUAL COSTS	
Operation and Maintenance	
Maintenance Item	**Assumed Frequency**
Inspection	Quarterly for estimate duration
Remove weeds and inspect riprap cover	Semiannually for estimate durations
Leachate collection	Years 1–50: Assumes average of 1,000 gal per year disposed of off-site at a commercial vendor Remainder of estimating period: Assume annual collection or 300 gal per year disposed of off-site at a commercial vendor
Replace leachate collection vaults	Every 100 years for estimate duration
Groundwater Monitoring • Monitor 6 wells • Sample semiannually for first five years • Sample annually following initial five year	
Five-Year Review	

The riprap and bedding layer would extend slightly past the existing toe of slope and would cover surface contamination near the compliance wells.

6.3.4 Alternative 5—Excavation, Disposal, Treatment, and LUCs

General Alternative 5 assembles RPOs primarily from the removal, treatment, and disposal GRAs. *Ex situ* treatment also is evaluated to treat wastes (as needed) on- site or off-site in accordance with ARARs prior to disposal should they not meet the disposal facility's WAC. Finally, LUCs are evaluated and would be implemented if excavation and *in situ* treatment do not result in UU/UE conditions.

Uncertainties. If it is determined that the SWMU 3 cap is radiologically contaminated and has caused surficial/shallow radiological contamination beyond the SWMU 3 administrative boundary, then this contamination will be addressed by Alternative 5.

6.3.4.1 Removal

The use of conventional excavation equipment, such as backhoes and trackhoes, is the RPO for the removal GRA at SWMU 3. This equipment is effective, implementable, and cost-effective for application at SWMU 3.

6.3.4.2 Postexcavation *in situ* treatment

The C-404 Landfill was an abovegrade structure. There is no known burial of liquid organic chemicals in the C-404 Landfill, and the historical disposal records do not support the presence of mobile COCs. As described in Section 6.1.1, metals, TCE, Tc-99, and U-238 have been detected in nearby UCRS groundwater. The CSM of SWMU 3 supports that RGs can be met through removal of SWMU 3 wastes and impacted soil. Therefore, treatment technologies and process options are not evaluated for SWMU 3.

6.3.4.3 Disposal

Both on-site and off-site disposal of excavated waste and contaminated soils were identified as RPOs for the subsurface vertical barriers technology. Additionally, the existing C-746-U Landfill was identified as a RPO for nonhazardous wastes that meet the C-746-U Landfill WAC (including authorized limits).

Use of the C-746-U Landfill is an effective location for disposal of nonhazardous wastes that meet the WAC, and its use should be evaluated in a disposal discussion. Additionally, both off-site and on-site disposal can be equally effective disposal means for the wastes generated through an excavation alternative.

The off-site waste disposal currently is implementable. Based on process knowledge of SWMU 3 wastes and industry practices for disposal of such wastes, it is assumed that all SWMU 3-generated wastes would meet the WAC of either a commercial landfill or a federally owned facility, such as NNSS. The on-site disposal process option only would be implementable if an on-site facility is available at the time of excavation. Regarding cost, disposing of wastes on-site would be significantly cheaper than off-site disposal.

Excavated soils/wastes may be treated on-site or off-site at a commercial facility as needed to meet the WAC of the disposal facility. On-site treatment would be done in containers, tanks, temporary units, and/or CAMUs in accordance with ARARs. Treatment of hazardous waste is necessary to meet LDR treatment standards or alternatively CAMU treatment standards, if sent to a designated CAMU.

Based on the evaluation factors of effectiveness, implementability, and cost, this FS will carry both the off-site and on-site disposal process options forward with the assumption that both process options would be paired with using the C-746-U Landfill. It is recognized that disposal at an on-site cell only would be implementable should one be constructed.

6.3.4.4 Land use controls

Consistent with Section 2.4.1, LUCs will be implemented at BGOU SWMUs where waste is left in place or source area-related contamination remains after active remediation that precludes unrestricted use. LUCs may be necessary at SWMU 3 if postexcavation treatment does not allow for UU/UE use.

Section 2.4.1.1 identifies the following LUCs to be evaluated on SWMU-specific and alternative-specific bases. This evaluation for SWMU 3, Alternative 5 is as follows.

Warning Signs. Warning signs provide a highly effective means to warn of the hazards of potential contaminant exposure. Additionally, the long-term effectiveness of warning signs can be improved by constructing signs of vandal-resistant materials and can be affixed to supporting structures in a manner that makes them not readily removable by vandals.

Fences. Because this alternative includes removal of the buried wastes and LUCs (if UU/UE is not achieved), the addition of fences is unnecessary. Fences will not be incorporated as a LUC in Alternative 5 at SWMU 3.

E/PP Program. The E/PP Program is a LUC administered by DOE's contractors at PGDP. It is an effective LUC for controlling potential personnel hazards related to trenching, excavation, and penetration greater than 6 inches into the earth, concrete, or pavement, or walls, floors, and ceilings of buildings. This program will be maintained for as long as DOE or its contractor maintain an on-site presence at the PGDP. The E/PP Program has proved to be highly implementable and at a low cost.

Property Record Notice, Deed and/or Lease Restrictions, and Environmental Covenant. These administrative controls are described in Section 2.4.1.1, and all are effective means of ensuring protection under the reasonably anticipated industrial future land use. These proprietary controls help ensure the land use remains industrial. Additionally, should that land use change, the change would be identified through the five-year review process, per CERCLA 121(c), and DOE would be required to take appropriate measures to ensure the continued protection of human health and the environment under the changed land use.

LUCs Summary. Alternative 5 at SWMU 3, which removes the source term but does not meet UU/UE conditions, will include the following LUCs as described in Section 2.4.1.1; the E/PP Program and a property record notice would not be necessary as the waste will be removed. Specific implementation details would be defined further in the LUCIP.

- Deed and/or lease restrictions (contingent upon transfer)

- Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer

- CERCLA 120(h)

These administrative controls afford a layered strategy that provides protection in different ways. Together administrative controls provide enhanced protection of potential receptors. Given that the excavation will remove waste and contaminated soil exceeding PRGs, physical controls will not be required.

6.3.4.5 Summary of SWMU-specific alternative

Based upon the evaluation of process options for effectiveness, implementability, and cost specific to SWMU 3, the following SWMU-specific alternative has been assembled and will be brought forward for detailed analysis at SWMU 3. No further screening of alternatives is necessary because the alternative screening was performed following the assembly of General Alternatives in Section 3.

- Excavation, disposal, treatment (as needed), and LUCs

Table 6.5 identifies the key features of the SWMU-specific alternative excavation and disposal, treatment, and LUCs.

Table 6.5. Alternative 5 Excavation, Disposal, Treatment, and LUCs

General Response Action	Technologies	Process Options
Removal	Excavators	Backhoes/trackhoes
Disposal	Landfill Disposal	Disposal based on waste stream-specific conditions. Excavated soils/wastes may be treated on-site or off-site at a commercial facility as needed to meet the WAC of the disposal facility.
LUCs	Administrative Controls	• E/PP Program • Deed and/or lease restrictions (contingent upon transfer) • CERCLA 120(h) • Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer

While not specifically identified in this FS as a separate alternative, disposal costs also will be evaluated assuming that an OSWDF is available for use.

Alternative 5 satisfies the first RAO. The potential contamination of groundwater is mitigated through removal.

Alternative 5 satisfies the second RAO and mitigates the potential for direct contact with the waste through removal. LUCs will be used to mitigate any remaining direct contact risk should excavation not result in achieving UU/UE conditions. Alternative 5 also mitigates the potential for direct contact with the SWMU 3 abandoned underground transfer line with LUCs.

Alternative 5 satisfies the third RAO. Excavated wastes, including PTW, would be treated if necessary to meet WAC requirements prior to disposal.

Additional details used for cost estimating purposes are presented in Table 6.6 and Appendix E. Appendix E includes detailed assumptions regarding the volume and treatment and disposition pathways for all excavation driven wastes associated with this alternative.

Table 6.6. SWMU 3, Alternative 5 Key Cost Drivers and Key Assumptions

CAPITAL COSTS
Shoring • No shoring necessary
Excavation • Dewatering — Mobilize two frac tanks and temporary water treatment plant — Groundwater not anticipated, but collection and treatment of rainwater anticipated • Excavation — Original pond bottom was at elevation 373 ft — Volumes estimated using geographic information system (GIS) — All soil above original pond bottom elevation will be removed — Assume RGs reached by excavating 4 ft below original pond grade — Historical records indicate one radioactive source that is assumed to have been disposed of in a concrete filled drum per historical plant procedure.
Treatment, Transportation, and Disposal Summary • Gold dissolver precipitate waste (645 55-gal drums) and surrounding soil will require treatment • A total of 2,000 bcy will require treatment • Treatment performed off-site prior to disposal
Transportation and Disposal Volumes (assuming OSWDF not available)

Item	Assumptions and Volume Calculation	*In Situ* Volume	Disposal Pathway	Resulting Treatment and/or Disposal Volume
Total Excavation Volume	Soil volume calculated via GIS above elevation 373 ft Soil volume of 4 ft excavation at the 373 ft contour line Total *in situ* volume:	48,437 bcy 8,089 bcy 56,526 bcy	See component volumes below	See component volumes below
Cap Volume	Volume of existing Subtitle C cap Assume 20% swell factor	23,734 bcy	C-764-U Landfill via dump truck (1,899 loads)	28,481 lcy
Waste and Soil in Original Impoundment Requiring Treatment	Assumes 2,000 bcy of drums and impacted soils requiring stabilization prior to disposal Disposal volume = 2,000 bcy × 1.2 swell factor = 2,400 yd^3 Energy*Solutions* without stabilization)	2,000 bcy of drums and impacted soils	Transport to Energy*Solutions* in Super Sacks® via rail for stabilization and disposal	2,400 yd^3

Table 6.6. SWMU 3, Alternative 5 Key Cost Drivers and Key Assumptions (Continued)

Transportation and Disposal Volumes (assuming OSWDF not available) (Continued)				
Item	**Assumptions and Volume Calculation**	***In Situ* Volume**	**Disposal Pathway**	**Resulting Treatment and/or Disposal Volume**
Waste, Cover Material, and Dike Materials in the Original Diked Area	Total abovegrade volume—cap volume—waste for stabilization volume = 22,703 bcy Assume 20% swell factor	22,703 bcy	Transport to Energy*Solutions* in Super Sacks® via rail	27,244 yd^3
Source	Disposal records indicate one source disposed of at C-404. It is assumed that disposal procedures were followed that the source was encased in concrete in a drum.	1/3 bcy	Via truck to NNSS	1 B-25 box
Below grade Contaminated Soils	Soil volume of 4 ft excavation at the 373 ft contour line Assume 20% swell factor	8,089 bcy	Transport to Energy*Solutions* in Super Sacks® via rail	9,707 lcy
Transportation and Disposal Volumes (assuming OSWDF available)				
Total Excavation Volume	Soil volume calculated via GIS above elevation 373 ft Soil volume of 4 ft excavation at the 373 ft contour line Total *in situ* volume:	48,437 bcy 8,089 bcy 56,526 bcy	See component volumes below	See component volumes below
Cap Volume	Volume of existing Subtitle C cap Assume swell 20% swell factor	23,734	C-764-U Landfill via dump truck (1,899 loads)	28,481 lcy
Waste and Soil in Original Diked Area Requiring Treatment	Assumes 2,000 bcy of drums and impacted soils requiring stabilization prior to disposal, and that stabilization would result in double the loose volume Disposal volume = 2,000 bcy × 1.2 swell factor × 2 = 4,800 yd3 The remainder of the material (6,234 bcy can be disposed of at OSWDF)	2,000 bcy of drums and impacted soils	Transport to EnergySolutions in Super Sacks® via rail for stabilization and disposal	4,800 yd^3 stabilized waste

Table 6.6. SWMU 3, Alternative 5 Key Cost Drivers and Key Assumptions (Continued)

Transportation and Disposal Volumes (assuming OSWDF available) (Continued)				
Item	**Assumptions and Volume Calculation**	***In Situ* Volume**	**Disposal Pathway**	**Resulting Treatment and/or Disposal Volume**
Waste, Cover Material, and Dike Materials in the Original Diked Area for Direct Disposal	Total abovegrade volume—cap volume—waste for stabilization volume = 22,703 bcy Assume 20% swell factor	22,703 bcy	Disposal at WDF via roll-off	27,244 yd^3
Source	Disposal records indicate one source disposed of at C-404. It is assumed that disposal procedures were followed that the source was encased in concrete in a drum	1/3 bcy	Via truck to NNSS	1 B-25 box
Below grade Contaminated Soils	Soil volume of 4 ft excavation at the 373-ft contour line Assume swell 20% swell factor	8,089 bcy	Disposal at WDF via dump truck	9,707 lcy
Backfill • Assumes off-site commercial backfill source imported, placed, and compacted				
ANNUAL COSTS				
Five-Year Review				

Table 6.7 identifies the key features of each SWMU 3-specific alternative that will undergo detailed analysis.

6.4 DETAILED ANALYSIS OF ALTERNATIVES

In this section, each of the SWMU-specific alternatives are analyzed against the nine evaluation criteria. Of the criteria, Overall Protection of Human Health and Environment and Compliance with ARARs are threshold criteria and the remaining seven criteria are balancing criteria.

Table 6.7. SWMU 3 Specific Alternative Key Features

Alternative	Name	Key features
1	No Action	No action
3	Containment, Surface Controls, LUCs, and Monitoring	• RCRA Subtitle C cap (Existing) • Riprap • Monitoring • LUCs • RDSI and Engineering Study to address uncertainties
5	Excavation and Disposal, Treatment, and LUCs	• Excavation of buried waste materials and affected soils • Post remediation sampling and analysis • WAC sampling and analysis • *Ex situ* waste treatment (as needed) to meet WAC requirements • Waste disposal* • Backfill excavation • LUCs

*While not identified as separate alternatives, Alternative 5 will develop cost estimates and evaluate the impacts of an OSWDF being available for use at PGDP.

6.4.1 Alternative 1—No Action

The No Action alternative is defined in accordance with CERCLA and provides a baseline to which other alternatives can be compared. A Subtitle C cap and clay bottom liner (i.e., well-tamped clay floor that served as the floor of the former surface impoundment) are in place at SWMU 3, which is a closed unit under the jurisdiction of the KY RCRA program. Note that there are uncertainties associated with the leachate pit (see Section 1.5.7). Under this alternative, SWMU 3 will continue to be monitored and managed in accordance with the requirements of the RCRA permit. A summary of the current postclosure care requirements of the RCRA permit are summarized in Appendix G.

Alternative 1 acknowledges the existence of a Subtitle C cap at SWMU 3 and current permit conditions.

6.4.1.1 Overall protection of human health and the environment

This alternative is not protective of human health and the environment because this alternative has no element that would extend controls or containment as long as waste is in place. Waste (including PTW) is not treated or removed at SWMU 3, but a cover is in place to control access to the waste and soils in close proximity to the waste. No additional controls would be implemented to protect site workers or the public. This alternative includes no elements to extend controls beyond the RCRA-designated period or the DOE-control period.

No ecological impacts at the BGOU are anticipated under this alternative (or any other alternative at SWMU 3). The BGOU is located at an active operational facility already disturbed by construction and operational activities and does not support any unique or significant ecological resources. No known archaeological or historical sites or T&E species would be impacted by this alternative.

6.4.1.2 Compliance with ARARs

There are no actions for Alternative 1; thus, there are no action-specific ARARs.

6.4.1.3 Long-term effectiveness and permanence

Existing site controls are present to prevent exposure to the waste and underlying groundwater. The potential for leaching of contaminants to the RGA currently is reduced or prevented by the existing Subtitle C cap and clay bottom liner (i.e., well-tamped clay floor that served as the floor of the former surface impoundment). Note that there are uncertainties associated with the leachate pit (see Section 1.5.7). This alternative does not provide any long-term controls to manage residual risk at this SWMU; thus, it has low long-term effectiveness and permanence.

6.4.1.3.1 Reduction of toxicity, mobility, or volume through treatment

This alternative does reduce toxicity, mobility, or volume through treatment to a small degree associated with leachate that currently is collected and treated. Note that there are uncertainties associated with the leachate pit (see Section 1.5.7).

6.4.1.3.2 Short-term effectiveness

No actions would be implemented under Alternative 1; therefore, no additional risks to workers, the public, or the environment would be incurred. The existing elements cause Alternative 1 to be effective in the short-term.

6.4.1.3.3 Implementability

The No Action alternative is implementable. If future monitoring in accordance with the post-closure permit indicates that additional remedial action is necessary, this alternative would not impede implementation of other remedial activities in the future.

The ongoing public awareness program would require regular coordination with the DOE, KY, and EPA.

6.4.1.3.4 Cost

The preliminary cost estimates for Alternative 1 serve as a baseline for comparison of the other remedial alternatives. These cost estimates are based upon FS-level scoping and are intended to aid with selection of a preferred alternative. There are no capital or O&M costs associated with Alternative 1; thus, the cost rating is high.

6.4.2 Alternative 3—Containment, Surface Controls, LUCs, and Monitoring

Alternative 3 prevents direct contact with waste and contaminated soil through the existing RCRA Subtitle C cap and LUCs. The existing cap mitigates vertical infiltration of water and promotes runoff. Riprap would be placed over the RCRA Subtitle C cap.

Uncertainties. As previously stated, there are uncertainties associated with (1) possible radiological contamination of the surface soil on/in the existing RCRA Subtitle C cap, (2) the integrity of the existing Subtitle C cap, (3) the integrity of the clay bottom liner (i.e., the well-tamped clay floor that served as the floor of the former surface impoundment), and (4) the integrity of the concrete leachate collection sump/pit (see Section 1.5.7, Table 1.13, Section 1.6.3.1, and Section 1.6.3.2).

In order to address these uncertainties, Alternative 3 will include a Remedial Design Site Investigation (RDSI) to evaluate each uncertainty. The RDSI activities will include a radiological survey and/or soil sampling to assess the cap contamination, an evaluation of performance data to determine the degree to which the cap may be leaking, additional groundwater elevation studies to determine if groundwater is intruding into the waste through the clay bottom liner, and a detailed evaluation of the sump/pit to determine if it is leaking.

An Engineering Evaluation will be conducted to determine whether interim measures need to be implemented for the cap to support the riprap. The Engineering Evaluation also will consider the RDSI data to determine if additional measures need to be implemented to address any/all of the uncertainties. Additional measures to address the uncertainties may include additional cover over the existing cap to address radiological contamination, additional liners over the existing cap to prevent rain water infiltration, slurry walls to prevent groundwater intrusion through the clay bottom liner, and/or lining or replacement of the sump/pit to prevent leakage.

If it is determined that the SWMU 3 cap is radiologically contaminated and has caused surficial/shallow radiological contamination beyond the SWMU 3 administrative boundary, then this contamination will be addressed by Alternative 3.

6.4.2.1 Overall protection of human health and the environment

This alternative is protective of human health and the environment through a combination of containment and LUCs. The waste is reliably contained and leachate is collected and treated. Note that there are uncertainties associated with the leachate pit (see Section 1.5.7). The existing Subtitle C cap augmented with riprap, and LUCs prevent direct contact with the waste.

6.4.2.2 Compliance with ARARs

Alternative 3 would meet this threshold criterion for SWMU 3.

Action-specific ARARs for this alternative are summarized in Appendix F.

No chemical-specific ARARs have been identified.

A wetlands assessment would be performed prior to remedy implementation. Although it is not anticipated, if an action should involve discharge of dredge or fill material into waters of the United States, including jurisdictional wetlands, potential location-specific ARARs are summarized in Appendix F.

6.4.2.3 Long-term effectiveness and permanence

Alternative 3 would be moderately effective regarding long-term effectiveness and permanence. It would mitigate the uncertainty of contact with surface soil and prevent exposure to waste and subsurface contamination at concentrations above RGs. It minimizes the contribution of contaminants to the RGA; however, waste and associated risk would remain at the unit. LUCs would protect current and future receptors (Section 2.4.1.1).

The degree of long-term effectiveness and permanence is dependent upon maintenance of the existing Subtitle C cap, O&M of the leachate pit, and groundwater monitoring.

Magnitude of Residual Risk. This alternative effectively manages direct contact risk by extending the depth from the surface to the buried waste. Signs and the multilayer cap also inform the intruder of the potential dangers associated with direct contact to the waste and contaminated soil.

This remedy includes groundwater monitoring, which will monitor remedy effectiveness at preventing COC migration to the RGA.

Need for Five-Year Review. Because this remedy will not result in UU/UE conditions, five-year reviews will be required to ensure that the remedy remains protective.

Adequacy and Reliability of Controls. The physical and administrative controls listed in this remedy are adequate to meet threshold criteria. The physical controls to protect from direct contact require a low degree of maintenance to maintain adequacy.

6.4.2.4 Reduction of toxicity, mobility, or volume through treatment

Alternative 3 includes very minimal treatment to reduce mobility, toxicity, or volume through treatment. Treatment only is accomplished for COCs collected through the leachate collection system.

PTW. The PTW identified at SWMU 3 would remain in place untreated.

6.4.2.5 Short-term effectiveness

The short-term effectiveness of Alternative 3 is high because it largely leaves waste undisturbed.

Protection of Community during Remedial Actions. Implementation of Alternative 3 has low potential for impact to the community during remedial action.

Protection of Workers during Remedial Actions. Implementation of Alternative 3 has low potential for remediation worker exposure. Exposure to contaminated surface soils, subsurface soils, and groundwater during environmental sampling also is low. Potential exposure pathways include inhalation of dust containing surficial soils, dermal contact with surficial and subsurface soils, exposure to external penetrating radiation associated with buried waste, and dermal contact with contaminated groundwater.

Environmental Impacts. No ecological impacts at the BGOU are anticipated under this alternative. The BGOU is located at an active operational facility already disturbed by construction and operational activities and does not support any unique or significant ecological resources. No known archaeological or historical sites or T&E species would be impacted by this alternative. Risk assessment and mitigation of potential risks for ecological receptors in nearby drainage ditches are within the scope of the Surface Water OU.

6.4.2.6 Implementability

Implementation of the remedial action components of Alternative 3 is technically feasible, and the alternative consists of demonstrated technologies, standard construction methods, materials, and equipment that are available from vendors and contractors.

Ability to Construct and Operate Technology. All construction components of Alternative 3 are highly implementable consisting of demonstrated technologies and standard construction methods, materials, and equipment. Therefore, this alternative is highly implementable in the short-term.

Reliability of Technology. All of the technologies employed in Alternative 3 are highly reliable.

Ease of Undertaking Additional Remediation. The addition of riprap (to the existing cap) could impede additional remediation should it be undertaken (e.g., would increase the cost of a future excavation), but it would not prevent additional remediation.

Monitoring Considerations. As indicated in Chapter 3, SWMU 3 is located over a contaminant plume (i.e., the PGDP Northwest Plume), so there would be impediments to the evaluation of groundwater monitoring data. Statistical evaluations and trending would be used to identify any groundwater impacts that may be attributable to SWMU 3.

Coordination with Other Agencies. The means and methods for coordinating with other agencies are established in the PGDP FFA. This remedy would not require involvement of new agencies.

Availability of Equipment and Specialists. All equipment and specialists are readily available.

6.4.2.7 Cost

Consistent with EPA guidance (EPA 2000), the cost estimates in this FS consist of a 1,000-year period due to the nature of the contaminants, including long-lived radionuclides. Net present value/worth cost estimates are presented for the individual and comparative analysis of alternatives and for remedy selection (EPA 1988). The real discount rate has been obtained from OMB guidance (reference Appendix C in OMB circular A-94). In addition, nondiscounted cost estimates (i.e., capital and average annual O&M) are presented for comparison purposes only.

Net Present Worth Cost	$15,257,000
Nondiscounted Cost	
• Capital Cost	$5,995,000
• Average Annual O&M Cost	$92,090

6.4.3 Alternative 5—Excavation, Disposal, Treatment, and LUCs

Alternative 5 anticipates waste disposal using existing pathways (commercial or federally owned).

Based on the original C-404 design drawings, the floor of the original impoundment was at elevation 373 ft. For estimating purposes, a 4 ft over-excavation is assumed. For estimating purposes, it is assumed that all soils above elevation 372 will be removed with a contingency included to remove one additional ft of soil (to elevation 371).

Excavation, treatment of excavated waste, and disposal of waste materials and affected soils for Alternative 5 is based on removal of the entire area of SWMU 3 (137 ft × 387 ft) to a depth of approximately 4 ft below pond bottom. This excavation will generate approximately 28,000 yd^3 (loose) of contaminated waste materials. The LLW/MLLW (20,000 yd^3) may be treated on-site, in accordance with ARARs, or off-site, then disposed of off-site at a licensed commercial or federal facility, or a potential OSWDF, if available. The remaining soil volume would be disposed of at C-746-U Landfill (7,000 yd^3) on-site at PGDP. If it is determined that the SWMU 3 cap is radiologically contaminated and has caused surficial/shallow radiological contamination beyond the SWMU 3 administrative boundary, then this contamination will be addressed by Alternative 5.

Additional assumptions for excavation, transportation, disposal, treatment, excavation dewatering, etc., for SWMU 3 can be found in Appendix E. Excavation would remove waste materials and affected soils to comply with RGs. This alternative provides the best long-term protection and also best addresses uncertainties associated with wastes disposed of within SWMU 3.

Any depression left as a result of excavation will be restored, as detailed in the RAWP, and will be consistent with future site use. This may include regrading the area to drain, backfilling to existing grades, or maintaining the depression as a detention basin or potential wetland area.

6.4.3.1 Overall protection of human health and the environment

Alternative 5 would meet this threshold criterion. Potential short-term risks to remediation workers due to direct contact with the waste material and affected soils and inhalation hazards are significantly greater than any of the other alternatives. In addition, potential risks to the public and the environment as a result of potential shipping and handling concerns are associated with off-site shipments. These concerns are reduced for disposal in a potential OSWDF.

Waste and contaminated soil will be removed from the SWMU, may be treated (as needed) on-site, in accordance with ARARs, or off-site, and will be disposed of in one or more appropriate disposal facilities, including a potential OSWDF, thus meeting RAOs for waste and associated soils in SWMU 3.

6.4.3.2 Compliance with ARARs

Alternative 5 would meet this threshold criterion for SWMU 3.

Action-specific ARARs for this alternative are summarized in Appendix F.

No chemical-specific ARARs have been identified.

A wetlands assessment would be performed prior to remedy implementation. Although it is not anticipated, if an action should involve discharge of dredge or fill material into waters of the United States, including jurisdictional wetlands, potential location-specific ARARs are summarized in Appendix F.

6.4.3.3 Long-term effectiveness and permanence

Excavation eliminates on-site contaminant migration because no wastes or associated contaminated soils would remain in the SWMU; therefore, this alternative offers a high degree of risk reduction, effectiveness, and permanence. Excavated materials will be treated to meet the WAC of the disposal facility.

Alternative 5 would eliminate unacceptable threats from direct contact with wastes, surface soils, or subsurface soils. Alternative 5 eliminates uncertainties associated with the source term.

Magnitude of Residual Risk. This alternative will remove waste and contaminated soil. If the remedy does not support UU/UE, a deed restriction contingent on property transfer that restricts residential use would be required.

Need for Five-Year Review. This remedy may not result in UU/UE conditions. If not, five-year reviews will be required to ensure that the remedy remains protective.

Adequacy and Reliability of Controls. The administrative LUCs listed in this remedy are adequate to meet threshold criteria. No physical controls are included in the alternative because waste and contaminated soil will be removed. Administrative controls will prevent unauthorized use.

6.4.3.4 Reduction of toxicity, mobility, or volume through treatment

Some reduction of toxicity, mobility, and/or volume will be achieved through postexcavation waste stabilization that will be required to meet the receiving facility's WAC requirements.

6.4.3.5 Short-term effectiveness

The RAOs for SWMU 3 would be achieved immediately following completion of excavation and disposal activities. Excavation and disposal would be accomplished in approximately two years.

Protection of Community during Remedial Actions. Short-term risks to the community resulting from excavation activities at the SWMU are expected only as they relate to transport of excavated materials to off-site disposal locations. This risk would be reduced greatly by disposing of waste in a potential OSWDF.

Protection of Workers during Remedial Actions. Short-term exposures of workers to COCs could occur during implementation of Alternative 5. Potential exposure pathways include direct contact with soil (ingestion, inhalation) and exposure to external penetrating radiation. Worker risks are not expected to exceed acceptable limits because exposure frequency and duration are less than those evaluated in the baseline risk assessment and will be subject to health and safety protocols. To protect workers, PPE, ambient conditions monitoring, and decontamination protocols would be used in accordance with an approved, site-specific HASP. Short-term effectiveness is moderate for Alternative 5.

Excavation and disposal would be conducted by trained personnel in accordance work planning documents to maintain a work environment that minimizes injury or exposure to risks to human health or the environment.

Environmental Impacts. No ecological impacts at the BGOU are anticipated under this alternative. The BGOU is located at an active operational facility already disturbed by construction and operational activities and does not support any unique or significant ecological resources. No known archaeological or historical sites or T&E species would be impacted by this alternative.

6.4.3.6 Implementability

Ability to Construct and Operate Technology. Alternative 5 is technically and administratively feasible and implementable. The equipment and technologies associated with implementation of this alternative have been proven to be feasible technically and are available from contractors or vendors. The implementability of construction-related activities during excavation at SWMU 3 subject to Alternative 5 is very similar to that carried out routinely at other sites, so it is considered high. Likewise, sampling, analysis, transportation, and disposal at an approved location are performed routinely and, if properly implemented, are proven to be safe. On-site treatment would be done in accordance with ARARs in containers, tanks, temporary units, and/or CAMUs. Treatment is assumed to be necessary to address principle hazardous constituents.

Reliability of Technology. All of the technologies employed in Alternative 5 are highly reliable.

Ease of Undertaking Additional Remediation. None of the technologies employed in Alternative 5 would impede additional remediation.

Monitoring Considerations. Monitoring during excavation will follow proven industrial hygiene and environmental monitoring practices. Monitoring of groundwater should not be necessary once the buried wastes and subsurface soils are removed.

Coordination with Other Agencies. The means and methods for coordinating with other agencies are established in the PGDP FFA. This remedy would not require involvement of new agencies.

Availability of Equipment and Specialists. All equipment and specialists are readily available.

6.4.3.7 Cost

Consistent with EPA guidance (EPA 2000), the cost estimates in this FS consist of a 1,000-year period due to the nature of the contaminants, including long-lived radionuclides. Net present value/worth cost estimates are presented for the individual and comparative analysis of alternatives and for remedy selection (EPA 1988). The real discount rate has been obtained from OMB guidance (reference Appendix C in OMB circular A-94). In addition, nondiscounted cost estimates (e.g., capital and average annual O&M) are presented for comparison purposes only.

The following costs are estimated for Alternative 5. The first set of costs assumes that an OSWDF will not be available for disposal of SWMU 3 wastes. The second set of costs assumes that an OSWDF would be available.

	Without OSWDF Available	With OSWDF Available
Net Present Worth Cost	$129,669,000	$42,084,000
Nondiscounted Cost		
• Capital Cost	$128,780,000	$41,195,000
• Average Annual O&M Cost	$10,000	$10,000

Disposal assumptions used to prepare cost estimates can be found in Appendix E.

6.5 COMPARATIVE ANALYSIS OF ALTERNATIVES

Table 6.8 summarizes the detailed analysis conducted in Section 6.4. Table 6.9 provides a comparative analysis for source area alternatives for SWMU 3.

Table 6.8. Summary of SWMU 3 Detailed Analysis

	Alternative 1	Alternative 3	Alternative 5
Criteria	**No Action**	**Containment, Surface Controls, LUCs, and Monitoring**	**Excavation, Disposal, Treatment, and LUCs**
Overall Protection of Human Health and the Environment	Does not meet the threshold criterion.	Meets the threshold criterion.	Meets the threshold criterion.
Compliance with ARARs	No ARARs identified.	Meets the threshold criterion.	Meets the threshold criterion.
• Action-Specific ARARs	None	Alternative can meet all ARARs.	Alternative can meet all ARARs.
• Chemical-Specific ARARs	None	None identified.	None identified.
• Location-Specific ARARs	None	Wetlands survey will be performed. If wetlands are found, then location-specific ARARs will be met.	Wetlands survey will be performed. If wetlands are found, then location-specific ARARs will be met.
Long-Term Effectiveness and Permanence			
• Magnitude of Residual Risk	No action is taken; therefore, no change in residual risk.	Residual risk remains and protectiveness relies on continuation of LUCs selected as part of the CERCLA remedy.	Risk is mitigated through excavation. Excavation may not result in UU/UE conditions in the main body of SWMU 3.
• Need for Five-Year Review	None	Five-Year Review needed.	Five-Year Review needed if excavation does not support UU/UE.
• Adequacy and Reliability of Controls	None	The physical controls to protect from direct contact require little to no maintenance to maintain adequacy. Relies on continuation of LUCs selected as part of the CERCLA remedy.	Relies on continuation of LUCs selected as part of the CERCLA remedy should UU/UE conditions not be met.
Reduction of Toxicity, Mobility, or Volume through Treatment	None	No treatment or removal of PTW.	Removed waste will be treated as needed to meet the receiving facilities' WAC requirements. Treatment below excavation targets mobile COCs that may have migrated from the unit. PTW will be removed.

Table 6.8. Summary of SWMU 3 Detailed Analysis (Continued)

	Alternative 1	Alternative 3	Alternative 5
Criteria	**No Action**	**Containment, Surface Controls, LUCs, and Monitoring**	**Excavation, Disposal, Treatment, and LUCs**
Short-Term Effectiveness			
• Protection of Community during Remedial Actions	None	No significant impact to the community.	No significant impact to the community.
• Protection of Workers during Remedial Actions	None	Risks to workers largely due to heavy equipment operations associated with MW installation. Risks can be mitigated through work control practices, such as training, administrative controls, physical controls, and PPE.	Risk to workers largely due to heavy equipment operations associated with excavation. This alternative does place workers in contact with waste and contaminated soil during excavation, *ex situ* treatment, and waste packaging. Risks can be mitigated through work control practices, such as training, administrative controls, physical controls, and PPE.
• Environmental Impacts	None	No significant environmental impacts.	No significant environmental impacts.
Implementability			
• Ability to Construct and Operate Technology	N/A	All construction means and methods are proven technologies. Monitoring will follow established PGDP practices.	All construction means and methods are proven technologies and are used routinely at other DOE sites as well as in private industry.
• Reliability of Technology	N/A	Technologies implemented are highly reliable and in common use.	Technologies implemented are highly reliable and in common use.
• Ease of Undertaking Additional Remediation	N/A	No features of this remedy would impede additional remediation, although riprap removal would add cost if a future removal were to be conducted.	No features of this remedy would impede additional remediation.
• Monitoring Considerations	N/A	SWMU 3 is located over the Northwest Plume, so there would be impediments to the evaluation of groundwater monitoring data.	Monitoring of groundwater should not be necessary once the buried wastes and subsurface soils are removed.
• Coordination with Other Agencies	Agency coordination will follow FFA. No new agencies involved.	Agency coordination will follow FFA. No new agencies involved.	Agency coordination will follow FFA. No new agencies involved.

Table 6.8. Summary of SWMU 3 Detailed Analysis (Continued)

	Alternative 1	Alternative 3	Alternative 5
Criteria	**No Action**	**Containment, Surface Controls, LUCs, and Monitoring**	**Excavation, Disposal, Treatment, and LUCs**
• Availability of Equipment and Specialists	N/A	All equipment and specialists are readily available.	All equipment and specialists are readily available.
Cost (without OSWDF available)			
• Net Present Worth Cost	$0	$15,257,000	$129,669,000
Nondiscounted Cost • Capital Cost • Average Annual O&M Cost	$0 $0	$5, 995,000 $92,090	$128,780,000 $10,000
Costs (with OSWDF available)			
• Net Present Worth Cost	$0	N/A	$42,084,000
Nondiscounted Cost • Capital Cost • Average Annual O&M Cost	$0	N/A	$41,195,000 $10,000

Table 6.9. SWMU 3 Comparative Analysis

Criteria	Analysis
Overall Protection of Human Health and the Environment	• The No Action alternative does not meet the overall protection criterion. • All action alternatives meet the overall protection criterion.
Compliance with ARARs	
• Action-Specific ARARs	• No ARARs are identified for the No Action alternative. • All action alternatives can meet ARARs.
• Chemical-Specific ARARs	• No chemical-specific ARARs are identified for any of the alternatives.
• Location-Specific ARARs	• Implementation of all alternatives will require that a wetlands survey be performed; if wetlands are found, then location-specific ARARs will be met.
Long-Term Effectiveness and Permanence	
• Magnitude of Residual Risk	• Alternative 5 provides the greatest degree of residual risk reduction by removing the buried wastes and contaminated soils that exceed RGs. • Alternative 3 provides less residual risk reduction (i.e., less than Alternative 5) by leaving the buried waste and contaminated soils in place and mitigating risks to groundwater and direct contact with the existing cap and adding a layer of riprap. • Cleanup will achieve RGs. If Alternative 5 does not support UU/UE, then a deed restriction would be implemented (contingent on property transfer) that restricts residential use. Alternative 3 will not support UU/UE; LUCs would be implemented to restrict certain uses to ensure the remedy remains protective, and groundwater monitoring would be conducted.
• Need for Five-Year Review	• Alternative 5 removes waste; therefore, five-year reviews will be required if the remedy does not support UU/UE. Alternative 3 contains waste in place and will not support UU/UE; therefore, five-year reviews would be necessary.
• Adequacy and Reliability of Controls	• Alternative 5 removes waste to meet RGs; if this alternative does not support UU/UE, then a deed restriction would be implemented (contingent on property transfer) that restricts residential use. • Alternative 3 leaves waste in place; therefore, it relies on LUCs to a greater degree than does Alternative 5.
Reduction of Toxicity, Mobility, or Volume through Treatment	• Alternative 5 may require that a portion of the excavated waste be treated if necessary to meet the receiving facility's WAC prior to disposal. Alternative 5 removes PTW from the site. • Alternative 3 would not reduce the toxicity, mobility or volume through treatment. Alternative 3 contains PTW in place.

Table 6.9. SWMU 3 Comparative Analysis (Continued)

Criteria	Analysis
Short-Term Effectiveness	
• Protection of Community during Remedial Actions	• None of the alternatives present significant impact to the community.
• Protection of Workers during Remedial Actions	• Alternative 3 leaves waste in place and does not place workers in contact with waste or contaminated soil. Protection of workers during implementation of this alternative would largely entail protection against the physical hazards largely associated with heavy equipment operations during cap construction. • Alternative 5 includes excavation of the buried wastes and contaminated soils. Protection of workers during implementation of this alternative is more complex because workers could be exposed during excavation and waste handling activities. These hazards can be mitigated through work control practices, such as engineering controls, physical controls, administrative controls, training, and PPE. Protection of workers during implementation of these alternatives also would entail protection against the physical hazards largely associated with heavy equipment operations.
• Environmental Impacts	• None of the alternatives presents significant environmental impacts.
Implementability	
• Ability to Construct and Operate Technology	• All construction means and methods are proven technologies and routinely used at other DOE sites as well as in private industry. The following process options have been implemented at PGDP: capping, monitoring, and LUCs.
• Reliability of Technology	• The evaluated technologies are highly reliable and in common use.
• Ease of Undertaking Additional Remediation	• Alternative 5 removes waste and contaminated soil, so any additional remediation activities would not be impacted. • Alternative 3 leaves buried waste and contaminated soil in place and includes construction of a cap, so any additional remediation activities may be impacted by the presence of the waste/contaminants and/or the cap.
• Monitoring Considerations	• Alternative 3 includes groundwater monitoring; there are no impediments to monitoring implementation; however, the difficulties and limitations of monitoring in commingled plume conditions that exist at SWMU 3 are recognized.
• Coordination with Other Agencies	• Agency coordination with EPA and KY will follow the FFA. No new agencies involved.
• Availability of Equipment and Specialists	• All equipment and specialists are available commercially.

Table 6.9. SWMU 3 Comparative Analysis (Continued)

Criteria	Analysis
Cost	The following analysis is based on the net present value costs (EPA 1988) for 1,000 years (EPA 2000). • The cost for Alternative 3 ($15M) is significantly less than the cost for Alternative 5 ($130M) without an OSWDF available. • The cost for Alternative 3 ($15M) is less than the cost for Alternative 5 ($42M) if an OSWDF is available. The capital cost for Alternative 3 is less than the capital cost for Alternative 5 (with or without an OSWDF available), but the average annual O&M cost for Alternative 5 is less than the average annual O&M cost for Alternative 3.

7. SWMU 7

Previous sections of this document present a framework that collects sitewide information and uses it to formulate a general approach to developing alternatives to address the COCs present in BGOU SWMUs 2, 3, 7 and 30. This framework also discusses key elements of the alternatives that are used as the basis for technology screening and development of SWMU-specific alternatives. This section (Section 7) of the document develops the candidate alternatives for SWMU 7 by expanding the general alternatives to address SWMU-specific conditions.

Section 7.1 presents SWMU-specific history and background including a discussion of COCs summarized in Section 1.6 of this report. Section 7.2 presents SWMU-specific RAOs that were developed from the general RAOs in Section 2.2.2. Section 7.3 refines the general alternatives that were developed in Section 3.4 into SWMU-specific alternatives; this includes a detailed screening of the RPOs from Section 3 for effectiveness, implementability, and cost to identify SWMU-specific RPOs and define each SWMU-specific remedial alternative. Section 7.4 presents the individual detailed analysis for each SWMU-specific alternative using the nine CERCLA criteria. Finally, Section 7.5 presents the comparative analysis of the SWMU-specific alternatives.

7.1 SWMU 7 HISTORY AND BACKGROUND

The C-747-A area is located in the northwest corner of the PGDP secured area. SWMU 7 comprises the eastern two-thirds of C-747-A. The SWMU is bounded on the north and south sides by perimeter ditches, on the west side by the C-747-A Burn Area (SWMU 30), and on the east side by the C-746-E Contaminated Scrap Yard. SWMU 7 covers approximately 240,900 ft^2 and includes six discrete burial pit areas described below and illustrated in Figure 7.1 (DOE 1998b).

- Pit B—This pit is approximately 60 ft by 172 ft. According to the Phase II SI geophysical survey, the actual excavation extends beyond the designated boundaries and may connect with the adjacent burial pit (Pit C). A geophysical survey conducted for the BGOU RI interprets B and C as separate pits.

- Pit C—This pit is approximately the same size as Pit B. Based on the Phase II geophysical survey, Pit C and Pit B may be one continuous pit; however, a geophysical survey conducted for this RI interprets B and C as separate pits.

- Pit D—This pit is approximately 15 ft by 99 ft.

- Pit E (outside the eastern boundary of SWMU 7 and within the C-746-E Contaminated Scrap Yard)—This pit is approximately 15 ft by 143 ft.

- Pits F1–F5—These pits are all small (average size of each pit is approximately 20 ft by 80 ft). Engineering drawings indicate a sixth “F” pit that was not labeled, but is included with the F pits.

- Pit G—This pit was determined to be approximately 27 ft by 122 ft.

Records indicate the burial cells, in general, were excavated to a depth of 6 ft to 7 ft bgs, filled with wastes, and covered with approximately 3 ft of earth (Union Carbide 1978); however, geophysical surveys during the Phase II SI indicated waste in pits to a depth of 8–15 ft (CH2M HILL 1992).

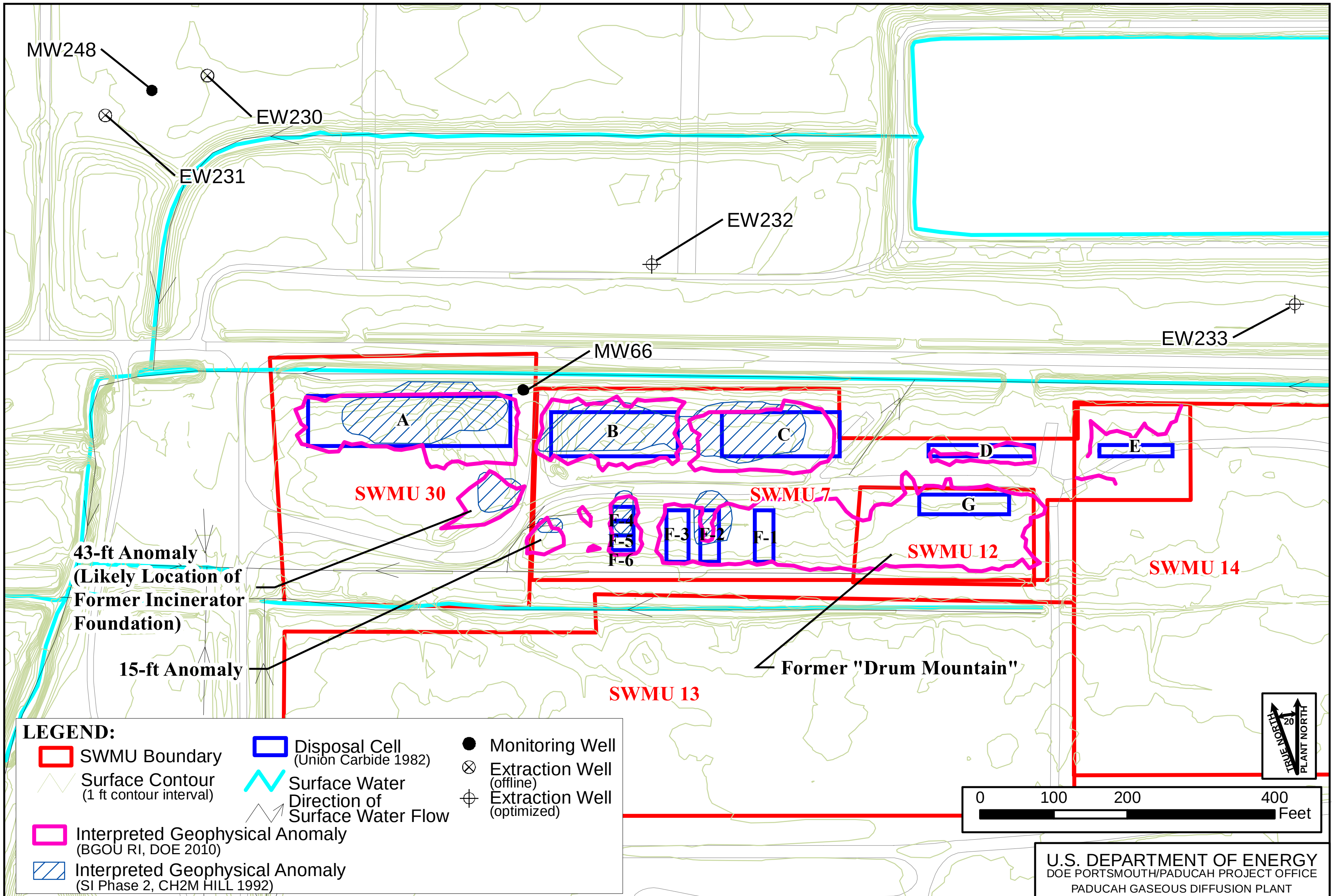

Figure 7.1. SWMUs 7 and 30 Historical Layout

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In addition to the burial cells, storage areas (SWMUs 12 and 14) were located within portions of SWMU 7 that were sampled as part of the Soils OU (DOE 2011c; DOE 2013b).

The C-747-A UF_4 Drum Yard (SWMU 12) was used between 1978 and 2000, for the storage of emptied, rinsed, and crushed drums that had contained UF_4. The stockpile of radiologically contaminated scrap drums, locally known as Drum Mountain, formerly was located on the southeast corner covering Pit G, which was reported to contain noncombustible, contaminated, and uncontaminated trash and equipment of the SWMU 7 burial grounds. SWMU 12 has been removed and has an NFA status. Interviews with a former operator who worked in the SWMU 7 area indicate Drum Mountain was created only after the area between the F Pits and Pit G had been filled with similar material. This interview was corroborated by geophysical evidence.

The C-746-E Contaminated Scrap Yard (SWMU 14) was used for the storage of uranium-contaminated scrap metal, including ferrous alloys, copper and copper alloys, nickel-plated steel, Monel®, and aluminum from the 1950s through 2005. A portion of SWMU 14 was located above Burial Pit E. The aboveground material from these storage yards has been removed. SWMU 14 was in the Soils OU RI and will be evaluated in the Soils OU FS. Samples collected in the area that covers both SWMU 7 and SWMU 14 as part of the Soils OU RI in 2010 are discussed in Sections 1.5 and 1.6 of this FS.

The additional surface and subsurface soil data collected within the boundaries of SWMU 7 as part of the Soils Operable Unit are incorporated into the decision process for this BGOU FS. The land surface slopes within SWMU 7. Burial Pits B and C form a slight hill on the north side of SWMU 7 and Burial Pit F forms a lesser mound on the south side of the SWMU. Pit D underlies a level area north of where Drum Mountain once was located. Shallow drainage swales occur on the west side of Burial Pit B, between Burial Pits C and D. The surface water that drains from SWMU 7 into the surrounding ditches ultimately is carried west through Outfall 001 into Bayou Creek. In 2002, a sedimentation basin was constructed to contain runoff from PGDP scrap yards. Runoff flows into the sedimentation basin and is released periodically into Outfall 001. The ground surface of the west half of the SWMU is covered by grassy vegetation, except where gravel roads extend through the site. A PGDP scrap metal project covered the west half of the SWMU, with 1 ft to 2 ft of gravel as a working base for truck and tractor traffic. This gravel also prevents exposure to soil contaminated from the historical use of the area to store scrap in the former Drum Mountain.

PGDP used the burial cells for disposal of wastes from 1957 to 1979. Burial Pits B, C, and G were used for disposal of noncombustible, contaminated and uncontaminated trash, material, and equipment. Contaminated concrete removed from the C-410 Feed Plant during May and June 1960 was placed in Burial Pits D and E. Burial Pit F was used for disposal of uranium-contaminated scrap metal and equipment. Empty uranium and magnesium powder drums also were reported to have been buried in Burial Pit F (Union Carbide 1978).

The following summarizes what is known about the disposed waste in the burial cells.

- Pit B—Buried material includes noncombustible trash and contaminated and noncombustible material and equipment (however, no specific disposal records exist).

- Pit C—Historical records indicate that both Pit B and C received the same material.

- Pit D—Documented buried material consists of uranium-contaminated concrete pieces of reactor tray bases from C-410 used during the fluorination process of UF_4 to UF_6.

- Pit E—Documented buried material consists of uranium-contaminated concrete pieces of reactor tray bases.

- Pits F1–F5—Documented buried material consists of uranium-contaminated scrap metal and equipment and empty uranium and magnesium powder drums (engineering drawings indicate there was a sixth "F" pit that was not numbered).

- Pit G—Documented buried material consists of noncombustible trash and contaminated and noncombustible material and equipment.

In addition to these burial cells, the Phase II SI geophysical investigation also identified another anomaly in the shape of a rough circular area (15-ft diameter) between SWMU 30 and SWMU 7, west of the F4 and F5 Pits. There is no information confirming the presence or the nature of any buried wastes associated with this anomaly. Note: A second circular geophysical anomaly located in SWMU 30, approximately 43 ft in diameter is interpreted to be the foundation and remnants of the incinerator (see Section 8.1). Angled boring 030-004 was identified in the BGOU RI Work Plan and installed and sampled as part of the BGOU RI to address the referenced anomaly (i.e., samples were collected beneath and adjacent to the anomaly). See BGOU RI Report, Figures 2.5 and 2.13. The TCE results for the five soil samples collected at this location all were less than the analytical reporting limit.

7.1.1 Nature and Extent of Contamination

This summary of nature and extent reflects the BGOU RI (DOE 2010b) and the Soils OU RI (DOE 2013b). Additional information can be found in Sections 1.5 and 1.6 of this report.

Sources of contamination at SWMU 7 are known to include uranium and various metals. TCE (including degradation products) present in UCRS as DNAPL and/or high concentration TCE residual soil contamination is identified as PTW. Excavation of test pits and analysis of drummed wastes at the TP-3 and TP-5 areas during the 1992 SI (CH2M HILL 1992) identified no PTW. Note: The test pit investigation was designed to evaluate whether the geophysical anomalies that indicated buried metal have buried wastes rather than the empty drums reported to have been disposed of.

Buried drums of waste were removed from a shallow test pit excavated in SWMU 7 during the Phase II Site Investigation in 1992 (CH2M HILL 1992). Analyses of samples of the drummed waste and surrounding soils collected from Test Pit 5 (TP-5) at depths of less than 5 ft indicated the following: (1) contaminants present in TP-5 samples also were detected in subsurface soil samples collected elsewhere in SWMU 7 and (2) elevated concentrations of U-235 and U-238 were detected in TP-5 samples, at similar concentrations to those detected in other SWMU 7 subsurface soil samples. Section 1.6.4 indicates TCE was not detected in the TP-5 samples. The data are consistent with the reported nature of the waste as empty drums. The nature and extent of the TP-3 and TP-5 contents is apparently similar to the waste and subsurface soil contamination found elsewhere in SWMU 7 and can be addressed using the same alternatives. These areas were not found to contain PTW.

Metals concentrations in subsurface soil samples of SWMU 7 rarely exceed background levels. Prior to the Soils OU RI, uranium metal had been detected above background levels only at three locations that characterize Burial Pits B and C that contained uranium-contaminated noncombustible trash. The Soils OU RI investigated the soils beneath the location of former SWMU 12, the former "Drum Mountain," and found uranium metal up to 4,325.1 mg/kg (DOE 2012). The extent of contamination is limited to shallow soil depths (5 to 10 ft bgs).

Two VOCs (vinyl chloride and 1,1-DCE) were identified as contaminants, though both were detected infrequently. U-238 is the most widely detected radionuclide contaminant above PGDP background levels in subsurface soils at SWMU 7, with most exceedances limited to depths less than 15 ft bgs. Arsenic was found at background concentrations in the BGOU data included in the RI; however, arsenic was detected at somewhat higher concentrations in selected samples collected for the Soils OU. Arsenic was retained as a COC for SWMU 7 based on results of elevated concentrations in samples.

The RI identified 14 metals in UCRS groundwater samples from SWMU 7 above screening levels. Arsenic, iron, and manganese were the most frequently detected metals. Organic contaminants in UCRS groundwater at SWMU 7 consisted of five VOCs. TCE and its reductive dechlorination products, *cis*-12-DCE and vinyl chloride, were the most frequently detected organic contaminants. (Ethene was not analyzed for at SWMU 7. It is uncertain if TCE is biodegrading to this final degradation product.) The radionuclide contaminants present in the SWMU 7 UCRS groundwater samples were Rn-222 and the uranium isotopes U-234 and U-238.

The analyses of groundwater samples from MW66 (an upper RGA well located between Burial Pits A and B of SWMUs 30 and 7, respectively) reveal abrupt rises or spikes of dissolved TCE that correlate to periods of higher hydraulic head (TCE spikes often exceed 10,000 μg/L). This spiking behavior suggests a UCRS DNAPL source that releases contaminant mass in response to seasonal variations (more mass being released during times of higher hydraulic head). If this potential DNAPL source extended deeper into the RGA, the TCE trend would not fluctuate as much as observed. The SWMUs 7 and 30 RI report also postulated a DNAPL source near Burial Pit B (DOE 1998a).

Historical and RI data reveal the occurrence of 12 metal contaminants in the RGA groundwater samples from SWMU 7. As in the UCRS samples, arsenic, iron, and manganese were the most frequently detected groundwater contaminants. All of the SWMU 7 RGA organic groundwater contaminants were VOCs. TCE was the dominant organic contaminant. The RGA groundwater radionuclide contaminants of SWMU 7 consist of Tc-99, U-234, and U-238. Although a potential TCE DNAPL source is believed to exist near Pit B, as discussed, the primary occurrence of VOCs and Tc-99 in the RGA largely is due to the Northwest Plume, which passes beneath SWMU 7 (Figure 7.2).

The review of the McNairy groundwater analyses identified TCE and chloroform as the only SWMU 7 McNairy groundwater contaminants. This VOC contamination in the McNairy formation in the vicinity of SWMU 7 is likely from an upgradient source.

Depending on the originating source, the TCE could be a listed hazardous waste with one or more waste codes (F001, F002, or U228) and/or be a characteristic hazardous waste (D040), if generated by the response action. Excavated soil and/or debris from the burial grounds could be RCRA characteristic hazardous waste (e.g., toxicity for metals).

7.1.2 Risk Summary

This risk summary reflects the summary presented in the BGOU RI (DOE 2010b). Additional information can be found in Sections 1.5 and 1.6 of this report.

The carcinogenic ELCRs and noncarcinogenic HIs posed by contaminants detected at SWMU 7 that are addressed in this FS were identified, as described in Sections 1.5 and 1.6 of this FS. For SWMU 7, the additional data collected for the BGOU RI primarily were collected at depths greater than 10 ft to better characterize potential releases from the source areas; however, additional soil samples to a depth of 10 ft collected as part of Soils OU SWMU 12 and SWMU 14 investigations also were incorporated into the BGOU data set.

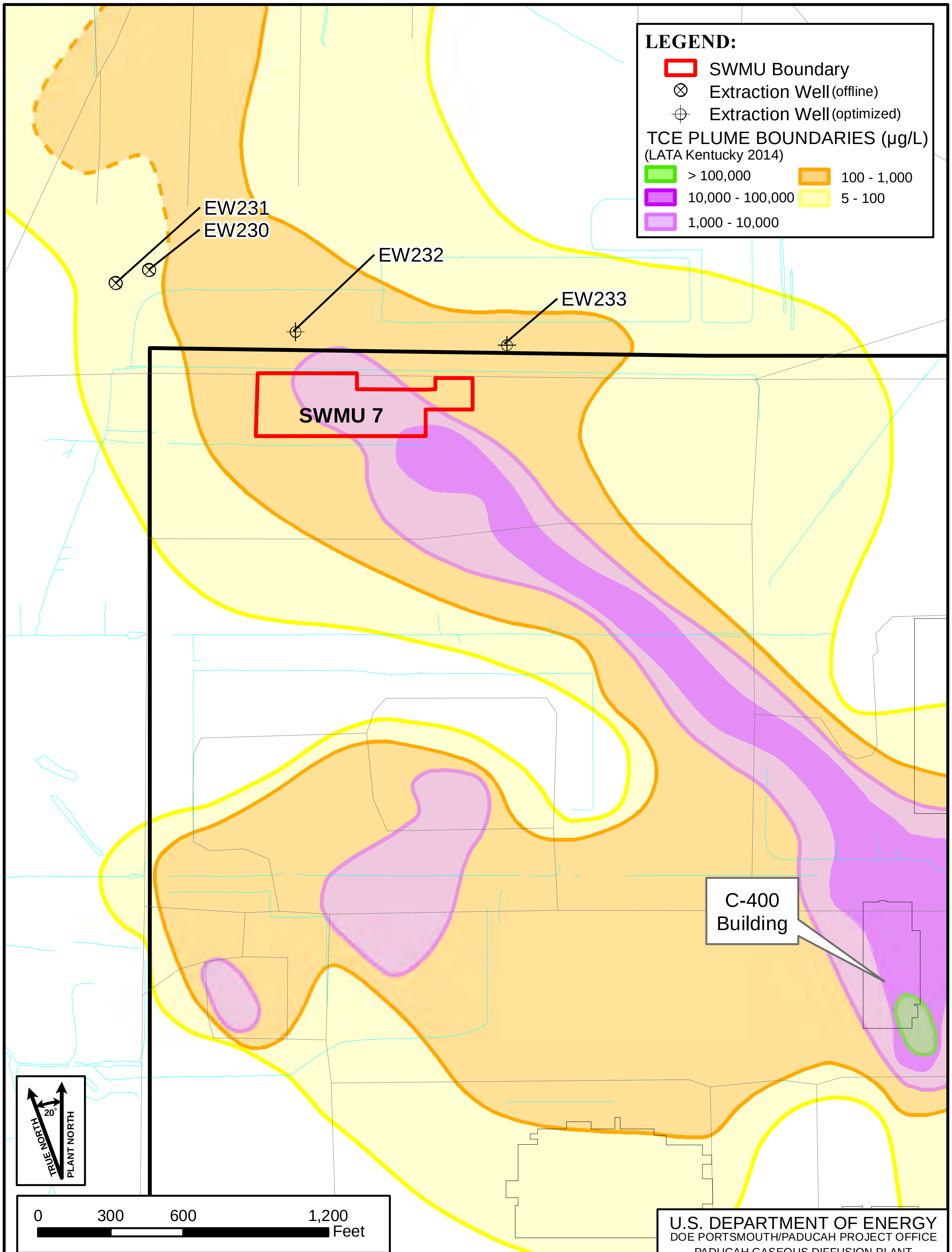

Figure 7.2. Location of SWMU 7 within the Northwest Plume

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Although there is a substantial soils data set, only limited data are available to characterize the source term at SWMU 7, creating an uncertainty when evaluating potential risks for direct contact with wastes As presented in the BGOU RI BHHRA, the FS assumes that direct contact with buried wastes would pose an unacceptable threat under some future use scenarios.

Unacceptable direct contact risks to future industrial and future excavation workers from exposure to surface and subsurface soils were identified in Sections 1.5 and 1.6 of this FS.

No completed migration pathway from the SWMU 7 burial cells to the adjacent ditches was identified. No seeps originating from SWMU 7 were identified, and water has not been determined to overflow from the cells into the ditch.

The SERA identified ecological COPCs in surface soils. Actions taken to address human health in this FS will reduce potential exposures to these ecological COPCs. Residual risks will be evaluated in a future sitewide ecological risk assessment.

7.1.3 Hydrogeological Interpretation

The study area geology and hydrogeology is summarized below, as documented in the BGOU RI (DOE 2010b). Because SWMUs 7 and 30 are adjacent to each other, their hydrogeological interpretation is discussed as one.

Stratigraphy. Like other on-site BGOU SWMUs, the HU1 silt interval contains the burial cells of SWMUs 7 and 30. The base of HU1 is at a depth of approximately 20 ft, approximately 8 ft below the deepest of the burial cells (SWMU 30). A single discontinuous sand and gravel horizon, in a clay matrix, defines the underlying HU2 interval. The sand and gravel deposits commonly range between 5- and 10-ft thick. Silt and clay members, with a cumulative thickness of 20 ft to 35 ft, comprise the HU3 interval below SWMUs 7 and 30.

In the area of SWMUs 7 and 30, the RGA consists of an intermittent HU4 sand overlying 20 ft to 40 ft of the HU5 sand with gravel layers. The top of the RGA commonly occurs at depths of 45 ft to 60 ft.

UCRS Groundwater Flow and Hydraulic Potential. The SWMUs 7 and 30 RI (DOE 1998a) found that a shallow water table exists approximately 5 ft bgs and within the burial cells. UCRS piezometer and well measurements documented a strong downward gradient within the area UCRS. The vertical downward hydraulic gradient is more than 10 times the lateral hydraulic gradient at SWMUs 7 and 30. This, along with lack of connectivity with shallow sand and gravel strata, leads to predominantly downward groundwater flow through the UCRS. These trends suggest that dissolved contaminants from the burial grounds have the potential to migrate into the RGA.

The elevation of the water table is above the elevation of the ditches that bound SWMUs 7 and 30 on the north and south sides.[12] Seeps have been observed along the bank of the northern bounding ditch in SWMU 30 following heavy rains during the spring, but seeps or flow into the ditch have not been observed from SWMU 7 and are not observed in SWMU 30 during the dry season. Additional field investigation was conducted along the bank of the northern ditch during the spring and summer of 2011 following heavy rainfall. The 2011 spring was a time of historic flooding. Observations indicated that no seeps originate from SWMU 7, the SWMU 7 burial cells do not extend to the ditch, and water does not

[12] The bottom elevation of the ditches on the north and south sides of SWMUs 7 and 30, as well as piezometer measurements within SWMUs 7 and 30, provided definitive control of the water table in those areas.

overflow from the cells into the ditch. The investigation also identified that seeps to the ditch do originate from SWMU 30 apparently as the result of water overflowing from the burial pit "bathtub" during the wet season.

RGA Groundwater Flow and Hydraulic Potential. The high-contamination core of the Northwest Plume passes beneath the west end of SWMU 7 in the RGA. RGA flow beneath SWMUs 7 and 30 is to the northwest, as defined by the TCE and Tc-99 plumes orientation. The historical south wellfield of the Northwest Plume Pump-and-Treat system is located approximately 650 ft to the northwest of SWMU 7. Two new extraction wells were installed east of the south wellfield and put into operation in 2010. EW232 and EW233 extract groundwater at approximately 110 gpm each. As a result of this optimization, the RGA groundwater flow vector has moved more northerly. Nevertheless, the SWMU 7 RGA groundwater remains within the capture zone of the Northwest Plume Pump-and-Treat system. A pumping test of EW231, an extraction well of the south wellfield, determined the hydraulic conductivity of the area RGA to be approximately 1,300 ft/day.

The TCE concentrations in MW66, located near the boundary between SWMUs 7 and 30, exhibit spikes that can be correlated with similar TCE spikes at MW248 near the south wellfield. Concentrations in MW66 and MW248 have been decreasing over time; however, the rate of decrease has been somewhat obscured by the intermittent concentration spikes. The distance between the two wells (650 ft) that exhibit this spiking behavior divided by the time lag between TCE "events" in MW66 and MW248 (six months) would suggest the local groundwater flow rate is ~ 3.5 ft/day if these two wells have the same source for the spikes. These wells are located along the western edge of the high concentration portion of the plume; thus, the spikes may indicate a potential UCRS DNAPL. Typical groundwater flow rates in the Northwest Plume are thought to range from 1 to 3 ft/day. The RGA groundwater flow velocity beneath SWMUs 7 and 30 is accelerated by groundwater extraction in the south wellfield and the new wells located to the east. The absolute direction of the local flow vectors have been modified by the Northwest Plume Pump-and-Treat system optimization.

7.2 SWMU-SPECIFIC RAOs

RAOs that are specific to SWMU 7 were developed based on the findings and observations from the BGOU RI Report (DOE 2010b). The SWMU-specific RAOs are directed toward conditions related to the waste materials and affected soils, the surface soils, and the subsurface soils at the SWMU.

The lack of information concerning the source term results in the assumption that direct contact with the source term is expected to pose unacceptable risks under some future use scenarios. Impacts from contact with soils have been identified that pose unacceptable risks to future industrial and excavation workers. Soil contaminants are present that may migrate to the RGA groundwater, including elevated concentrations of TCE and its degradation products.

These risks result in the following SWMU-specific RAOs.

SWMU-Specific RAO for Protection of Groundwater. Contribute to the protection of groundwater by eliminating, reducing, or controlling sources of groundwater contamination (see Section 1.6 for a list of target COCs) that could result in an exceedance in RGA groundwater of the MCL (or risk-based concentration for residential use of groundwater in the absence of an MCL).

SWMU-Specific RAO for Protection of Direct Contact with Waste. Prevent exposure to waste that exceeds target cumulative ELCRs and cumulative noncancer HIs for the future industrial and future excavation worker receptors. The acceptable cumulative risk levels for this RAO are defined as follows:

- Waste: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future excavation worker [considering a five-year exposure duration based on the outdoor worker scenario in the 2013 Risk Methods Document (DOE 2013a)]

SWMU-Specific RAO for Protection of Direct Contact with Contaminated Soils. Prevent exposure to contaminated soils that exceed target cumulative ELCRs and cumulative noncancer HIs for the future industrial and future excavation worker receptors. The acceptable cumulative risk levels for this RAO are defined as follows:

- Surface Soil: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future industrial worker [considering default exposures in the 2013 Risk Methods Document (DOE 2013a)]

- Surface and Subsurface Soil: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future excavation worker [considering a five-year exposure duration based on the outdoor worker scenario in the 2013 Risk Methods Document (DOE 2013a)]

COCs in affected soils are listed in Section 1.6.4.

SWMU-Specific RAO for PTW. Treat or remove PTW wherever practicable, consistent with 40 *CFR* § 300.430 (a)(1)(iii)(A).

The PRGs identified for target COCs to be addressed in this FS at SWMU 7 are listed in Table 7.1.

The presence of TCE DNAPL or high TCE concentration residual soil contamination in the UCRS at SWMU 7 is one explanation of the source of the historical groundwater concentration spikes from MW66, but its presence has not been confirmed by other RGA wells or by UCRS soil, groundwater, or test pit samples. Alternatives have been formulated to address the risks associated with the PTW, with supplemental technologies to address a TCE DNAPL or soil source at SWMU 7. An alternative that incorporates TCE DNAPL/soil source remediation RPOs will be formulated fully and considered in this FS, though the location of TCE DNAPL is not currently known. If an excavation alternative were to be implemented at SWMU 7, supplemental technologies for treating the residual TCE DNAPL or soil source would be employed if PRGs are not met by excavation alone.

7.3 DEVELOPMENT OF SWMU SPECIFIC ALTERNATIVES

General alternatives were assembled and screened in Section 3. This section refines those general alternatives brought forward for specific application at SWMU 7 to develop SWMU-specific alternatives. RPOs from Section 3 are evaluated for effectiveness, implementability, and cost to identify SWMU-specific RPOs for inclusion in SWMU-specific remedial alternatives. Once SWMU-specific alternatives are developed, they undergo detailed analysis using the nine CERCLA criteria.

The general alternatives retained in Section 3 are shown in Table 7.2.

For each GRA or technology identified in a general alternative, corresponding technologies and/or process options will be evaluated against the criteria of effectiveness, implementability, and cost for inclusion in a SWMU-specific alternative.

Table 7.1. Soil PRGs at SWMU 7

COC	Units	PRG for Surface Soil[a]	PRG for Subsurface Soil[b]	PRG for Subsurface Soil for Groundwater Protection[c]
1,1-DCE	mg/kg	N/A	N/A	1.46E-01
cis-1,2-DCE	mg/kg	N/A	N/A	1.19E+00
TCE	mg/kg	N/A	N/A	1.03E-01
Vinyl chloride	mg/kg	N/A	N/A	3.97E-02
Total PAHs[e]	mg/kg	2.51E-01	2.51E-01	N/A
Total PCBs	mg/kg	N/A	N/A	1.00E+01[d]
Arsenic	mg/kg	1.69E+01	1.04E+01	1.69E+01
Cobalt	mg/kg	1.40E+01	1.30E+01	N/A
Iron	mg/kg	2.80E+04	2.80E+04	N/A
Manganese	mg/kg	1.50E+03	8.20E+02	8.20E+02
Mercury	mg/kg	6.03E+00	N/A	N/A
Nickel	mg/kg	N/A	7.89E+01	N/A
Uranium[f]	mg/kg	7.83E+02	4.31E+02	7.83E+02
Np-237	pCi/g	2.61E-01	N/A	N/A
Tc-99	pCi/g	N/A	N/A	2.12E+01
U-234	pCi/g	3.06E+02	2.18E+02	4.88E+06
U-235	pCi/g	9.20E+00	1.21E+01	5.07E+04
U-238	pCi/g	3.74E+01	4.53E+01	2.64E+02

N/A = not applicable, these analytes are not COCs for the referenced media for SWMU 7.
[a] PRGs for surface soil are taken from Table 1.21 of this report.
[b] PRGs for subsurface soil are taken from Table 1.22 of this report.
[c] PRGs for subsurface soil for groundwater protection are taken from Table 1.23 of this report.
[d] Determined during June 2009 BGOU FS scoping meeting.
[e] Direct contact PRGs are based on total carcinogenic PAHs. The groundwater protective PRG is based on values for benz(a)anthracene.
[f] Direct contact PRGs are based on uranium, soluble salts.

Table 7.2. SWMU 7 Retained General Alternatives

Alternative Number/Description	
1	**No Action**
4	***In Situ* Source Treatment, Containment, Surface Controls, LUCs, and Monitoring**
5	**Excavation and Disposal, Treatment, and LUCs**

7.3.1 Alternative 1—No Action

The No Action alternative is defined in accordance with CERCLA and provides a baseline to which other alternatives can be compared. Under this alternative, no action would be taken to implement remedial activities for SWMU 7 or to reduce the potential hazard to human or ecological receptors.

PTW and COCs would not be treated under this alternative because no remedial actions would be performed.

7.3.2 Alternative 4—*In Situ* Source Treatment, Containment, Surface Controls, LUCs, and Monitoring

Alternative 4 evaluates process options to treat mobile COCs wastes and then effectively contain LLTW.

Under this alternative, a cap (RCRA Subtitle C or KY Subtitle D cap) will be designed and installed to prevent direct contact and significantly reduce infiltration of precipitation into buried wastes. Other containment technologies, such as hydraulic isolation, including vertical subsurface barriers and groundwater extraction, will be evaluated for inclusion on a SWMU-specific basis. Surface controls, monitoring, and LUCs also will be evaluated. Finally, the treatment RPOs identified in Section 2 will be evaluated for inclusion in a SWMU-specific alternative.

The results of the SWMU-specific evaluation and a summary of the SWMU-specific alternative are shown in Section 7.3.1.6.

7.3.2.1 Containment

General Alternative 4 identified containment as a GRA. Caps, subsurface vertical barriers, and hydraulic containment are containment technologies for which RPOs are evaluated for inclusion into a SWMU 7-specific alternative.

7.3.2.1.1 Caps

Effectiveness. Both the RCRA Subtitle C and KY Subtitle D caps are identified as RPO options. Both of these "caps" are effective at preventing surface water from migrating to the underlying waste. The RCRA Subtitle C cap, as recommended in EPA guidance, includes a 24-inch low permeable soil layer and a 20-mil geosynthetic membrane, which makes it a more robust cap than the KY Subtitle D cap in terms of infiltration reduction and intrusion prevention (EPA 1991b).

Implementability. Both the RCRA Subtitle C and KY Subtitle D caps use similar construction means and methods and are both highly implementable at SWMU 7.

Cost. The RCRA Subtitle C cap is more costly to install due to its increased low permeable layer thickness and the inclusion of a defined geosynthetic membrane. Long-term maintenance costs are equal for both caps.

Based on the evaluation factors of effectiveness, implementability, and cost, a KY Subtitle D cap is the RPO option for caps. This evaluation takes into account that the only PTW identified at SWMU 7 is TCE, which would be treated. Based on the historical disposal records, the increased cost and layers of the RCRA Subtitle C cap is not merited.

Contaminated surface soils outside the cap area not meeting RGs would be excavated and consolidated under the KY Subtitle D cap prior to cap placement. Any such excavation would be identified in the RAWP. Additionally, it is anticipated that a consolidated cap would be placed at SWMU 7 which would cover the discrete disposal cells and the area between cells. Additionally, the cap would be placed with the low permeable layer carrying to the ditch that runs parallel to and north of the SWMU. The placement of the cap and relocation of the ditch will mitigate the uncertainty of COCs migrating to the ditch. Finally, corner markers would be placed identifying the edge of the cap.

7.3.2.1.2 Subsurface vertical barriers

Specific subsurface vertical barrier process options will not be evaluated for inclusion at SWMU 7. Subsurface vertical barriers are not considered feasible because the wastes disposed of at the SWMU 7 area include noncombustible, contaminated and uncontaminated trash, material, and equipment believed to lie largely above the water table. Cap installation and ditch relocation mitigates the uncertainty of seeps. Installation of a subsurface vertical barrier does not improve protection of human health and the environment. Because of this, subsurface vertical barrier process options will not be considered any further and an evaluation will not be performed.

7.3.2.1.3 Hydraulic isolation

Groundwater extraction is identified in Section 2 as the RPO for the containment technology hydraulic isolation. Hydraulic isolation is also not considered feasible at SWMU 7 because of the nature of the wastes (noncombustible, contaminated and uncontaminated trash, material, and equipment) and because the wastes are believed to lie largely above the water table. Cap installation and ditch relocation mitigates the uncertainty of seeps. Installation of a subsurface vertical barrier does not improve protection of human health and the environment. Because of this, hydraulic isolation process options will not be considered any further and an evaluation will not be performed.

Groundwater extraction, as a component of a conventional groundwater P&T, will be evaluated as a means to capture and treat TCE as the treatment process option.

7.3.2.2 Surface controls

Section 2.4.3 identifies soil covers and riprap as RPOs.

Because this alternative includes a KY Subtitle D cap and LUCs to ensure protectiveness, no additional surface controls are necessary. Surface controls are evaluated for use in the event DOE transfers the property.

Effectiveness. Riprap is differentiated from soil covers in that riprap can be sized large enough (e.g., boulders) so as not to be man-portable and therefore cannot readily be removed without the use of heavy equipment. Riprap may be left uncovered to provide a striking contrast to the surrounding area as a warning, or it may be covered with a vegetative cover.

Implementability. Both soil and riprap are readily available in the local market, and placement of each is readily implementable. Riprap would need to be placed on a bedding material (smaller aggregate) to prevent erosion. Both covers, a vegetative soil cover and riprap, would need long-term maintenance. A soil cover would need mowing to maintain the vegetative cover, while the exposed riprap would need periodic weeding to inhibit plant ingrown.

Cost. Riprap is a somewhat more expensive product to install initially, but it is not prohibitively expensive compared to soil cover. It is estimated that maintenance costs are equal.

Alternative 4 at SWMU 7 does not leave PTW or significant volumes of long-lived radionuclides in place at SWMU 7. Also, Alternative 4 at SWMU 7 would include a KY Subtitle D cap, which includes multilayers that are distinctly different from the natural subsoils and provide greater depth to the buried waste. These aspects (thickness and distinct properties) of the cap are expected to provide protection of individuals from intrusion by alerting them that this is a man-made, engineered cover over something that is potentially hazardous to human health and by making it more difficult to expose the buried waste. Additional surface controls are not needed, therefore, and will not be included in the SWMU-specific alternative.

7.3.2.3 Treatment

General Alternative 4 identifies *in situ* treatment as a GRA. Table 7.3 identifies the RPOs from their respective technologies.

Table 7.3. General Alternative 4, Treatment RPOs

Technology	RPOs	Comments
Physical/Chemical	• Air stripping (*ex situ*) • Ion exchange (*ex situ*) • Granulated activated carbon (*ex situ*)	These components will be evaluated together as the *ex situ* components of a conventional P&T system.
Physical/Chemical	• DPE (*in situ*) • Deep soil mixing • Jet grouting	None.
Biological	Enhanced biodegradation	None.
Thermal	ERH	None.
Chemical	ZVI	None.

7.3.2.3.1 Pump-and-treat

In the conventional use, P&T systems are installed to capture contaminated groundwater *in situ* and treat the water *ex situ*. Also, in the conventional use, a P&T system would be most applicable with wells installed in the RGA such as the P&T system installed for the Northwest Plume.

Effectiveness. TCE (including degradation products) is present in the UCRS as DNAPL and/or high concentration TCE residual soil contamination and constitutes PTW. A P&T system at SWMU 7 would be an effective means to capture TCE and degradation products at the UCRS/RGA interface. While TCE (including degradation products) is present in the UCRS as DNAPL or high concentration TCE residual soil contamination, no specific source was identified during the RI, nor is there a history of TCE disposal at SWMU 7. A P&T system resolves the uncertainty associated with the source or sources because all water and COCs migrating from the unit would be captured.

Implementability. P&T has been implemented at PGDP and would be readily implementable at SWMU 7.

Cost. The cost of P&T includes both the cost of the initial installation as well as O&M costs. Additionally, any P&T system installed at SWMU 7 may have to operate for an extensive period incurring substantial long-term costs.

Because P&T is effective and mitigates source term uncertainty, it will be included in a SWMU 7-specific alternative. Based on the current understanding of groundwater flow, SWMU 7 is upgradient of the current Northwest Plume Pump-and-Treat system, which could be adopted for use, should it still be functional during remedy implementation. For evaluation purposes, this FS will assume that the Northwest Plume Pump-and-Treat system is not in operation, and the cost estimate will assume construction of a new system sized and designed specifically for SWMU 7.

7.3.2.3.2 Dual-phase extraction

Effectiveness. DPE would not be effective as a stand-alone remedy because the soil UCRS soil conditions (silts and clays) are not conducive to effective DPE. DPE has proved effective for remediating TCE within the UCRS at PGDP when paired with a heat source such as ERH. ERH is a treatment RPO and will be evaluated separately.

Implementability. DPE has been implemented at PGDP when paired with ERH and would be implementable at SWMU 7.

Cost. DPE without the application of a heat source does not have a cost-effective application at SWMU 7.

Based on an evaluation of effectiveness, implementability, and cost, DPE will not be included in a remedial action alone, but will be evaluated as a remedy component paired with ERH or another heating process option.

7.3.2.3.3 Deep soil mixing (solidification/stabilization)

Effectiveness. As applied at SWMU 7, deep soil mixing would involve injecting chemical/cement or bentonite slurry into the waste underlying soil through a rotating large diameter auger or mixer. This method would mix the waste, contaminated, soil and uncontaminated soil effectively with the reagent forming a monolithic block with a reduced mobility. *In situ* stabilization/solidification has been used to treat both organic and inorganic hazardous waste constituents at other hazardous waste sites.

Implementability. Deep soil mixing is implementable at SWMU 7, but it may require removal of wastes prior to implementation. Unlike SWMU 2, SWMU 7 disposal records indicate the disposal of concrete, equipment, and scrap metal that could interfere with mixing equipment. Additionally, deep soil mixing is only effective within the diameter of the mixing annulus (auger). Because of this, implementability, and effectiveness would rely on defining the specific source area to be treated.

Cost. Deep soil mixing is not prohibitively expensive.

Because the contents of the SWMU 7 waste, such as equipment or concrete, may prevent implementation of deep soil mixing without prior removal, deep soil mixing will not be incorporated into a SWMU 7-specific Alternative 4.

7.3.2.3.4 Jet grouting

Jet grouting can be used to inject treatment reagents into a soil matrix in a manner similar to deep soil mixing; however, jet grouting does so at high pressures that destroy the existing soil matrix creating a slurry of existing soil and reagent, generally cement and/or bentonite.

Effectiveness. Unlike soil mixing in which full mixing can be assured within the diameter of the mixing apparatus, jet grouting relies on pressure to force slurry into the soil matrix, and the diameter of the soil column is not dictated by a physical measure such as an auger. This limitation could be overcome by using horizontal or angled drilling methods to verify adequate treatment coverage.

Implementability. There is uncertainty as to the implementability of jet grouting. SWMU 7 wastes include concrete and equipment. These wastes could prevent a uniform distribution of injection points, which could result in gaps in the treatment volume. Additionally, jet grouting is less implementable in HU3 because of the soil clay content. Any chemical delivery method such as jet grouting would need to consider the need not to impair the effectiveness of the HU3 layer at preventing COC migration.

Cost. Jet grouting is not prohibitively expensive.

Because of the uncertainties in obtaining uniform treatment, jet grouting will not be developed into a SWMU 7-specific alternative.

7.3.2.3.5 *In situ* enhanced biodegradation

Effectiveness. The effectiveness of *in situ* enhanced bioremediation is uncertain. TCE DNAPL could migrate from the unit prior to sufficient residence time in the treatment area.

Implementability and Cost. *In situ* enhanced biodegradation has a low cost.

While *in situ* enhanced bioremediation is the RPO, it would not be effective for TCE DNAPL that could migrate from the unit prior to treatment being accomplished. It will therefore not be incorporated into a SWMU-specific alternative at SWMU 7.

7.3.2.3.6 Electrical resistance heating

Effectiveness. ERH is the RPO for thermal technologies and has been successfully implemented for TCE remediation in the UCRS at C-400.

Implementability. Excavation may be required prior to implementation of ERH. Other process options, such as thermal conductive heating or steam injection, could be implemented in the source zone to overcome ERH's limitation to operate near electrically conductive metals. Based on previous ERH installations at C-400, ERH, and any other heating method, is implementable in the UCRS. RGA groundwater velocities require a much higher energy input to accomplish heating in the RGA than in the UCRS. This should not impact implementation at SWMU 7 because current groundwater monitoring does not indicate an RGA DNAPL source at SWMU 7; therefore, thermal treatment would be limited to the UCRS.

Cost. The cost of ERH or other thermal treatments is high.

Because ERH has proved to be a successfully implemented remedy at PGDP, albeit at high cost, it will be incorporated into a SWMU-specific Alternative 4 and brought forward for detailed analysis.

7.3.2.3.7 ZVI

Effectiveness. TCE (including degradation products) is present in the UCRS as DNAPL and/or high-concentration TCE residual soil contamination and constitutes PTW. Uncertainty exists as to the effectiveness of ZVI because the volume and concentrations of DNAPL and/or high concentration TCE residual soil contamination at SWMU 7 are not well understood. Mobile COCs could migrate from the unit prior to sufficient residence time in the treatment area. Additionally, at SWMU 7, the effectiveness of the HU3 layer serving as a low-permeable layer to prevent migration is uncertain. Any chemical delivery method would need to consider the need not to impair the effectiveness of the HU3 layer at preventing COC migration.

Implementability. The injection of ZVI is implementable; however, its implementability needs to be viewed also in terms of the delivery methods used. Deep soil mixing or jet injection could be used to deliver a reagent.

Cost. ZVI is considered to have a moderate installation cost with no additional O&M cost.

Given the lack of source term data and its impact upon effectiveness, implementability, and cost, ZVI (chemical treatment) will not be included into an alternative at SWMU 7.

7.3.2.3.8 Treatment summary

Based on an evaluation of effectiveness, implementability, and cost, two treatment process options will be assembled into Alternative 4 at SWMU 7 to create a SWMU-specific alternative. These process options include installation of a conventional P&T system and ERH. These two alternatives best accommodate the site conditions and have proven effectiveness and implementability at PGDP.

7.3.2.4 Land use controls

Consistent with Section 2.4.1, LUCs will be implemented at BGOU SWMUs where waste is left in place or source area-related contamination remains after active remediation that precludes UU/UE conditions.

Section 2.4.1.1 identifies the following LUCs to be evaluated on SWMU-specific and alternative-specific bases. This evaluation for SWMU 7, Alternative 4 is as follows.

Warning Signs. Warning signs provide a highly effective means to warn of the hazards of potential contaminant exposure. An initial sign installation is highly implementable; however, a drawback to signs is that they can be removed or defaced by vandals. This drawback negatively affects both the effectiveness and implementability of signs, but can be mitigated by constructing signs of vandal resistant materials and that can be affixed to supporting structures in a manner so as to make them not readily removable by vandals. Overall, warning signs are viewed as having high effectiveness and high implementability at a low cost.

Fences. Fences can be an effective LUC to prevent access or intrusion and also are highly implementable as a first installation; however, as with signs, fences require significant long-term maintenance at a significant cost in order to ensure adequate long-term effectiveness. Also, fences can be readily defeated by an intruder with common hand tools. While the pairing of fence and warning signs does offer a minimal increase in effectiveness, it does not offset the increased cost due to long-term maintenance that a fence requires.

For these reasons, fences will not be incorporated as a LUC in Alternative 4 at SWMU 7.

E/PP Program. The E/PP Program is a LUC administered by DOE's contractors at PGDP. It is an effective LUC for controlling potential personnel hazards related to trenching, excavation, and penetration greater than 6 inches into the earth, concrete, pavement or walls, floors, and ceilings of buildings. This program will be maintained for as long as DOE or its contractor maintain an on-site presence at the PGDP. The E/PP Program has proved to be highly implementable and at a low cost.

Property Record Notice, Deed and/or Lease Restrictions, and Environmental Covenant. These administrative controls are described in Section 2.4.1.1 and are all effective means of ensuring protection under the reasonably anticipated industrial future land use. These proprietary controls help ensure the land use remains industrial. Additionally, any land use change would be identified through the five-year review process per CERCLA 121(c), and DOE would be required to take appropriate measures to ensure the continued protection of human health and the environment under the changed land use. These administrative LUCs are highly implementable and at a low cost.

Alternative 4 at SWMU 7, which leaves waste in place, will include the following LUCs as described in Section 2.4.1.1. Specific implementation details would be further defined in the LUCIP.

- Warning signs
- E/PP Program
- Property record notices
- Deed and/or lease restrictions (contingent upon transfer)

- Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer

- CERCLA 120(h)

These administrative and physical controls together provide enhanced protection and afford a layered strategy that provides protection in different ways. Fences are not included as a LUC for this alternative at SWMU 7 because they offer limited additional effectiveness at increased cost when evaluated with the alternative's other physical means of preventing intrusion such as KY Subtitle D cap and warning signs.

7.3.2.5 Monitoring

Conventional sampling and analysis of MWs is the identified RPO for the monitoring technology. This process option is an effective means of monitoring that protection of human health and the environment is maintained by the remedy.

The following paragraphs identify the objectives, schedules, reporting requirements, sampling strategies, and technologies for the groundwater monitoring program to ensure remedy effectiveness (DOE 1998c).

Groundwater monitoring at SWMU 7 is made more complex because the SWMU overlies the Northwest Plume, which is an upgradient source of both dissolved-phase TCE and Tc-99.

Monitoring. To understand groundwater conditions, comparisons and statistical analysis of upgradient and downgradient wells would be performed.

Objective. The objective of groundwater monitoring would be to detect and characterize any releases of hazardous constituents from the SWMU that may adversely impact the uppermost aquifer. This is sometimes referred to as detection monitoring. Samples would be collected periodically from the MWs and analyzed for specific indicator parameters and any other waste constituents or reaction products that could indicate that a release might have occurred.

Monitoring Schedule/Frequency. Monitoring would be performed annually, provided no indication of potential adverse environmental impacts to groundwater is detected.

Reporting Requirements. Results of SWMU 7 groundwater monitoring will be reported twice annually in the FFA Semiannual Report. These results will be evaluated for the triggers described below every five years in the CERCLA Five-Year Review.

Sampling Strategy—Monitoring Locations. Due to the size of SWMU 7, two upgradient and five downgradient RGA MWs would be sufficient to monitor for releases. The cost estimates assume construction of seven new monitoring wells.

Sampling Strategy—Analytical Parameters. At a minimum, SWMU 7 MWs would be monitored for the COCs for the protection of groundwater determined in the FS. These contaminants are listed in Table 7.1 of this FS. Nationally recognized methods, where applicable (e.g., SW-846, ASTM), would be used to analyze the groundwater samples.

Sampling Strategy—Monitoring Triggers. The following triggers may be used to determine whether adverse environmental impacts have occurred to groundwater associated with this SWMU.

- A statistically significant trend of any of the COCs or a significant change to other monitored parameters (e.g., pH, dissolved oxygen) within an individual MW.

- An increase in downgradient MW results above upgradient MW results (i.e., a statistically significant increase in the downgradient levels of any of the monitored constituents when compared to the upgradient levels).

Technologies. Standard technologies would be used to collect the groundwater samples and transport them to a suitable laboratory. As previously stated, nationally recognized methods would be used to analyze the groundwater samples. Contaminated surface soils outside the cap area not meeting RGs would be excavated and consolidated under the Kentucky Subtitle D cap prior to cap placement. This consolidation would eliminate the need for subsequent surface water monitoring.

7.3.2.6 Summary of SWMU-Specific Alternatives

Based upon the evaluation of process options for effectiveness, implementability, and cost specific to SWMU 7, the following SWMU-specific alternatives have been assembled and will be brought forward for detailed analysis at SWMU 7. No further screening of alternatives is necessary because the alternative screening was performed following the assembly of General Alternatives in Section 3.

Alternative 4 contains two treatment options: P&T and ERH. These options are identified/designated as shown below using "P&T" to denote the pump and treat option and "ERH" to denote the ERH option.

- Alternative 4 (P&T)—Cap, P&T, LUCs, and Monitoring
- Alternative 4 (ERH)—Cap, ERH, LUCs, and Monitoring

Tables 7.4 and 7.5 identify the key features of these SWMU-specific alternatives.

Table 7.4. Alternative 4 (P&T) Components

General Response Action	Technologies	RPOs
Containment	Caps	KY Subtitle D cap
Treatment	Physical/Chemical	P&T
Surface Controls	Surface Barriers	Soil cover—as provided through the KY Subtitle D cap
Monitoring	Groundwater Monitoring	Conventional groundwater monitoring
LUCs	Physical Controls	Warning signs
	Administrative Controls	• E/PP Program • Property record notices • Deed and/or lease restrictions (contingent upon transfer) • CERCLA 120(h) • Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer

Table 7.5. Alternative 4 (ERH) Components

General Response Action	Technologies	RPOs
Containment	Caps	KY Subtitle D cap
Treatment	Thermal	ERH
Monitoring	Groundwater Monitoring	Conventional groundwater monitoring
Land Use Controls	Physical Controls	Warning signs
	Administrative Controls	• E/PP Program • Property record notices • Deed and/or lease restrictions (contingent upon transfer) • CERCLA 120(h) • Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer

Alternatives 4 (P&T) and 4 (ERH) satisfy the first RAO. They contain waste in place. The risk of direct contact would be mitigated through layered controls:

- The KY Subtitle D cap over the waste area forms a barrier to prevent infiltration, and also mitigate intrusion.

- Contaminated surface soils outside the cap area not meeting RGs would be consolidated under the cap prior to cap placement.

- Physical LUCs (signs) would provide warning at the site, and administrative LUCs would provide warning and mitigate potential exposure.

Alternatives 4 (P&T) and 4 (ERH) satisfy the second RAO. The potential for groundwater contamination is mitigated through containment and treatment.

- TCE is captured and removed through either a conventional P&T system or ERH.

- The KY Subtitle D cap prevents water from migrating through the waste.

- The uncertainty of migration to the ditch is mitigated through cap placement and ditch realignment.

- Groundwater monitoring assures remedy effectiveness.

Alternatives 4 (P&T) and 4 (ERH) satisfy the third RAO through treatment of TCE (PTW).

Additional details used for cost estimating purposes are presented in Table 7.6, Table 7.7, Figure 7.3, and Appendix E.

7.3.3 Alternative 5—Excavation and Disposal, Treatment, and LUCs

General Alternative 5 assembles RPOs from the removal and disposal GRAs. *In situ* treatment is also evaluated for treatment of TCE at SWMU 7. LUCs are evaluated and would be implemented if excavation and *in situ* treatment do not result in UU/UE conditions.

Table 7.6. SWMU 7, Alternative 4 (P&T) Key Cost Drivers and Key Assumptions

SWMU 7, Alternative 4 (P&T): Cap, P&T, LUCs, and Monitoring
CAPITAL COSTS
Cap Construction • Relocate ditch and road to north of SWMU prior to cap construction • Assumed cap area is 230,000 ft^2 • KY Subtitle D cap layers consist of — Filter fabric or other approved material — 18-inch clay layer with a maximum permeability of 1E-07 cm/sec — 12-inch drainage layer with a minimum permeability of 1E-03 cm/sec — 36-inch vegetative soil layer • Four corner markers
Pump-and-Treat system • One extraction well • Air stripper • Ion exchange • Granulated activated carbon
ANNUAL COSTS
Cap Maintenance • Inspection—Quarterly • Remove weeds—Semiannually • Replace signs—Every 30 years **Pump-and-Treat System O&M** • Assumes 50-year O&M period **Groundwater Monitoring** • Monitor seven wells annually (two upgradient and five downgradient) **Five-Year Review**

Table 7.7. SWMU 7, Alternative 4 (ERH) Key Cost Drivers and Key Assumptions

SWMU 7, Alternative 4 (ERH): Cap, ERH, LUCs, and Monitoring
CAPITAL COSTS
Cap Construction • Relocate ditch and road to north of SWMU prior to cap construction • Assumed cap area is 230,000 ft^2 • KY Subtitle D cap layers consist of — Filter fabric or other approved material — 18-inch clay layer with a maximum permeability of 1E-07 cm/sec — 12-inch drainage layer with a minimum permeability of 1E-03 cm/sec — 36-inch vegetative soil layer • Four corner markers
ERH • RDSI includes limited excavation to confirm conditions suitable for ERH • Assumes RDSI will support a 75 ft × 75 ft treatment area • Treatment assumed to 60 ft bgs
ANNUAL COSTS
Cap Maintenance • Inspection—Quarterly • Remove weeds—Semiannually • Replace signs—Every 30 years **Groundwater Monitoring** • Monitor seven wells annually (two upgradient and five downgradient) **Five-Year Review**

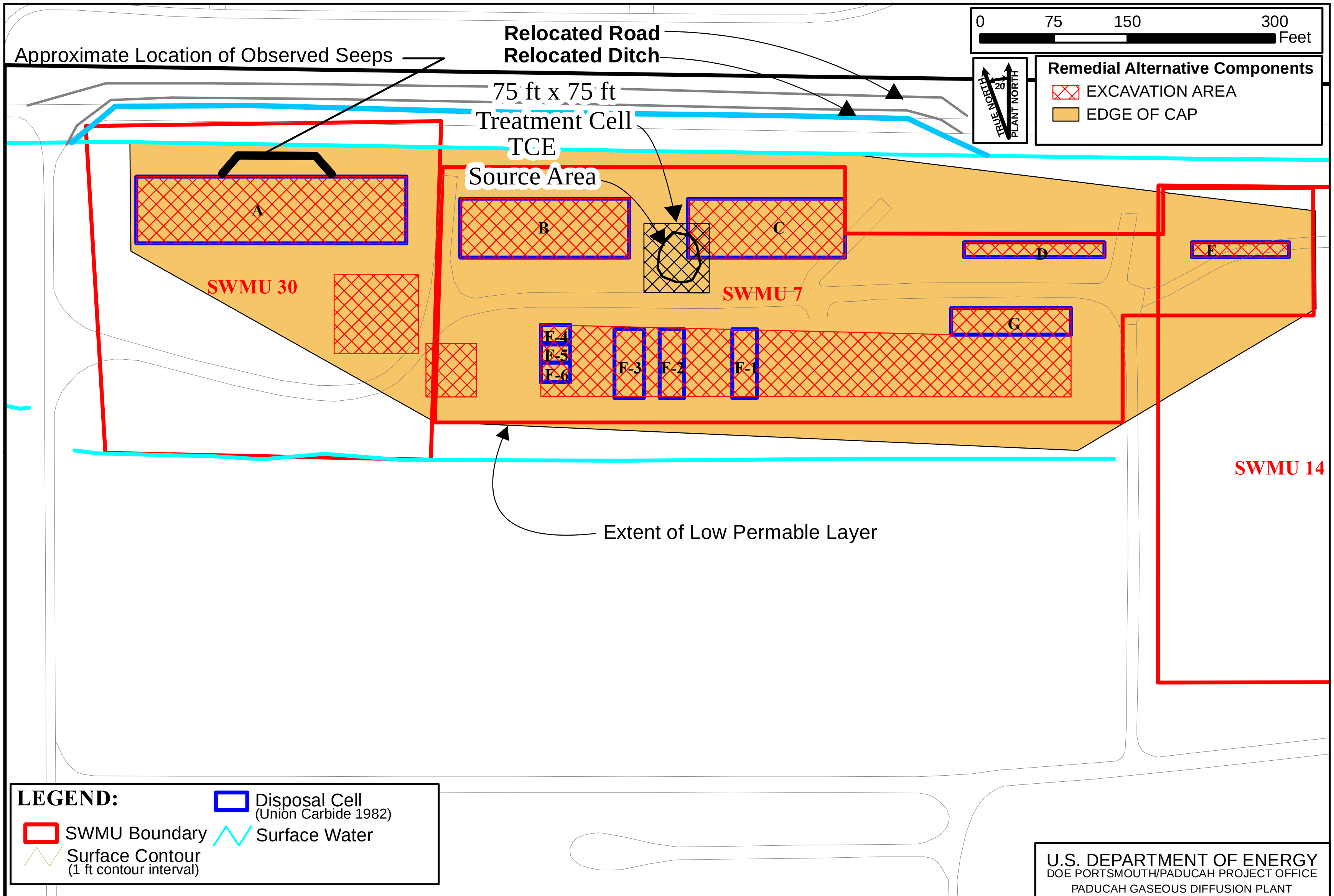


Figure 7.3. SWMUs 7 and 30 Excavation, Cap, and Treatment Areas

7.3.3.1 Removal

The use of conventional excavation equipment such as backhoes and trackhoes is the RPO for the removal GRA at SWMU 7. This equipment is effective, implementable, and cost-effective for application at SWMU 7.

7.3.3.2 Treatment

In situ treatment process options are evaluated in Section 7.3.1.3. While excavation should eliminate the uncertainty of the source term, excavation would not remove TCE and degradation products that have migrated below the practical maximum depth of excavation and therefore excavation has little impact on the treatment evaluation, although treatment duration likely would be reduced. Therefore, Alternative 5 also will carry conventional P&T and ERH into detailed analysis.

It is assumed for estimating purposes that should treatment be required in order to meet the disposal facility's WAC, treatment would be performed off-site with corresponding off-site disposal. However, stabilization of small volumes of waste may be performed on-site.

7.3.3.3 Disposal

Both on-site and off-site disposal of excavated waste and contaminated soils were identified as RPOs. Additionally, the existing C-746-U Landfill was identified as an RPO for nonhazardous wastes that meet the C-746-U Landfill WAC (including authorized limits).

Use of the C-746-U Landfill is an effective location for disposal of nonhazardous wastes that meet the WAC and its use should be evaluated in a disposal discussion. Additionally, both off-site and on-site disposal can be equally effective disposal means for the wastes generated through an excavation alternative.

Off-site waste disposal is currently implementable. Based on process knowledge of the SWMU 7 wastes and industry practices for disposal of such wastes, it is assumed that all SWMU 7 generated wastes would meet the WAC of either a commercial landfill or a federally owned facility such as NNSS. The on-site disposal process option would only be implementable if an on-site facility is available at the time of excavation. Regarding cost, disposing of wastes on-site would cost significantly less than off-site disposal.

Based on the evaluation factors of effectiveness, implementability, and cost, this FS will carry both the off-site and on-site disposal process options forward with the assumption that both process options would be paired with use of the C-746-U Landfill. It is recognized that disposal at an on-site cell would only be implementable should one be constructed.

7.3.3.4 Land use controls

Consistent with Section 2.4.1, LUCs will be implemented at BGOU SWMUs where waste is left in place or source area-related contamination remains after active remediation that precludes unrestricted use.

Section 2.4.1.1 identifies the following LUCs to be evaluated on SWMU-specific and alternative-specific bases. This evaluation for SWMU 7, Alternative 5 is as follows.

Warning Signs. Because the waste and contaminated soils would be excavated/removed and replaced with clean backfill, warning signs are unnecessary.

Fences. Because the waste and contaminated soils would be excavated/removed and replaced with clean backfill, fences are unnecessary.

E/PP Program. The E/PP Program is a LUC administered by DOE's contractors at PGDP. It is an effective LUC for controlling potential personnel hazards related to trenching, excavation, and penetration greater than 6 inches into the earth, concrete, pavement or walls, floors, and ceilings of buildings. This program will be maintained for as long as DOE or its contractor maintain an on-site presence at the PGDP. The E/PP Program has proved to be highly implementable and at a low cost.

Property Record Notice. Because the waste and contaminated soils would be excavated/removed and replaced with clean backfill, a property record notice is unnecessary.

Deed and/or Lease Restrictions, and Environmental Covenant. These administrative controls are described in Section 2.4.1.1 and are all effective means of ensuring protection under the reasonably anticipated industrial future land use. These proprietary controls help ensure the land use remains industrial. Additionally, should that land use change, the change would be identified through the five-year review process per CERCLA 121(c) and DOE would be required to take appropriate measures to ensure the continued protection of human health and the environment under the changed land use. These administrative LUCs are highly implementable and at a low cost.

LUCs Summary. Alternative 5 at SWMU 7, which removes the source term but may not meet UU/UE conditions, will include the following LUCs as described in Section 2.4.1.1. The E/PP Program and a property record notice would not be necessary as the waste will be removed. Specific implementation details would be further defined in the LUCIP.

- Deed and/or lease restrictions (contingent upon transfer)
- Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer
- CERCLA 120(h)

These administrative and physical controls together provide enhanced protection and afford a layered strategy that provides protection in different ways. Physical controls are not included as a LUC for this alternative at SWMU 7 because the depth of any contaminants remaining in place is sufficiently deep that they offer limited additional effectiveness at increased cost.

7.3.3.5 Summary of SWMU-specific alternatives

Based upon the evaluation of process options for effectiveness, implementability, and cost specific to SWMU 7, the following SWMU-specific alternative has been assembled and will be brought forward for detailed analysis at SWMU 7. No further screening of alternatives is necessary because the alternative screening was performed following the assembly of General Alternatives in Section 3.

Alternative 5 contains two treatment options: P&T and ERH. These options are identified/designated as shown below using "P&T" to denote the pump and treat option and "ERH" to denote the ERH option.

- Alternative 5 (P&T)—Excavation and Disposal, P&T, and LUCs
- Alternative 5 (ERH)—Excavation and Disposal, ERH, and LUCs

Table 7.8 identifies the key features of the SWMU-specific alternatives.

While not specifically identified in this FS as a separate alternative, disposal costs will be developed assuming both that an OSWDF is available and is not available for use.

Alternatives 5 (P&T) and 5 (ERH) satisfy the first RAO. The potential for contamination of groundwater is mitigated through both removal of the waste and extraction/treatment of the residual contaminants.

Table 7.8. Alternative 5 Excavation and Disposal, and LUCs

General Response Action	Technologies	Process Options
Removal	Excavators	Backhoes/trackhoes
Disposal	Landfill Disposal	Disposal based on waste stream specific conditions, but will include a combination of off-site and on-site disposal facilities
Treatment	Physical/Chemical Thermal	Alternative 5 (P&T)—P&T Alternative 5 (ERH)—ERH
LUCs	Administrative Controls	• E/PP Program • Deed and/or lease restrictions (contingent upon transfer) • CERCLA 120(h) • Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer

Alternatives 5 (P&T) and 5 (ERH) satisfy the second RAO. They mitigate the potential for direct contact through removal. Should contamination at concentrations above RGs remain below the excavation, it will be treated and LUCs used to mitigate any direct contact risk.

Alternatives 5 (P&T) and 5 (ERH) satisfy the third RAO by treating all PTW where practicable.

Additional details used for cost estimating purposes are presented in Tables 7.9, 7.10, and Appendix E.

7.4 DETAILED ANALYSIS OF ALTERNATIVES

Alternatives retained after screening undergo detailed evaluation in this section, using the process described in EPA (1988) and the NCP. Each alternative is assessed against two threshold criteria and five balancing criteria designed to address CERCLA requirements and additional considerations for appropriate remedial alternative selection. The extent to which the criteria are met by each alternative is evaluated in the context of the specific conditions and the associated risks identified at SWMU 7.

The following five SWMU-specific alternatives are evaluated in the following subsections.

- Alternative 1—No Action
- Alternative 4 (P&T)—Cap, P&T, LUCs, and Monitoring
- Alternative 4 (ERH)—Cap, ERH, LUCs, and Monitoring
- Alternative 5 (P&T)—Excavation and Disposal, P&T, and LUCs
- Alternative 5 (ERH)—Excavation and Disposal, ERH, and LUCs

Table 7.9. SWMU 7, Alternative 5 (P&T) Key Cost Drivers and Key Assumptions

SWMU 7, Alternative 5 (P&T): Excavation and Disposal, Pump-and-Treat, LUCs

CAPITAL COSTS

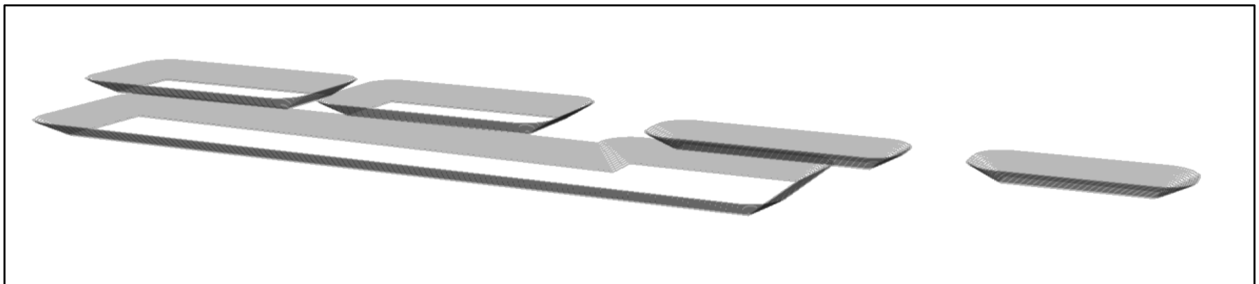
Shoring

- No shoring included due to area of excavation
- Calculated volumes include slope

Excavation

- Dewatering
  - Mobilize five frac tanks and temporary water treatment plant
  - Groundwater not anticipated, but dewatering of rainwater anticipated
- Excavation
  - Volumes estimated using GIS (see illustration)
  - Soil volumes based on a 15-ft deep excavation and a 1.5:1 slope
  - Assumes 25% of the remaining surface soils will be excavated to a depth of 2 ft
- Treatment, Transportation, and Disposal Summary
  - Assumes that 5% of the waste cell volume will require stabilization prior to disposal
  - Stabilization will occur off-site

GIS Rendering of SWMU 7 Cell Excavation with Slope



Transportation and Disposal Volumes (assuming OSWDF not available)

Item	Assumptions and Volume Calculation	*In Situ* Volume	Disposal Pathway	Resulting Treatment and/or Disposal Volume
Pit: slope and cells (see sketch)	Total volume of cells and slope as calculated through GIS Surface soils calculated through GIS	57,179 bcy	N/A	N/A
	Assume 33% to be disposed of at C-746-U Landfill	18,869 bcy	In trucks without additional packaging	22,643 lcy
	Assumes 62% to be disposed of at Energy*Solutions* 5% of the total volume requiring stabilization prior to disposal	35,450 bcy 2,858 bcy	In Super Sacks® shipped via rail	42,540 lcy 6,859 lcy
Surface Soil	Assumes 75% to be disposed of at C-746-U Landfill	6,789 bcy	In trucks without additional packaging	8,147 lcy
	Assumes 25% to be disposed of at Energy*Solutions* without treatment	2,264 bcy	In Super Sacks® shipped via rail	2,716 lcy

Notes:

- All disposal volumes based on a 1.2 swell factor
- Treatment volume effectively doubles the swelled volume

Table 7.9. SWMU 7, Alternative 5 (P&T) Key Cost Drivers and Key Assumptions (Continued)

Transportation and Disposal Volumes (assuming OSWDF available)				
Item	**Assumptions and Volume Calculation**	***In Situ* Volume**	**Disposal Pathway**	**Resulting Treatment and/or Disposal Volume**
Volume of Pits: slope and cell waste (see sketch)	Cells and slope as calculated through GIS Surface soils calculated through GIS	57,179 bcy	N/A	N/A
	Assume 33% to be disposed of at C-746-U Landfill	18,869 bcy	In trucks without additional packaging	22,643 lcy
	Assumes 62% to be disposed of at OSWDF	35,450 bcy	In trucks without additional packaging	42,540 lcy
	5% of the total volume requiring stabilization at Energy*Solutions* prior to disposal at Energy*Solutions*	2,858 bcy	In Super Sacks® shipped via rail	6,859 lcy
Surface Soil	Assumes 75% to be disposed of at C-746-U Landfill	6,789 bcy	In trucks without additional packaging	8,147 lcy
	Assumes 25% to be disposed of at OSWDF without treatment	2,264 bcy	In trucks without additional packaging	2,716 lcy
Notes: • All disposal volumes based on a 1.2 swell factor • Treatment volume effectively doubles the swelled volume				
Backfill • Assumes off-site commercial backfill source imported, placed, and compacted				
Pump-and-Treat System • One extraction well • Air stripper • Ion exchange • Granulated activated carbon				
ANNUAL COSTS				
Five-Year Review				

Table 7.10. SWMU 7, Alternative 5 (ERH) Key Cost Drivers and Key Assumptions

SWMU 7, Alternative 5 (ERH): Excavation and Disposal, ERH, LUCs

CAPITAL COSTS

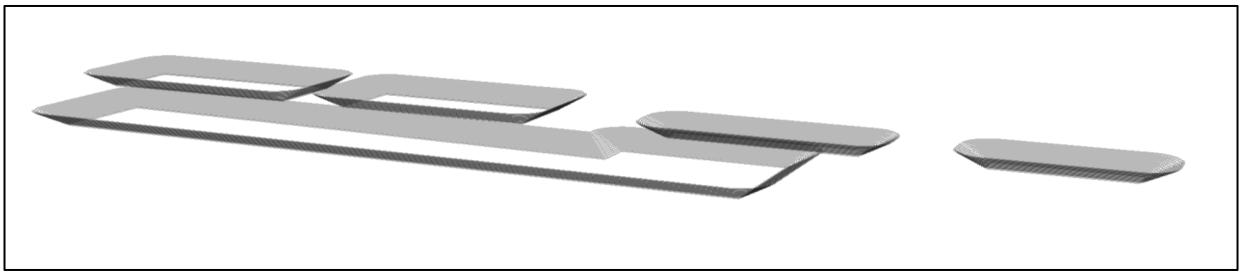
Shoring

- No shoring included due to area of excavation
- Calculated volumes include slope

Excavation

- Dewatering
  - Mobilize five frac tanks and temporary water treatment plant
  - Groundwater not anticipated, but dewatering of rainwater anticipated
- Excavation
  - Volumes estimated using GIS
  - Soil volumes based on a 15-ft deep excavation and a 1.5:1 slope
  - Assumes 25% of the remaining surface soils will be excavated to a depth of 2 ft
- Treatment, Transportation and Disposal Summary
  - Assumes that 5% of the cell volume will require stabilization prior to disposal
  - Stabilization will occur off-site

GIS Rendering of SWMU 7 Cell Excavation with Slope



Transportation and Disposal Volumes (assuming OSWDF not available)

Item	Assumptions and Volume Calculation	*In Situ* Volume	Disposal Pathway	Resulting Treatment and/or Disposal Volume
Pit cell and slope (see sketch)	Total volume of cells and slope as calculated through GIS Surface soils calculated through GIS	57,179 bcy	N/A	N/A
	Assume 33% to be disposed of at C-746-U Landfill	18,869 bcy	In trucks without additional packaging	22,643 lcy
	Assumes 62% to be disposed of at Energy*Solutions*	35,450 bcy	In Super Sacks® shipped via rail	42,540 lcy
	Assumes 5% of the total volume to be stabilized and disposed of at Energy*Solutions*	2,858 bcy	In Super Sacks® shipped via rail	6,859 lcy
Surface Soil	Assumes 75% to be disposed of at C-746-U Landfill	6,789 bcy	In trucks without additional packaging	8,147 lcy
	Assumes 25% to be disposed of at Energy*Solutions* without treatment	2,264 bcy	In Super Sacks® shipped via rail	2,716 lcy

Notes:
- All disposal volumes based on a 1.2 swell factor
- Treatment volume effectively doubles the swelled volume

Table 7.10. SWMU 7, Alternative 5 (ERH) Key Cost Drivers and Key Assumptions (Continued)

Transportation and Disposal Volumes (assuming OSWDF available)				
Item	**Assumptions and Volume Calculation**	***In Situ* Volume**	**Disposal Pathway**	**Resulting Treatment and/or Disposal Volume**
Pit cell and slope (see sketch)	Total volume of cells and slope as calculated through GIS Surface soils calculated through GIS	57,179 bcy	N/A	N/A
	Assume 33% to be disposed of at C-746-U Landfill	18,869 bcy	In trucks without additional packaging	22,643 lcy
	Assumes 62% to be disposed of at OSWDF	35,450 bcy	In trucks without additional packaging	42,540 lcy 6,859 lcy
	5% of the total volume requiring stabilization at Energy*Solutions* prior to disposal at Energy*Solutions*	2,858 bcy	In Super Sacks® shipped via rail	6,859 lcy
Surface Soil	Assumes 75% to be disposed of at C-746-U Landfill	6,789 bcy	In trucks without additional packaging	8,147 lcy
	Assumes 25% to be disposed of at Energy*Solutions* without treatment	2,264 bcy	In Super Sacks® shipped via rail	2,716 lcy
Notes: • All disposal volumes based on a 1.2 swell factor • Treatment volume effectively doubles the swelled volume				
Backfill • Assumes off-site commercial backfill source imported, placed, and compacted				
ERH • RDSI includes limited excavation to confirm conditions suitable for ERH • Assumes RDSI will support a 75 ft × 75 ft treatment area • Treatment assumed to 60 ft bgs				
ANNUAL COSTS				
Five-Year Review				

7.4.1 Alternative 1—No Action

The No Action alternative is defined in accordance with CERCLA and provides a baseline to which other alternatives can be compared. Under this alternative, no action would be taken to implement remedial alternatives for SWMU 7 or to reduce the potential hazard to human or ecological receptors.

PTW and COCs would not be treated under this alternative as no remedial actions would be performed.

7.4.1.1 Overall protection of human health and the environment

This alternative does not meet the threshold criterion because there is an unacceptable risk associated with some future use scenarios that is not addressed.

RGA groundwater currently is captured and treated through the Northwest Plume Pump-and-Treat system, and SWMU 7 is upgradient of the extraction wells. While the focus of the Northwest Plume

Pump-and-Treat system is to capture the TCE and Tc-99 plumes, any potential COC contribution from SWMU 7 also is captured; therefore, further migration of contaminated groundwater is mitigated.

7.4.1.2 Compliance with ARARs

No ARARs have been identified for Alternative 1.

7.4.1.3 Long-term effectiveness and permanence

Alternative 1 would not provide long-term effectiveness or permanence because it does not limit future exposure to waste and affected soil.

7.4.1.4 Reduction of toxicity, mobility, or volume through treatment

Reduction of toxicity, mobility, or volume through treatment would not be applicable to the No Action alternative because it does not include treatment.

7.4.1.5 Short-term effectiveness

No actions would be implemented under Alternative 1; therefore, no additional risks to workers, the public, or the environment would be incurred. There would be no short-term change to existing conditions.

7.4.1.6 Implementability

The No Action alternative can be implemented readily. If future remedial action is necessary, this alternative would not impede implementation of such action.

The ongoing public awareness program would require regular coordination with DOE, KY, and EPA.

7.4.1.7 Cost

The preliminary cost estimates for Alternative 1 serve as a baseline for comparison of the other remedial alternatives. These cost estimates are based upon FS-level scoping and are intended to aid with selection of a preferred alternative. There are no capital or O&M costs associated with Alternative 1.

7.4.2 Alternative 4 (P&T)—Cap, Pump-and-Treat, LUCs, and Monitoring

Alternative 4 (P&T) is described in Section 7.3.2.5 with additional implementation data included in Appendix E. Alternative 4 (P&T) controls direct contact to surface soils and wastes by placing a KY Subtitle D cap over the waste and through LUCs. Any remaining mobile wastes within SWMU 7, such as TCE, will migrate much more slowly through the UCRS and eventually be captured by a P&T system.

7.4.2.1 Overall protection of human health and the environment

Construction of a KY Subtitle D cap over SWMU 7 burial cells addresses TCE/VOCs and Tc-99 potential for worker exposure to waste or contaminated soil. When combined with LUCs to ensure the covers are maintained and not breached, exposure pathways will be controlled. This remedy prevents TCE migration through the installation of a conventional groundwater P&T system.

7.4.2.2 Compliance with ARARs

Alternative 4 (P&T) would meet this threshold criterion for SWMU 7.

Action-specific ARARs for this alternative are summarized in Appendix F.

No chemical-specific ARARs have been identified.

A wetlands assessment would be performed prior to remedy implementation. Although it is not anticipated, if an action should involve discharge of dredge or fill material into waters of the United States, including jurisdictional wetlands, potential location-specific ARARs are summarized in Appendix F.

7.4.2.3 Long-term effectiveness and permanence

This alternative is designed to provide protection against exposure to surface soil, waste, and soil in close proximity to the waste and capture any mobile wastes leaving the SWMU. LUCs will ensure that the cap is not breached; thus, the remedy will maintain its effectiveness and permanence.

Magnitude of Residual Risk. This alternative effectively manages direct contact risk by extending the depth from the surface to the buried waste. Signs and the multilayer cap also inform the intruder of the potential dangers associated with direct contact to the waste and contaminated soil through physical and administrative LUCs.

This remedy includes groundwater treatment through installation of a conventional P&T system that will capture mobile COCs, namely TCE and its degradation products, prior to leaving the unit. Finally, groundwater monitoring will monitor remedy effectiveness at preventing COC migration from the unit.

Need for Five-Year Review. Because this remedy would not result in UU/UE conditions, five-year reviews would be required to ensure that the remedy remains protective.

Adequacy and reliability of controls. The physical and administrative LUCs listed in this remedy are adequate to meet threshold criteria. The physical controls to protect from direct contact require a low degree of maintenance to maintain adequacy. Administrative controls also would ensure protectiveness. However, a higher degree of long-term O&M of the groundwater extraction system would be required.

7.4.2.4 Reduction of toxicity, mobility, or volume through treatment

This alternative reduces toxicity, mobility, or volume through treatment by capturing and treating mobile COCs, namely TCE and its degradation products, potentially leaving the unit by operation of a P&T system.

PTW. PTW, namely TCE (including degradation products) present in the UCRS as DNAPL and/or high-concentration soil contamination, would be treated through installation and operation of a P&T system.

7.4.2.5 Short-term effectiveness

The short term effectiveness of Alternative 4 (P&T) is high because it largely leaves waste undisturbed, thus workers have no contact with the waste. Implementation includes some small potential for worker exposure to contaminated surface soils and groundwater during environmental sampling and construction.

Protection of Community during Remedial Actions. Implementation of Alternative 4 (P&T) has low potential for impact to the community during remedial action because the wastes are not exposed.

Protection of Workers during Remedial Actions. Implementation of Alternative 4 (P&T) will involve remediation worker exposure to surficial soil contamination during consolidation of surface soils prior to cap placement. Potential exposure pathways include inhalation of dust containing surficial soils, dermal contact with surficial and subsurface soils, exposure to external penetrating radiation associated with buried waste, and dermal contact with contaminated groundwater. Limited volumes of TCE would need to be managed as part of P&T operations. The risk from these potential exposures can be mitigated readily through engineering controls and implementing safe work practices.

Environmental Impacts. No ecological impacts at the BGOU are anticipated under this alternative. The BGOU is located at an active operational facility already disturbed by construction and operational activities and does not support any unique or significant ecological resources. No known archaeological or historical sites or T&E species would be impacted by this alternative. Risk assessment and mitigation for ecological receptors in nearby drainage ditches are within the scope of the Surface Water OU.

Time Frame to Achieve Protectiveness. Protectiveness for direct contact would be achieved upon cap completion. Groundwater protectiveness would be achieved when mobile COCs have migrated through the unit, and the SWMU no longer contributes to the RGA in such a manner that would cause an exceedance of RGs. For estimating purposes and based on modeling results, this period of 50 years is assumed.

7.4.2.6 Implementability

Implementation of this alternative is high because it uses standard construction methods, materials, and equipment that are available from vendors and contractors.

Ability to Construct and Operate Technology. All construction components of Alternative 4 (P&T) are highly implementable and consist of demonstrated technologies and standard construction methods, materials, and equipment; therefore, this alternative is highly implementable.

Reliability of Technology. All of the technologies employed in Alternative 4 (P&T) are highly reliable.

Ease of Undertaking Additional Remediation. The presence of the KY Subtitle D cap could impede additional remediation should it be undertaken (e.g., would increase the cost of a future excavation, etc.), but it would not prevent additional remediation.

Monitoring Considerations. Groundwater monitoring at SWMU 7 is made more complex because the SWMU overlies the Northwest Plume, so there would be impediments to the evaluation of groundwater monitoring data. The Northwest Plume is an upgradient source of both dissolved-phase TCE and Tc-99. In order to understand groundwater conditions, comparisons and statistical analysis of upgradient and downgradient wells would be performed.

Coordination with Other Agencies. The means and methods for coordinating with other agencies are established in the PGDP FFA. This remedy would not require involvement of new agencies.

Availability of Equipment and Specialists. All equipment and specialists are readily available.

7.4.2.7 Cost

Consistent with EPA guidance (EPA 2000), the cost estimates in this FS consist of a 1,000-year period due to the nature of the contaminants, including long-lived radionuclides. Net present value/worth cost estimates are presented for the individual and comparative analysis of alternatives and for remedy selection (EPA 1988). The real discount rate has been obtained from OMB guidance (reference Appendix C in OMB circular A-94). In addition, nondiscounted cost estimates (i.e., capital and average annual O&M) are presented for comparison purposes only.

Net Present Worth Cost	$37,116,000
Nondiscounted Cost	
• Capital Cost	$14,579,000
• Average Annual O&M Cost	$167,233

A significant cost savings could be realized if the Northwest Plume Pump-and Treat system is available to be considered for inclusion in the remedial action, thus eliminating the need to construct a new system.

Assumptions used to prepare cost estimates can be found in Appendix E.

7.4.3 Alternative 4 (ERH)—Cap, ERH, LUCs, and Monitoring

Alternative 4 (ERH) is described in Section 7.3.2.5 with additional implementation data included in Appendix E. Alternative 4 (ERH) controls direct contact to surface soils and wastes by placing a KY Subtitle D cap over the waste and through LUCs. Any remaining mobile wastes within SWMU 7, such as TCE, would be treated using ERH ground heating and an *ex situ* treatment train.

7.4.3.1 Overall protection of human health and the environment

Construction of a KY Subtitle D cap over SWMU 7 will reduce the potential for worker exposure to waste or contaminated soil and eliminate infiltration through the waste limiting COC migration. When combined with LUCs to ensure the covers are maintained and not breached, exposure pathways will be controlled. ERH treatment would remove PTW from SWMU 7 and be protective of groundwater for VOCs. Groundwater monitoring would provide an indirect protection, because monitoring contaminant migration allows for minimizing the potential for exposure to contaminated environmental media through early identification and avoidance.

7.4.3.2 Compliance with ARARs

Alternative 4 (ERH) would meet this threshold criterion for SWMU 7.

Action-specific ARARs for this alternative are summarized in Appendix F.

No chemical-specific ARARs have been identified.

A wetlands assessment would be performed prior to remedy implementation. Although it is not anticipated, if an action should involve discharge of dredge or fill material into waters of the United States, including jurisdictional wetlands, potential location-specific ARARs are summarized in Appendix F.

7.4.3.3 Long-term effectiveness and permanence

This alternative is designed to provide protection against exposure to waste in surface soils and treat PTW. Since the toxicity or volume of the remaining waste and contaminated environmental media associated with direct contact risks would remain near current levels and concentrations (assuming limited degradation and negligible natural attenuation of residual waste and contaminants), some direct contact risk would remain. The *in situ* VOC treatment component (ERH) would remove any PTW identified during the RDSI phase, along with other VOCs. The long-term effectiveness and permanence of this alternative for VOC source remediation, therefore, is high. Tc-99 would remain in place and would constitute a low risk in association with leaching to groundwater. Potential migration of Tc-99 to groundwater would be reduced by the KY Subtitle D cap that would limit infiltration of rain water.

LUCs would ensure the remedy maintains protectiveness.

Magnitude of Residual Risk. This alternative effectively manages direct contact risk by extending the depth from the surface to the buried waste. Signs and the multilayer cap inform the intruder of the potential dangers associated with direct contact to the waste and contaminated soil through physical and administrative LUCs.

This remedy includes groundwater treatment through ERH that would treat TCE and its degradation products. Additionally, monitoring would provide an indirect protection, because monitoring contaminant migration allows for minimizing the potential for exposure to contaminated environmental media through early identification and avoidance.

Need for Five-Year Review. Because this remedy would not result in UU/UE conditions, five-year reviews will be required to ensure that the remedy remains protective.

Adequacy and Reliability of Controls. The physical and administrative controls listed in this remedy are adequate to meet threshold criteria. The physical controls to protect from direct contact require a low degree of maintenance to maintain adequacy. Administrative controls also would ensure protectiveness.

7.4.3.4 Reduction of toxicity, mobility, or volume through treatment

Alternative 4 (ERH) will remove TCE/DNAPL sources and other VOCs present at the site; however, non-VOC shallow subsurface contaminants would remain in place.

PTW. PTW, namely TCE (including degradation products) present in the UCRS as DNAPL and/or high-concentration soil contamination, would be treated through installation and operation of ERH.

7.4.3.5 Short-term effectiveness

The short-term effectiveness of Alternative 4 (ERH) is moderate to high because it largely leaves waste undisturbed, thus workers have little contact with the waste. Operation of the ERH system includes the potential for worker exposure to high concentration TCE.

Protection of Community during Remedial Actions. Implementation of Alternative 4 (ERH) has low potential for impact to the community during remedial action because the wastes are not exposed.

Protection of Workers during Remedial Actions. Implementation of Alternative 4 (ERH) will involve remediation worker exposure to surficial soil contamination during consolidation of surface soils prior to cap placement. Potential exposure pathways include inhalation of dust containing surficial soils, dermal contact with surficial and subsurface soils, exposure to external penetrating radiation associated with buried waste, and dermal contact with contaminated groundwater. Limited volumes of TCE would need to be managed as part of ERH operations. The risk from these potential exposures can be mitigated readily through engineering controls and implementing safe work practices.

Implementation of Alternative 4 (ERH) also involves operation of an ERH system and the potential for direct contact with high concentration TCE. These risks also can be mitigated through engineering controls and implementation of safe work practices.

Environmental Impacts. No ecological impacts at the BGOU are anticipated under this alternative. The BGOU is located at an active operational facility already disturbed by construction and operational activities and does not support any unique or significant ecological resources. No known archaeological or historical sites or T&E species would be impacted by this alternative. Risk assessment and mitigation for ecological receptors in nearby drainage ditches are within the scope of the Surface Water OU.

Time Frame to Achieve Protectiveness. Protectiveness would be achieved at the completion of ERH treatment and cap installation. Monitoring suggests no significant Tc-99 impacts to RGA groundwater originating from SWMU 7; therefore, the presence of Tc-99 in surface soils at SWMU 7 should be a minor consideration in alternative selection. The potential for direct contact with radioactive and inorganic contaminants would be addressed by installation of the KY Subtitle D Cap. PTW and groundwater protection from VOCs would be met by ERH. Implementation of Alternative 4 (ERH) may take three-plus years to achieve.

7.4.3.6 Implementability

Overall implementability of this alternative for TCE/DNAPL source treatment using ERH is moderate.

Ability to Construct and Operate Technology. All construction components of Alternative 4 (ERH) are implementable, consisting of demonstrated technologies and standard construction methods, materials, and equipment. As previously discussed, uncertainty exists regarding the location of the TCE source and therefore the source treatment area. Should the source treatment area include metal or debris that would preclude the use of ERH, another thermal treatment, such as conductive heating or steam injection, could be substituted for ERH.

Implementation of these alternatives for TCE/DNAPL source treatment using ERH is feasible administratively and has been performed previously at PGDP. Recovered vapor would be treated to meet allowable emission levels prior to discharge.

Reliability of Technology. All of the technologies employed in Alternative 4 (ERH) are highly reliable. Additional investigation would be required to identify the source treatment area adequately.

Ease of Undertaking Additional Remediation. The presence of the KY Subtitle D cap could impede additional remediation should it be undertaken (e.g., would increase the cost of a future excavation, etc.), but it would not prevent additional remediation.

Monitoring Considerations. Groundwater monitoring at SWMU 7 is made more complex because the SWMU overlies the Northwest Plume, so there would be impediments to the evaluation of groundwater monitoring data. The Northwest Plume is an upgradient source of both dissolved-phase TCE and Tc-99. In order to understand groundwater conditions, comparisons and statistical analysis of upgradient and downgradient wells would be performed.

Coordination with Other Agencies. The means and methods for coordinating with other agencies are established in the PGDP FFA. This remedy would not require involvement of new agencies.

Availability of Equipment and Specialists. Equipment, personnel, and services required to implement this alternative are available commercially, but the field of experienced ERH vendors is limited. No additional development of these technologies would be required.

7.4.3.7 Cost

The cost to construct a KY Subtitle D cap and implement ERH is moderate to high. Consistent with EPA guidance (EPA 2000), the cost estimates in this FS consist of a 1,000-year period due to the nature of the contaminants, including long-lived radionuclides. Net present value/worth cost estimates are presented for the individual and comparative analysis of alternatives and for remedy selection (EPA 1988). The real discount rate has been obtained from OMB guidance (reference Appendix C in OMB circular A-94). In addition, nondiscounted cost estimates (i.e., capital and average annual O&M) are presented for comparison purposes only.

Net Present Worth Cost	$80,352,000
Nondiscounted Cost	
• Capital Cost	$66,164,000
• Average Annual O&M Cost	$156,333

Assumptions used to prepare cost estimates can be found in Appendix E.

7.4.4 Alternative 5 (P&T)—Excavation and Disposal, Pump-and-Treat, and LUCs

Alternative 5 (P&T) is described in Section 7.3.3.6, with additional implementation data included in Appendix E. This alternative would involve excavation to remove waste from the burial pits and the associated affected soils.

The excavation component of this alternative would include the following:

- RD and focused investigation to characterize and delineate TCE/DNAPL source(s), waste limits and surface soils;
- Excavation of buried materials and contaminated soils within the identified disposal cells;
- Excavation of identified surface soil hot spots;
- Excavation pit dewatering;
- Segregation, bulking, and consolidation of compatible waste groups;
- Confirmation and WAC sampling and analysis;
- Disposition of waste materials and affected soils; and
- Installation and operation of a P&T system for TCE removal.

Alternative 5 (P&T) would remove the potential for direct contact with wastes (e.g., uranium and other radionuclides, Total PAHs) and associated affected soils by excavation and disposal. This alternative also would remove risks associated with TCE/DNAPL sources removed through excavation and treatment.

7.4.4.1 Overall protection of human health and the environment

These alternatives will meet this threshold criterion. Potential short-term risks to remediation workers due to direct contact with the waste material are greater than some of the other alternatives evaluated for this SWMU. In addition, potential risks to the public and the environment as a result potential shipping and handling concerns should be considered for off-site shipments. These concerns are reduced for disposal in a potential OSWDF. These risks may be mitigated by proper engineering and administrative precautions, while achieving the long-term risk reduction.

Wastes and contaminated soils, including any TCE/DNAPL soil source, would be removed from the SWMU and disposed of in one or more appropriate disposal facilities, including a potential OSWDF.

7.4.4.2 Compliance with ARARs

Alternative 5 (P&T) would meet this threshold criterion for SWMU 7.

Action-specific ARARs for this alternative are summarized in Appendix F.

No chemical-specific ARARs have been identified.

A wetlands assessment would be performed prior to remedy implementation. Although it is not anticipated, if an action should involve discharge of dredge or fill material into waters of the United States, including jurisdictional wetlands, potential location-specific ARARs are summarized in Appendix F.

7.4.4.3 Long-term effectiveness and permanence

Excavation offers a high degree of long-term effectiveness and permanence because it removes the waste and associated soil and treats TCE and degradation products that may migrate from the unit.

Magnitude of Residual Risk. This alternative will remove waste and contaminated soil. If the remedy does not support UU/UE, a deed restriction contingent on property transfer that restricts residential use will be required.

The P&T component mitigates the uncertainty associated with potential migration from the unit.

Need for Five-Year Review. Depending on the degree of cleanup, a five-year review may be required to ensure that the remedy remains protective.

Adequacy and Reliability of Controls. The administrative LUCs controls listed in this remedy are adequate to meet threshold criteria. No physical controls are included in the alternative because waste and contaminated soil will be removed. Administrative controls would ensure protectiveness if UU/UE conditions are not met and LUCs are implemented. However, a higher degree of long-term O&M of the groundwater extraction system would be required.

7.4.4.4 Reduction of toxicity, mobility, or volume through treatment

Alternative 5 (P&T) would reduce or eliminate the mobility and volume of contaminants from the unit, including PTW, by removal and treatment. The toxicity of the residual soils would be reduced drastically and/or eliminated. Excavated materials would be segregated and treated on-site and/or off-site, reducing their toxicity and destroying selected COCs. The removal and disposal of waste and contaminated soil from an unlined burial cell containing COCs to an appropriate disposal facility prevents those contaminants from migrating to the groundwater. COCs that already have migrated to beneath the unit or to the RGA will be collected and treated, further reducing the toxicity through treatment.

PTW. PTW, namely TCE (including degradation products) present in the UCRS as DNAPL and/or high-concentration soil contamination would be excavated and disposed of or captured in the P&T system.

7.4.4.5 Short-term effectiveness

Protection of Community during Remedial Actions. Short-term risks to the community resulting from excavation activities at the SWMU are expected only as they relate to transport of excavated materials to off-site disposal locations. This risk would be reduced greatly by disposing of waste in a potential OSWDF.

Protection of Workers during Remedial Actions. Short-term exposures of workers to COCs could occur during implementation of Alternative 5 (P&T). Potential exposure pathways include inhalation of dust containing surficial soils, dermal contact with surficial and subsurface soils, exposure to external penetrating radiation associated with buried waste, and dermal contact with contaminated groundwater. Limited volumes of TCE would need to be managed as part of P&T operations. The risk from these potential exposures can be mitigated readily through engineering controls and implementing safe work practices.

Excavation and disposal would be conducted by trained personnel in accordance with work planning documents to maintain a work environment that minimizes injury or exposure to risks to human health or the environment.

Environmental Impacts. No ecological impacts at the BGOU are anticipated under this alternative. The BGOU is located at an active operational facility already disturbed by construction and operational activities and does not support any unique or significant ecological resources. No known archaeological or historical sites or T&E species would be impacted by this alternative.

Time Frame to Achieve Protectiveness. Protectiveness for direct contact would be achieved upon excavation completion. Groundwater protectiveness would be achieved when mobile COCs have migrated through the unit, and the SWMU no longer contributes to the RGA in such a manner that would cause an exceedance of RGs. For estimating purposes and based on modeling results, this period of 50 years is assumed.

7.4.4.6 Implementability

Ability to Construct and Operate Technology. Alternative 5 (P&T) is technically and administratively feasible and implementable. The maximum excavation will not exceed 20 ft bgs. At this depth, the equipment and technologies associated with implementation of this alternative have been proven to be feasible technically and are available from contractors or vendors. The implementability of construction-related activities during excavation at SWMU 7 subject to Alternative 5 (P&T) is very similar to that carried out routinely at other sites, so it is considered high. Likewise, sampling, analysis, transportation, and disposal at an approved location are performed routinely and, if properly implemented, are proven to be safe.

Additionally, installation of a P&T system is technically and administratively feasible and implementable as witnessed by the two existing PGDP P&T systems.

Reliability of Technology. All of the technologies employed in Alternative 5 (P&T) are highly reliable.

Ease of Undertaking Additional Remediation. None of the technologies employed in Alternative 5 (P&T) would impede additional remediation.

Monitoring Considerations. Monitoring during excavation will follow proven industrial hygiene and environmental monitoring practices. Monitoring of groundwater should not be necessary once the buried wastes and subsurface soils are removed.

Coordination with Other Agencies. The means and methods for coordinating with other agencies are established in the PGDP FFA. This remedy would not require involvement of new agencies.

Availability of Equipment and Specialists. All equipment and specialists are readily available.

7.4.4.7 Cost

Consistent with EPA guidance (EPA 2000), the cost estimates in this FS consist of a 1,000-year period due to the nature of the contaminants, including long-lived radionuclides. Net present value/worth cost estimates are presented for the individual and comparative analysis of alternatives and for remedy selection (EPA 1988). The real discount rate has been obtained from OMB guidance (reference Appendix C in OMB circular A-94). In addition, nondiscounted cost estimates (i.e., capital and average annual O&M) are presented for comparison purposes only.

The following costs are estimated for Alternative 5 (P&T). The first set of costs assumes that an OSWDF will not be available for disposal of SWMU 7 wastes. The second set of costs assumes that an OSWDF would be available.

	Without OSWDF Available	With OSWDF Available
Net Present Worth Cost	$172,389,000	$65,163,000
Nondiscounted Cost		
• Capital Cost	$163,150,000	$55,924,000
• Average Annual O&M Cost	$20,900	$20,900

Assumptions used to prepare cost estimates can be found in Appendix E.

7.4.5 Alternative 5 (ERH)—Excavation and Disposal, ERH, and LUCs

Alternative 5 (ERH) is described in Section 7.3.3.6 with additional implementation data included in Appendix E. This alternative would involve excavation to remove waste from the burial pits and the associated affected soils.

The excavation component of this alternative would include the following:

- RD and focused investigation to characterize and delineate TCE/DNAPL source(s), waste limits, and surface soils;
- Excavation of buried materials and contaminated soils within the identified disposal cells;
- Excavation of identified surface soil hot spots;
- Excavation pit dewatering;
- Segregation, bulking, and consolidation of compatible waste groups;
- Confirmation and WAC sampling and analysis;
- Disposition of waste materials and affected soils; and
- Installation and operation of ERH for TCE removal.

Assumptions for excavation, transportation, disposal, treatment, excavation dewatering, etc., for SWMU 7 can be found in Appendix E.

Alternative 5 (ERH) would remove the potential for direct contact wastes and associated affected soils by excavation and disposal. This alternative also would remove risks associated with TCE/DNAPL sources removed through excavation and ERH treatment.

7.4.5.1 Overall protection of human health and the environment

These alternatives will meet this threshold criterion. Potential short-term risks to remediation workers due to direct contact with the waste material are greater than some of the other alternatives evaluated for this SWMU. In addition, potential risks to the public and the environment as a result of potential shipping and handling concerns should be considered for off-site shipments. These concerns are reduced for disposal in a potential OSWDF. These risks may be mitigated by proper engineering and administrative precautions, while achieving the long-term risk reduction.

Wastes and contaminated soils, including any TCE/DNAPL soil source, would be removed from the SWMU and disposed of in one or more appropriate disposal facilities, including a potential OSWDF.

7.4.5.2 Compliance with ARARs

Alternative 5 (ERH) would meet this threshold criterion for SWMU 7.

Action-specific ARARs for this alternative are summarized in Appendix F.

No chemical-specific ARARs have been identified.

A wetlands assessment would be performed prior to remedy implementation. Although it is not anticipated, if an action should involve discharge of dredge or fill material into waters of the United States, including jurisdictional wetlands, potential location-specific ARARs are summarized in Appendix F.

7.4.5.3 Long-term effectiveness and permanence

Excavation offers a high degree of long-term effectiveness and permanence because it removes the waste and associated soil and treats TCE and other COCs that may migrate from the unit.

Magnitude of Residual Risk. This alternative will remove waste and contaminated soil. If the remedy does not support UU/UE, a deed restriction contingent on property transfer that restricts residential use will be required.

The ERH component mitigates the uncertainty associated with potential migration from the unit below the excavation.

Need for Five-Year Review. This remedy may not result in UU/UE conditions. If not, five-year reviews will be required to ensure that the remedy remains protective.

Adequacy and Reliability of Controls. The administrative LUCs controls listed in this remedy are adequate to meet threshold criteria. No physical controls are included in the alternative because waste and contaminated soil will be removed. Administrative controls would ensure protectiveness, if UU/UE conditions are not met and LUCs are implemented.

7.4.5.4 Reduction of toxicity, mobility, or volume through treatment

Alternative 5 (ERH) would reduce or eliminate the mobility and volume of contaminants from the unit, including PTW, by removal and treatment. The toxicity of the residual soils would be reduced drastically and/or eliminated. Excavated materials would be segregated and treated on-site and/or off-site, reducing their toxicity and destroying selected COCs. The removal and disposal of waste and contaminated soil from an unlined burial cell containing COCs to an appropriate disposal facility prevents those contaminants from migrating to the groundwater. COCs that already have migrated to beneath the unit or to the RGA will be collected and treated, further reducing the toxicity through treatment.

PTW. TCE would be removed either through excavation or capture in the ERH system.

7.4.5.5 Short-term effectiveness

Protection of Community during Remedial Actions. Short-term risks to the community resulting from excavation activities at the SWMU are expected only as they relate to transport of excavated materials to off-site disposal locations. This risk would be reduced greatly by disposing of waste in a potential OSWDF.

Protection of Workers during Remedial Actions. Short-term exposures of workers to COCs could occur during implementation of Alternative 5 (ERH). Potential exposure pathways include direct contact with soil (ingestion, inhalation) and exposure to external penetrating radiation. Worker risks are not expected to exceed acceptable limits because exposure frequency and duration are lower than those evaluated in the baseline risk assessment and will be subject to health and safety protocols. To protect workers, PPE, ambient conditions monitoring, and decontamination protocols would be used in accordance with an approved, site-specific HASP. Short-term effectiveness is moderate for Alternative 5 (ERH).

Excavation and disposal would be conducted by trained personnel in accordance with work planning documents to maintain a work environment that minimizes injury or exposure to risks to human health or the environment.

Environmental Impacts. No ecological impacts at the BGOU are anticipated under this alternative. The BGOU is located at an active operational facility already disturbed by construction and operational activities and does not support any unique or significant ecological resources. No known archaeological or historical sites or T&E species would be impacted by this alternative.

Time Frame to Achieve Protectiveness. Protectiveness for direct contact would be achieved upon excavation completion. Groundwater protectiveness would be achieved upon ERH completion, which could be completed in approximately 3 years from field mobilization.

7.4.5.6 Implementability

Ability to Construct and Operate Technology. Alternative 5 (ERH) is technically and administratively feasible and implementable. The maximum excavation will not exceed 20 ft bgs. At this depth, the equipment and technologies associated with implementation of this alternative have been proven to be feasible technically and are available from contractors or vendors. The implementability of construction-related activities during excavation at SWMU 7 subject to Alternative 5 (ERH) is very similar to that carried out routinely at other sites, so it is considered high. Likewise, sampling, analysis, transportation, and disposal at an approved location are performed routinely and, if properly implemented, are proven to be safe.

Additionally, installation of ERH is technically and administratively feasible and implementable as witnessed by the ERH projects being conducted at C-400 at PGDP.

Reliability of Technology. All of the technologies employed in Alternative 5 (ERH) are highly reliable.

Ease of Undertaking Additional Remediation. None of the technologies employed in Alternative 5 (ERH) would impede additional remediation.

Monitoring Considerations. Monitoring during excavation will follow proven industrial hygiene and environmental monitoring practices. Monitoring of groundwater should not be necessary once the buried wastes and subsurface soils are removed.

Coordination with Other Agencies. The means and methods for coordinating with other agencies are established in the PGDP FFA. This remedy would not require involvement of new agencies.

Availability of Equipment and Specialists. All equipment and specialists are readily available.

7.4.5.7 Cost

Consistent with EPA guidance (EPA 2000), the cost estimates in this FS consist of a 1,000-year period due to the nature of the contaminants, including long-lived radionuclides. Net present value/worth cost estimates are presented for the individual and comparative analysis of alternatives and for remedy selection (EPA 1988). The real discount rate has been obtained from OMB guidance (reference Appendix C in OMB circular A-94). In addition, nondiscounted cost estimates (i.e., capital and average annual O&M) are presented for comparison purposes only.

The following costs are estimated for Alternative 5 (ERH). The first set of costs assumes that an OSWDF will not be available for disposal of SWMU 7 wastes. The second set of costs assumes that an OSWDF would be available.

	Without OSWDF Available	With OSWDF Available
Net Present Worth Cost	$215,625,000	$108,398,000
Nondiscounted Cost		
• Capital Cost	$214,736,000	$107,509,000
• Average Annual O&M Cost	$10,000	$10,000

Assumptions used to prepare cost estimates can be found in Appendix E.

7.5 COMPARATIVE ANALYSIS OF ALTERNATIVES

Table 7.11 summarizes the detailed analysis conducted in Section 7.4. Table 7.12 provides a comparative analysis for source area alternatives for SWMU 7.

Table 7.11. Summary of SWMU 7 Detailed Analysis

	Alternative 1	**Alternative 4 (P&T)**	**Alternative 4 (ERH)**	**Alternative 5 (P&T)**	**Alternative 5 (ERH)**
Criteria	**No Action**	**Containment, P&T, LUCs, and Monitoring**	**Containment, ERH, LUCs, and Monitoring**	**Excavation and Disposal, P&T, and LUCs, Monitoring**	**Excavation and Disposal, ERH, and LUCs**
Overall Protection of Human Health and the Environment	Does not meet the threshold criterion.	Meets the threshold criterion.	Meets the threshold criterion.	Meets the threshold criterion.	Meets the threshold criterion.
Compliance with ARARs	No ARARs identified.	Meets the threshold criterion.	Meets the threshold criterion.	Meets the threshold criterion.	Meets the threshold criterion.
• Action-Specific ARARs	None	Alternative can meet all ARARs.	Alternative can meet all ARARs.	Alternative can meet all ARARs.	Alternative can meet all ARARs.
• Chemical-Specific ARARs	None	None identified.	None identified.	None identified.	None identified.
• Location-Specific ARARs	None	Wetlands survey will be performed. If wetlands are found, then location-specific ARARs will be met.	Wetlands survey will be performed. If wetlands are found, then location-specific ARARs will be met.	Wetlands survey will be performed. If wetlands are found, then location-specific ARARs will be met.	Wetlands survey will be performed. If wetlands are found, then location-specific ARARs will be met.
Long-Term Effectiveness and Permanence					
• Magnitude of Residual Risk	No action is taken; therefore, no change in residual risk.	Residual risk remains and protectiveness relies on continuation of LUCs selected as part of the CERCLA remedy. P&T remains active until RGs are met.	Residual risk remains and protectiveness relies on continuation of LUCs selected as part of the CERCLA remedy.	Risk is mitigated through excavation. If excavation does not result in UU/UE, a contingent deed restriction will be required.	Risk is mitigated through excavation. If excavation does not result in UU/UE, a contingent deed restriction will be required.
• Need for Five-Year Review	None	Five-year review needed.	Five-year review needed.	Five-year review likely because excavation will likely not result in UU/UE conditions for direct contact.	Five-year review likely because excavation will likely not result in UU/UE conditions for direct contact.

Table 7.11. Summary of SWMU 7 Detailed Analysis (Continued)

	Alternative 1	Alternative 4 (P&T)	Alternative 4 (ERH)	Alternative 5 (P&T)	Alternative 5 (ERH)
Criteria	**No Action**	**Containment, Pump-and-Treat, LUCs and Monitoring**	**Containment, ERH, LUCs and Monitoring**	**Excavation and Disposal, Pump-and-Treat, and LUCs**	**Excavation and Disposal, ERH, and LUCs**
• Adequacy and Reliability of Controls	None	The physical controls to protect from direct contact require little to no maintenance to maintain adequacy. Relies on continuation of LUCs selected as part of the CERCLA remedy.	The physical controls to protect from direct contact require little to no maintenance to maintain adequacy. Relies on continuation of LUCs selected as part of the CERCLA remedy.	Relies on continuation of LUCs selected as part of the CERCLA remedy.	Relies on continuation of LUCs selected as part of the CERCLA remedy.
Reduction of Toxicity, Mobility, or Volume through Treatment	None	P&T system remains operational until RGs are reached. Identified PTW treated.	ERH treats VOCs. Identified PTW treated.	Removed waste will be treated as needed to meet the receiving facilities' WAC requirements. Treatment (P&T) below excavation would achieve RGs. PTW will be removed.	Removed waste will be treated as needed to meet the receiving facilities' WAC requirements. Treatment (ERH) below excavation would achieve RGs. PTW will be removed.
Short-Term Effectiveness					
• Protection of Community during Remedial Actions	None	No significant impact to the community.	No significant impact to the community.	No significant impact to the community.	No significant impact to the community.

Table 7.11. Summary of SWMU 7 Detailed Analysis (Continued)

	Alternative 1	Alternative 4 (P&T)	Alternative 4 (ERH)	Alternative 5 (P&T)	Alternative 5 (ERH)
Criteria	**No Action**	**Containment, Pump-and-Treat, LUCs and Monitoring**	**Containment, ERH, LUCs and Monitoring**	**Excavation and Disposal, Pump-and-Treat and LUCs**	**Excavation and Disposal, ERH, and LUCs**
• Protection of Workers during Remedial Actions	None	Risks to workers largely due to heavy equipment operations associated with monitoring well installation. Risks can be mitigated through work control practices such as training, administrative controls, physical controls, and PPE.	Risks to workers largely due to heavy equipment operations associated with monitoring well installation. Risks can be mitigated through work control practices such as training, administrative controls, physical controls, and PPE.	Risk to workers largely due to heavy equipment operations associated with excavation. This alternative does place workers in contact with waste and contaminated soil during excavation, *ex situ* treatment, and waste packaging. Risks can be mitigated through work control practices such as training, administrative controls, physical controls, and PPE.	Risk to workers largely due to heavy equipment operations associated with excavation. This alternative does place workers in contact with waste and contaminated soil during excavation, *ex situ* treatment, and waste packaging. Risks can be mitigated through work control practices such as training, administrative controls, physical controls, and PPE.
• Environmental Impacts	None	No significant environmental impacts.	No significant environmental impacts.	No significant environmental impacts.	No significant environmental impacts.
• Time Frame to Achieve Protectiveness	N/A	50 years to achieve groundwater protectiveness.	Approximately 3 years from field mobilization.	50 years to achieve groundwater protectiveness.	Approximately 3 years from field mobilization.
Implementability					
• Ability to Construct and Operate Technology	N/A	All construction means and methods are proven technologies. Monitoring will follow established PGDP practices. P&T systems operating at PGDP.	All construction means and methods are proven technologies. Monitoring will follow established PGDP practices. ERH previously completed at PGDP.	All construction means and methods are proven technologies and routinely used at other DOE sites as well as in private industry. P&T systems operating at PGDP.	All construction means and methods are proven technologies and routinely used at other DOE sites as well as in private industry. ERH previously completed at PGDP.

Table 7.11. Summary of SWMU 7 Detailed Analysis (Continued)

	Alternative 1	Alternative 4 (P&T)	Alternative 4 (ERH)	Alternative 5 (P&T)	Alternative 5 (ERH)
Criteria	**No Action**	**Containment, Pump-and-Treat, LUCs and Monitoring**	**Containment, ERH, LUCs and Monitoring**	**Excavation and Disposal, Pump-and-Treat, and LUCs**	**Excavation and Disposal, ERH, and LUCs**
• Reliability of Technology	N/A	Technologies implemented are highly reliable and in common use.	Technologies implemented are highly reliable and in common use.	Technologies implemented are highly reliable and in common use.	Technologies implemented are highly reliable and in common use.
• Ease of Undertaking Additional Remediation	N/A	KY Subtitle D cap could impede additional remediation should it be undertaken, but it would not prevent additional remediation.	KY Subtitle D cap could impede additional remediation should it be undertaken, but it would not prevent additional remediation.	No features of this remedy would impede additional remediation.	No features of this remedy would impede additional remediation.
• Monitoring Considerations	N/A	SWMU 7 is located over the Northwest Plume, so there would be impediments to the evaluation of groundwater monitoring data.	SWMU 7 is located over the Northwest Plume, so there would be impediments to the evaluation of groundwater monitoring data.	Monitoring of groundwater should not be necessary once the buried wastes and subsurface soils are removed.	Monitoring of groundwater should not be necessary once the buried wastes and subsurface soils are removed.
• Coordination with Other Agencies	Agency coordination will follow FFA. No new agencies involved.	Agency coordination will follow FFA. No new agencies involved.	Agency coordination will follow FFA. No new agencies involved.	Agency coordination will follow FFA. No new agencies involved.	Agency coordination will follow FFA. No new agencies involved.
• Availability of Equipment and Specialists	N/A	All equipment and specialists are readily available.	All equipment and specialists for cap construction are readily available. The pool of specialty subcontractors for ERH is limited.	All equipment and specialists are readily available.	All equipment and specialists for cap construction are readily available. The pool of specialty subcontractors for ERH is limited.

Table 7.11. Summary of SWMU 7 Detailed Analysis (Continued)

	Alternative 1	Alternative 4 (P&T)	Alternative 4 (ERH)	Alternative 5 (P&T)	Alternative 5 (ERH)
Criteria	**No Action**	**Containment, Pump-and-Treat, LUCs and Monitoring**	**Containment, ERH, LUCs and Monitoring**	**Excavation and Disposal, Pump-and-Treat, and LUCs**	**Excavation and Disposal, ERH, and LUCs**
Cost (without OSWDF available)					
• Net Present Worth Cost	$0	$37,116,000	$80,352,000	$172,389,000	$215,625,000
Nondiscounted Cost • Capital Cost • Average Annual O&M Cost	$0 $0	$14,579,000 $167,233	$66,164,000 $156,333	$163,150,000 $20,900	$214,736,000 $10,000
Costs Assuming Presence of an OSWDF					
• Net Present Worth Cost	N/A	N/A	N/A	$65,163,000	$108,398,000
Nondiscounted Cost • Capital Cost • Average Annual O&M Cost	N/A	N/A	N/A	$55,924,000 $20,900	$107,509,000 $10,000

Table 7.12. SWMU 7 Comparative Analysis

Criteria	Analysis
Overall Protection of Human Health and the Environment	• The No Action alternative does not meet the overall protection criterion. • All action alternatives meet the overall protection criterion.
Compliance with ARARs	
• Action-Specific ARARs	• No ARARs are identified for the no-action alternative. • All action alternatives can meet ARARs.
• Chemical-Specific ARARs	• No chemical-specific ARARs are identified for any of the alternatives.
• Location-Specific ARARs	• Implementation of all action alternatives will require that a wetlands survey be performed; If wetlands are found, then location-specific ARARs will be met.
Long-Term Effectiveness and Permanence	
• Magnitude of Residual Risk	• Alternatives 5 (P&T) and 5 (ERH) provide the greatest degree of residual risk reduction by removing the buried wastes and contaminated soils that exceed RGs and by using P&T/ERH to extract the TCE PTW source material. Alternative 5 (P&T) mitigates the uncertainty associated with the limited characterization of the TCE PTW source zone; Alternative 5 (ERH) would extract the TCE PTW source material from the source zone more aggressively to achieve RGs more quickly. • Alternatives 4 (P&T) and 4 (ERH) provide less residual risk reduction [i.e., less than Alternatives 5 (P&T) or 5 (ERH)] by leaving the buried waste and contaminated soils in place and mitigating risks to groundwater and direct contact with a KY Subtitle D cap. • Cleanup will achieve RGs. If Alternatives 5 (P&T) or Alternative 5 (ERH) does not support UU/UE, then a deed restriction would be implemented (contingent on property transfer) that restricts residential use. Alternatives 4 (P&T) and 4 (ERH) will not support UU/UE; LUCs would be implemented to restrict certain uses to ensure the remedy remains protective, and groundwater monitoring would be conducted.
• Need for Five-Year Review	• Alternatives 5 (P&T) and 5 (ERH) remove waste; therefore, five-year reviews may be required if remedy does not support UU/UE. • Alternatives 4 (P&T) and 4 (ERH) contain waste in place, and will not support UU/UE; therefore, five-year reviews would be necessary.
• Adequacy and Reliability of Controls	• Alternatives 5 (P&T) and 5 (ERH) remove waste to meet RGs; if these alternatives do not support UU/UE, then a deed restriction would be implemented (contingent on property transfer) that restricts residential use. • Alternatives 4 (P&T) and 4 (ERH) leave waste in place and therefore rely on LUCs to a greater degree than do Alternatives 5 (P&T) and 5 (ERH).

Table 7.12. SWMU 7 Comparative Analysis (Continued)

Criteria	Analysis
Reduction of Toxicity, Mobility, or Volume through Treatment	• All action alternatives extract and treat TCE. • Alternatives 5 (P&T) and 5 (ERH) remove waste and may require some treatment of wastes to meet the disposal facility WAC(s). • All action alternatives extract and treat TCE PTW source material for groundwater protection.
Short-Term Effectiveness	
• Protection of Community during Remedial Actions	• None of the action alternatives present significant impact to the community.
• Protection of Workers during Remedial Actions	• Alternatives 4 (P&T) and 4 (ERH) leave waste in place and do not place workers in contact with waste or contaminated soil. Protection of workers during implementation of these alternatives would largely entail protection against the physical hazards largely associated with heavy equipment operations during cap construction. • Alternatives 5 (P&T) and 5 (ERH) include excavation of the buried wastes and contaminated soils. Protection of workers during implementation of these alternatives is more complex because workers could be exposed during excavation and waste handling activities, but these hazards can be mitigated through work control practices such as engineering controls, physical controls, administrative controls, training, and PPE. Protection of workers during implementation of these alternatives also would entail protection against the physical hazards largely associated with heavy equipment operations. • All action alternatives include extraction and treatment of contaminated water. Protection of workers during implementation of water extraction and treatment can be mitigated through work control practices such as engineering controls, physical controls, administrative controls, training, and PPE.
• Environmental Impacts	• None of the action alternatives presents significant environmental impacts.
Implementability	
• Ability to Construct and Operate Technology	• All construction means and methods are proven technologies and routinely used at other DOE sites as well as in private industry. The following process options have been implemented at PGDP: ERH, P&T, capping, monitoring, and LUCs.
• Reliability of Technology	• The evaluated technologies are highly reliable and in common use.

Table 7.12. SWMU 7 Comparative Analysis (Continued)

Criteria	Analysis
• Ease of Undertaking Additional Remediation	• Alternatives 5 (P&T) and 5 (ERH) remove waste and the TCE source material. Any additional remediation activities would not be impacted. • Alternatives 4 (P&T) and 4 (ERH) leave buried waste and contaminated soil in place and remove TCE source material, so any additional remediation activities may be impacted by the presence of the waste/contaminants and/or the cap.
• Monitoring Considerations	• There are no impediments to monitoring implementation. • All action alternatives recognize the difficulties and limitations of monitoring in comingled plume conditions that exist at SWMU 7.
• Coordination with Other Agencies	• Agency coordination with EPA and KY will follow the FFA. No new agencies will be involved.
• Availability of Equipment and Specialists	• All equipment and specialists are commercially available.
Cost	The following analysis is based on the net present value costs (EPA 1988) for 1,000 years (EPA 2000). • The costs for Alternative 4 (P&T) ($37M) and Alternative 4 (ERH) ($80M) are much less than the costs for Alternative 5 (P&T) ($172M) and Alternative 5 (ERH) ($216M) without an OSWDF available. • If an OSWDF is available, the costs for Alternative 4 (P&T) ($37M) and Alternative 4 (ERH) ($80M) are less than the costs for Alternative 5 (P&T) ($65M) and Alternative 5 (ERH) ($108M), respectively. With or without an OSWDF available, the capital costs for Alternative 4 (P&T) and Alternative 4 (ERH) are less than the capital cost for Alternative 5 (P&T) and Alternative 5 (ERH), but the average annual O&M costs for Alternative 5 (P&T) and Alternative 5 (ERH) are less than the average annual O&M costs for Alternative 4 (P&T) and Alternative 4 (ERH).

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8. SWMU 30

Previous sections of this document present a framework that collects sitewide information and uses it to formulate a general approach to developing alternatives to address the COCs present in BGOU SWMUs 2, 3, 7 and 30. This framework also discusses key elements of the alternatives that are used as the basis for technology screening and development of SWMU-specific alternatives. This section (Section 8) of the document develops the candidate alternatives for SWMU 30 by expanding the general alternatives to address SWMU-specific conditions.

Section 8.1 presents SWMU-specific history and background, including a discussion of COCs summarized in Section 1.6 of this report. Section 8.2 presents SWMU-specific RAOs that were developed from the general RAOs in Section 2.2.2. Section 8.3 refines the general alternatives that were developed in Section 3.4 into SWMU-specific alternatives; this includes a detailed screening of the RPOs from Section 3 from effectiveness, implementability, and cost to identify SWMU-specific RPOs and define each SWMU-specific remedial alternative. Section 8.4 presents the individual detailed analysis for each SWMU-specific alternative using the nine CERCLA criteria. Finally, Section 8.5 presents the comparative analysis of the SWMU-specific alternatives.

8.1 SWMU 30 HISTORY AND BACKGROUND

SWMU 30 is located in the northwestern section of the PGDP secured area and includes the western one-third of C-747-A. It consists of a historical burn and burial cell (Burial Pit A) and is the location of a former incinerator. The SWMU is bounded on the north and south sides by ditches, on the west side by a plant road, and on the east side by SWMU 7 (Figure 7.1). The unit encompasses approximately 128,000 ft^2. Burial Pit A is reported to extend to a depth of 12 ft and is covered with 4 ft of earth. The land surface slopes gently with a slight mound over the burial cell. Grassy vegetation covers the ground, except where gravel roads extend through the site.

SWMU 30 was used from 1951 to 1970 to burn combustible trash, which may have contained uranium, including uranium in the form of metallic dust and shavings. An incinerator was constructed for use at SWMU 30, but the extent of its use is uncertain. The incinerator was a steel mesh, "tee pee" shaped structure primarily used to burn paper, wood, cardboard, and other combustibles. Ash and debris were buried belowground in Burial Pit A beginning in 1962, when use of the on-site incinerator was discontinued. It is assumed that ash from the incineration was buried at SWMU 30 rather than taken elsewhere at the site. Site maps and a surface electromagnetic geophysical survey of the Phase II SI identified the location of Burial Pit A. Prior to identification during Phase II SI surface geophysics testing, it was believed that remnants of the former incinerator were not present. Further research identified images of the incinerator at the location. This disposal site covers an area of about 250 ft by 50 ft. Geophysical data from the Phase II SI indicate that the actual area of excavation extends to the north and east beyond the rectangular outline shown on facility drawings. Material disposed of in Pit A included contaminated and uncontaminated trash, ash, and debris.

In addition to Pit A, the Phase II SI geophysical investigation also identified another anomaly in the shape of a rough circle approximately 43 ft in diameter. The SWMUs 7 and 30 RI confirmed that this anomaly likely was the metal reinforcement within the footer and retaining walls of the former incinerator and/or parts of the unit buried there upon decommissioning (DOE 1998a).

8.1.1 Nature and Extent of Contamination

This summary of nature and extent reflects the BGOU RI (DOE 2010b). Additional information can be found in Sections 1.5 and 1.6 of this report.

The information on the activities at SWMU 30 suggests potential sources of uranium and residuals from combustion of a variety of materials. No wastes have been identified as PTW at SWMU 30. SWMU 30 contains LLTWs.

The presence of waste-related impacts in surface and subsurface soils was characterized in the BGOU RI. Appendix A contains figures that show concentrations of chemicals of interest that exceed screening values. For direct contact pathways, surface soil impacts are shown in Figure A.10 and surface and subsurface (0–16 ft) in Figure A.11. Figure A.12 highlights locations where soils have levels of contaminants that potentially may migrate and impact RGA groundwater.

The soil sampling results indicate that one or more uranium isotopes were detected above background in each of the surface soil samples, approximately 60% of the samples in the interval from 1–20 ft, and not detected above background in any of the samples at depths greater than 20 ft. The uranium isotopes U-234, U-235/236, and U-238 are the only radionuclide contaminants at depths of 10 ft or less.

Concentrations are highest in surface soils, the maximum and average concentrations of U-238 decrease more than a factor of 10 in the interval from 1–20 ft. Np-237 and Pu-239 also were detected above background in surface soils; however, Pu-239 did not exceed the industrial worker NAL at any of these locations, while Np-237 exceeded in three locations. Similar to the distribution of radionuclides, some metals show a higher frequency of exceeding background concentrations in surface soils, occasionally present above screening values.

The history of the waste unit does not suggest significant contributions of VOCs would be present. The soil data showed one detection of TCE (0.0374 mg/kg at a depth of 30 ft) and one detection of 1,1-DCE (0.005 mg/kg at a depth of 60 ft).

In the four water samples collected from open boreholes in the UCRS within the SWMU boundary, TCE was not detected and is not present at concentrations above the MCL; however, the organics, TCE, benzene, and vinyl chloride, were detected above screening levels.

Of the organic analytes, only TCE was detected frequently above screening levels, in all four RGA groundwater MWs. The highest concentration of TCE within the RGA is at MW66, a well located along the eastern edge of SWMU 30; thus, it is not downgradient from the waste unit. Tetrachloroethene was detected at only one location, MW66, at 0.32 mg/L, which is above the screening level.

Total PAHs may be present associated with the combustion done at the site. Total PAHs were detected in 7 of 11 surface soil locations in concentrations from 0.002 to 12.5 mg/kg. Two of the 3 highest concentrations were in ditch samples at the southern boundary of the site. PAHs were detected in only 2 subsurface locations at concentrations below screening values. This pattern is similar to that of other chemicals of interest in that the greater residual concentrations at SWMU 30 remain near the surface.

Total PCBs were detected at the site, with the highest frequency of detection and concentrations in surface samples. Total PCBs were detected in 9 of 9 surface soil locations ranging from 26 to 15,000 µg/kg. They were not detected at depths greater than 20 ft.

Tc-99 is not known to be associated with activities at this SWMU, but was detected above background. Tc-99 was not detected above background in any samples collected at depths greater than 20 ft, and above background in only 1 of 10 samples collected at depths from 1–20 ft. There were four surface locations with Tc-99 above background; two of these that also had the highest concentrations were in the drainage ditch to the south of the site.

Tc-99 was not detected in any of the water samples collected from borings or MWs in the UCRS. The uranium isotopes U-234 and U-238 frequently exceeded screening levels in the SWMU 30 UCRS groundwater samples. RI screening of the sample analyses revealed nine metal contaminants in UCRS groundwater samples: arsenic, cadmium, iron, lead, manganese, molybdenum, nickel, uranium, and vanadium. All but cadmium were detected at levels exceeding screening criteria in 50% or more of the samples.

The RGA groundwater samples from SWMU 30 contained five metal contaminants: arsenic, iron, lead, manganese, and uranium. Radon-222 and Tc-99 were the most frequently detected radionuclide contaminants. The Tc-99 MCL was exceeded only in RGA well MW66, a well not located downgradient from the waste unit.

No McNairy groundwater data were available.

Depending on the originating source, the TCE could be a listed hazardous waste with one or more waste codes (F001, F002, or U228) and/or be a characteristic hazardous waste (D040), if generated by the response action. Any soils or wastes with PCB concentrations at or greater than 50 ppm would be regulated for disposal as TSCA PCB waste if generated by the response action. Excavated soil and/or debris from the burial grounds could be RCRA characteristic hazardous waste (e.g., toxicity for metals).

8.1.2 Risk Summary

This risk summary reflects the summary presented in the BGOU RI (DOE 2010b). Additional information can be found in Sections 1.5 and 1.6 of this report.

This FS addresses the current and potential future carcinogenic ELCRs and noncarcinogenic HIs posed by contaminants detected in soil as described in Sections 1.5 and 1.6 of this FS. This FS also addresses uncertainties and reviews data collected subsequent to completion of the BHHRA. For SWMU 30, the additional data collected for the BGOU RI primarily were collected at depths greater than 10 ft to better characterize potential releases from the source areas.

The primary uncertainty is associated with the threat from direct contact with the waste. As presented in the BGOU RI BHHRA, the source term is assumed to contain COCs at levels that pose an unacceptable risk under at least some future use scenarios. Unacceptable direct contact risks associated with COCs in soils accrue to future industrial and future excavation workers per the BHHRA. The COCs in soil to be addressed in this FS include those listed in Sections 1.5 and 1.6; however, Figures A.10 and A.11 identify locations where PRGs for HI and/or ELCR are exceeded.

The Tc-99 modeled concentration in RGA groundwater at the SWMU boundary was below the MCL (287 pCi/L). Two locations with concentrations above the screening level were identified in surface samples in an adjacent drainageway at locations subsequently covered. Further review of these data suggests migration of Tc-99 is not a potential threat to be addressed in this FS for this site. Tc-99 is potentially highly mobile; however, the distribution of Tc-99 at the SWMUs suggests vertical migration through the UCRS may be limited, and the Tc-99 in the RGA in the vicinity of SWMU 30 is sourced from upgradient.

- Similar to other BGOU sites, the highest concentrations and frequency of detection remain in samples collected in the 0–1 ft interval.

- Tc-99 was detected above background in only 1 of 20 subsurface soil locations.

- The site activities occurred 40–60 years ago. If Tc-99 present in these soils behaved consistently with expected mobility, it no longer would be a significant soil source to groundwater.

Drainageways are located adjacent to the site. Contamination present in surface soil at the SWMU has the potential to migrate to these drainageways via runoff. Additionally, while seeps have been observed at SWMU 30 multiple times, the WAG 22 SWMU 7 and 30 RI Report noted that, "…there is no evidence that contaminants from the waste burial pits are migrating through the subsurface to the north drainage ditch. However, because seeps have been observed, there is the uncertainty that future seeps could result in contamination migrating to the ditch" (DOE 1998a).

The SERA identified ecological COPCs in surface soils. Actions taken to address human health in this FS will reduce potential exposures to these ecological COPCs. Residual risks will be evaluated in a future baseline ecological risk assessment.

8.1.3 Hydrogeological Interpretation

The study area geology and hydrogeology are summarized below, as documented in the BGOU RI (DOE 2010b). Because SWMUs 7 and 30 are adjacent to each other, their hydrogeological interpretation is discussed as one.

Stratigraphy. As with other on-site SWMUs, the HU1 silt interval contains the burial cells of SWMUs 7 and 30. The base of HU1 is at a depth of 20 ft, approximately 8 ft below the deepest of the burial cells in SWMU 30. A single sand and gravel horizon, in a clay matrix, defines the underlying HU2 interval. The sand and gravel deposits commonly range between 5- and 10-ft thick. Silt and clay members, with a cumulative thickness of 20 to 35 ft, comprise the HU3 interval below SWMUs 7 and 30.

In the area of SWMUs 7 and 30, the RGA consists of an intermittent HU4 sand overlying 20 ft to 40 ft of the HU5 sand with gravel layers. The top of the RGA commonly occurs at depths of 45 ft to 60 ft.

UCRS Groundwater Flow and Hydraulic Potential. The SWMUs 7 and 30 RI (DOE 1998a) determined that a shallow water table exists approximately 5 ft bgs and within the burial cells. UCRS piezometer and well measurements document a strong downward gradient within the UCRS. The vertical downward hydraulic gradient is more than 10 times the lateral hydraulic gradient at SWMUs 7 and 30. This condition, along with lack of connectivity among shallow sand and gravel strata, leads to predominantly downward groundwater flow through the UCRS. These trends result in the dissolved contaminants from the burial grounds having the potential to migrate into the RGA.

The elevation of the water table is above the elevation of the ditches that bound SWMUs 7 and 30 on the north and south sides.[13] Seeps have been observed intermittently along the bank of the northern bounding ditch adjacent to SWMU 30 following heavy rains at certain times of the year, but seeps or flow into the ditch are not discernable under dry season conditions. These observations suggest that there is limited

[13] The bottom elevation of the ditches on the north and south sides of SWMUs 7 and 30, as well as well and piezometer measurements within SWMUs 7 and 30, provide control of the water table in those areas.

lateral flow through the UCRS silts and clays; however, groundwater can overflow lower-permeability matrix materials at locations where the burial cell walls are thin or missing. With the UCRS groundwater flow vector oriented steeply downward, the area generating an intermittent seep is limited to a thin border along the ditches.

RGA Groundwater Flow and Hydraulic Potential. The high-contamination core of the Northwest Plume passes beneath SWMU 30 and the west end of SWMU 7 in the RGA. RGA flow in SWMUs 7 and 30 is to the northwest, as defined by the plume orientation. The historical south wellfield of the Northwest Plume Pump-and-Treat system is located approximately 650 ft to the northwest of SWMU 7. A pumping test of EW231, an extraction well of the south wellfield, determined the hydraulic conductivity of the area RGA to be approximately 1,300 ft/day. In August 2010, the Northwest Plume Pump-and-Treat system was optimized by the installation and operation of two higher capacity extraction wells located north of SWMU 7, but east of EW231. EW232 and EW233 extract groundwater at approximately 110 gpm each. This optimization has changed the local flow direction of the RGA somewhat; however, all the RGA groundwater beneath SWMU 30 (as well as SWMU 7) is well within the capture zone of the Northwest Plume Pump-and-Treat system.

The TCE concentrations in MW66, located near the boundary between SWMUs 7 and 30, exhibit spikes in TCE concentrations that can be correlated with similar TCE spikes at MW248 in the south wellfield. Concentrations have been decreasing over time; however, the rate of decrease is obscured by the intermittent concentration spikes. The distance between the two wells (650 ft) that exhibit spiking behavior divided by the time lag between TCE "events" in MW66 and MW248 (6 months) would suggest the local groundwater flow rate is ~ 3.5 ft/day, if they have the same source for the spikes. Typical groundwater flow rates in the Northwest Plume are thought to range from 1 to 3 ft/day. The RGA groundwater flow velocity beneath SWMUs 7 and 30 is accelerated by groundwater extraction in the south wellfield, and the absolute direction of the local flow vectors have been modified by the Northwest Plume Pump-and-Treat system optimization.

8.2 SWMU-SPECIFIC RAOs

RAOs that are specific to SWMU 30 were developed based on the findings and observations from the BGOU RI Report. The SWMU-specific RAOs are directed toward conditions related to the waste materials and affected soils, the surface soils, and the subsurface soils at the SWMU.

Impacts to soils have been identified that pose unacceptable risks to future industrial and excavation workers. The waste materials remaining at SWMU 30 are assumed to pose risks equal to or exceeding those identified for direct contact to soils. No wastes have been identified as PTW at SWMU 30. No soil impacts are identified that will result in impacts to the RGA groundwater that would limit future residential use.

SWMU-Specific RAO for Protection of Direct Contact with Waste. Prevent exposure to waste that exceeds target cumulative ELCRs and cumulative noncancer HIs for the future industrial and future excavation worker receptors. The acceptable cumulative risk levels for this RAO are defined as follows:

- Waste: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future excavation worker [considering a five-year exposure duration based on the outdoor worker scenario in the 2013 Risk Methods Document (DOE 2013a)].

SWMU-Specific RAO for Protection of Direct Contact with Contaminated Soils. Prevent exposure to contaminated soils that exceeds target cumulative ELCRs and cumulative noncancer HIs for the future industrial and future excavation worker receptors. The acceptable cumulative risk levels for this RAO are defined as follows:

- Surface Soil: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future industrial worker [considering default exposures in the 2013 Risk Methods Document (DOE 2013a)].

- Surface and Subsurface Soil: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future excavation worker [considering a five-year exposure duration based on the outdoor worker scenario in the 2013 Risk Methods Document (DOE 2013a)].

The PRGs identified for target COCs to be addressed in this FS for protection of future industrial workers and excavation workers at SWMU 30 are listed in Table 8.1.

Table 8.1. PRGs for SWMU 30

COC	Units	PRG for Surface Soil[a]	PRG for Subsurface Soil[b]	PRG for Subsurface Soil for Groundwater Protection[c]
1,1-DCE	mg/kg	N/A	N/A	1.46E-01
TCE	mg/kg	N/A	N/A	1.03E-01
Total PAHs[e]	mg/kg	2.51E-01	2.51E-01	N/A
Total PCBs	mg/kg	1.00E+01[d]	1.00E+01[d]	N/A
Uranium[f]	mg/kg	7.83E+02	4.31E+02	7.83E+02
Np-237	pCi/g	2.61E-01	N/A	N/A
Tc-99	pCi/g	N/A	N/A	2.12E+01
U-234	pCi/g	3.06E+02	2.18E+02	4.88E+06
U-235	pCi/g	9.20E+00	1.21E+01	5.07E+04
U-238	pCi/g	3.74E+01	4.53E+01	2.64E+02

N/A = not applicable, these analytes are not COCs for the referenced media for SWMU 30.
[a] PRGs for surface soil are taken from Table 1.21 of this report.
[b] PRGs for subsurface soil are taken from Table 1.22 of this report.
[c] PRGs for subsurface soil for groundwater protection are taken from Table 1.23 of this report.
[d] Determined during June 2009 BGOU FS scoping meeting.
[e] Direct contact PRGs are based on total carcinogenic PAHs. The groundwater protective PRG is based on values for benz(a)anthracene.
[f] Direct contact PRGs are based on uranium, soluble salts.

8.3 DEVELOPMENT OF SWMU-SPECIFIC ALTERNATIVES

General alternatives were assembled and screened in Section 3. For each GRA or technology identified in a general alternative, corresponding technologies and/or process options will be evaluated against the criteria of effectiveness, implementability, and cost for inclusion in a SWMU-specific alternative.

The general alternatives retained in Section 3 are shown in Table 8.2.

Table 8.2. SWMU 30 Retained General Alternatives

Alternative Number/Description	
1	No Action
3	Cap, LUCs, and Monitoring
5	Excavation, Disposal, Treatment, and LUCs

8.3.1 Alternative 1—No Action

The No Action alternative is defined in accordance with CERCLA and provides a baseline to which other alternatives can be compared. Under this alternative, no action would be taken to implement remedial activities for SWMU 30 or to reduce the potential hazard to human or ecological receptors.

COCs would not be treated under this alternative as no remedial actions would be performed.

8.3.2 Alternative 3—Containment, LUCs, and Monitoring

Under this alternative, a cap (RCRA Subtitle C or KY Subtitle D cap) will be designed and installed to prevent direct contact and significantly reduce infiltration of precipitation into buried wastes. Other containment technologies, such as hydraulic isolation, including vertical subsurface barriers and groundwater extraction, will be evaluated for inclusion on a SWMU-specific basis. Additionally, surface controls, monitoring, and LUCs will be evaluated.

The results of the SWMU-specific evaluation and a summary of the SWMU-specific alternative are shown in Section 8.3.2.5.

8.3.2.1 Containment

General Alternative 3 identified containment as a GRA. Caps, subsurface vertical barriers, and hydraulic isolation are containment technologies for which RPOs are evaluated for inclusion into a SWMU 30-specific alternative.

8.3.2.1.1 Caps

Effectiveness. Both the RCRA Subtitle C and KY Subtitle D caps are identified as RPOs. Both of these "caps" are effective at preventing surface water from migrating to the underlying waste. The RCRA Subtitle C cap, as recommended in EPA guidance, includes a 24-inch low permeable soil layer and a 20-mil geosynthetic membrane, which makes it a more robust cap than the KY Subtitle D cap in terms of infiltration reduction and intrusion prevention (EPA 1991b).

Implementability. Both the RCRA Subtitle C and KY Subtitle D caps use similar construction means and methods and both are highly implementable at SWMU 30.

Cost. A RCRA Subtitle C cap is more costly to install due to its increased low permeable layer thickness and the inclusion of a defined geosynthetic membrane. Long-term maintenance costs are equal for both caps.

Based on the evaluation factors of effectiveness, implementability, and cost, a KY Subtitle D cap is the RPO for caps. This evaluation takes into account that no PTW is identified at SWMU 30. Because no mobile PTW was disposed of at SWMU 30, the increased cost and layers of the RCRA Subtitle C is not merited.

Contaminated surface soils outside the cap area not meeting RGs would be consolidated under the KY Subtitle D cap prior to cap placement. These activities would be identified in the RAWP. Additionally, it is anticipated that a consolidated cap would be placed at SWMU 30 to cover the burn area and Burial Pit A. Additionally, the cap would be placed with the low permeable layer carrying to the ditch that runs parallel to and north of the SWMU. The placement of the cap and relocation of the ditch will mitigate the uncertainty of COCs migrating to the ditch. Finally, corner markers would be placed identifying the edge of the cap.

8.3.2.1.2 Subsurface vertical barriers

Specific subsurface vertical barrier process options will not be evaluated for inclusion at SWMU 30. Subsurface vertical barriers are not considered feasible because the wastes disposed of at the SWMU 30 area include contaminated and uncontaminated trash, ash, and debris believed to lie largely above the water table. Cap installation and ditch relocation mitigates the uncertainty of seeps. Installation of a subsurface vertical barrier does not improve protection of human health and the environment. Because of this, subsurface vertical barrier process options will not be considered any further, and an evaluation will not be performed.

8.3.2.1.3 Hydraulic isolation

Groundwater extraction is the sole process option for containment (hydraulic isolation). Hydraulic isolation is not considered feasible at SWMU 30 because it does not improve protection of human health and the environment commensurate with the cost. Because of this, an evaluation of hydraulic isolation will not be performed.

8.3.2.2 Surface controls

Section 2.4.3 identifies soil covers and riprap as RPOs.

Because this alternative includes a KY Subtitle D cap and LUCs to ensure protectiveness, no additional surface controls are necessary. Surface controls are evaluated for use in the event DOE transfers the property.

Effectiveness. Riprap is differentiated from soil covers in that riprap can be sized large enough so as not to be man-portable and, therefore, cannot readily be removed without the use of heavy equipment. Riprap may be left uncovered to provide a striking contrast to the surrounding area as a warning, or it may be covered with a vegetative cover.

Implementability. Both soil and riprap are readily available in the local market, and placement of each is readily implementable. Riprap would need to be placed on a bedding material (smaller aggregate) to slow infiltration. There is little difference in the long-term implementability between covers (vegetative) and riprap (exposed). A soil cover would need mowing to maintain the vegetative cover, while the exposed riprap would need periodic weeding to inhibit plant ingrown.

Cost. Riprap is a somewhat more expensive product to install initially because it requires a bedding material. Additionally, the thickness of the protective soil layer included in the KY Subtitle D cap would need to remain as a cap component. It cannot be replaced by riprap because the soil thickness is needed to act as an insulating layer to protect the low permeable layer from freezing. It is estimated that maintenance costs are equal.

Alternative 3 at SWMU 30 would include a KY Subtitle D cap, which includes multilayers that are distinctly different to the natural subsoils and provides greater depth to the buried waste. These aspects (thickness and distinct properties) of the cap are expected to provide protection of individuals from intrusion by alerting them that this is a man-made engineered cover over something that is potentially hazardous to human health and by making it more difficult to expose the buried waste. Therefore, additional surface controls are not needed and will not be included in the SWMU-specific alternative.

8.3.2.3 Land use controls

Consistent with Section 2.4.1, LUCs will be implemented at BGOU SWMUs where waste is left in place or source area-related contamination remains after active remediation that precludes UU/UE conditions.

Section 2.4.1.1 identifies the following LUCs to be evaluated on SWMU-specific and alternative-specific bases. This evaluation for SWMU 30, Alternative 3 is as follows.

Warning Signs. Warning signs provide a highly effective means to warn of the hazards of potential contaminant exposure. An initial sign installation is highly implementable; however, a drawback to signs is that they can be removed or defaced by vandals. This drawback negatively affects both the effectiveness and implementability of signs, but can be mitigated by constructing signs of vandal-resistant materials and that can be affixed to supporting structures in a manner so as to make them not readily removable by vandals. Overall, warning signs are viewed as having high effectiveness and high implementability at a low cost.

Fences. Fences can be an effective LUC to prevent access or intrusion and also are highly implementable as a first installation; however, as with signs, fences require significant long-term maintenance at a significant cost in order to ensure adequate long-term effectiveness. Also, fences can be readily defeated by an intruder with common hand tools. While the pairing of fences and warning signs does offer a minimal increase in effectiveness, it does not offset the increased cost due to the long-term maintenance that a fence requires.

For these reasons, fences will not be incorporated as a LUC in Alternative 3 at SWMU 30.

E/PP Program. The E/PP Program is a LUC administered by DOE's contractors at PGDP. It is an effective LUC for controlling potential personnel hazards related to trenching, excavation, and penetration greater than 6 inches into the earth, concrete, pavement, or walls, floors, and ceilings of buildings. This program will be maintained for as long as DOE or its contractor maintain an on-site presence at the PGDP. The E/PP Program has proved to be highly implementable and at a low cost.

Property Record Notice, Deed and/or Lease Restrictions, and Environmental Covenant. These administrative controls are described in Section 2.4.1.1 and all are effective means of ensuring protection under the reasonably anticipated industrial future land use. These proprietary controls help ensure the land use remains industrial. Additionally, any land use change would be identified through the five-year review process, per CERCLA 121(c), and DOE would be required to take appropriate measures to ensure the continued protection of human health and the environment under the changed land use. These administrative LUCs are highly implementable at a low cost.

Alternative 3 at SWMU 30, which leaves waste in place, will include the following LUCs, as described in Section 2.4.1.1. Specific implementation details would be further defined in the LUCIP.

- Warning signs
- E/PP Program
- Property record notices
- Deed and/or lease restrictions (contingent upon transfer)

- Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer

- CERCLA 120(h)

These administrative and physical controls together provide enhanced protection and afford a layered strategy that provides protection in different ways. Fences are not included as a LUC for this alternative at SWMU 30 because they offer limited additional effectiveness at increased cost when evaluated with the alternative's other physical means of preventing intrusion, such as KY Subtitle D cap and warning signs.

8.3.2.4 Monitoring

Conventional sampling and analysis of MWs is the identified RPO for the monitoring technology. This process option is an effective means of monitoring that protection of human health and the environment is maintained by the remedy.

The following paragraphs identify the objectives, schedules, reporting requirements, sampling strategies, and technologies for the groundwater monitoring program to ensure remedy effectiveness (DOE 1998c).

Objective. Because no releases/leaks have been detected from this SWMU, the objective of groundwater monitoring would be to detect and characterize any releases of hazardous constituents from the SWMU that may impact the uppermost aquifer adversely. This is sometimes referred to as detection monitoring. Samples would be collected periodically from the MWs and analyzed for specific indicator parameters and any other waste constituents or reaction products that could indicate that a release might have occurred.

Monitoring Schedule/Frequency. Monitoring would be performed annually, provided no indication of potential adverse environmental impacts to groundwater were detected.

Reporting Requirements. Results of SWMU 30 groundwater monitoring will be reported twice annually in the FFA Semiannual Report. These results will be evaluated for the triggers described below every five years in the CERCLA Five-Year Review.

Sampling Strategy—Monitoring Locations. One upgradient RGA MW and three downgradient RGA MWs would be sufficient to monitor for releases. The cost estimates assume construction of four new monitoring wells.

Sampling Strategy—Analytical Parameters. At a minimum, SWMU 30 MWs would be monitored for the COCs for the protection of groundwater determined in the FS. These contaminants are listed in Table 8.1 of this FS. Nationally recognized methods, where applicable (e.g., SW846, ASTM), would be used to analyze the groundwater samples.

Sampling Strategy—Monitoring Triggers. The following triggers may be used to determine whether adverse environmental impacts to groundwater associated with this SWMU have occurred.

- A statistically significant trend of any of the COCs or a significant change to other monitored parameters (e.g., pH, dissolved oxygen) within an individual MW.

- An increase in downgradient MW results above upgradient MW results (e.g., a statistically significant increase in the downgradient levels of any of the monitored constituents when compared to the upgradient levels).

Technologies. Standard technologies would be used to collect the groundwater samples and transport them to a suitable laboratory. As previously stated, nationally recognized methods would be used to analyze the groundwater samples. It is anticipated that contaminated surface soils outside the cap area not meeting RGs would be consolidated under the KY Subtitle D cap prior to cap placement. This consolidation would eliminate the need for subsequent surface water monitoring.

8.3.2.5 Summary of SWMU-specific alternative

Based upon the evaluation of process options for effectiveness, implementability, and cost specific to SWMU 30, the following SWMU-specific alternative has been assembled and will be brought forward for detailed analysis at SWMU 30. No further screening of alternatives is necessary because the alternative screening was performed following the assembly of general alternatives in Section 3.

- Alternative 3—Cap, LUCs, and Monitoring

Table 8.3 identifies the key features of this SWMU-specific alternative.

Table 8.3. Alternative 3 Components

General Response Action	Technologies	RPOs
Containment	Caps	KY Subtitle D cap
Monitoring	Groundwater Monitoring	Conventional groundwater monitoring
Land Use Controls	Physical Controls	Warning signs
	Administrative Controls	• E/PP Program • Property record notices • Deed and/or lease restrictions (contingent upon transfer) • Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer

Alternative 3 satisfies the first RAO. Potential for impacts to groundwater is mitigated through containment.

Alternative 3 satisfies the second RAO. A KY Subtitle D cap would be installed to contain waste in place. The risk of direct contact would be mitigated through layered controls.

- Contaminated surface soils outside the cap area would be consolidated under the cap prior to cap placement. The RDSI would include surface soil sampling to characterize the shallow soils (within the SWMU but outside the burial pit footprint) to identify the soils that exceed RGs.

- The KY Subtitle D cap forms a barrier to prevent infiltration and mitigate intrusion.

- Physical LUCs would provide warning at the site, and administrative LUCs would provide warning and mitigate potential exposure.

Additional details used for cost estimating purposes are presented in Table 8.4 and Appendix E.

Table 8.4. SWMU 30, Alternative 3 Key Cost Drivers and Key Assumptions

Alternative 3: Cap, LUCs, and Monitoring
CAPITAL COSTS
Surface Soil Consolidation • Consolidate surface soils under the cap area • Assumes 25% of SWMU area not under the cap (1,116 yd^3) to 2 ft bgs will be placed at the cap area prior to cap construction
Cap Construction • Relocate ditch and road to north of SWMU prior to cap construction • Assumed cap area is 57,350 ft^2 • KY Subtitle D cap layers consist of — Filter fabric or other approved material — 18-inch clay layer with a maximum permeability of 1E-07 cm/sec — 12-inch drainage layer with a minimum permeability of 1E-03 cm/sec — 36-inch vegetative soil layer • Four corner markers
Backfill • Assumes off-site commercial backfill source placed and compacted
Monitoring • Four MWs
ANNUAL COSTS
• Operation and Maintenance — Inspection—Quarterly — Mow cap—Semiannually — Replace signs—Every 30 years • Groundwater Monitoring — Monitor four wells — Assume annual well monitoring

8.3.3 Alternative 5—Excavation, Disposal, and LUCs

General Alternative 5 assembles RPOs from the removal and disposal GRAs. LUCs are evaluated and would be implemented if excavation does not result in UU/UE conditions.

8.3.3.1 Excavation

Using conventional excavation equipment, such as backhoes and trackhoes, is the RPO for the removal GRA at SWMU 30. This equipment is effective, implementable, and cost-effective for application at SWMU 30.

8.3.3.2 Disposal

Both on-site and off-site disposal of excavated waste and contaminated soils were identified as RPOs. Additionally, the existing C-746-U Landfill was identified as a RPO for nonhazardous wastes that meet the C-746-U Landfill WAC (including authorized limits).

Using the C-746-U Landfill is an effective location for disposal of nonhazardous wastes that meet the WAC, and its use should be evaluated in a disposal discussion. Additionally, both off-site and on-site disposal can be equally effective disposal means for the wastes generated through an excavation alternative.

The off-site waste disposal is currently implementable. Based on process knowledge of the SWMU 30 wastes and industry practices for disposal of such wastes, it is assumed that all SWMU 30-generated wastes would meet the WAC of either a commercial landfill or a federally owned facility, such as NNSS. The on-site disposal process option would be implementable only if an on-site facility is available at the time of excavation. Regarding cost, disposing of wastes on-site would be significantly cheaper than off-site disposal.

Based on the evaluation factors of effectiveness, implementability, and cost, this FS will carry both the off-site and on-site disposal process options forward with the assumption that both process options would be paired with use of the C-746-U Landfill. Disposal at a potential CERCLA OSWDF would be implementable only should one be constructed.

Should treatment be required in order to meet the disposal facility's WAC, treatment would be performed off-site with corresponding off-site disposal.

8.3.3.3 Land use controls

Consistent with Section 2.4.1, LUCs will be implemented at BGOU SWMUs where waste is left in place or source area-related contamination remains after active remediation that precludes unrestricted use. LUCs may be necessary at SWMU 30 if excavation does not allow for UU/UE use.

Section 2.4.1.1 identifies the following LUCs to be evaluated on SWMU-specific and alternative-specific bases. This evaluation for SWMU 30, Alternative 5, is as follows.

Warning Signs. Because the waste and contaminated soils would be excavated/removed and replaced with clean backfill, warning signs are unnecessary.

Fences. Because the waste and contaminated soils would be excavated/removed and replaced with clean backfill, fences are unnecessary.

E/PP Program. The E/PP Program is a LUC administered by DOE's contractors at PGDP. It is an effective LUC for controlling potential personnel hazards related to trenching, excavation, and penetration greater than 6 inches into the earth, concrete, pavement, or walls, floors, and ceilings of buildings. This program will be maintained for as long as DOE or its contractor maintain an on-site presence at the PGDP. The E/PP Program has proved to be highly implementable and at a low cost.

Property Record Notice. Because the waste and contaminated soils would be excavated/removed and replaced with clean backfill, a property record notice is unnecessary.

Deed and/or Lease Restrictions, and Environmental Covenant. These administrative controls are described in Section 2.4.1.1 and all are effective means of ensuring protection under the reasonably anticipated industrial future land use. These proprietary controls help ensure the land use remains industrial. Additionally, any land use change would be identified through the five-year review process, per CERCLA 121(c), and DOE would be required to take appropriate measures to ensure the continued protection of human health and the environment under the changed land use. These administrative LUCs are highly implementable at a low cost.

LUCs Summary. Alternative 5 at SWMU 30, which removes the source term but may not meet UU/UE conditions, will include the following LUCs, as described in Section 2.4.1.1 the E/PP program and a property record notice would not be necessary as the waste will be removed. Specific implementation details would be further defined in the LUCIP.

- Deed and/or lease restrictions (contingent upon transfer)
- Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer
- CERCLA 120(h)

These administrative and physical controls together provide enhanced protection and afford a layered strategy that provides protection in different ways. Physical controls are not included as a LUC for this alternative at SWMU 30 because the depth of any contaminants remaining in place is sufficiently deep that they offer limited additional effectiveness at increased cost.

8.3.3.4 Monitoring

Conventional sampling and analysis from MWs is the identified RPO for the monitoring technology. This process option is an effective means of monitoring that protection of human health and the environment is maintained by the remedy.

No mobile COCs are known to have been disposed of at SWMU 30. It is assumed that postexcavation groundwater monitoring would not be necessary and, therefore, groundwater monitoring would not be incorporated into the SWMU-specific alternative at SWMU 30.

8.3.3.5 Summary of SWMU-specific alternative

Based upon the evaluation of process options for effectiveness, implementability, and cost specific to SWMU 30, the following SWMU-specific alternative has been assembled and will be brought forward for detailed analysis at SWMU 30. No further screening of alternatives is necessary because the alternative screening was performed following the assembly of general alternatives in Section 3.

- Alternative 5—Excavation, Disposal, and LUCs

Table 8.5 identifies the key features of the SWMU-specific alternative.

While not specifically identified in this FS as a separate alternative, disposal costs also will be evaluated assuming that an OSWDF is available for use.

Table 8.5. Alternative 5, Excavation, Disposal, and LUCs

General Response Action	Technologies	Process Options
Removal	Excavators	Backhoes/trackhoes
Disposal	Landfill Disposal	Disposal based on waste stream-specific conditions, but will include off-site and on-site disposal facilities
LUCs	Administrative Controls	• E/PP Program • Deed and/or lease restrictions (contingent upon transfer) • CERCLA 120(h) • Environmental Covenant meeting the requirements of *KRS* 224.80-100 *et seq*. to be filed at the time of property transfer

Alternative 5 satisfies the first RAO. The potential for contamination of groundwater is mitigated through removal of the waste.

Alternative 5 satisfies the second RAO. It mitigates the potential for direct contact through removal.

Additional details used for cost estimating purposes are presented in Table 8.6 and Appendix E.

For Alternative 5, which removes waste, the potential for direct contact and the potential for groundwater contamination would be mitigated through removal.

Additional details used for cost estimating purposes can be found in Appendix E.

8.4 DETAILED ANALYSIS OF ALTERNATIVES

8.4.1 Alternative 1—No Action

The No Action alternative is defined in accordance with CERCLA and provides a baseline to which other alternatives can be compared. Under this alternative, no action is taken to implement remedial activities for SWMU 30 or to reduce the potential hazard to human or ecological receptors.

8.4.1.1 Overall protection of human health and the environment

No controls are included with the No Action alternative. Thus, this alternative does not meet the threshold criterion of protection of human health and the environment because the COCs remaining at the site pose an unacceptable threat under some future use scenarios, including an unrestricted future use. Although site controls existing outside of the remedy currently prevent a land use that would result in an unacceptable exposure, these controls are not established in a manner that would preclude future use that may pose an unacceptable risk.

8.4.1.2 Compliance with ARARs

No action-specific ARARs have been identified for Alternative 1, the No Action alternative.

8.4.1.3 Long-term effectiveness and permanence

Alternative 1 does not provide long-term effectiveness or permanence because under some future scenarios direct contact with wastes or contamination at levels above PRGs could occur. The alternative does not provide long-term controls to manage residual risk at this SWMU.

8.4.1.4 Reduction of toxicity, mobility, or volume through treatment

Alternative 1 does not reduce toxicity, mobility, or volume through treatment.

8.4.1.5 Short-term effectiveness

This alternative is not considered to be effective in the short-term because some potential exposure scenarios are not controlled sufficiently under all future use scenarios; however, there are no additional risks to workers, the public, or the environment incurred as a result of this alternative.

Table 8.6. SWMU 30, Alternative 5 Key Cost Drivers and Key Assumptions

Alternative 5: Excavation, Disposal, and LUCs

CAPITAL COSTS

Shoring

- No shoring included due to area of excavation
- Calculated volumes include slope

Excavation

- Dewatering
  - — Mobilize five frac tanks and temporary water treatment plant
- Pit A assumptions
  - — Excavation area of 100 ft × 250 ft
  - — Waste is covered by 4 ft of overburden
  - — Total depth of excavation would be 14 ft
- Burn area assumptions
  - — Excavation area of 75 ft × 75 ft
  - — Waste is covered by 4 ft of overburden
  - — Total depth of excavation would be 14 ft
- Surface Soils
  - — 25% of the surface area of the SWMU will be excavated to a depth of 2 ft

Transportation and Disposal Volumes (assuming OSWDF not available)

Waste Stream	Volume (*in situ*)	Assumed Disposal Pathway	Resulting Disposal Volumes
Pit A Overburden	925 bcy	Energy*Solutions* via rail in Super Sacks®	1,110 lcy
Pit A Overburden	2,778 bcy	C-746-U Landfill via trucks	3,334 lcy
Pit A Slope	305 bcy	Energy*Solutions* via rail in Super Sacks®	366 lcy
Pit A Slope	4043 bcy	C-746-U Landfill via trucks	4,852 lcy
Pit A Waste Cell	6,944 bcy	Energy*Solutions* via rail in Super Sacks®	8,333 lcy
Pit A Waste Cell	2,314 bcy	C-746-U Landfill via trucks	2,777 lcy
Burn Area	392 bcy	Energy*Solutions* via rail in Super Sacks®	470 lcy
Burn Area	1,176 bcy	C-746-U Landfill via trucks	1,411 lcy
Surface Soils	2,178 bcy	Energy*Solutions* via rail in Super Sacks®	2,614 lcy

Transportation and Disposal Volumes (assuming OSWDF available)

Waste Stream	Volume (*in situ*)	Assumed Disposal Pathway	Resulting Disposal Volumes
Pit A Overburden	925 bcy	WDA via trucks	1,110 lcy
Pit A Overburden	2,778 bcy	C-746-U Landfill via trucks	3,334 lcy
Pit A Slope	305 bcy	WDA via trucks	366 lcy
Pit A Slope	4043 bcy	C-746-U Landfill via trucks	4,852 lcy
Pit A Waste Cell	6,944 bcy	WDA via trucks	8,333 lcy
Pit A Waste Cell	2,314 bcy	C-746-U Landfill via trucks	2,777 lcy
Burn Area	392 bcy	WDA via trucks	470 lcy
Burn Area	1,176 bcy	C-746-U Landfill via trucks	1,411 lcy
Surface Soils	2,178 bcy	WDA via trucks	2,614 lcy

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8.4.1.6 Implementability

The No Action alternative can be implemented readily. If future remedial action is necessary, this alternative would not impede implementation of other remedial activities.

The ongoing public awareness program would require regular coordination with DOE, KY, and possibly with other governmental agencies.

8.4.1.7 Cost

The preliminary cost estimates for Alternative 1 serve as a baseline for comparison of the other remedial alternatives. These cost estimates are based upon FS-level scoping and are intended to aid with selection of a preferred alternative. There are no capital or O&M costs associated with Alternative 1.

8.4.2 Alternative 3—Cap, LUCs, and Monitoring

Alternative 3 is described in Section 8.3.2.5 with additional implementation data included in Appendix E. This alternative combines the design and installation of a Subtitle D cap with LUCs and monitoring. The components of the cap are detailed in Section 2.4. This cover limits exposure to wastes and contaminated media while also limiting infiltration of precipitation of surface water through the unit. As necessary, LUCs will be required to ensure that the cover is not breached.

8.4.2.1 Overall protection of human health and the environment

Construction of a KY Subtitle D cap over SWMU 30 would reduce the potential for worker exposure to waste or contaminated soil. When combined with LUCs to ensure the covers are maintained and not breached, exposure pathways will be controlled.

8.4.2.2 Compliance with ARARs

Alternative 3 would meet this threshold criterion for SWMU 30.

Action-specific ARARs for this alternative are summarized in Appendix F.

No chemical-specific ARARs have been identified.

A wetlands assessment would be performed prior to remedy implementation. Although it is not anticipated, if an action should involve discharge of dredge or fill material into waters of the United States, including jurisdictional wetlands, potential location-specific ARARs are summarized in Appendix F.

8.4.2.3 Long-term effectiveness and permanence

This alternative is designed to provide protection against exposure to waste, surface soil, and subsurface soil; thus, it is moderately to highly effective in regard to long-term effectiveness and permanence. Because the toxicity or volume of waste and contaminated environmental media is not expected to attenuate significantly, the LUCs will have to be maintained indefinitely to prevent unrestricted use of this facility; thus, there is some potential threat to long-term effectiveness associated with the challenge of maintaining LUCs indefinitely.

Magnitude of Residual Risk. This alternative effectively manages direct contact risk by extending the depth from the surface to the buried waste. Signs and the multilayer cap inform the intruder of the potential dangers associated with direct contact to the waste and contaminated soil through physical and administrative LUCs.

Need for Five-Year Review. Because this remedy would not result in UU/UE conditions, five-year reviews would be required to ensure that the remedy remains protective.

Adequacy and Reliability of Controls. The physical and administrative controls listed in this remedy are adequate to meet threshold criteria. The physical controls to protect from direct contact require a low degree of maintenance to maintain adequacy. Administrative controls also ensure protectiveness.

8.4.2.4 Reduction of toxicity, mobility, or volume through treatment

Alternative 3 does not reduce toxicity, mobility, or volume through treatment. No PTW has been identified at SWMU 30.

8.4.2.5 Short-term effectiveness

The short-term effectiveness of Alternative 3 is moderate to high because it largely leaves waste undisturbed, thus workers have little contact with the waste.

Protection of Community during Remedial Actions. Implementation of Alternative 3 has low potential for impact to the community during remedial action because the wastes are not exposed.

Protection of Workers during Remedial Actions. Implementation of Alternative 3 will involve remediation worker exposure to surficial soil contamination during consolidation of surface soils prior to cap placement. Potential exposure pathways include inhalation of dust containing surficial soils, dermal contact with surficial and subsurface soils, exposure to external penetrating radiation associated with buried waste, and dermal contact with contaminated groundwater. The risk from these potential exposures can be mitigated readily through engineering controls and implementing safe work practices.

Environmental Impacts. No ecological impacts at the BGOU are anticipated under this alternative. The BGOU is located at an active operational facility already disturbed by construction and operational activities and does not support any unique or significant ecological resources. In fact, surface soil quality will improve upon implementation. No known archaeological or historical sites or T&E species would be impacted by this alternative. Risk assessment for ecological receptors in nearby drainage ditches is within the scope of the Surface Water OU.

Time Frame to Achieve Protectiveness. Protectiveness would be achieved at the completion of cap installation, which is estimated to be less than one year from field mobilization.

8.4.2.6 Implementability

Overall implementability of Alternative 3 is high.

Ability to Construct and Operate Technology. All construction components of Alternative 3 are implementable, consisting of demonstrated technologies and standard construction methods, materials and equipment.

Reliability of Technology. All of the technologies employed in Alternative 3 are highly reliable.

Ease of Undertaking Additional Remediation. None of the technologies employed in Alternative 3 would impede additional remediation.

Monitoring Considerations. SWMU 30 is located over a contaminant plume (i.e., the PGDP Northwest Plume), so there would be impediments to the evaluation of groundwater monitoring data. Statistical evaluations and trending would be used to identify any groundwater impacts that may be attributable to SWMU 30.

Coordination with Other Agencies. The means and methods for coordinating with other agencies are established in the PGDP FFA. This remedy would not require involvement of new agencies.

Availability of Equipment and Specialists. Equipment, personnel, and services required to implement this alternative are available commercially. No additional development of these technologies would be required.

8.4.2.7 Cost

Consistent with EPA guidance (EPA 2000), the cost estimates in this FS consist of a 1,000-year period due to the nature of the contaminants, including long-lived radionuclides. Net present value/worth cost estimates are presented for the individual and comparative analysis of alternatives and for remedy selection (EPA 1988). The real discount rate has been obtained from OMB guidance (reference Appendix C in OMB circular A-94). In addition, nondiscounted cost estimates (i.e., capital and average annual O&M) are presented for comparison purposes only.

Net Present Worth Cost	$10,863,000
Nondiscounted Cost	
• Capital Cost	$5,602,000
• Average Annual O&M Cost	$58,099

8.4.3 Alternative 5—Excavation and Disposal

Alternative 5 is described in Section 8.3.3.5 with additional implementation data included in Appendix E. Alternative 5 would remove risk from SWMU 30 through excavation and disposal; however, this alternative also relies on LUCs that would be implemented should excavation not result in UU/UE conditions.

8.4.3.1 Overall protection of human health and the environment

Alternative 5 would meet this threshold criterion. There are manageable potential short-term risks to remediation workers due to direct contact with the waste material, and inhalation hazards are much larger than any of the other alternatives evaluated for SWMU 30. In addition, there are manageable potential risks to the public and the environment that could result from shipping and handling of wastes sent off-site. Any exposure concerns are reduced for disposal in a potential OSWDF or at the C-746-U Landfill.

Waste and contaminated soil will be removed from the SWMU and disposed of in one or more appropriate disposal facilities, including a potential OSWDF, thus meeting all RAOs.

8.4.3.2 Compliance with ARARs

Alternative 5 would meet this threshold criterion.

Action-specific ARARs for this alternative are summarized in Appendix F.

No chemical-specific ARARs have been identified.

A wetlands assessment would be performed prior to remedy implementation. Although it is not anticipated, if an action should involve discharge of dredge or fill material into waters of the United States, including jurisdictional wetlands, potential location-specific ARARs are summarized in Appendix F.

8.4.3.3 Long-term effectiveness and permanence

Complete excavation offers the most effective and permanent management of contaminants because no wastes would remain in the SWMU. Waste and contaminated soils would be excavated to meet RGs.

Alternative 5 allows for potential risks associated with contaminants in SWMU 30 to be reduced or eliminated.

Magnitude of Residual Risk. The potential for direct contact with waste and surface soils will be eliminated since the primary source and associated contaminated soils will be removed; however, because less than 50% of the footprint is expected to be excavated, there is some uncertainty concerning whether there are buried wastes or affected soils in other locations within the SWMU boundary. This risk of other burial locations will be mitigated to a large degree by additional surface soil investigation performed during the RDSI and by defining the excavation area based on the results of previous geophysical investigations that identified the burial locations. Residual risk can be managed by administrative LUCs.

Need for Five-Year Review. This remedy may not result in UU/UE conditions. If not, five-year reviews would be required to ensure that the remedy remains protective.

Adequacy and Reliability of Controls. The administrative LUCs controls listed in this remedy are adequate to meet threshold criteria. No physical controls are included in the alternative because waste and contaminated soil will be removed. Administrative controls also would ensure protectiveness if UU/UE conditions are not met and LUCs are implemented.

8.4.3.4 Reduction of toxicity, mobility, or volume through treatment

Alternative 5 does not significantly reduce or eliminate the toxicity, mobility, or volume of contaminants through treatment. No PTW has been identified at SWMU 30.

8.4.3.5 Short-term effectiveness

Protection of Community during Remedial Actions. Short-term risks to the community resulting from excavation activities at the SWMU are not expected. Potential risks resulting from migration of airborne contaminants to off-site locations would be controlled as detailed in the RAWP. These alternatives, however, include a potential risk to site workers and the public from excavation and transportation of the wastes, soil, or liquids to disposal and/or treatment facilities. The risks to the public would be reduced greatly by disposing of waste in a potential OSWDF.

Protection of Workers during Remedial Actions. Short-term exposures of workers to COCs during implementation of Alternative 5 could occur. Worker risks are not expected to exceed acceptable limits because exposure frequency and duration are less than those evaluated in the BHHRA. Risks from handling waste/contaminated soils will be minimized through adherence to health and safety protocols.

To protect workers, PPE, ambient conditions monitoring, and decontamination protocols would be used in accordance with an approved, site-specific HASP.

The remedy would be effective immediately upon excavation for the excavated areas. Excavation, treatment, and disposal of residuals could be accomplished in approximately three years. Excavation and disposal would be conducted by trained personnel in accordance with standard radiological, engineering, and operational procedures, DSAs, HASPs, and safe work practices to maintain a work environment that minimizes injury or exposure to risks to human health or the environment.

Environmental Impacts. No ecological impacts at the BGOU are anticipated under this alternative. The BGOU is located at an active operational facility already disturbed by construction and operational activities and does not support any unique or significant ecological resources. Final backfill, cover soils, and vegetation will be improvements on existing conditions for ecological receptors. No known archaeological or historical sites or T&E species would be impacted by this alternative. Risk assessment and mitigation for ecological receptors in nearby drainage ditches is within the scope of the Surface Water OU.

Time Frame to Achieve Protectiveness. Protectiveness would be achieved at the completion of excavation, which is estimated to be approximately one year from field mobilization.

8.4.3.6 Implementability

Ability to Construct and Operate Technology. Alternative 5 is considered technically and administratively feasible and implementable. The equipment and technologies associated with implementation of this alternative have been proven to be feasible technically and are available from contractors or vendors. The implementability of construction-related activities during excavation and backfilling is very similar to that carried out routinely at other sites, so it is considered high.

Reliability of Technology. All of the technologies employed in Alternative 5 are highly reliable.

Ease of Undertaking Additional Remediation. None of the technologies employed in Alternative 5 would impede additional remediation.

Monitoring Considerations. SWMU 30 is located over a contaminant plume (i.e., the PGDP Northwest Plume), so there would be impediments to the evaluation of groundwater monitoring data. Statistical evaluations and trending would be used to identify any groundwater impacts that may be attributable to SWMU 30.

Coordination with Other Agencies. The means and methods for coordinating with other agencies are established in the PGDP FFA. This remedy would not require involvement of new agencies.

Availability of Equipment and Specialists. All equipment and specialists are readily available.

8.4.3.7 Cost

Consistent with EPA guidance (EPA 2000), the cost estimates in this FS consist of a 1,000-year period due to the nature of the contaminants, including long-lived radionuclides. Net present value/worth cost estimates are presented for the individual and comparative analysis of alternatives and for remedy selection (EPA 1988). The real discount rate has been obtained from OMB guidance (reference Appendix C in OMB circular A-94). In addition, nondiscounted cost estimates (i.e., capital and average annual O&M) are presented for comparison purposes only.

The following costs are estimated for Alternative 5. The first set of costs assumes that an OSWDF will not be available for disposal of SWMU 30 wastes. The second set of costs assumes that an OSWDF would be available.

	Without OSWDF Available	With OSWDF Available
Net Present Worth Cost	$45,066,000	$14,450,000
Nondiscounted Cost		
• Capital Cost	$44,177,000	$13,561,000
• Average Annual O&M Cost	$10,000	$10,000

Assumptions used to prepare cost estimates can be found in Appendix E.

8.5 COMPARATIVE ANALYSIS OF ALTERNATIVES

Table 8.7 summarizes the detailed analysis conducted in Section 8.4. Table 8.8 provides a comparative analysis for source area alternatives for SWMU 30.

Table 8.7. Summary of SWMU 30 Detailed Analysis

	Alternative 1	Alternative 3	Alternative 5
Criteria	**No Action**	**KY Subtitle D Cap, LUCs, and Monitoring**	**Excavation, Disposal, and LUCs**
Overall Protection of Human Health and the Environment	Does not meet the threshold criterion.	Meets the threshold criterion.	Meets the threshold criterion.
Compliance with ARARs	No ARARs identified.	Meets the threshold criterion.	Meets the threshold criterion.
• Action-Specific ARARs	None	Alternative can meet all ARARs.	Alternative can meet all ARARs.
• Chemical-Specific ARARs	None	None identified.	None identified.
• Location-Specific ARARs	None	Wetlands survey will be performed. If wetlands are found, then location-specific ARARs will be met.	Wetlands survey will be performed. If wetlands are found, then location-specific ARARs will be met.
Long-Term Effectiveness and Permanence			
• Magnitude of Residual Risk	No action is taken; therefore, no change in residual risk.	Residual risk remains and protectiveness relies on continuation of LUCs selected as part of the CERCLA remedy.	Risk is greatly diminished through excavation. If excavation does not result in UU/UE, a contingent deed restriction will be required.
• Need for Five-Year Review	None	Five-year review needed.	Five-year review would be necessary if excavation does not result in UU/UE conditions.
• Adequacy and Reliability of Controls	None	The physical controls to protect from direct contact require little to no maintenance to maintain adequacy. Relies on continuation of LUCs selected as part of the CERCLA remedy.	Relies on continuation of LUCs selected as part of the CERCLA remedy unless UU/UE conditions are met through excavation.
Reduction of Toxicity, Mobility, or Volume through Treatment	None No PTW identified.	None No PTW identified.	None anticipated; however, wastes would be treated if needed to meet WAC requirements. No PTW identified.

Table 8.7. Summary of SWMU 30 Detailed Analysis (Continued)

	Alternative 1	Alternative 3	Alternative 5
Criteria	**No Action**	**KY Subtitle D Cap, LUCs, and Monitoring**	**Excavation, Disposal, and LUCs**
Short-Term Effectiveness			
• Protection of Community during Remedial Actions	None	No significant impact to the community.	No significant impact to the community.
• Protection of Workers during Remedial Actions	None	Risks to workers largely due to heavy equipment operations associated with MW installation. Risks can be mitigated through work control practices such as training, administrative controls, physical controls, and PPE.	Risk to workers largely due to heavy equipment operations associated with excavation. This alternative does place workers in contact with waste and contaminated soil during excavation, *ex situ* treatment, and waste packaging. Risks can be mitigated through work control practices, such as training, administrative controls, physical controls, and PPE.
• Environmental Impacts	None	No significant environmental impacts.	No significant environmental impacts.
• Time Frame to Achieve Protectiveness	N/A	Less than one year from mobilization.	Approximately one year from field mobilization.
Implementability			
• Ability to Construct and Operate Technology	N/A	All construction means and methods are proven technologies. Monitoring will follow established PGDP practices.	All construction means and methods are proven technologies and routinely used at other DOE sites as well as in private industry.
• Reliability of Technology	N/A	Technologies implemented are highly reliable and in common use.	Technologies implemented are highly reliable and in common use.

Table 8.7. Summary of SWMU 30 Detailed Analysis (Continued)

	Alternative 1	Alternative 3	Alternative 5
Criteria	**No Action**	**KY Subtitle D Cap, LUCs, and Monitoring**	**Excavation, Disposal, and LUCs**
• Ease of Undertaking Additional Remediation	N/A	KY Subtitle D cap could impede additional remediation should it be undertaken, but it would not prevent additional remediation.	No features of this remedy would impede additional remediation.
• Monitoring Considerations	N/A	SWMU 30 is located over the Northwest Plume, so there would be impediments to the evaluation of groundwater monitoring data.	Groundwater monitoring would not be required following excavation.
• Coordination with Other Agencies	Agency coordination will follow FFA. No new agencies involved.	Agency coordination will follow FFA. No new agencies involved.	Agency coordination will follow FFA. No new agencies involved.
• Availability of Equipment and Specialists	N/A	All equipment and specialists are readily available.	All equipment and specialists are readily available.
Cost			
• Net Present Worth Cost	$0	$10,863,000	$45,066,000
Nondiscounted Cost • Capital Cost • Average Annual O&M • Cost	$0 $0	$5,602,000 $58,099	$44,177,000 $10,000
Costs Assuming Presence of an OSWDF			
• Net Present Worth Cost	N/A	N/A	$14,450,000
Nondiscounted Cost • Capital Cost • Average Annual O&M Cost	N/A	N/A	$13,561,000 $10,000

Table 8.8. SWMU 30 Comparative Analysis

Criteria	Analysis
Overall Protection of Human Health and the Environment	• The No Action alternative does not meet the overall protection criterion. • All action alternatives meet the overall protection criterion.
Compliance with ARARs	
• Action-Specific ARARs	• No action-specific ARARs are identified for the No Action alternative. • All action alternatives can meet ARARs.
• Chemical-Specific ARARs	• No chemical-specific ARARs are identified for any of the alternatives.
• Location-Specific ARARs	• Implementation of all action alternatives will require that a wetlands survey be performed. If wetlands are found, then location-specific ARARs will be met.
Long-Term Effectiveness and Permanence	
• Magnitude of Residual Risk	• Alternative 5 provides the greatest degree of residual risk reduction by removing the buried wastes and contaminated soils that exceed RGs. • Alternative 3 provides less residual risk reduction (i.e., less than Alternative 5) by leaving the buried waste and contaminated soils in place and mitigating risks to groundwater and direct contact with a KY Subtitle D cap. • Cleanup will achieve RGs. If Alternative 5 does not support UU/UE, then a deed restriction would be implemented (contingent on property transfer) that restricts residential use. Alternative 3 will not support UU/UE; LUCs would be implemented to restrict certain uses to ensure the remedy remains protective, and groundwater monitoring would be conducted.
• Need for Five-Year Review	• Alternative 5 removes waste; therefore, five-year reviews may be required if remedy does not support UU/UE. • Alternative 3 contains waste in place and will not support UU/UE; therefore, five-year reviews would be necessary.
• Adequacy and Reliability of Controls	• All remedies may rely on continuation of LUCs selected as part of the CERCLA remedy. Alternative 5 removes waste to meet RGs; if this alternative does not support UU/UE, then a deed restriction would be implemented (contingent on property transfer) that restricts residential use. • Alternative 3 leaves waste in place and, therefore, relies on controls to a greater degree than does Alternative 5.
Reduction of Toxicity, Mobility, or Volume through Treatment	• Neither Alternatives 3 nor 5 reduces the toxicity, mobility or volume through treatment. Alternative 5 may require that a limited amount of waste be treated to meet WAC requirements prior to disposal. • No PTW is identified at SWMU 30.

Table 8.8. SWMU 30 Comparative Analysis (Continued)

Criteria	Analysis
Short-Term Effectiveness	
• Protection of Community during Remedial Actions	• None of the action alternatives present significant impact to the community.
• Protection of Workers during Remedial Actions	• Alternative 3 leaves waste in place and does not place workers in contact with waste or contaminated soil. Protection of workers during implementation of this alternative largely would entail protection against the physical hazards mainly associated with heavy equipment operations during cap construction. • Alternative 5 includes excavation of the buried wastes and contaminated soils. Protection of workers during implementation of this alternative is more complex because workers could be exposed during excavation and waste handling activities, but these hazards can be mitigated through work control practices, such as engineering controls, physical controls, administrative controls, training, and PPE. Protection of workers during implementation of this alternative also would entail protection against the physical hazards largely associated with heavy equipment operations.
• Environmental Impacts	• None of the action alternatives presents significant environmental impacts.
Implementability	
• Ability to Construct and Operate Technology	• All construction means and methods are proven technologies and routinely used at other DOE sites as well as in private industry. The following process options have been implemented at PGDP: ERH, P&T, capping, monitoring, and LUCs.
• Reliability of Technology	• The evaluated technologies are highly reliable and in common use.
• Ease of Undertaking Additional Remediation	• Alternative 5 removes waste and contaminated soil, so any additional remediation activities would not be impacted. • Alternative 3 leaves buried waste and contaminated soil in place and includes construction of a cap, so any additional remediation activities may be impacted by the presence of the waste/contaminants and/or the cap.
• Monitoring Considerations	• Alternative 3 includes groundwater monitoring. There are no impediments to monitoring implementation; however, the difficulties and limitations of monitoring in commingled plume conditions that exist at SWMU 30 are recognized.
• Coordination with Other Agencies	• Agency coordination with EPA and KY will follow the FFA. No new agencies will be involved.

Table 8.8. SWMU 30 Comparative Analysis (Continued)

Criteria	Analysis
• Availability of Equipment and Specialists	• All equipment and specialists are available commercially.
Cost	The following analysis is based on the net present value costs (EPA 1988) for 1,000 years (EPA 2000). • The cost for Alternative 3 ($11M) is much less than the cost for Alternative 5 ($45M) without an OSWDF available. • The cost for Alternative 3 ($11M) is roughly equivalent to the cost for Alternative 5 ($14M) if an OSWDF is available. The capital cost for Alternative 3 is less than the capital cost for Alternative 5, but the average annual O&M cost for Alternative 5 is less than the average annual O&M cost for Alternative 3.

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APPENDIX A

INFORMATION SUPPORTING EVALUATION OF BGOU COCS

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CONTENTS

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FIGURES

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ACRONYMS

BGOU	Burial Grounds Operable Unit
BHHRA	Baseline Human Health Risk Assessment
COC	contaminant of concern
ELCR	excess lifetime cancer risk
FS	feasibility study
HI	hazard index
NAL	no action level
PGDP	Paducah Gaseous Diffusion Plant
PRG	preliminary remediation goal
RAO	remedial action objective
RI	remedial investigation
SADA	Spatial Analysis and Decision Assistance
SWMU	solid waste management unit

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A.1 INFORMATION SUPPORTING EVALUATION OF BURIAL GROUNDS OPERABLE UNIT CONTAMINANTS OF CONCERN

This appendix accompanies the *Feasibility Study for Solid Waste Management Units 2, 3, 7, and 30 of the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-1274&D2 (FS), which has been prepared to evaluate remedial alternatives for Solid Waste Management Units (SWMUs) 2, 3, 7, and 30 of the Burial Grounds Operable Unit (BGOU) at the Paducah Gaseous Diffusion Plant (PGDP). This appendix provides figures illustrating the distribution of contaminants of concern (COCs), including supporting data used to further address uncertainties that are referred to in discussions in other sections of this report. These data are the BGOU surface and subsurface soil results used to characterize potential releases from the waste. The soils data may not be representative of the contamination present within the units themselves. This FS addresses potential impacts from waste and affected media. The soil data presented in this appendix identify the potential additional volume of impacted media that will need to be addressed over and above the buried wastes. A comparison of sampling results to the range of background concentrations is provided in Attachment A1 to this appendix.

The figures in this appendix show where the target compounds to be addressed in this FS are at concentrations that exceed the preliminary remediation goals (PRGs) for direct contact (see Appendix C) and protection of groundwater (see Appendix B). The PRGs for direct contact are used to identify locations where actions may be required, with the general remedial action objectives (RAOs) set to meet the following targets for cumulative excess lifetime cancer risk (ELCR) and cumulative noncancer hazard index (HI) at the SWMUs.

- Surface Soil: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future industrial worker

- Surface and Subsurface Soil: Cumulative ELCR < 1E-05 and cumulative HI ≤ 1 for a future excavation worker

Attachment 2 to this appendix provides a comparison of soil concentrations to selected PRGs by Spatial Analysis and Decision Assistance layer.

The COCs for direct contact were identified in the Waste Area Grouping 22 Baseline Human Health Risk Assessment. The samples collected subsequent to completion of the BGOU Remedial Investigation are addressed in this FS by identifying those specific sample locations in which the target RAO is exceeded by comparing concentrations at these locations to no action levels and background (see Appendix C). This process was used to demonstrate that meeting PRGs is expected to allow the remedy to meet RAOs, identifying all locations where the RAO is exceeded and confirming that no additional chemicals in these additional data are needed to select the remedy. This concept was incorporated into development of the figures for SWMUs 2, 3, 7, and 30 to illustrate that the PRGs appropriately identify risks/hazards at these SWMUs.

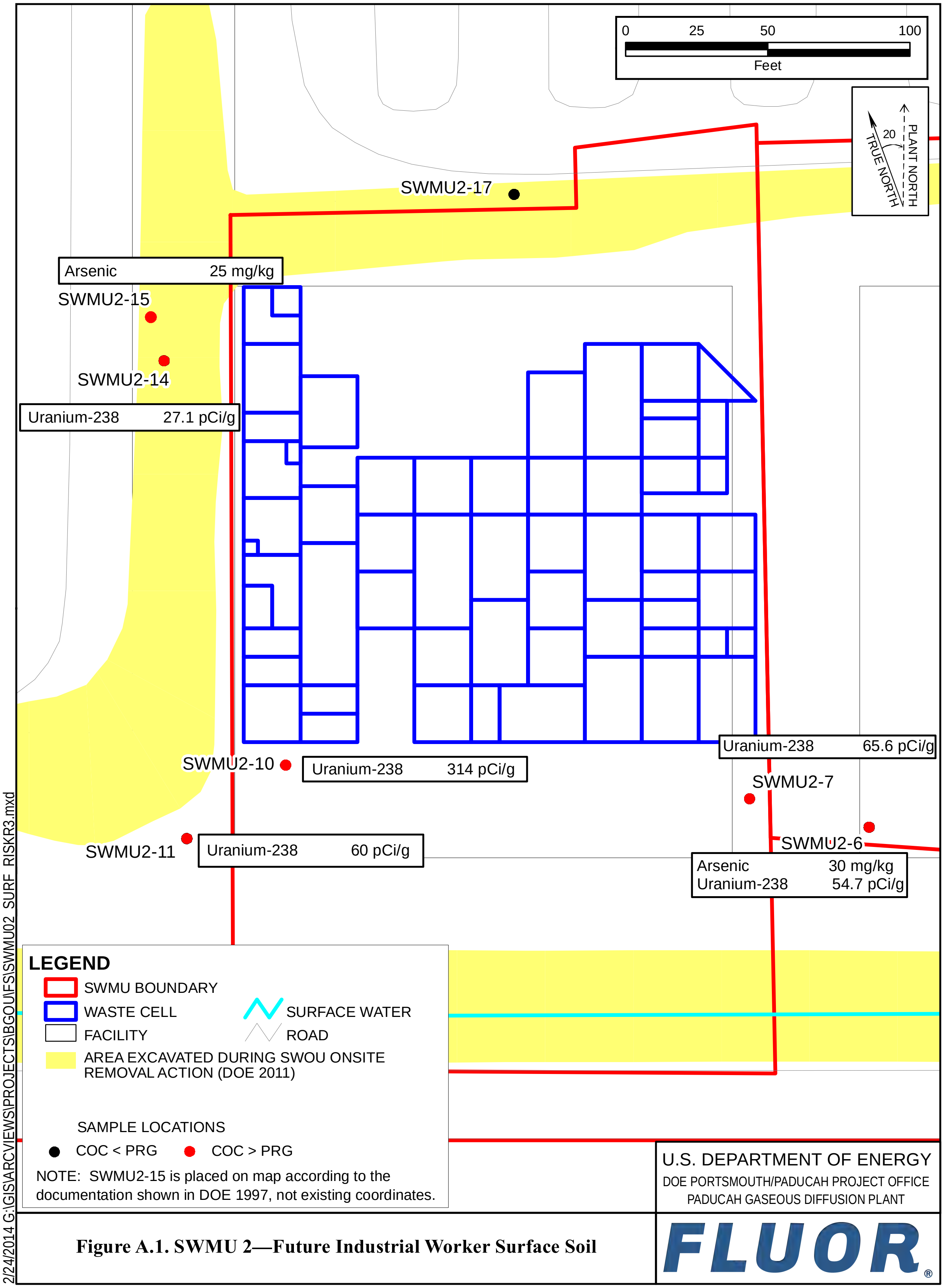

Figure A.1. SWMU 2—Future Industrial Worker Surface Soil

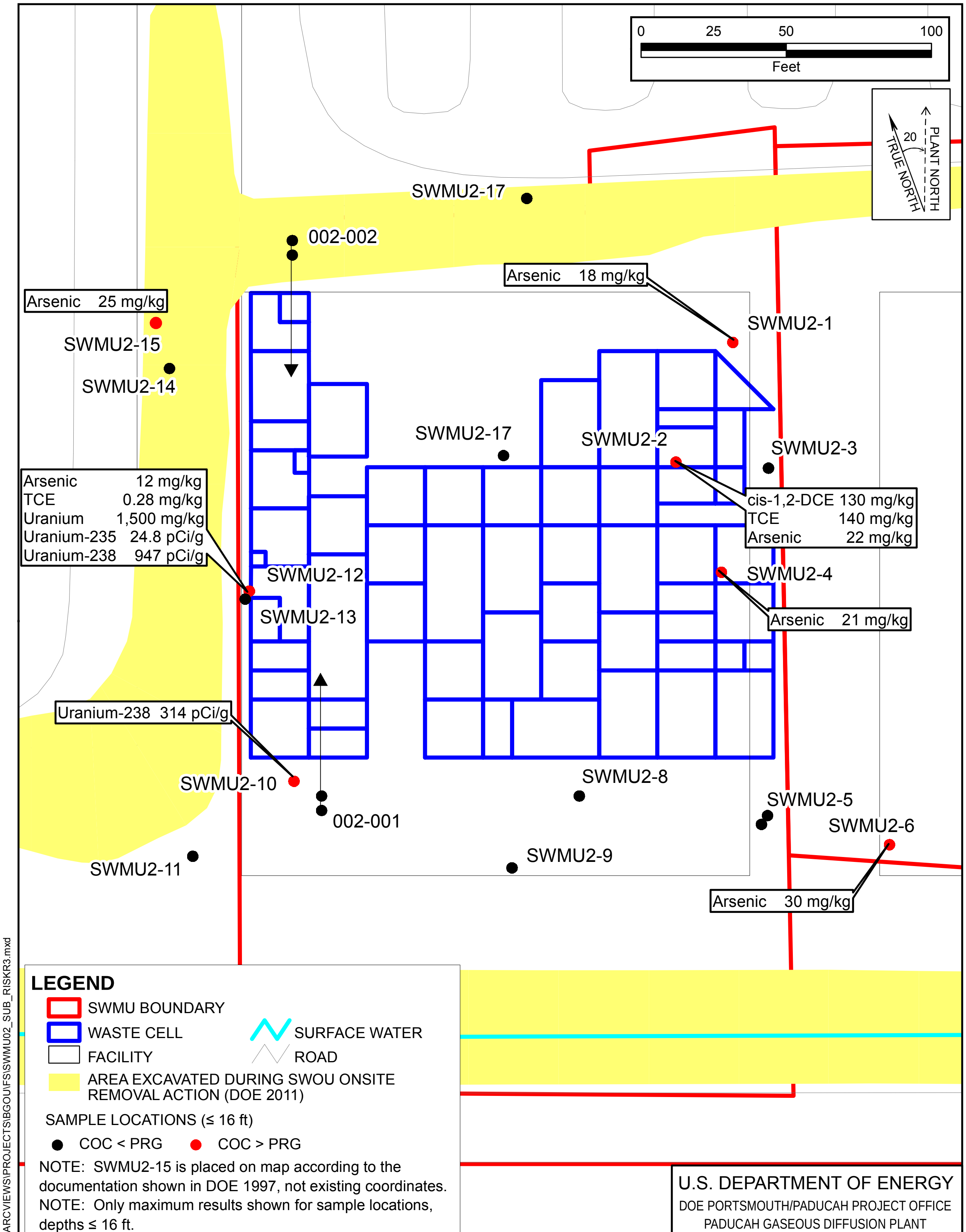

Figure A.2. SWMU 2—Future Excavation Worker Surface/Subsurface Soil

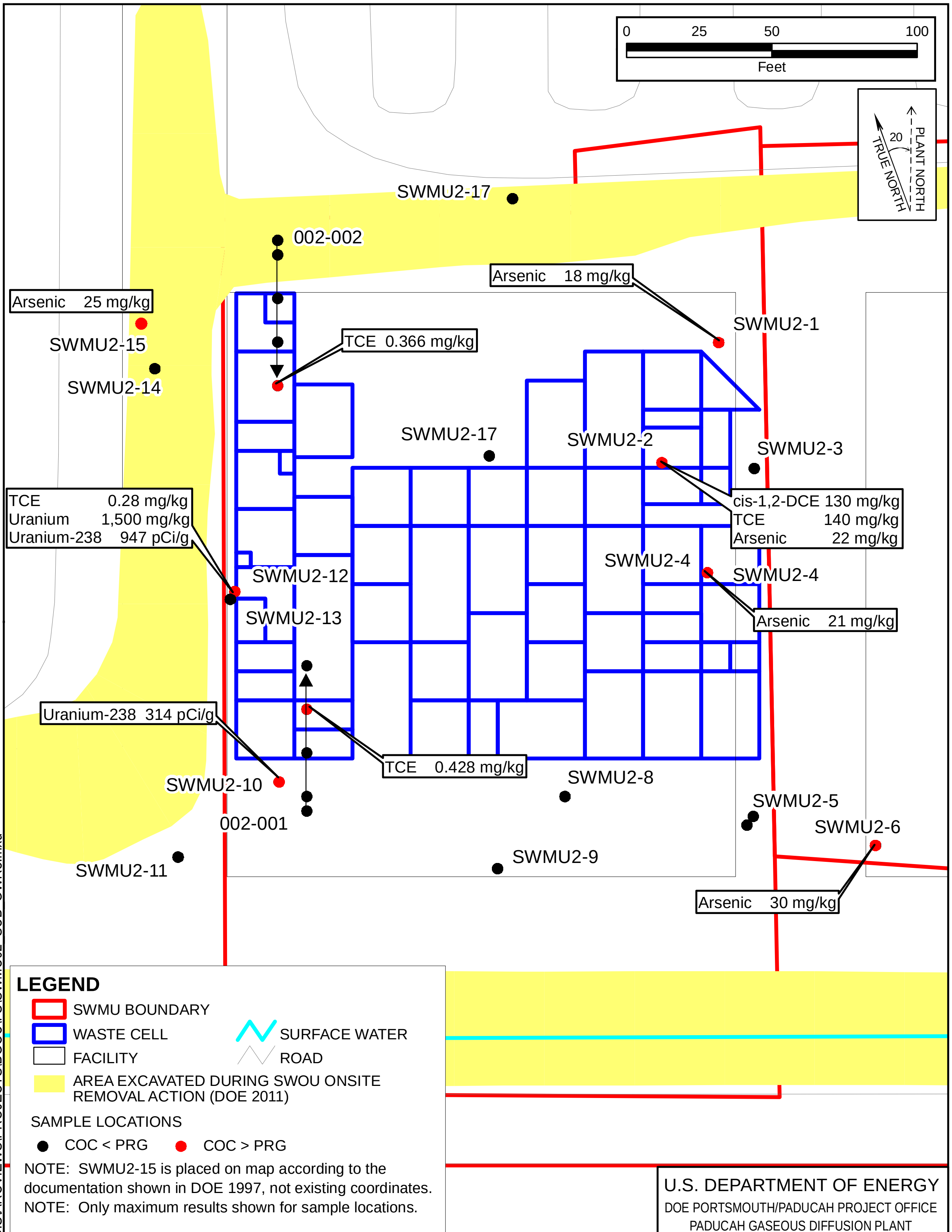

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Figure A.3. SWMU 2—Protection of Groundwater

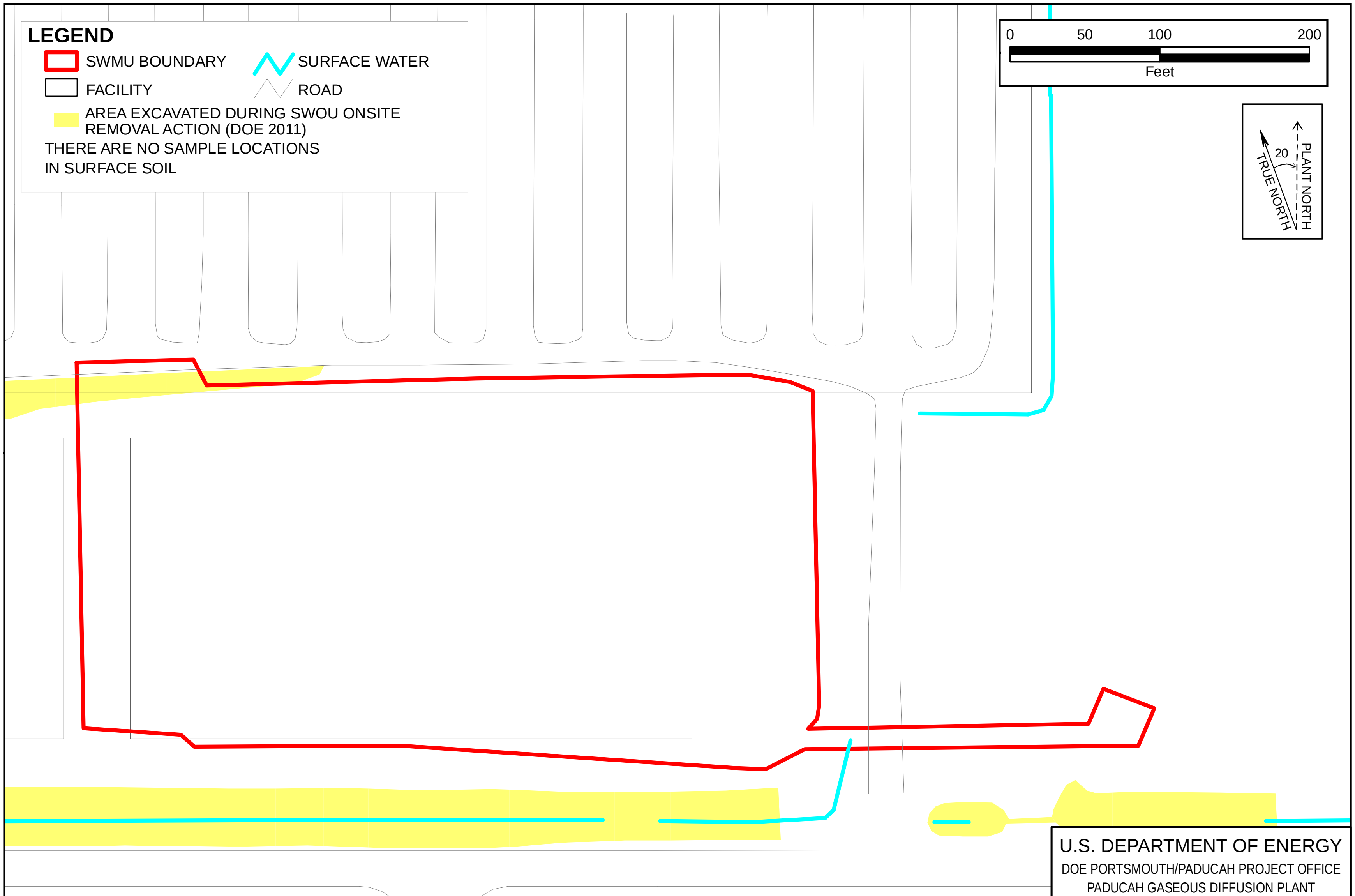

Figure A.4. SWMU 3—Future Industrial Worker Surface Soil

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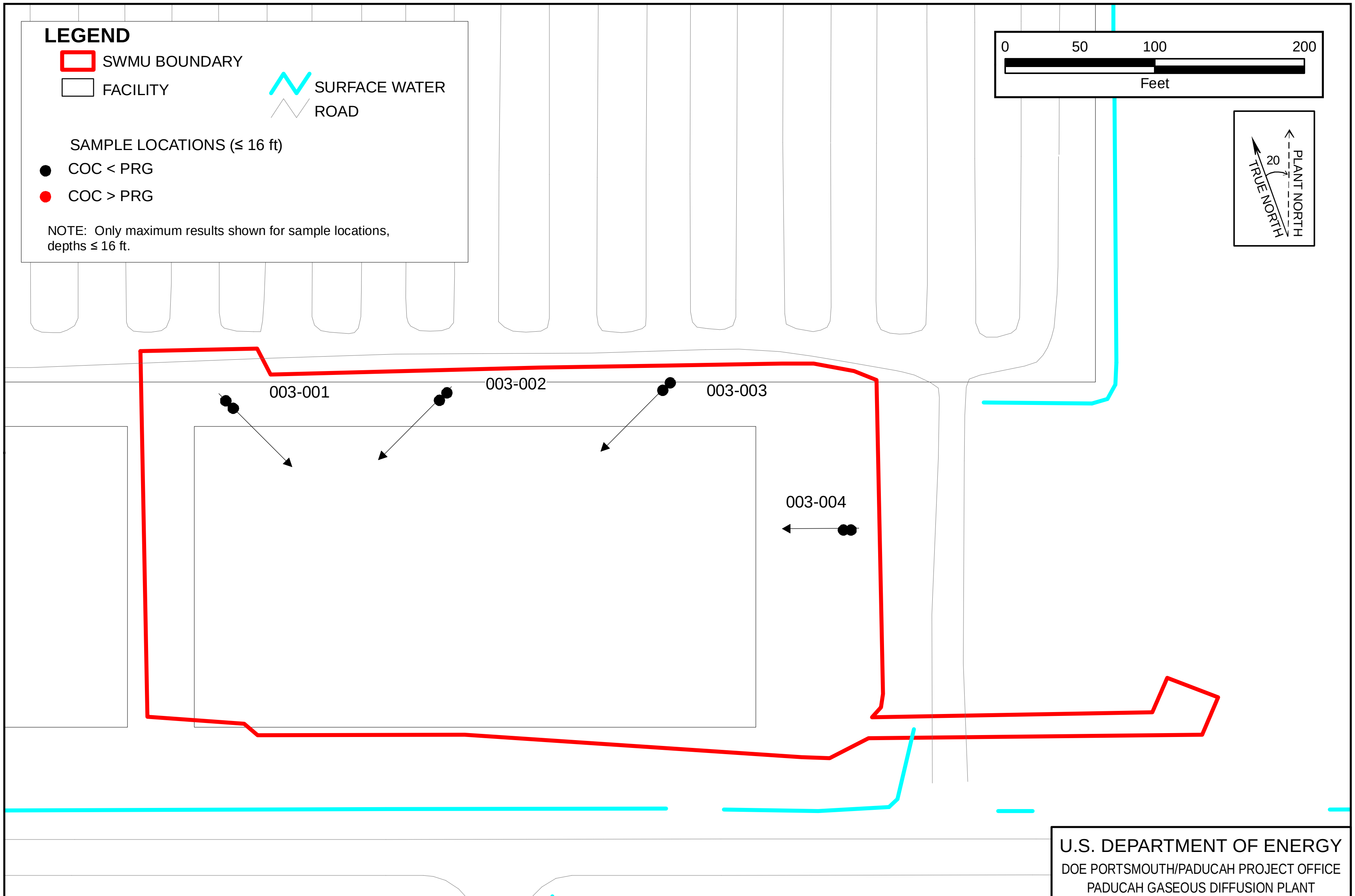

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Figure A.5. SWMU 3—Future Excavation Worker Surface/Subsurface Soil

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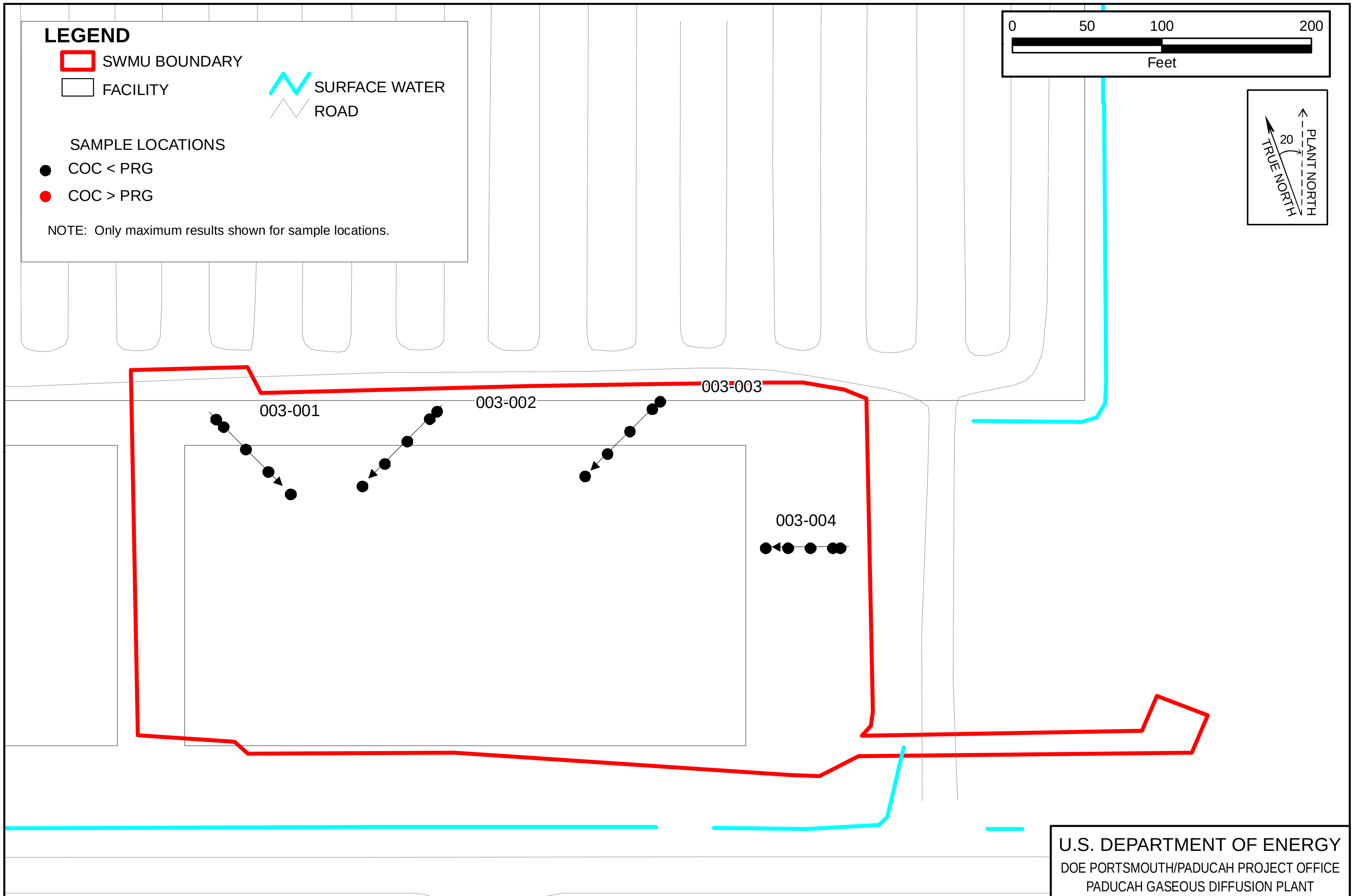

Figure A.6. SWMU 3—Protection of Groundwater

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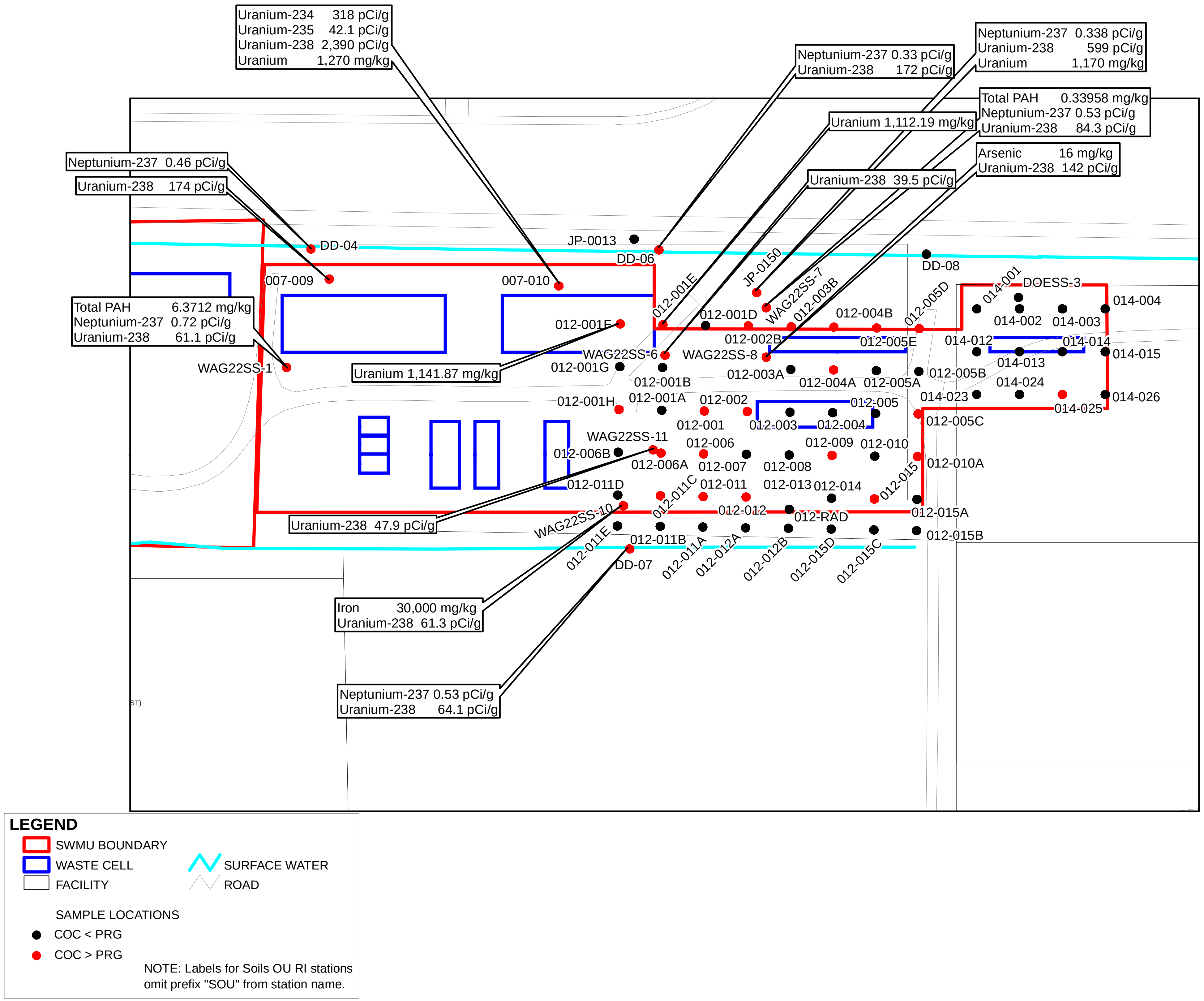

Soils OU RI Stations with Results > PRGs

012-001	Iron	31267.61	mg/kg
012-001E	Uranium	1112.19	mg/kg
012-001F	Uranium	1141.87	mg/kg
012-001H	Iron	107000	mg/kg
012-001H	Manganese	4380	mg/kg
012-002	Iron	44876.79	mg/kg
012-002B	Iron	41351.42	mg/kg
012-003B	Iron	31090.08	mg/kg
012-004A	Iron	39798.05	mg/kg
012-004B	Iron	34187.77	mg/kg
012-005C	Mercury	7.39	mg/kg
012-005D	Mercury	8.8	mg/kg
012-005E	Iron	29925.04	mg/kg
012-006	Iron	38334.43	mg/kg
012-006A	Iron	29348.08	mg/kg
012-009	Iron	45914.29	mg/kg
012-009	Uranium	1197.28	mg/kg
012-010	Iron	46490.48	mg/kg
012-010A	Arsenic	85.9	mg/kg
012-010A	Iron	42200	mg/kg
012-011	Iron	32013.88	mg/kg
012-011C	Iron	30999.05	mg/kg
012-012	Iron	29045.67	mg/kg
012-015	Cobalt	17.5	mg/kg
012-015	Iron	28200	mg/kg
012-015	Uranium	1379.58	mg/kg
012-015	Uranium-238	117	pCi/g
014-025	Iron	29680.63	mg/kg

0 50 100 200
Feet

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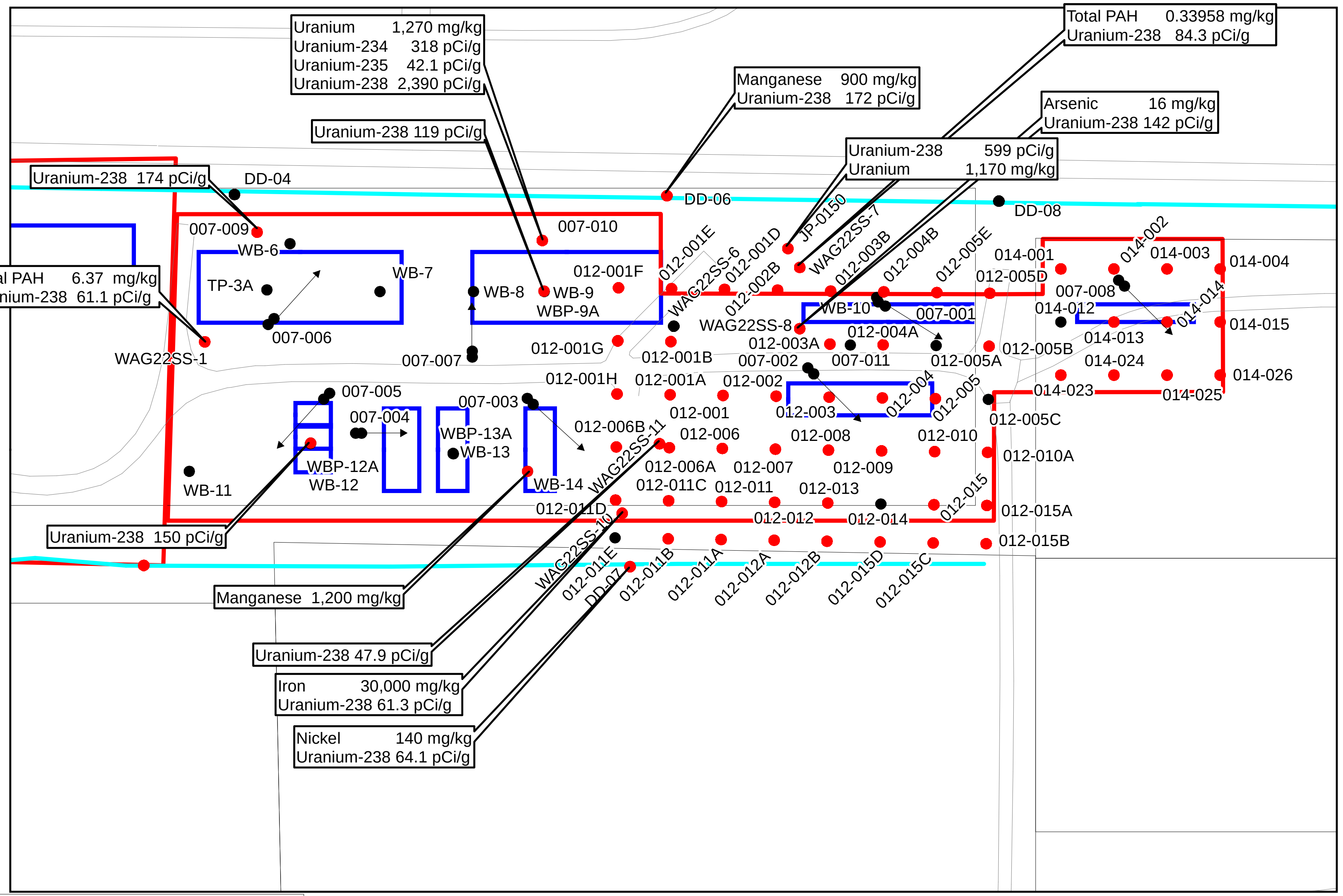
Figure A.7. SWMU 7—Future Industrial Worker Surface Soil



LEGEND

- SWMU BOUNDARY
- WASTE CELL
- FACILITY
- SURFACE WATER
- ROAD

SAMPLE LOCATIONS (≤ 16 ft)

- ● COC < PRG
- ● COC > PRG

NOTE1 : Only maximum results shown for sample locations, depths ≤ 16 ft

NOTE 2: Labels for Soils OU RI stations omit prefix "SOU" from station name.

Soils OU RI Stations with Results > PRGs

012-001	Iron	31267.61	mg/kg
012-001	Nickel	96.28	mg/kg
012-001	Uranium	1225.9	mg/kg
012-001A	Nickel	183.92	mg/kg
012-001A	Uranium	438.8	mg/kg
012-001D	Arsenic	11.04	mg/kg
012-001D	Iron	44757.49	mg/kg
012-001D	Nickel	84.54	mg/kg
012-001E	Uranium	1112.19	mg/kg
012-001F	Nickel	80.69	mg/kg
012-001F	Uranium	1141.87	mg/kg
012-001G	Arsenic	10.5	mg/kg
012-001G	Uranium	717.72	mg/kg
012-001H	Cobalt	14	mg/kg
012-001H	Iron	107000	mg/kg
012-001H	Manganese	4380	mg/kg
012-001H	Nickel	93.43	mg/kg
012-002	Arsenic	10.52	mg/kg
012-002	Iron	51054.55	mg/kg
012-002	Manganese	1042.45	mg/kg
012-002	Nickel	81.2	mg/kg
012-002	Uranium	2085.89	mg/kg
012-002B	Iron	41351.42	mg/kg
012-002B	Manganese	1008.79	mg/kg
012-002B	Nickel	88.57	mg/kg
012-003	Arsenic	18.32	mg/kg
012-003	Iron	72426.78	mg/kg
012-003	Manganese	1070.38	mg/kg
012-003A	Iron	46482.14	mg/kg
012-003B	Iron	31090.08	mg/kg
012-004	Iron	30697.57	mg/kg
012-004A	Iron	39798.05	mg/kg
012-004B	Iron	34187.77	mg/kg
012-005B	Arsenic	31.3	mg/kg
012-005B	Cobalt	107	mg/kg
012-005B	Iron	82400	mg/kg
012-005B	Nickel	83.54	mg/kg
012-005D	Nickel	106.3	mg/kg
012-005E	Iron	29925.04	mg/kg
012-006	Arsenic	15.07	mg/kg
012-006	Iron	38334.43	mg/kg
012-006	Uranium	4325.1	mg/kg
012-006A	Arsenic	12.08	mg/kg
012-006A	Iron	29348.08	mg/kg
012-006A	Manganese	1151.06	mg/kg
012-007	Arsenic	12.29	mg/kg
012-007	Nickel	94.18	mg/kg
012-007	Uranium	785.1	mg/kg
012-008	Iron	30950.97	mg/kg
012-008	Nickel	83.51	mg/kg
012-008	Uranium	1936.88	mg/kg
012-009	Iron	45914.29	mg/kg
012-009	Uranium	1197.28	mg/kg
012-010	Arsenic	11.37	mg/kg
012-010	Iron	46490.48	mg/kg
012-010A	Arsenic	85.9	mg/kg
012-010A	Iron	42200	mg/kg
012-011	Iron	32013.88	mg/kg
012-011	Manganese	925.72	mg/kg
012-011	Nickel	91.07	mg/kg
012-011	Uranium	612.68	mg/kg
012-011A	Nickel	81.35	mg/kg
012-011C	Iron	30999.05	mg/kg
012-011D	Uranium	560.86	mg/kg
012-012	Iron	29045.67	mg/kg
012-012	Manganese	890.71	mg/kg
012-012A	Arsenic	11.98	mg/kg
012-013	Arsenic	12.6	mg/kg
012-013	Cobalt	40.3	mg/kg
012-013	Iron	112000	mg/kg
012-013	Manganese	906	mg/kg
012-013	Nickel	83.9	mg/kg
012-013	Uranium	539	mg/kg
012-013	Uranium-238	47.4	pCi/g
012-015	Cobalt	17.5	mg/kg
012-015	Iron	28200	mg/kg
012-015	Nickel	159.98	mg/kg
012-015	Uranium	1379.58	mg/kg
012-015	Uranium-238	117	pCi/g
012-015A	Cobalt	31.4	mg/kg
012-015A	Manganese	4330	mg/kg
014-001	Arsenic	15.2	mg/kg
014-001	Iron	80721.84	mg/kg
014-001	Nickel	118.58	mg/kg
014-002	Nickel	94.17	mg/kg
014-003	Arsenic	11.33	mg/kg
014-003	Iron	32291.55	mg/kg
014-003	Nickel	133.3	mg/kg
014-004	Nickel	97.67	mg/kg
014-013	Nickel	93.37	mg/kg
014-014	Arsenic	10.85	mg/kg
014-014	Iron	40799.64	mg/kg
014-015	Iron	31900	mg/kg
014-015	Nickel	80.31	mg/kg
014-023	Manganese	823.59	mg/kg
014-024	Arsenic	12.07	mg/kg
014-024	Iron	30590.89	mg/kg
014-024	Manganese	1092.86	mg/kg
014-024	Nickel	540.71	mg/kg
014-025	Iron	36098.83	mg/kg
014-025	Manganese	1123.15	mg/kg
014-025	Nickel	602.31	mg/kg
014-026	Iron	42641.3	mg/kg
014-026	Manganese	1229.39	mg/kg
014-026	Nickel	1293.64	mg/kg

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Feet

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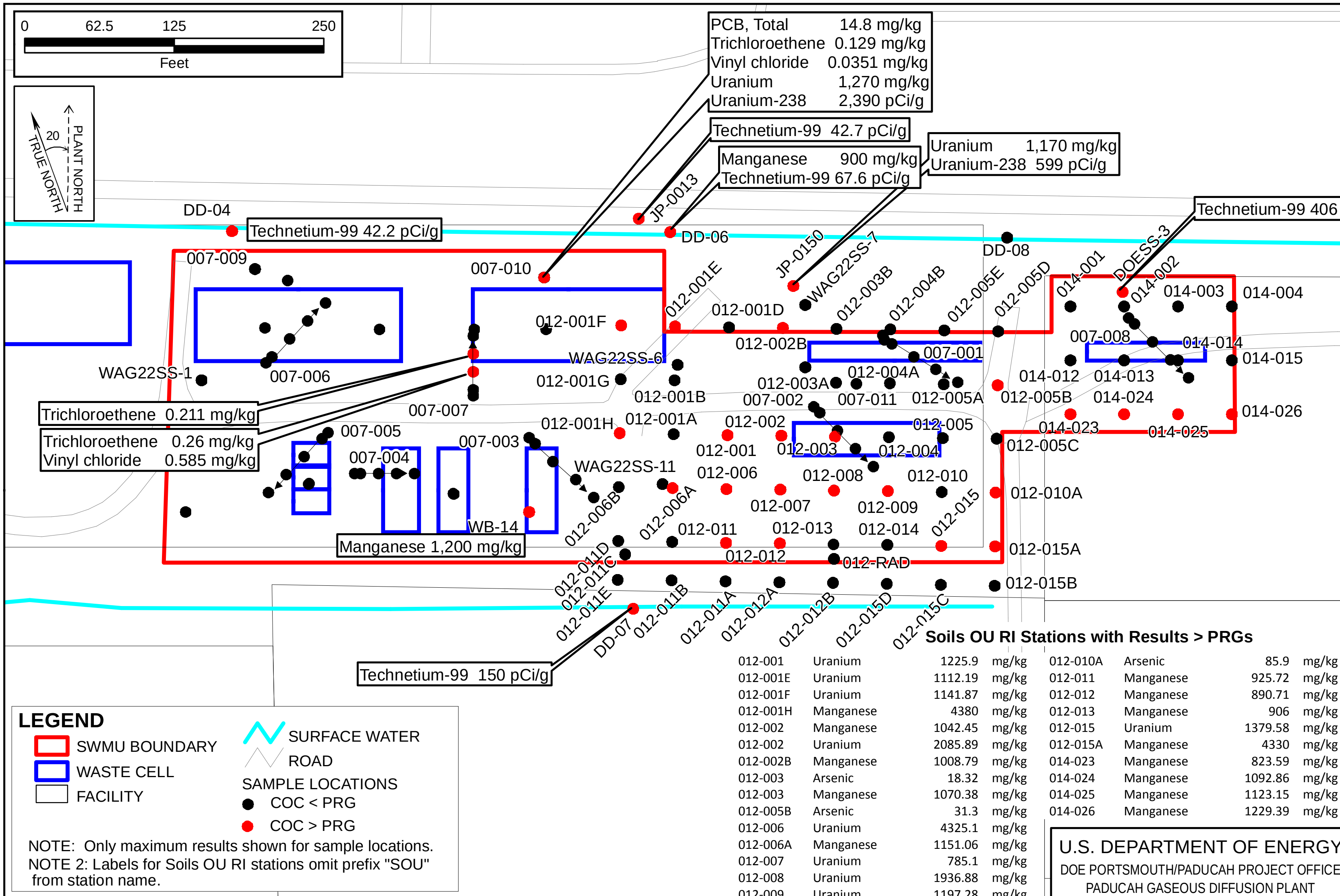
Figure A.8. SWMU 7—Future Excavation Worker Surface/Subsrface Soil



Soils OU RI Stations with Results > PRGs

012-001	Uranium	1225.9	mg/kg
012-001E	Uranium	1112.19	mg/kg
012-001F	Uranium	1141.87	mg/kg
012-001H	Manganese	4380	mg/kg
012-002	Manganese	1042.45	mg/kg
012-002	Uranium	2085.89	mg/kg
012-002B	Manganese	1008.79	mg/kg
012-003	Arsenic	18.32	mg/kg
012-003	Manganese	1070.38	mg/kg
012-005B	Arsenic	31.3	mg/kg
012-006	Uranium	4325.1	mg/kg
012-006A	Manganese	1151.06	mg/kg
012-007	Uranium	785.1	mg/kg
012-008	Uranium	1936.88	mg/kg
012-009	Uranium	1197.28	mg/kg
012-010A	Arsenic	85.9	mg/kg
012-011	Manganese	925.72	mg/kg
012-012	Manganese	890.71	mg/kg
012-013	Manganese	906	mg/kg
012-015	Uranium	1379.58	mg/kg
012-015A	Manganese	4330	mg/kg
014-023	Manganese	823.59	mg/kg
014-024	Manganese	1092.86	mg/kg
014-025	Manganese	1123.15	mg/kg
014-026	Manganese	1229.39	mg/kg

Figure A.9. SWMU 7—Protection of Groundwater

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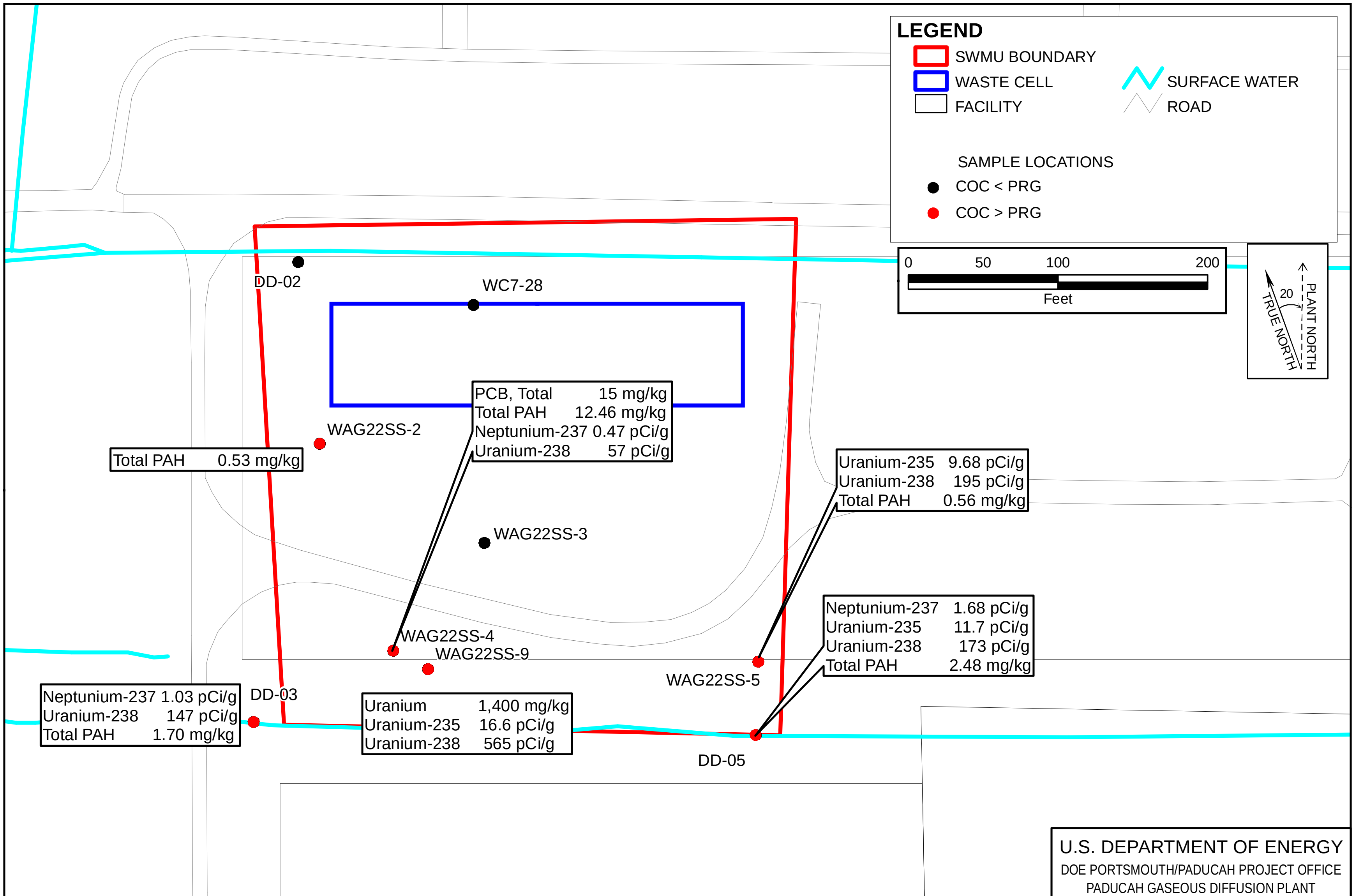

Figure A.10. SWMU 30—Future Industrial Worker Surface Soil

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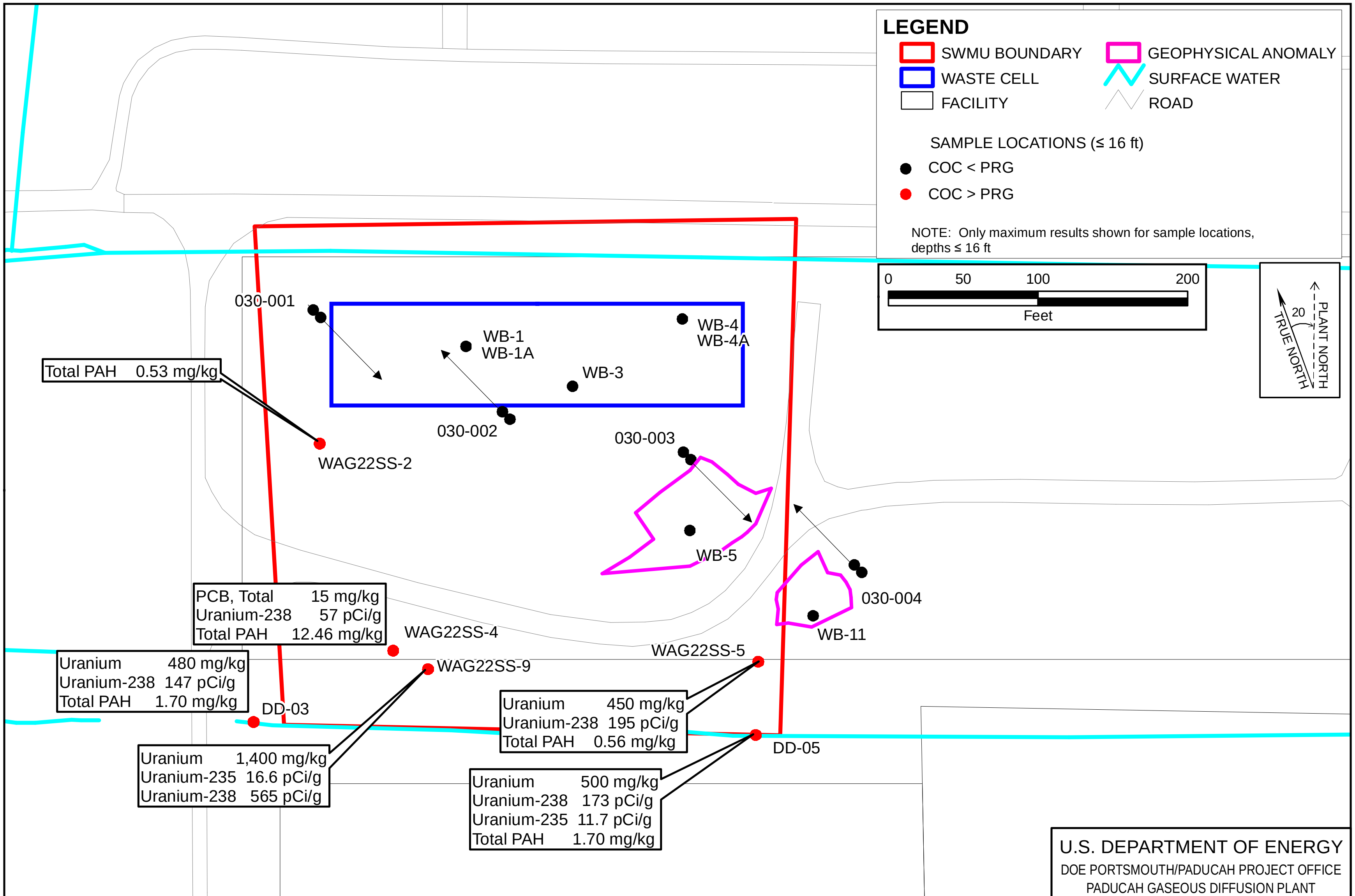

Figure A.11. SWMU 30—Future Excavation Worker Surface/Subsurface Soil

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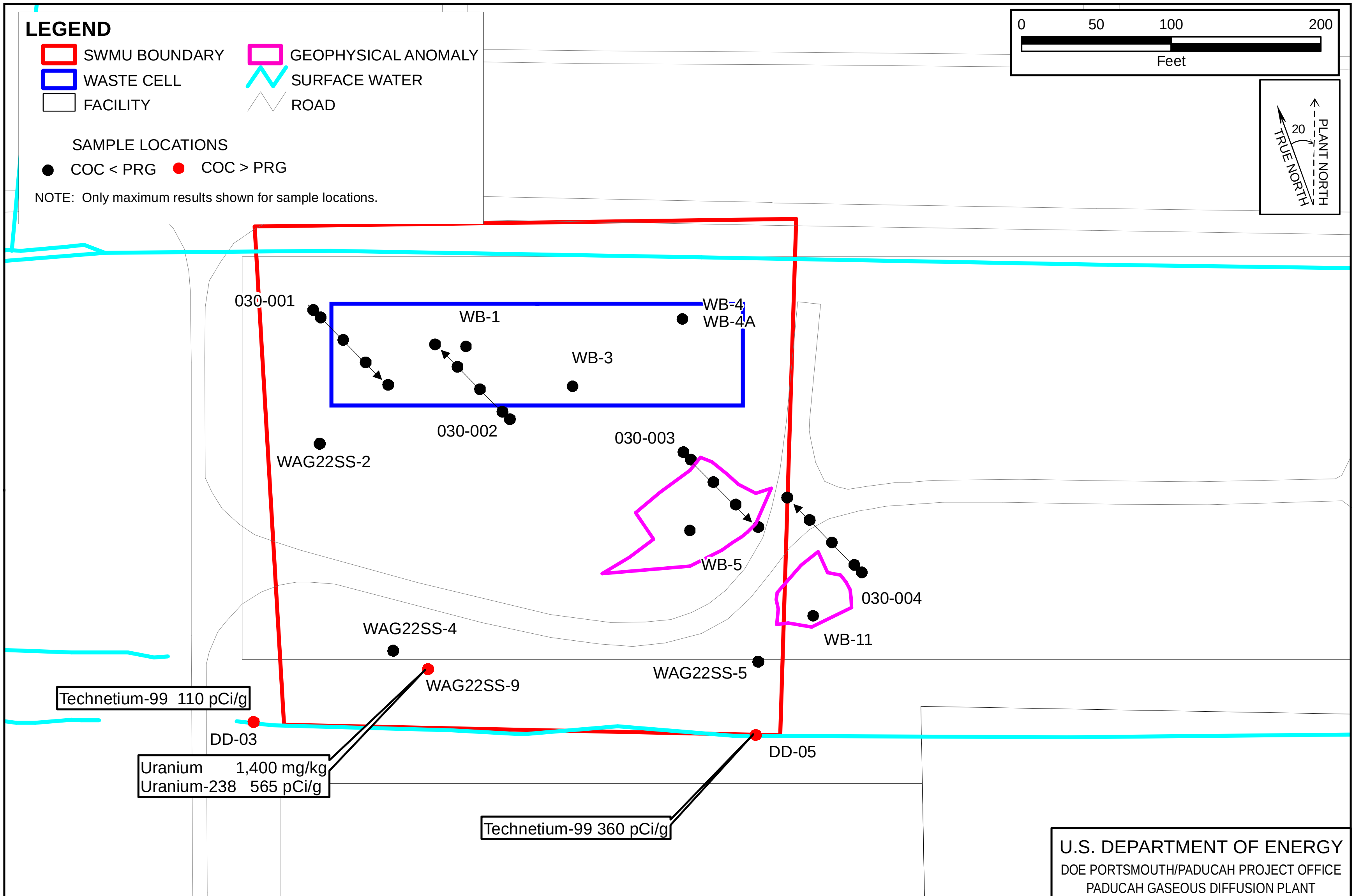

Figure A.12. SWMU 30—Protection of Groundwater

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ATTACHMENT A1

SCREENING OF METALS AND NATURALLY OCCURRING RADIONUCLIDES AGAINST ADDITIONAL BACKGROUND SOILS CRITERIA

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A1. SCREENING OF METALS AND NATURALLY OCCURRING RADIONUCLIDES AGAINST ADDITIONAL BACKGROUND SOILS CRITERIA

The summaries of data for Solid Waste Management Units (SWMUs) 2, 3, 7, and 30 contaminants of concern (COCs) are presented in Tables 1.17 and 1.18 in Section 1.5 of the main text. Tables 1.17 and 1.18 summarize data only for those analytes that were selected as COCs for SWMUs 2, 3, 7, and 30 in the Burial Grounds Operable Unit Remedial Investigation Baseline Human Health Risk Assessment. Additionally, Tables 1.17 and 1.18 present minimum, maximum, and average (or mean) summaries of detected concentrations of chemicals. Finally the tables show the frequencies of detection and exceedance of screening criteria. An incremental adjustment was used in comparing detected uranium isotope results with screening values. Additional information regarding uranium isotope results is included in the uncertainties section.

The following text describes and illustrates the spatial distribution of the COCs having site-specific background and/or no action level (NAL) exceedances, with accompanying charts of results compared to background. This analysis is done to determine if the analyte is generally present at concentrations above its background concentration or if the detected concentrations of the analyte above the selected background concentration is consistent with natural enrichment. The 2013 Risk Methods Document (DOE 2013) was the primary source used for comparing SWMUs 2, 3, 7, and 30 results with background and NALs; however, in order to better focus on chemicals presenting potential concern for the burial grounds, additional screening values were considered. These screening values used for comparison are the generic statewide ambient background values published by the Kentucky Natural Resources and Environmental Protection Cabinet [now known as the Kentucky Energy and Environment Cabinet (KEEC)] and included in Appendix E of the Risk Methods Document (DOE 2013). The intent of the additional screen is not to screen against the most conservative of the background values available, but to screen results against values that reasonably could be expected to occur naturally.

To apply the guidance established by KEEC and conclude that the results for a COC fall within the range of background, all of the criteria must be met as listed below.

1. The mean site concentration for inorganic constituents must be below the 95% upper confidence limit (UCL) of the mean concentrations of background for inorganic constituents.

2. At least half of the data points should be less than the 60th percentile.

3. No data points should be above the upper bound value (95th percentile).

A1.1 SWMU 2 SURFACE SOILS

There are no surface soil samples at SWMU 2 that exceed site-specific background values that could be considered within the range of background.

A1.2 SWMU 3 SURFACE SOILS

There are no surface soil samples at SWMU 3.

A1.3 SWMU 7 SURFACE SOILS

A1.3.1 Aluminum

Aluminum values in surface soil samples at SWMU 7 exceed the site-specific background value of 13,000 mg/kg (DOE 2013) in 1 of 19 samples. The exceeding value is 14,000 mg/kg. The mean[1] concentration for surface aluminum at SWMU 7 is 6,871 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 11,314 mg/kg, and 18 of the 19 results (more than half) were not detected or were less than the 60th percentile of 10,800 mg/kg, which meets the criteria for applying ambient background values established by KEEC. These aluminum values are below the 95th percentile of the generic statewide ambient background value (21,000 mg/kg); therefore, aluminum likely is not present in SWMU 7 on the surface above the range of background. Additionally, Figure A1.1 shows the aluminum values in surface soils at SWMU 7 are not grouped geographically.

A1.3.2 Beryllium

Beryllium values in surface soil samples at SWMU 7 exceed the site-specific background value of 0.67 mg/kg (DOE 2013) in 5 of 21 samples. The exceeding values range from 0.68 to 1.3 mg/kg. The mean concentration for surface beryllium at SWMU 7 is 0.628 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 0.83 mg/kg, and 15 of the 21 results (more than half) were not detected or were less than the 60th percentile of 0.75 mg/kg, which meets the criteria for applying ambient background values established by KEEC. These beryllium values are all below the 95th percentile of the generic statewide ambient background value (1.8 mg/kg); therefore, beryllium likely is not present in SWMU 7 on the surface above the range of background. Additionally, these values are not grouped geographically (see Figure A1.2).

A1.3.3 Cobalt

Cobalt values in surface soil samples at SWMU 7 exceed the site-specific background value of 14 mg/kg (DOE 2013) in 1 of 19 samples. The exceeding value is 17.5 mg/kg. The mean concentration for surface cobalt at SWMU 7 is 7.26 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 12.4 mg/kg, and 17 of the 19 results (more than half) were not detected or were less than the 60th percentile of 13.1 mg/kg, which meets the criteria for applying ambient background values established by KEEC. These cobalt values are all below the 95th percentile of the generic statewide ambient background value (25.1 mg/kg); therefore, cobalt likely is not present in SWMU 7 on the surface above the range of background. Additionally, Figure A1.3 shows the cobalt values in surface soils at SWMU 7 are not grouped geographically.

A1.3.4 Thallium

Thallium values in surface soil samples at SWMU 7 exceed the site-specific background value of 0.21 mg/kg (DOE 2013) in 11 of 19 samples. The exceeding values range from 0.23 to 2 mg/kg. The maximum detection is less than the 95th percentile of the generic statewide ambient background value (7.95 mg/kg), no other criteria (e.g., the 60th percentile and the 95% UCL of the mean concentrations) is presented in the KEEC guidance. Figure A1.4 shows thallium values in surface soil samples at SWMU 7. While comparisons are not conclusive for surface soil, the comparisons for subsurface soil lend support to the conclusion that thallium in surface soil likely is present within the range of background. Therefore, thallium will not be considered present in SWMU 7 on the surface above the range of background.

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[1] The mean concentration reported here and in later discussions is the arithmetic average of the detected concentrations. It is taken from Table 1.17 of the main text for surface soils and Table 1.18 of the main text for subsurface soils.

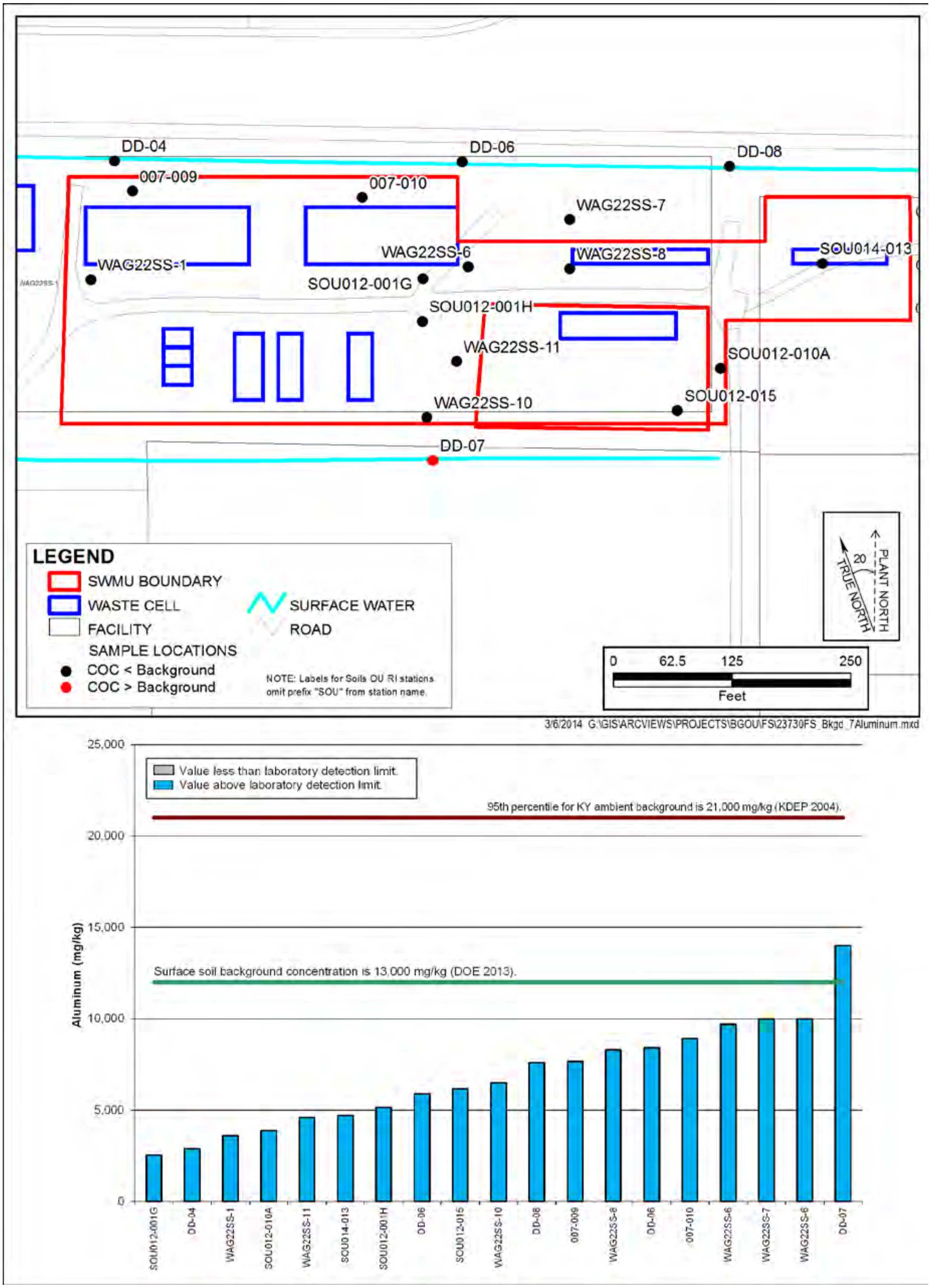

Figure A1.1. Aluminum in Surface Soil at SWMU 7

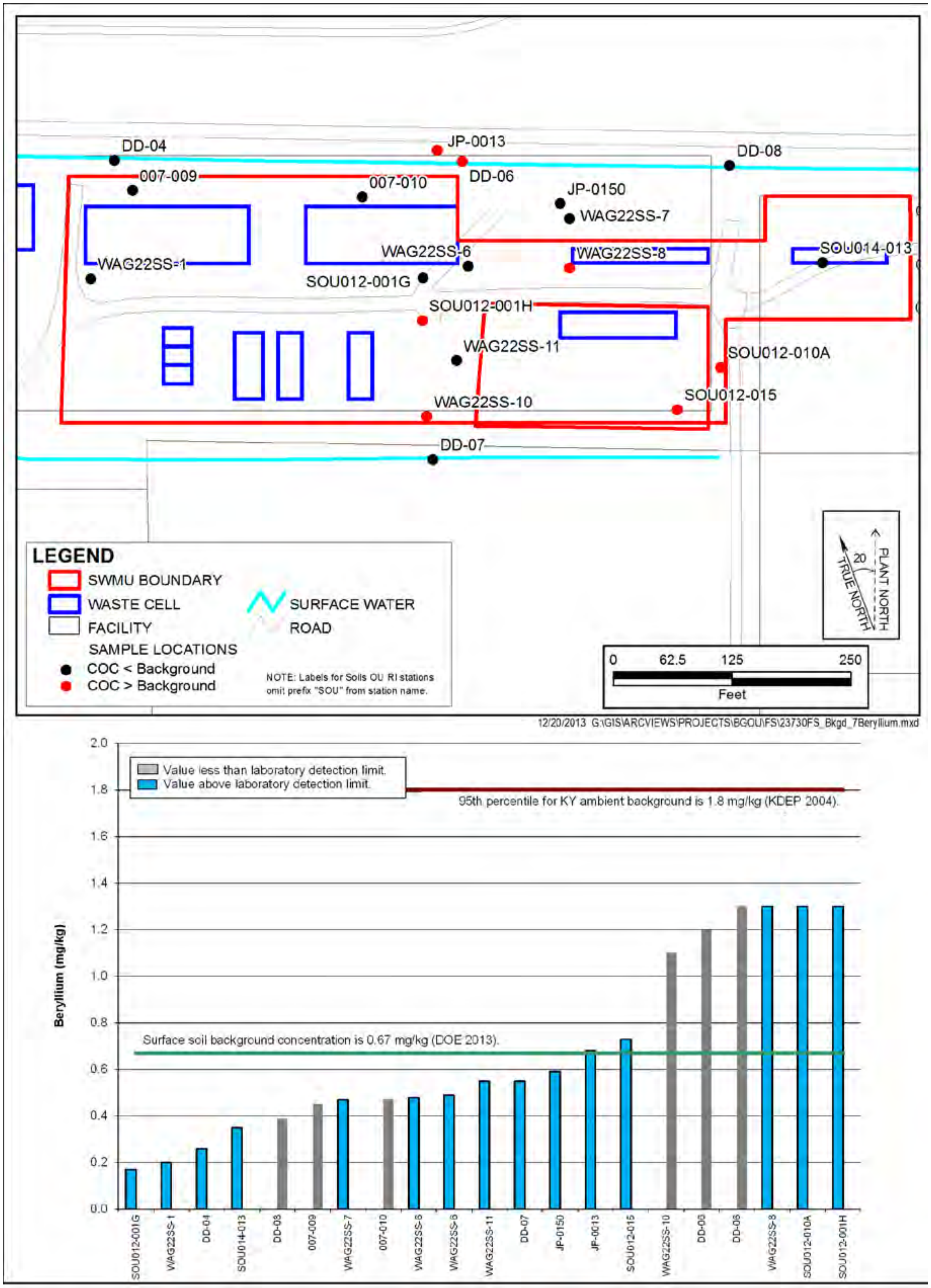

Figure A1.2. Beryllium in Surface Soil at SWMU 7

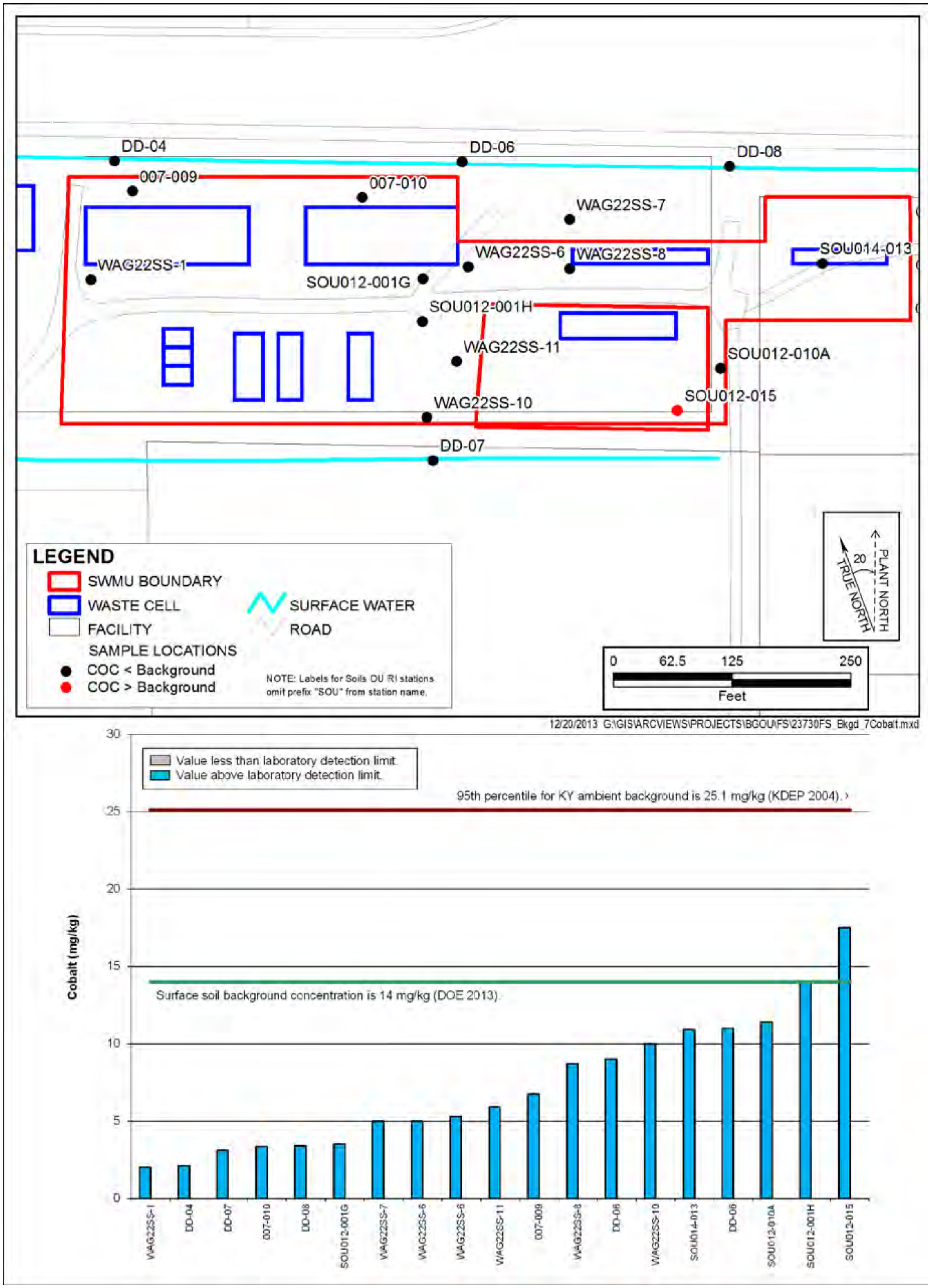

Figure A1.3. Cobalt in Surface Soil at SWMU 7

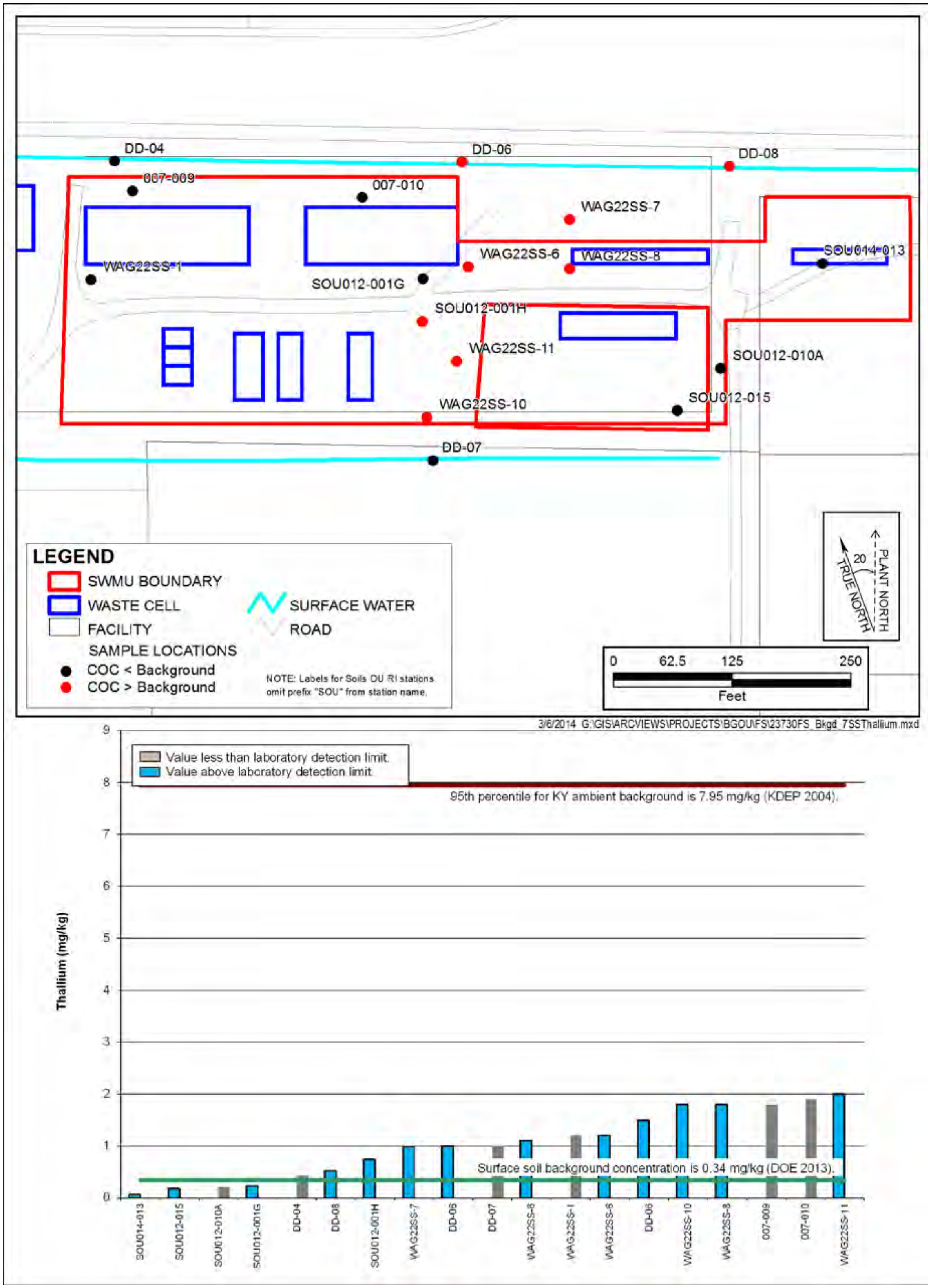

Figure A1.4. Thallium in Surface Soil at SWMU 7

A1.4 SWMU 30 SURFACE SOILS

A1.4.1 Beryllium

Beryllium values in surface soil samples at SWMU 30 exceed the site-specific background value of 0.67 mg/kg (DOE 2013) in 3 of 8 samples. The exceeding values range from 0.68 to 0.85 mg/kg. The mean concentration for surface beryllium at SWMU 30 is 0.636 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 0.83 mg/kg, and 6 of the 8 results (more than half) were not detected or were less than the 60th percentile of 0.75 mg/kg, which meets the criteria for applying ambient background values established by KEEC. These beryllium values are all below the 95th percentile of the generic statewide ambient background value (1.8 mg/kg); therefore, beryllium likely is not present in SWMU 30 on the surface above the range of background. Additionally, these values are not grouped geographically (see Figure A1.5).

A1.5 SWMU 2 SUBSURFACE SOILS

A1.5.1 Manganese

Manganese in subsurface soil samples at SWMU 2 exceeds the site-specific background value of 820 mg/kg (DOE 2013) in 2 of 29 samples. The exceeding values are 850 and 1,200 mg/kg. The mean concentration for subsurface manganese at SWMU 2 is 315 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 1,071 mg/kg, and 28 of the 29 results (more than half) were not detected or were less than the 60th percentile of 948 mg/kg, which meets the criteria for applying ambient background values established by KEEC. These manganese values are all below the 95th percentile of the generic statewide ambient background value (2,620 mg/kg); therefore, manganese likely is not present in SWMU 2 in the subsurface above the range of background. Figure A1.6 shows the manganese values in subsurface soils at SWMU 2.

A1.6 SWMU 3 SUBSURFACE SOILS

There are no subsurface soil samples at SWMU 3 that exceed site-specific background values that could be considered within the range of background.

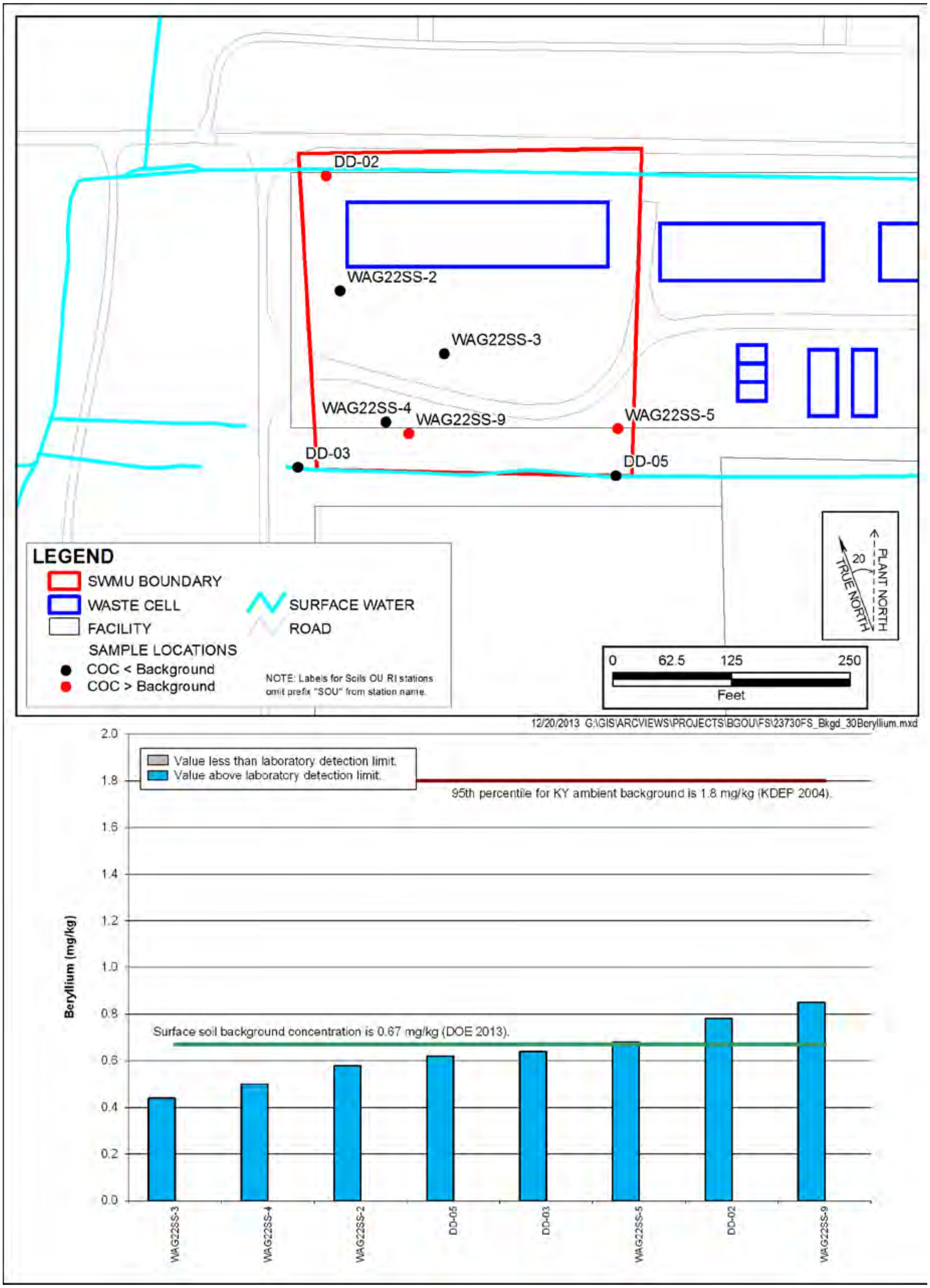

Figure A1.5. Beryllium in Surface Soil at SWMU 30

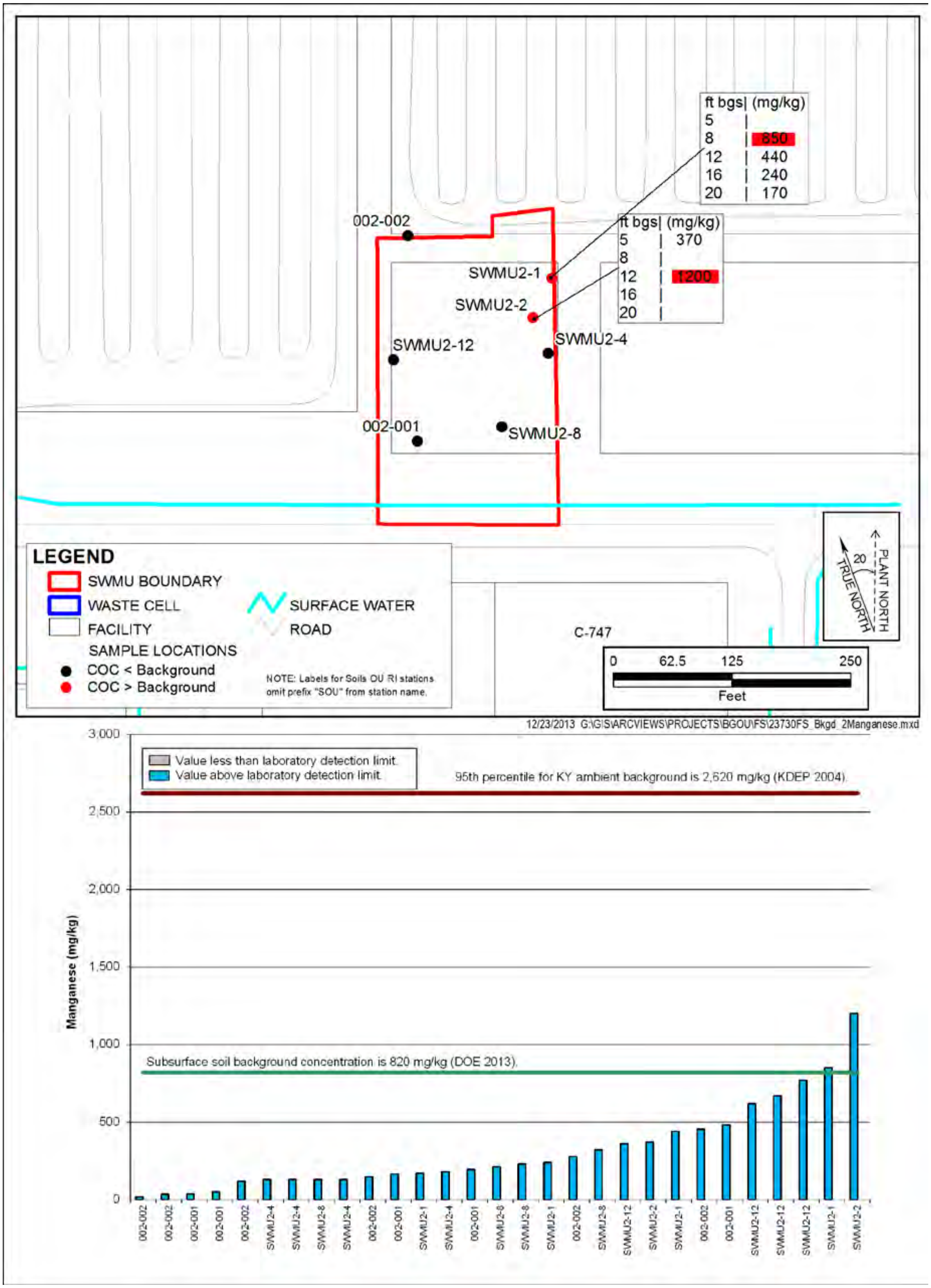

Figure A1.6. Manganese in Subsurface Soil at SWMU 2

A1.7 SWMU 7 SUBSURFACE SOILS

A1.7.1 Aluminum

Aluminum in subsurface soil samples at SWMU 7 exceeds the site-specific background value of 12,000 mg/kg (DOE 2013) in 2 of 80 samples. The exceeding values are 13,600 and 16,000 mg/kg. The mean concentration for subsurface aluminum at SWMU 7 is 6,630 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 11,314 mg/kg, and 75 of the 80 results (more than half) were not detected or were less than the 60th percentile of 10,800 mg/kg, which meets the criteria for applying ambient background values established by KEEC. These aluminum values are all below the 95th percentile of the generic statewide ambient background value (21,000 mg/kg); therefore, aluminum likely is not present in SWMU 7 in the subsurface above the range of background. Additionally, Figure A1.7 shows the aluminum values in subsurface soils at SWMU 7 are not grouped geographically.

A1.7.2 Lead

Lead in subsurface soil samples at SWMU 7 exceeds the site-specific background value of 23 mg/kg (DOE 2013) in 9 of 204 samples. The exceeding values range 24.25 to 62.4 mg/kg. The mean concentration for subsurface lead at SWMU 7 is 10.9 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 33 mg/kg, and 195 of the 204 results (more than half) were not detected or were less than the 60th percentile of 20.9 mg/kg, which meets the criteria for applying ambient background values established by KEEC. These lead values are all below the 95th percentile of the generic statewide ambient background value (84.6 mg/kg); therefore, lead can be considered not present in SWMU 7 in the subsurface above the range of background. Figure A1.8 shows these lead values at SWMU 7.

A1.7.3 Thallium

Thallium in subsurface soil samples at SWMU 7 exceeds the site-specific background value of 0.34 mg/kg (DOE 2013) in 1 of 80 samples. The exceeding value is 0.51 mg/kg. The maximum detection is less than the 95th percentile of the generic statewide ambient background value (7.95 mg/kg), no other criteria (i.e., the 60th percentile and the 95% UCL of the mean concentrations) is presented in the KEEC guidance. Therefore, thallium will not be considered present in SWMU 7 in the subsurface above the range of background. Additionally, since only 1 sample exceeded site-specific background, the value is not grouped geographically.

A1.8 SWMU 30 SUBSURFACE SOILS

A1.8.1 Aluminum

Aluminum in subsurface soil samples at SWMU 30 exceeds the site-specific background value of 12,000 mg/kg (DOE 2013) in 1 of 25 samples. The exceeding value is 19,000 mg/kg. The mean concentration for subsurface aluminum at SWMU 30 is 8,180 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 11,314 mg/kg, and 22 of the 25 results (more than half) were not detected or were less than the 60th percentile of 10,800 mg/kg, which meets the criteria for applying ambient background values established by KEEC. These aluminum values are all below the 95th percentile of the generic statewide ambient background value (21,000 mg/kg); therefore, aluminum can be considered not present in SWMU 30 in the subsurface above the range of background. Additionally, these values are not grouped geographically (see Figure A1.9).

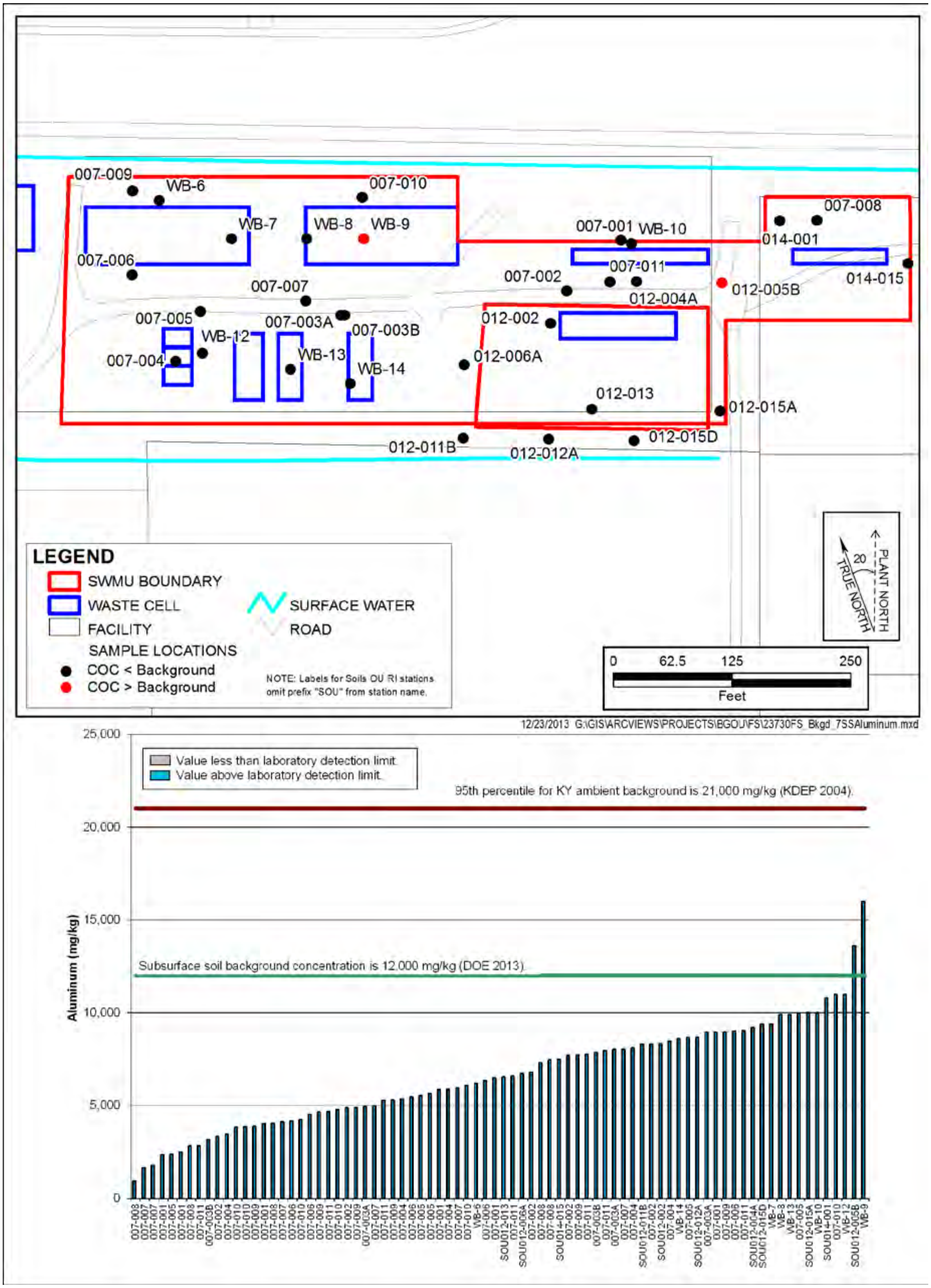

Figure A1.7. Aluminum in Subsurface Soil at SWMU 7

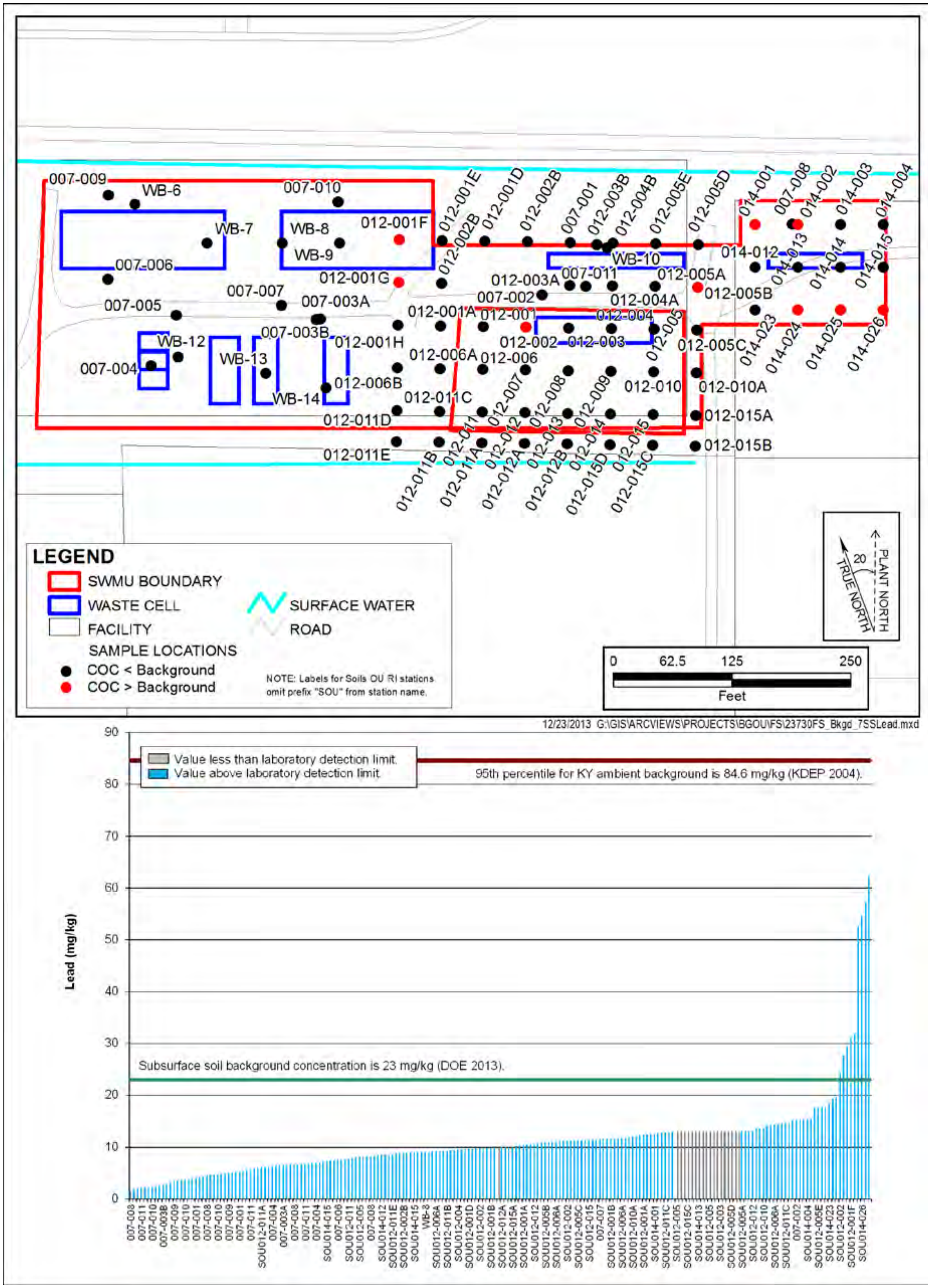

Figure A1.8. Lead in Subsurface Soil at SWMU 7

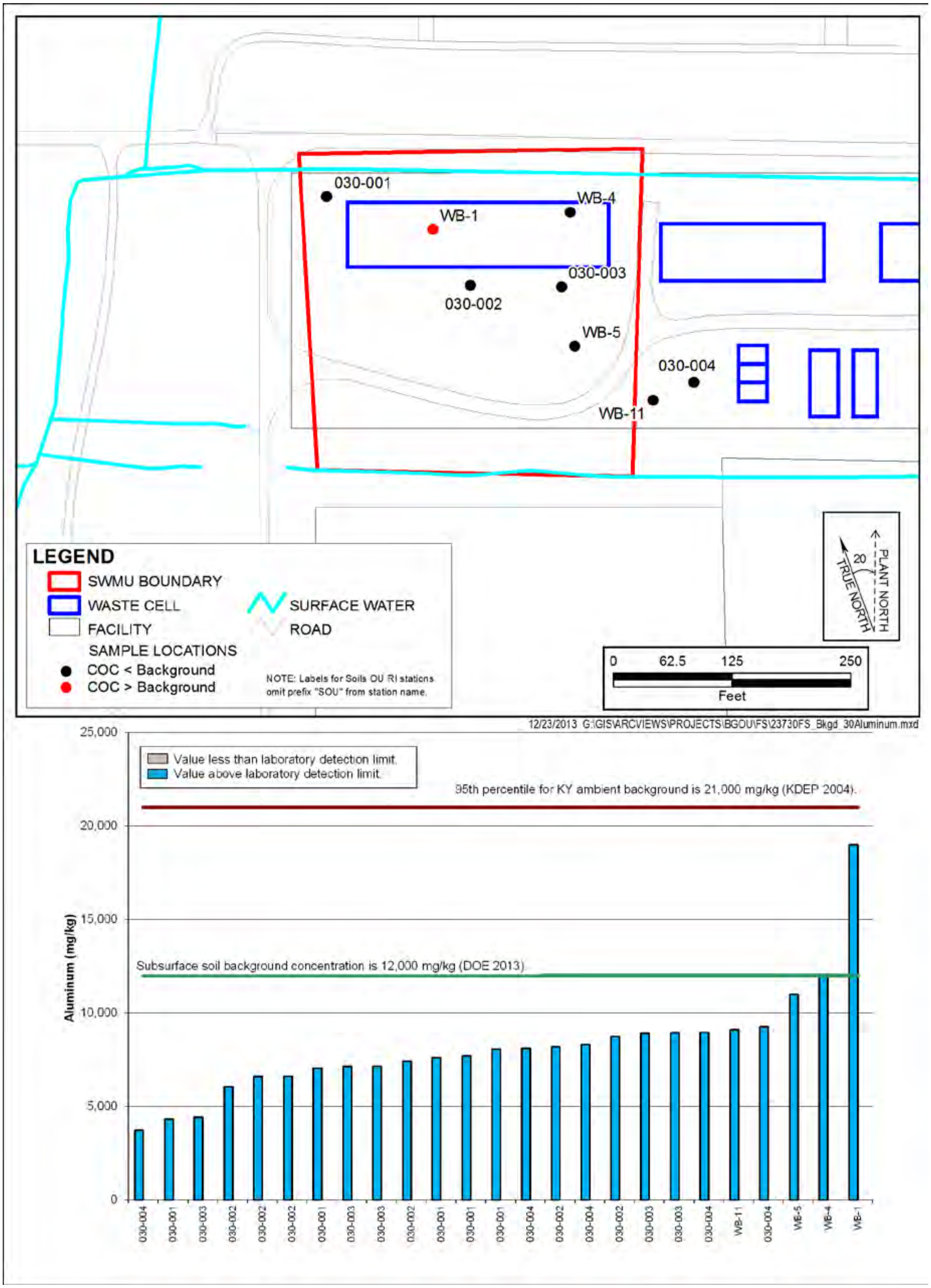

Figure A1.9. Aluminum in Subsurface Soil at SWMU 30

A1.8.2 Copper

Copper in subsurface soil samples at SWMU 30 exceeds the site-specific background value of 25 mg/kg (DOE 2013) in 2 of 25 samples. The exceeding values are 33 and 35 mg/kg. The mean concentration for subsurface copper at SWMU 30 is 10.6 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 21.3 mg/kg, and 20 of the 25 results (more than half) were not detected or were less than the 60th percentile of 13.8 mg/kg, which meets the criteria for applying ambient background values established by KEEC. These copper values are all below the 95th percentile of the generic statewide ambient background value (41.7 mg/kg); therefore, copper can be considered not present in SWMU 30 in the subsurface above the range of background. Additionally, these values are not grouped geographically (see Figure A1.10).

A1.8.3 Iron

Iron in subsurface soil samples at SWMU 30 exceeds the site-specific background value of 28,000 mg/kg (DOE 2013) in 1 of 25 samples. The exceeding value is 29,000 mg/kg. The mean concentration for subsurface iron at SWMU 30 is 14,100 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 23,284 mg/kg, and 23 of the 25 results (more than half) were not detected or were less than the 60th percentile of 22,000 mg/kg, which meets the criteria for applying ambient background values established by KEEC. These iron values are all below the 95th percentile of the generic statewide ambient background value (47,600 mg/kg); therefore, iron can be considered not present in SWMU 30 in the subsurface above the range of background. Additionally, these values are not grouped geographically (see Figure A1.11).

A1.8.4 Manganese

Manganese in subsurface soil samples at SWMU 30 exceeds the site-specific background value of 820 mg/kg (DOE 2013) in 1 of 25 samples. The exceeding value is 1,200 mg/kg. The mean concentration for subsurface manganese at SWMU 30 is 180 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 1,071 mg/kg, and 24 of the 25 results (more than half) were not detected or were less than the 60th percentile of 948 mg/kg, which meets the criteria for applying ambient background values established by KEEC. These manganese values are all below the 95th percentile of the generic statewide ambient background value (2,620 mg/kg); therefore, manganese can be considered not present in SWMU 30 in the subsurface above the range of background. Additionally, these values are not grouped geographically (see Figure A1.12).

A1.8.5 Selenium

Selenium in subsurface soil samples at SWMU 30 exceeds the site-specific background value of 0.71 mg/kg (DOE 2013) in 1 of 25 samples. The exceeding value is 1 mg/kg. The mean concentration for subsurface selenium at SWMU 30 is 0.763 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 0.99 mg/kg, and all of the 25 results were not detected or were less than the 60th percentile of 1.38 mg/kg, which meets the criteria for applying ambient background values established by KEEC. These selenium values are all below the 95th percentile of the generic statewide ambient background value (2.1 mg/kg); therefore, selenium can be considered not present in SWMU 30 in the subsurface above the range of background. Additionally, these values are not grouped geographically (see Figure A1.13).

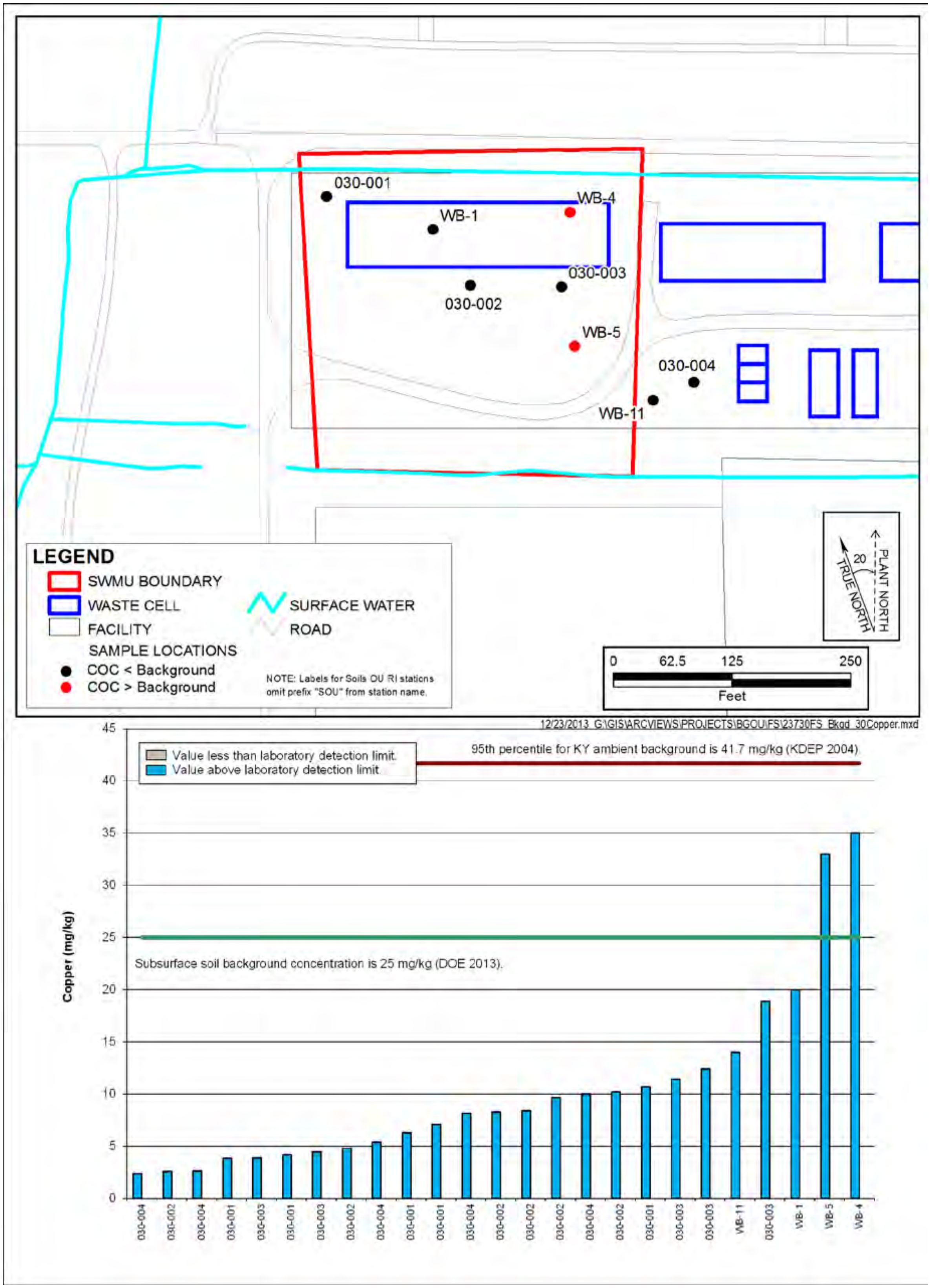

Figure A1.10. Copper in Subsurface Soil at SWMU 30

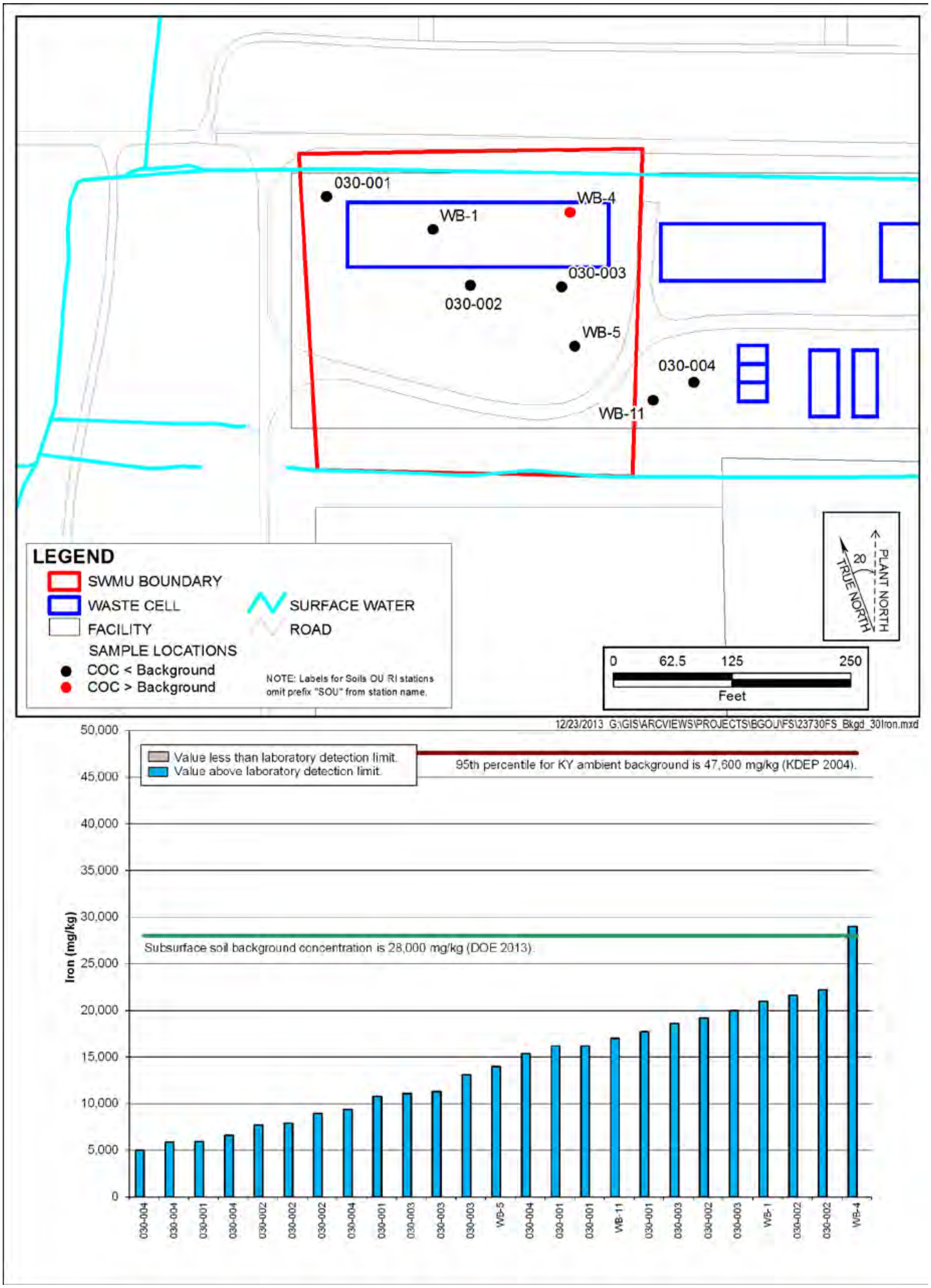

Figure A1.11. Iron in Subsurface Soil at SWMU 30

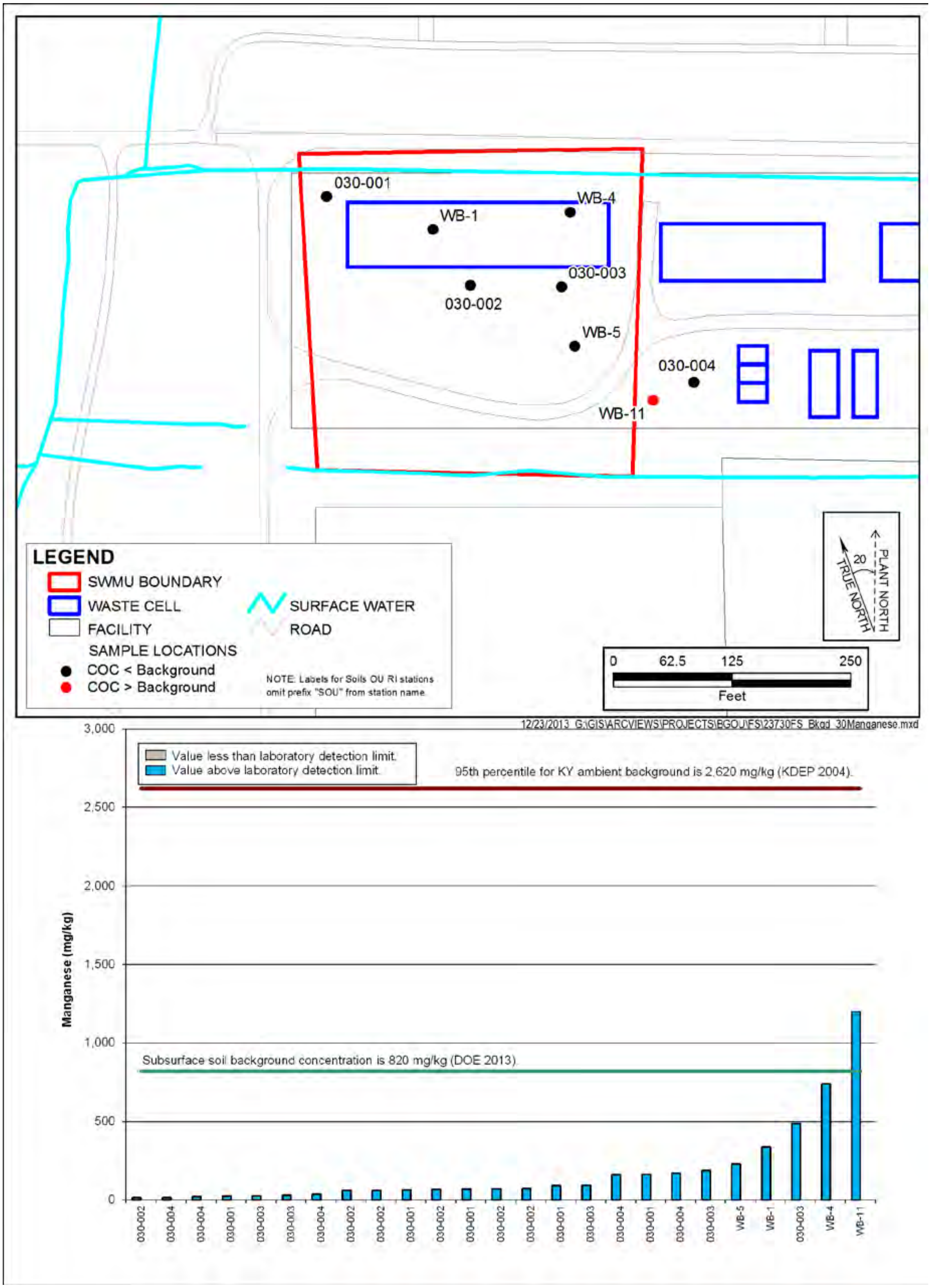

Figure A1.12. Manganese in Subsurface Soil at SWMU 30

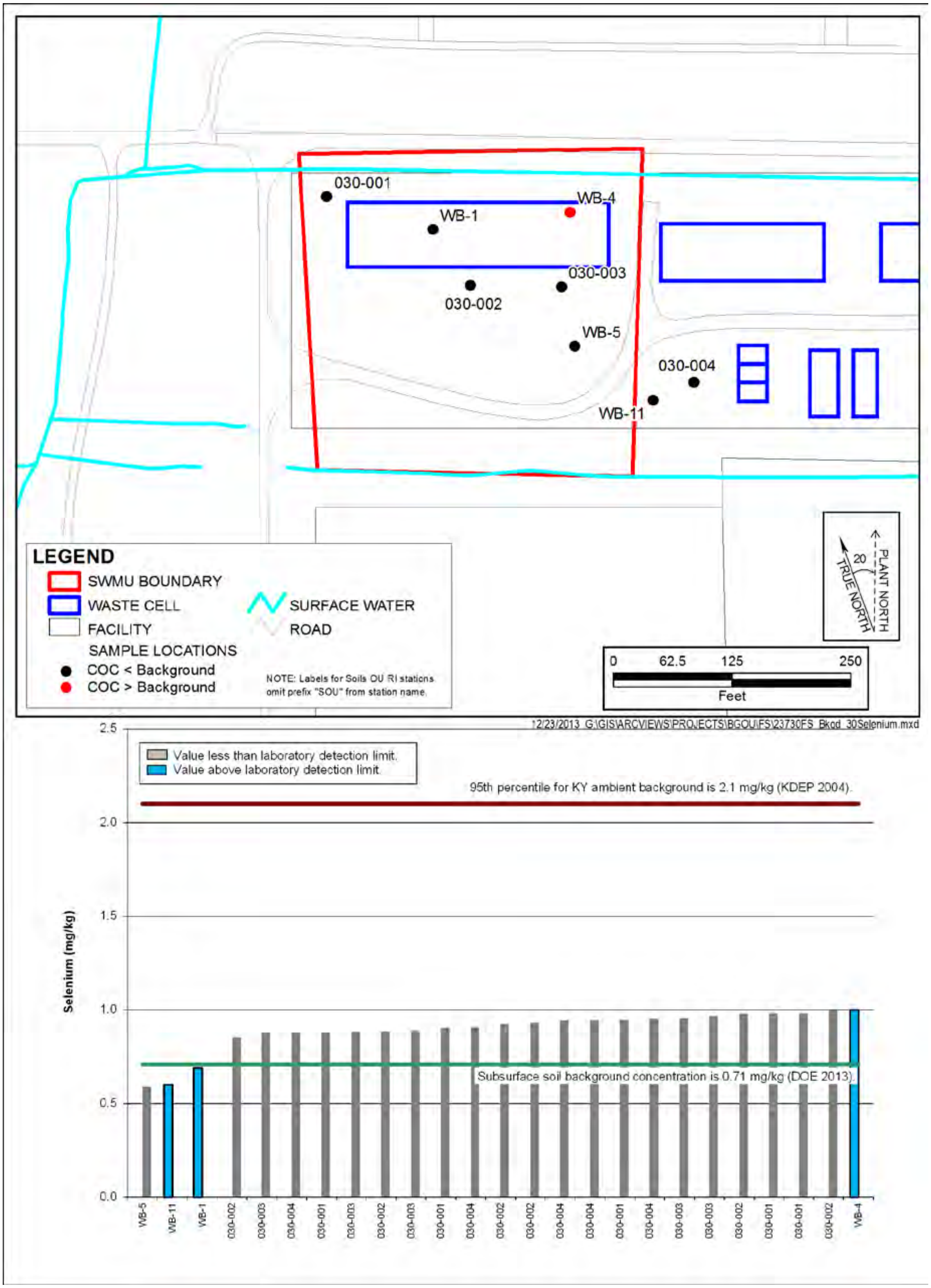

Figure A1.13. Selenium in Subsurface Soil at SWMU 30

A1.8.6 Vanadium

Vanadium in subsurface soil samples at SWMU 30 exceeds the site-specific background value of 37 mg/kg (DOE 2013) in 1 of 25 samples. The exceeding value is 40 mg/kg. The mean concentration for subsurface vanadium at SWMU 30 is 11 mg/kg, which is below Kentucky's 95% UCL of the mean concentrations of background of 27.7 mg/kg, and 22 of the 25 results (more than half) were not detected or were less than the 60th percentile of 27.3 mg/kg, which meets the criteria for applying ambient background values established by KEEC. These vanadium values are all below the 95th percentile of the generic statewide ambient background value (48.6 mg/kg); therefore, vanadium can be considered not present in SWMU 30 in the subsurface above the range of background. Additionally, these values are not grouped geographically (see Figure A1.14).

A1.9 CONCLUSIONS

Based on the comparisons presented in this attachment, the following chemicals can be considered present within the range of background for SWMUs 2, 3, 7, and 30.

- Surface Soils
  - SWMU 7: aluminum, beryllium, cobalt, and thallium
  - SWMU 30: beryllium
- Subsurface Soils
  - SWMU 2: manganese
  - SWMU 7: aluminum, lead, and thallium
  - SWMU 30: aluminum, copper, iron, manganese, selenium, and vanadium

These chemicals no longer are considered COCs for this FS.

A1.10 REFERENCES

ANL (Argonne National Lab) 2007. *Radiological and Chemical Fact Sheets to Support Health Risk Analyses for Contaminated Areas*, Argonne National Laboratory, Environmental Science Division, Lemont, IL, March.

DOE (U.S. Department of Energy) 1997. *Background Levels of Selected Radionuclides and Metals in Soils and Geologic Media at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/OR/07-1586&D2, U.S. Department of Energy, Paducah, KY, June.

DOE 2013. *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, Volume 1, Human Health, DOE/LX/07-0107&D2/R2/V1, U.S. Department of Energy, Paducah, KY, June.

KEEC (Kentucky Energy and Environment Cabinet) 2004. *Kentucky Guidance for Ambient Background Assessment*, Kentucky Energy and Environment Cabinet, Frankfort, KY, January.

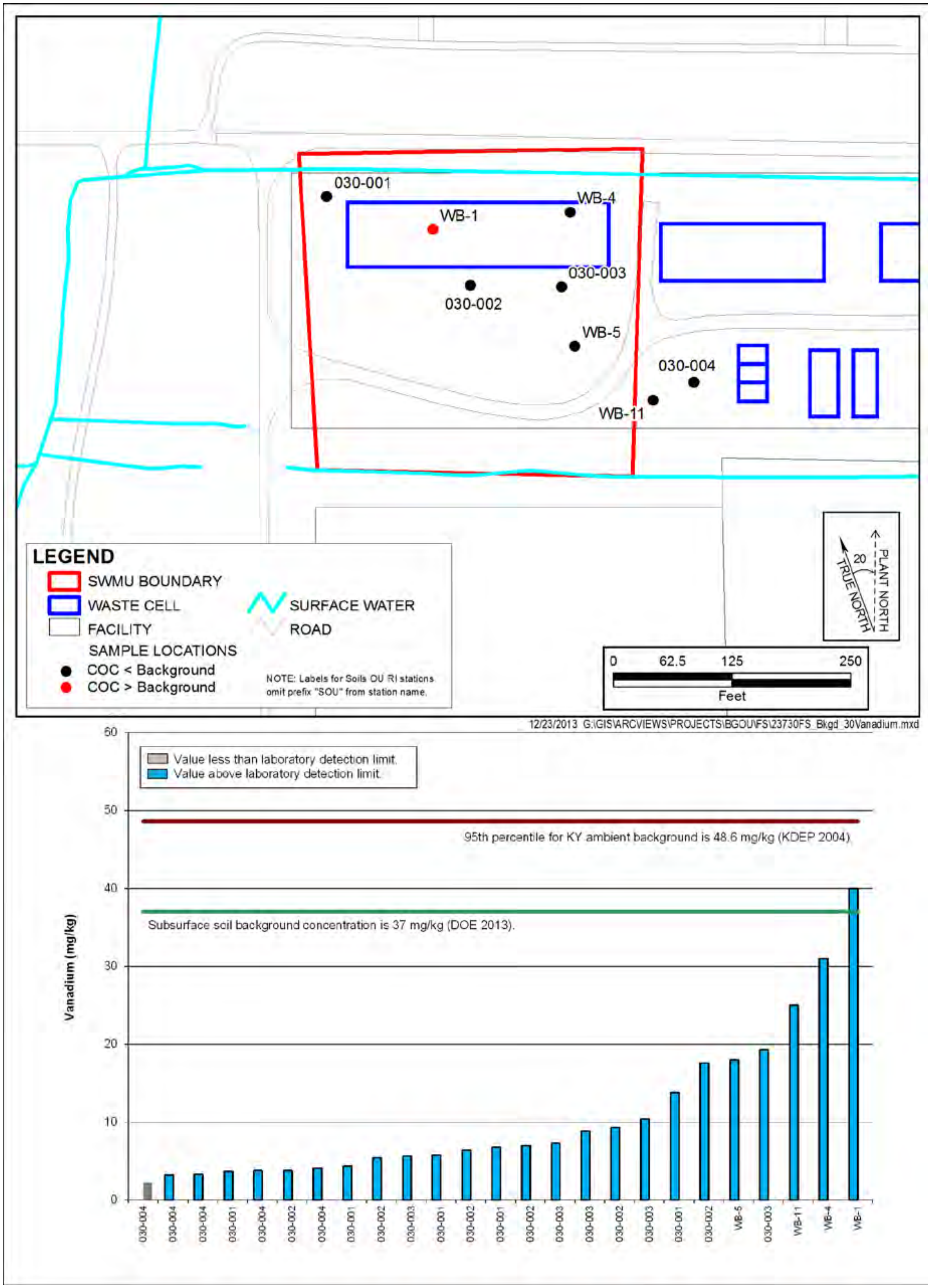

Figure A1.14. Vanadium in Subsurface Soil at SWMU 30

ATTACHMENT A2

COMPARISON OF SOIL CONCENTRATIONS TO PRELIMINARY REMEDIATION GOALS BY SADA LAYER

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A2. COMPARISON OF SOIL CONCENTRATIONS TO SELECTED PRELIMINARY REMEDIATION GOALS BY SPATIAL ANALYSIS AND DECISION ASSISTANCE LAYER

This attachment provides a layer-by-layer detailed comparison of the maximum concentration, mean of the detectable concentrations, and mean model concentration of selected COCs to the appropriate soil preliminary remediation goals (PRGs) (see Tables 1.21 and 1.22 of the main text) using the data available in the Burial Grounds Operable Unit (BGOU) Remedial Investigation (RI) Report (DOE 2010) for selected contaminant of concern (COCs). [COCs screened are from the Baseline Human Health Risk Assessment (BHHRA) and are trichloroethene (TCE), uranium and its isotopes, and polychlorinated biphenyls (PCBs). Each of the COCs has been identified as a contaminant in principal threat waste, as discussed in the main text.] These comparisons are presented as Tables A2.1 to A2.4 for each solid waste management unit (SWMU). Layer concentrations were developed by assigning data points for chemicals analyzed to the appropriate Spatial Analysis and Decision Assistance (SADA) model layer as defined for the RI soil geostatistical modeling. The assignments of samples to specific layers were made based on the sample depths as reported in the BGOU RI Report (DOE 2010) and are used in this feasibility study to be fully consistent with the RI for the BGOU.

The observed maximum concentration, mean of the detectable concentrations, and model mean concentration for each COC in each layer at each SWMU are compared to the PRGs (Tables 1.21, 1.22, and 1.23) for that respective COC. The value is shown in bold, red typeface where it exceeds the PRG. For COCs that are dispersed throughout the soil column and the mean of the detected concentrations exceeds the PRG concentration, a Y in bold, red typeface in the last column indicates the entire layer is considered for remedial action. An H in bold, orange typeface indicates localized concentrations (i.e., “hot spots”) are considered for remedial action.

If the average concentration for a COC exceeded the PRG and two or more concentrations exceeded the PRG for that COC, the entire layer was evaluated for treatment, removal, or containment of the contaminated soils in the layer. If the maximum concentration exceeded the PRG, but the average did not, a localized treatment option for the hot spot could be considered. Each table also provides for comparison, where available, the layer average concentration derived by the SADA geostatistical model and used in the Seasonal Soil Compartment Model leaching model conducted for the RI.

The average concentration for a COC in each subsurface soil conceptual layer was computed from the detected concentrations as reported in the data tables in the RI Report (DOE 2010) and these concentrations are shown in Tables A2.1 to A2.4. The surface soil values shown in Tables A2.1 to A2.4 were extracted from the database contained in Appendix C of the RI Report (DOE 2010). The surface soil sample results were subjected to statistical analysis to derive the maximum and average concentrations for the 0 to 1-ft interval at each SWMU. The results of these analyses are summarized in Tables A2.1 to A2.4 for the noted sample depth (0 ft). PRGs used for the comparison are shown in bold in the last column of the table for each SWMU in Tables A2.1 to A2.4 for COCs reported for surface soils only. The PRG appears on the line for Layer 1. If there is no PRG specifically for surface soil, the subsurface soil PRG applies.

Table A2.1. Comparison of Average Layer Soil Concentrations of Selected COCs to PRGs for SWMU 2

COC SADA Layer[a]	Sample Depths (ft) Start	 End	Detectable Concentrations above the PRG	Maximum Concentration[b] (mg/kg or pCi/g)	Layer Average[b] (mg/kg or pCi/g)	SADA Layer[c] (mg/kg or pCi/g)	PRG for soil (mg/kg or pCi/g)[d]
TCE						**Surface soil**	Not a COC for surface soil
						Subsurface soil	**0.103**
1	0		0	ND	ND	0	N
2	5 8		1	**0.28**	**0.15**	**0.13**	**Y**
3	10 15	12 16	1	**140**	**47**	**43**	**Y**
4	20	25	0	ND	ND	**24**	N
5	30	35	0	ND	ND	**15**	N
6	40	45	1	**0.43**	**0.22**	**8.9**	**Y**
7	50	55	0	0.0034	NA	**0.20**	N
Uranium-235						**Surface soil**	**9.2**
						Subsurface soil	**12.1**
1	0		0	4.1	NA	2.7	N
2	5 8		0	**26**	4.37	3.43	**Y**
3	10 15	12 16	0	0.38	0.10	0.09	N
4	20	25	0	0.09	0.07	0.08	N
5	30	35	0	0.11	0.07	0.07	N
6	40	45	0	0.12	0.07	0.07	N
7	50	55	0	0.07	0.06	0.00	N
Uranium-238						**Surface soil**	**37.4**
						Subsurface soil	**45.3**
1	0		5	**314**	NA	**88**	**H**
2	5 8		1	**947**	**160**	**84**	**H,Y**
3	10 15	12 16	0	8.02	1.9	1.5	N
4	20	25	0	1.4	0.8	1.1	N
5	30	35	0	1.0	0.57	1.02	N
6	40	45	0	1.27	NA	0.88	N
7	50 60	55	0	1.3	0.81	0.71	N

COC—Identified according to criteria specified in the BHHRA and for inorganic constituents that exceed the range of background for Paducah Gaseous Diffusion Plant (PGDP) DOE 2013).
N—The average layer concentration is less than the PRG.
ND—not detected
NA—layer average not available
Y—Bold, red typeface indicates the layer's mean concentration exceeds the PRG.
H—Bold, orange typeface indicates the maximum concentration within the layer exceeds the PRG. Not used if layer's mean concentration also exceeds the PRG.
[a] SADA Layer corresponds to the layer depth intervals used in the geostatistical model developed for the BGOU fate and transport modeling (DOE 2010).
[b] Data for subsurface soil are detected concentrations as reported in Table 4.7 of the BGOU RI Report only (DOE 2010). Nondetect results are not included in the computation of the layer mean. Surface soil data was obtained from the database in Appendix C of the BGOU RI Report (DOE 2010).
[c] SADA layer concentrations are from reported values in Table E.3.3, Appendix E of the BGOU RI Report (DOE 2010).
[d] PRGs are taken from Tables 1.21, 1.22, and 1.23 of the main text.

Table A2.2. Comparison of Average Layer Soil Concentrations of Selected COCs to PRGs for SWMU 3

COC SADA Layer[a]	Sample Depths (ft) Start	Sample Depths (ft) End	Detectable Concentrations above the PRG	Maximum Concentration[b] (mg/kg or pCi/g)	Layer Average[b] (mg/kg or pCi/g)	SADA Layer[c] (mg/kg or pCi/g)	PRG for soil (mg/kg or pCi/g)[d]
Uranium-238						**Surface soil**	**37.4**
						Subsurface soil	**45.3**
1	0	1	0	6.0	1.5	1.3	N
2	5	10	0	22	4.8	6.7	N
3	15		0	0.35	0.34	12.6	N
4	20	30	0	0.19	0.19	12.6	N
5	30		No Samples from this Interval			12.3	
6	45		0	0.27	0.20	12.3	N
7	60		0	0.19	0.17	10.5	N
COC Shown for Surface Soils Only							
Uranium-235	0	1	0	0.079	NA	NA	**9.2**

COC—Identified according to criteria specified in the BHHRA and for inorganic constituents that exceed the range of background for PGDP (DOE 2013).
N—The average layer concentration is less than the PRG.
NA—layer average not available
ND—not detected.
Y—Bold, red typeface indicates the layer's mean concentration exceeds the PRG.
H—Bold, orange typeface indicates the maximum concentration within the layer exceeds the PRG. Not used if layer's mean concentration also exceeds the PRG.
[a] SADA layer corresponds to the layer depth intervals used in the geostatistical model developed for the BGOU fate and transport modeling (DOE 2010).
[b] Data for subsurface soil are detected concentrations as reported in Table 4.9 of the BGOU RI Report only (DOE 2010). Nondetect results are not included in the computation of the layer mean. Surface soil data was obtained from the database in Appendix C of the BGOU RI Report (DOE 2010).
[c] SADA layer concentrations are from reported values in Table E.3.7, Appendix E of the BGOU RI Report (DOE 2010).
[d] PRGs are taken from Tables 1.21, 1.22, and 1.23 of the main text.

Table A2.3. Comparison of Average Layer Soil Concentrations of Selected COCs to PRGs for SWMU 7

COC / SADA Layer[a]	Sample Depths (ft) Start	End	Detectable Concentrations greater than the PRG	Maximum Concentration[b] (mg/kg or pCi/g)	Layer Average[b] (mg/kg or pCi/g)	SADA Layer[c] (mg/kg or pCi/g)	PRG for soil (mg/kg or pCi/g)[d]
TCE						**Groundwater protection**	**0.103**
1	0	1	0	ND	ND	0	N
2	5	10	0	0.01	0.01	**0.56**	N
	10						
3	15		0	0.01	0.01	**0.57**	N
4	30		1	**0.26**	0.10	**0.82**	**H**
6	45		3	**0.21**	NA	**1.00**	**H**
7	60		0	0.09	0.09	**0.69**	N
Uranium (mg/kg)						**Surface**	**783**
						Subsurface	**431**
1	0	1	6	**1,380**	NA	**375**	**H**
2	5	10	11	**4,325**	NA	16	**H**
	10						
3	15		0	ND	ND	21.4	N
4	30		0	1.5	1.3	16.2	N
6	45		0	1.3	1.3	12.3	N
7	60		0	1.2	1.1	14.8	N
Uranium-234						**Surface**	**306**
						Subsurface	**218**
1	0	1	1	**318**	NA	61	**H**
2	5	10	2	115	9.1	3	N
	10						
3	15		0	1.1	NA	3.12	N
4	30		0	0.3	0.2	12.13	N
6	45		0	0.4	0.3	11.24	N
7	60		0	0.33	0.24	8.23	N
Uranium-235						**Surface**	**9.20**
						Subsurface	**12.1**
2	5	10	0	1.0	0.5	NA	N
	10		No Uranium-235 data in L3 through L7 are available				
3	15						
4	30						
6	45						
7	60						

Table A2.3. Comparison of Average Layer Soil Concentrations of Selected COCs to PRGs for SWMU 7 (Continued)

COC / SADA Layer[a]	Sample Depths (ft) Start	End	Detectable Concentrations greater than the PRG	Maximum Concentration[b] (mg/kg or pCi/g)	Layer Average[b] (mg/kg or pCi/g)	SADA Layer[c] (mg/kg or pCi/g)	PRG for soil (mg/kg or pCi/g)[d]
Uranium-238						**Surface**	**37.4**
						Subsurface	**45.3**
1	0	1	15	**2,390**	NA	**388**	**H**
2	5	10	5	**150**	NA	8.7	**H**
	10						
3	15		0	0.2	0.2	24	N
4	30		0	0.5	0.3	26	N
6	45		0	1.3	0.6	25	N
7	60		0	0.20	0.20	22	N
COCs compared for Surface Soil only at SWMU 7							
PCBs							**10**
1	0	1	1	**15**	7.5	1.1	**H**

COC—Identified according to criteria specified in the BHHRA and for inorganic constituents that exceed the range of background for PGDP (DOE 2013).
N—The average layer concentration is less than the PRG.
ND—not detected
NA—layer average not available
Y—Bold, red typeface indicates the layer's mean concentration exceeds the PRG.
H—Bold, orange typeface indicates the maximum concentration within the layer exceeds the PRG. Not used if layer's mean concentration also exceeds the PRG.
[a] SADA layer corresponds to the layer depth intervals used in the geostatistical model developed for the BGOU fate and transport modeling (DOE 2010).
[b] Data for subsurface soil are detected concentrations as reported in Table 4.17 of the BGOU RI Report only (DOE 2010). Nondetect results are not included in the computation of the layer mean.
[c] SADA layer concentrations are from reported values in Table E.3.21, Appendix E of the BGOU RI Report (DOE 2010).
[d] PRGs are taken from Tables 1.21, 1.22, and 1.23 of the main text.

Table A2.4. Comparison of Average Layer Soil Concentrations of Selected COCs to PRGs for SWMU 30

COC / SADA Layer[a]	Sample Depths (ft) Start	Sample Depths (ft) End	Detectable Concentrations greater than the PRG	Maximum Concentration[b] (mg/kg or pCi/g)	Layer Average[b] (mg/kg or pCi/g)	SADA Layer[c] (mg/kg or pCi/g)	PRG for soil (mg/kg or pCi/g)[d]
Uranium-234						**Surface**	**306**
						Subsurface	**218**
1	0		2	115	56	43	N
2	5	10	0	6.6	NA	4.4	N
	10						
3	15		0	2.5	NA	4.6	N
4	30		0	ND	ND	4.5	N
6	45		0	0.43	0.25	4.0	N
7	60		0	0.52	0.28	3.5	N
Uranium-235						**Surface**	**9.2**
						Subsurface	**12.1**
1	0		3	17	6	4.4	H
2	5	10	0	0.55	0.25	0.31	N
	10		0	ND	NA	0.33	N
3	15		0	0.1	NA	0.31	N
4	30		0	ND	NA	0.34	N
6	45		0	ND	NA	0.35	N
7	60		0	ND	NA	0.36	N
Uranium-238						**Surface**	**37.4**
						Subsurface	**45.3**
1	0		5	**565**	**167**	**104**	**H, Y**
2	5	10	0	10.3	NA	7.6	N
	10						
3	15		0	0.77	NA	9.4	N
4	30		0	ND	ND	10	N
6	45		0	0.36	0.25	9.0	N
7	60		0	ND	ND	8.6	N
TCE						**Groundwater protection**	**0.103**
1	0		0	ND	ND	0	N
2	5	10	0	ND	ND	0.037	N
	10						
3	15		0	ND	ND	0.037	N
4	30		0	0.04	0.037	0.037	N
6	45		0	ND	ND	0.037	N
7	60		0	ND	ND	0.037	N
PCBs, Total						**Surface/Subsurface**	**10**
1	0		1	15	2.87	1.74	H
2	5	10	0	0.18	0.07	0.08	N
	10						
3	15		0	ND	ND	0.07	N
4	30		0	ND	ND	0.07	N
6	45		0	ND	ND	0.05	N
7	60		0	ND	ND	0.05	N

Table A2.4. Comparison of Average Layer Soil Concentrations of Selected COCs to PRGs for SWMU 30 (Continued)

COC—Identified according to criteria specified in the BHHRA and for inorganic constituents that exceed the range of background for PGDP (DOE 2013).
N—The average layer concentration is less than the PRG.
ND—not detected.
Y—Red bold typeface indicates the layer's mean concentration exceeds the PRG.
H—Orange bold typeface indicates the maximum concentration within the layer exceeds the PRG. Not used if layer's mean concentration also exceeds the PRG.
[a] SADA layer corresponds to the layer depth intervals used in the geostatistical model developed for the BGOU fate and transport modeling (DOE 2010). No data are available for Layer 5, 30 to 40 ft depth.
[b] Data for subsurface soil are detected concentrations as reported in Table 4.19 of the BGOU RI Report only (DOE 2010). Nondetect results are not included in the computation of the layer mean. Surface soil data was obtained from the database in Appendix C of the BGOU RI Report (DOE 2010).
[c] SADA layer concentrations are from reported values in Table E.3.25, Appendix E of the BGOU RI Report (DOE 2010).
[d] PRGs are taken from Tables 1.21, 1.22, and 1.23 of the main text.

The SWMU-specific summary tables provide the following information for each COC for conceptual model Layers 1 through 7:

- The number of detectable concentrations above the PRG in each layer;
- The maximum detectable concentration in each layer;
- The average concentration for the layer;
- The SADA model average concentration for each layer; and
- An indication if the layer exceeds a PRG.

Concentrations that exceed a PRG are shown in a bold, red typeface. If the layer average concentration exceeds the PRG, a bold, red "Y" is present in the last column. If a subsurface layer average concentration is below the PRG, but the maximum concentration exceeds the PRG, a bold, orange "H" is present in the last column indicating the presence of a "hot spot." The last column shown for the surface layer is the PRG. Table A2.5 provides a summary of selected COCs that exceeding PRGs.

REFERENCES

DOE (U.S. Department of Energy) 2010. *Remedial Investigation Report for the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-0030&D2, U.S. Department of Energy, Paducah, KY, April.

DOE 2013. *Methods for Conducting Risk Assessments and Risk Evaluations at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, Volume 1, Human Health, DOE/LX/07-0107&D2/R2/V1, U.S. Department of Energy, Paducah, KY, June.

Table A2.5. Summary of Selected COCs Exceeding Preliminary Remediation Goals[a]

SADA Layer (Depth in ft below grade)	Uranium	^{234}U	^{235}U	^{238}U	TCE	PCBs
SWMU 2						
1 (0–1 ft bgs)	**NA**	**NA**		**H**		**NA**
2 (1–10 ft bgs)	**NA**	**NA**		**A**	**A**	**NA**
3 (10–20 ft bgs)	**NA**	**NA**			**A**	**NA**
4 (20–30 ft bgs)	**NA**	**NA**				**NA**
5 (30–40 ft bgs)	**NA**	**NA**				**NA**
6 (40–50 ft bgs)	**NA**	**NA**			**A**	**NA**
7 (50–65 ft bgs)	**NA**	**NA**				**NA**
SWMU 3						
1 (0–1 ft bgs)	**NA**	**NA**			**NA**	**NA**
2 (1–10 ft bgs)	**NA**	**NA**	**NA**		**NA**	**NA**
3 (10–20 ft bgs)	**NA**	**NA**	**NA**		**NA**	**NA**
4 (20–30 ft bgs)	**NA**	**NA**	**NA**		**NA**	**NA**
5 (30–40 ft bgs)	**NA**	**NA**	**NA**		**NA**	**NA**
6 (40–50 ft bgs)	**NA**	**NA**	**NA**		**NA**	**NA**
7 (50–65 ft bgs)	**NA**	**NA**	**NA**		**NA**	**NA**
SWMU 7						
1 (0–1 ft bgs)	**H**	**H**		**H**		**H**
2 (1–10 ft bgs)	**H**	**H**	**NA**	**H**		**NA**
3 (10–20 ft bgs)			**NA**			**NA**
4 (20–30 ft bgs)			**NA**		**H**	**NA**
5 (30–40 ft bgs)	**NA**	**NA**	**NA**	**NA**	**NA**	**NA**
6 (40–50 ft bgs)			**NA**		**H**	**NA**
7 (50–65 ft bgs)			**NA**			**NA**
SWMU 30						
1 (0–1 ft bgs)	**NA**		**H**	**A**		**H**
2 (1–10 ft bgs)	**NA**					
3 (10–20 ft bgs)	**NA**					
4 (20–30 ft bgs)	**NA**					
5 (30–40 ft bgs)	**NA**					
6 (40–50 ft bgs)	**NA**					
7 (50–65 ft bgs)	**NA**					

[a] Selected COCs are those identified as principal threat waste in soil (see main text for additional explanation).
Blanks cells indicate the COC is not present at that depth in concentrations that exceed its PRG.

A COC is detected at concentrations above the PRG in one or more samples and in the layer average.
H COC is detected at concentrations above the PRG in one or more samples
N Constituent was not identified as a COC for this SWMU.
NA Data comparison is not available because the COC was not summarized in Tables A2.1 through A2.4.

APPENDIX B

DEVELOPMENT OF PRELIMINARY SOIL REMEDIATION GOALS FOR PROTECTION OF GROUNDWATER

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CONTENTS

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TABLES

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ACRONYMS

AT123D	Analytical Transient 1-,2-,3-Dimensional Model
BGOU	Burial Grounds Operable Unit
BD	bulk density
bgs	below ground surface
BHHRA	baseline human health risk assessment
COC	contaminant of concern
DAF	dilution attenuation factor
DCE	dichloroethene
ELCR	excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
FS	feasibility study
MCL	maximum contaminant level
NAL	no action level
OU	operable unit
PCB	polychlorinated biphenyl
PGDP	Paducah Gaseous Diffusion Plant
POE	point of exposure
PRG	preliminary remediation goal
RGA	Regional Gravel Aquifer
RI	remedial investigation
SESOIL	Seasonal Soil Compartment Model
SSL	soil screening level
SWMU	solid waste management unit
Tc-99	technetium-99
TCE	trichloroethene
UCRS	Upper Continental Recharge System

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B.1. INTRODUCTION

This appendix accompanies the *Feasibility Study for Solid Waste Management Units 2, 3, 7, and 30 of the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky*, DOE/LX/07-1274&D2 (FS), which has been prepared to evaluate remedial alternatives for Solid Waste Management Units (SWMUs) 2, 3, 7, and 30 of the Burial Grounds Operable Unit (BGOU) at the Paducah Gaseous Diffusion Plant (PGDP). This appendix of the FS provides a discussion of development of preliminary remediation goals (PRGs) to address the following remedial action objective:

- Contribute to the protection of groundwater by eliminating, reducing, or controlling sources of groundwater contamination.

The PRGs are allowable soil concentrations of contaminants of concern (COCs) in the waste zone [0–20 ft below ground surface (bgs)] in soil that would not result in concentrations in the Regional Gravel Aquifer (RGA) groundwater exceeding maximum contaminant levels (MCLs), or in the absence of an MCL, a risk-based concentration for residential use of groundwater.

Because COCs for the protection of groundwater have been added to those developed originally by the BGOU Remedial Investigation (RI) (DOE 2010a), modeling performed for the initial BGOU FS (DOE 2010b) to determine groundwater protection PRGs was limited. Due to this limitation, this appendix uses soils screening levels (SSLs) determined for the Soils Operable Unit (OU) RI as PRGs for the protection of groundwater (DOE 2013a).

B.2. COCs AND GROUNDWATER CONCENTRATIONS USED TO CALCULATE GROUNDWATER-PROTECTIVE PRGs FOR SOIL

Groundwater fate and transport modeling was performed as part of the BGOU RI. Seasonal Soil Compartment Model (SESOIL) (Bonazountas and Wagner 1984) was used for leachate modeling, downward through the Upper Continental Recharge System (UCRS). The hydrologic modeling parameter values and chemical-specific parameters used in the SESOIL modeling were based on representative conditions at PGDP and site-specific values for the individual SWMU. These parameters are listed in Tables B.1 and B.2. Analytical Transient 1-,2-,3-Dimensional Model (AT123D) Simulation of Waste Transport in the Aquifer System (Yeh 1981) was used to model horizontal contaminant migration in the saturated zone (i.e., in the RGA) to selected downgradient points of exposure (POEs). The chemical-specific parameters match those used in SESOIL modeling, except no degradation of trichloroethene (TCE) was assumed in the RGA. Excluding the distance to the POEs, Table B.3 presents the hydrogeologic parameters used for saturated flow and contaminant transport modeling for the BGOU RI.

The BGOU RI baseline human health risk assessment (BHHRA) identified COCs that could limit future use of RGA groundwater, based on risks associated with modeled concentrations in the RGA at the SWMU boundary. For this FS, the groundwater target concentrations are MCLs, or in the absence of an MCL, a risk-based concentration for residential use of groundwater. The U.S. Environmental Protection Agency (EPA) provides guidance for use of MCL values at Comprehensive Environmental Response, Compensation, and Liability Act sites (EPA 1998).

Table B.1. Soil Parameters for the UCRS Used in SESOIL Modeling for the BGOU RI*

Input Parameter	Value	Source
Soil type	Silty clay	PGDP site-specific
Bulk density (g/cm^3)	1.46	Laboratory analysis
Percolation rate (cm/year)	11	PGDP calibrated model
Intrinsic permeability (cm^2)	1.6E-10	Calibrated
Disconnectedness index	10	Calibrated
Porosity	0.45	Laboratory analysis
Depth to water table (m)		Site specific (to RGA) based on field observation
SWMU 2	19.5	
SWMU 3	19.8	
SWMU 7	18.3	
SWMU 30	18.6	
Fraction of organic carbon (%)	0.08	Laboratory analysis
Freundlich equation exponent	1	SESOIL default value

Table is taken from Table E.3.1 of the BGOU RI Report (DOE 2010a).

*When retardation is minimal, as characterized by small K_d values, approximately 25 years is required for UCRS contamination to reach the RGA (see Section B.3.2).

Table B.2. Chemical-Specific Parameters of the Analytes Used in SESOIL Modeling for BGOU RI

Analyte	Mol. Wt. (MW) (g/mol)	Solubility in water (mg/L)	Diffusion in air (cm^2/s)	Diffusion in water (m^2/hour)	Henry's Constant (atm.m^3/mol)	K_{oc} (L/kg)	K_d[a] (L/kg)	Half-Life (years)[b]
1,1-DCE	97	2.25E+03	0.09	3.74E-06	0.0261	65	0.013	infinite
Acenaphthene	154.0	4.20	0.04	2.77E-6	1.60E-04	4.90E+03	3.9	infinite
Antimony	121.75	1.00E+07	NA	3.60E-07	NA	NA	45	infinite
Arsenic	74.92	1.00E+07	NA	3.60E-07	NA	NA	29	infinite
Benzo(a)pyrene	252.32	1.62E-03	4.3E-02	3.24E-06	1.13E-06	9.69E+05	772	infinite
Cadmium	112.41	1.00E+07	NA	3.60E-07	NA	NA	75	infinite
cis-1,2-DCE	96.94	3.50E+03	0.07	4.07E-06	4.08E-03	35.5	0.028	infinite
Dibenzo(a,h) anthracene	278.33	0.0025	0.020	1.86E-06	1.47E-08	1.78E+06	1,424	infinite
Fluoranthene	202.26	0.206	0.030	2.29E-06	1.61E-05	4.91E+04	39.3	infinite
Fluorene	166.0	1.90	0.061	2.84E-06	7.7E-05	7.9E+03	6.3	infinite
Manganese	54.94	1.00E+07	NA	1.29E-07	NA	NA	65	infinite
Mercury	200.59	6.00E-02	3.07E-02	2.27E-06	2.44E-02	NA	52	infinite
Molybdenum	95.9	1.00E+07	NA	3.60E-07	NA	NA	10	infinite
Naphthalene	128.16	31.0	0.059	2.70E-06	4.83E-04	1.19E+03	0.95	infinite
Nickel	58.69	1.00E+07	NA	3.60E-07	NA	NA	300	infinite
PCB-1248	288	1.70E-02	1.75E-02	2.38E-06	1.60E-04	2.51E+04	20	infinite
PCB-1254	327	7.00E-02	1.56E-02	1.80E-06	3.40E-04	4.25E+04	34	infinite
PCB-1260	375.7	2.70E-02	1.38E-02	1.56E-06	7.40E-05	2.07E+05	165.6	infinite
Plutonium-239	239	1.00E+07	NA	3.60E-07	NA	NA	550	2.41E+04
Pyrene	202.3	0.135	0.0272	2.61E-06	1.1E-05	6.8E+04	54.4	infinite
Selenium	80.98	1.00E+07	NA	3.60E-07	NA	NA	5	infinite
Technetium-99	99	1.00E+07	NA	3.60E-07	NA	NA	0.2	2.13E+05
Tetrachloroethene	165.8	200	0.072	2.95E-06	0.0184	265	0.053	infinite
TCE	131	1,100	0.08	3.28E-06	0.0103	94	0.0752	26.6
Uranium-234	234	1.00E+07	NA	3.60E-07	NA	NA	66.8	2.44E+05
Uranium-235	235	1.00E+07	NA	3.60E-07	NA	NA	66.8	7.04E+08
Uranium-238	238	1.00E+07	NA	3.60E-07	NA	NA	66.8	4.47E+09
Uranium	238	1.00E+07	NA	3.60E-07	NA	NA	66.8	4.47E+09
Vanadium	50.94	1.00E+07	NA	3.60E-07	NA	NA	1,000	infinite
Vinyl Chloride	63	2,760	0.11	4.43E-07	0.0270	18.8	0.0152	infinite
Zinc	67.41	1.00E+07	NA	3.60E-07	NA	NA	62	infinite

Table B.2. Chemical-Specific Parameters of the Analytes Used in SESOIL Modeling for BGOU RI (Continued)

Table is taken from Table E.3.4 of the BGOU RI Report (DOE 2010a).
[a] The soil/water distribution coefficient (K_d) of an organic compound depends on the soil's organic content (f_{oc}) and compound's organic partition coefficient (K_{oc}). K_d values presented for organic compounds are for UCRS soils (with f_{oc} value of 0.08%) only. K_ds used in AT123D are different due to the f_{oc} of 0.02% in the RGA.
[b] Half-life shown is for radioactive half-life and, therefore, not applicable to nonradionuclides.

Table B.3. Hydrogeologic Parameters for the RGA Used in AT123D Modeling for the BGOU RI

Input Parameter	Value	Source
Bulk density (kg/m^3)	1,670	Laboratory analysis
Effective porosity	0.3	PGDP sitewide model calibrated value
Hydraulic conductivity (m/hour)		PGDP sitewide model calibrated value
SWMUs 2, 3, 7, and 30	19.05	
Hydraulic gradient (m/m)		PGDP sitewide model calibrated value
SWMUs 2 and 3	0.0002	
SWMU 7	0.0003	
SWMU 30	0.00036	
Aquifer thickness	9.14 m 30 ft	Site average
Longitudinal dispersivity (m)	15	Approximate values used in the past
Density of water (kg/m^3)	1,000	Default
Fraction of organic carbon (%)	0.02[a]	Laboratory analysis
Source Area	Variable	These dimensions were derived from the Spatial Analysis and Decision Assistance analysis for each analyte.

Table is taken from Table E.3.2 of the BGOU RI Report (DOE 2010a).
[a] UCRS soils were assigned an f_{oc} value of 0.08%, while the RGA was assigned an f_{oc} value of 0.02%.

As highlighted in Table B.4, several of the COCs had modeled groundwater concentrations that did not exceed MCLs at the SWMU boundary, which is the point of compliance for containment alternatives. These COCs were evaluated further and are discussed in this appendix because the point of compliance for excavation scenarios is the RGA groundwater concentrations beneath the SWMU.

Table B.4. Model-predicted Concentrations in RGA Groundwater at the SWMU Boundaries

Analyte	Predicted Maximum Groundwater Concentration[a] (mg/L or pCi/L)*	MCL or Risk-Based Concentration (mg/L or pCi/L)*
SWMU 2		
Arsenic	***3.54E-02***	0.01
cis-1,2-DCE	***1.15E+01***	0.07
Manganese	***7.16E-01***	0.0245[b]
Naphthalene	***9.38E-04***	0.000143[b]
PCB-1248	***1.54E-03***	0.0000284[b]
PCB-1260	***8.73E-05***	0.0000284[b]
Technetium-99	1.02E+02	900
Trichloroethene	***1.48E+00***	0.005
Uranium-234	1.58E+00	10.24[c]
Uranium-238	1.81E+00	9.99[c]
Uranium	9.86E-03	0.03

Table B.4. Model-predicted Concentrations in RGA Groundwater at the SWMU Boundaries (Continued)

Analyte	Predicted Maximum Groundwater Concentration[a] (mg/L or pCi/L)[*]	MCL or Risk-Based Concentration (mg/L or pCi/L)*
SWMU 3		
Arsenic	***3.29E-02***	0.01
Manganese	***8.95E-01***	0.0245[b]
Technetium-99	***5.560E+03***	900
Uranium-238	***1.59E+01***	9.99[c]
Uranium	***4.89E-02***	0.03
SWMU 7		
1,1-DCE	***8.98E-02***	0.007
Arsenic	***1.78E-02***	0.01
cis-1,2-DCE	2.35E-02	0.07
Manganese	***3.32E-01***	0.0245[b]
PCB-1254	***5.23E-05***	0.0000209[b]
Technetium-99	***9.09E+02***	900
Trichloroethene	***1.09E-02***	0.005
Uranium-234	7.94E+00	10.24[c]
Uranium-238	7.59E+00	9.99[c]
Uranium	3.46E-03	0.03
Vinyl Chloride	***1.35E-02***	0.002
SWMU 30		
1,1-DCE	8.18E-05	0.007
Arsenic	***1.82E-02***	0.01
Manganese	***3.78E-01***	0.0245[b]
Selenium	1.51E-02	0.05
Technetium-99	2.87E+02	900
Trichloroethene	9.11E-04	0.005
Uranium-234	3.99E+00	10.24[c]
Uranium-238	5.91E+00	9.99[c]
Uranium	8.40E-03	0.03

Table B.4 is taken from Table 5.2 of the BGOU RI (DOE 2010a); changes to the original are footnoted.
The MCL listed above for technetium-99 (Tc-99) is based on 4 mrem/year, using historical dosimetry assumptions.
[*]mg/L for chemicals, pCi/L for radionuclides
[a] Values in bold, italic font exceed the analyte's MCL.
[b] MCLs not available for these contaminants. A value was not included in the original table in the BGOU RI, but was added for this FS. Values are the groundwater no action levels (NALs) [i.e., the lesser of the hazard-based, using a target HI of 0.1, and cancer-based, using a target excess lifetime cancer risk (ELCR) of 1E-06 values when both are calculated] for the child resident taken from the 2013 Risk Methods Document [ELCRs (i.e. cancer NALs) were calculated using the child/adult age-adjusted lifetime scenario] (DOE 2013b). Additionally, modeled values that exceed this NAL have been shown in bold, italic font, as appropriate.
[c] The MCLs for uranium-234 and uranium-238 are from Table A.14 of the Risk Methods Document (DOE 2013b).

B.3. TARGET COCs FOR FS ALTERNATIVE EVALUATION

The list of COCs identified in the RI modeling (Table B.4) was evaluated by comparing measured soil concentrations to background concentrations (Section 1.6 of the main text). These COCs are listed in

Table B.5. In identifying target COCs, their presence in the RGA groundwater also was considered. These data were used to better understand the relationship between screening soils to identify potential for impacting the RGA as compared to groundwater patterns. This resulting groundwater data set summarizes the relative frequency of detections of analytes and frequency of exceedances of MCLs that are included in summaries of selected chemicals.

Table B.5. COCs for the Protection of Groundwater by SWMU

SWMU 2	SWMU 3	SWMU 7	SWMU 30
cis-1,2-DCE TCE Arsenic Uranium Tc-99 U-234 U-235 U-238	TCE Arsenic Uranium Tc-99 U-234 U-235 U-238	1,1-DCE *cis*-1,2-DCE TCE Vinyl chloride Arsenic Manganese Uranium Tc-99 U-234 U-235 U-238	1,1-DCE TCE Uranium Tc-99 U-234 U-235 U-238

B.3.1 COC LIST REFINED BASED ON TRANSPORT

UCRS groundwater contamination migrates vertically to the RGA. Along the migration pathway, contaminants are potentially subjected to the effects of retardation (which, as the name implies, increases travel times to the RGA) and biodegradation that reduces concentrations along the migration pathway. Retardation, quantified by the K_d, does not reduce groundwater concentration along the migration pathway, it only delays the peak concentration arrival time. For this assessment, if the peak concentration arrival time is greater than 1,000 years, the contaminant is assumed to be immobile and Seasonal Soil Compartment Model (SESOIL) modeling is not warranted.

Defining chemicals as immobile (no loading to the RGA in 1,000-year travel time) is consistent with findings in the literature. Scientific evidence suggests that some chemicals become more resistant to desorption from soil as contact time increases (Loehr and Webster 1996; Alexander 1995; Pavlostathis and Mathavan 1992). Chemicals that have relatively low transport potential due to their high soil adsorption coefficients may, over time, become irreversibly adsorbed to soil and therefore immobile under normal conditions (Alexander 1995). This time period for reduced desorption to occur has been reported to be on the order of weeks or months for several chemicals while a 100-year time period has been used to identify immobile chemicals. For this FS, it is assumed that these chemicals do not pose a threat to groundwater if the travel time from the soil/waste contaminants to RGA groundwater is more than 1,000 years.

Figure B.1 shows the relationship between K_d and travel times to the RGA from typical UCRS source zone depths. In general, as simulated by SESOIL, the BGOU source zone depths extend from approximately 10 ft to 40 ft bgs. When retardation is minimal, as characterized by small K_d values, approximately 25 years is required for UCRS contamination to reach the RGA. K_d values greater than 12 result in contaminant travel times in excess of 1,000 years. Thus, chemicals with K_d greater than 12 do not require SESOIL modeling.

The effects of biodegradation on expected RGA groundwater concentrations are evaluated by using the chemical specific K_d value and Figure B.1 to determine the expected travel time from the UCRS source zones to the RGA for a chemical of interest. That travel time is used along with the chemical-specific biological half-life in the following equation to predict expected RGA groundwater concentrations.

$$M(t) = M_0 \times e^{-kt}$$

Where:
- M_0 = initial concentration
- M(t) = concentration at the time of interest
- e = 2.71828183
- k = ln(2)/biodegradation half-life
- t = migration time through the UCRS

The chemical's water solubility is used as the initial concentration. If the predicted RGA chemical concentration is below the MCL, or risk-based concentration for residential use of groundwater in the absence of an MCL, then additional SESOIL modeling is not required.

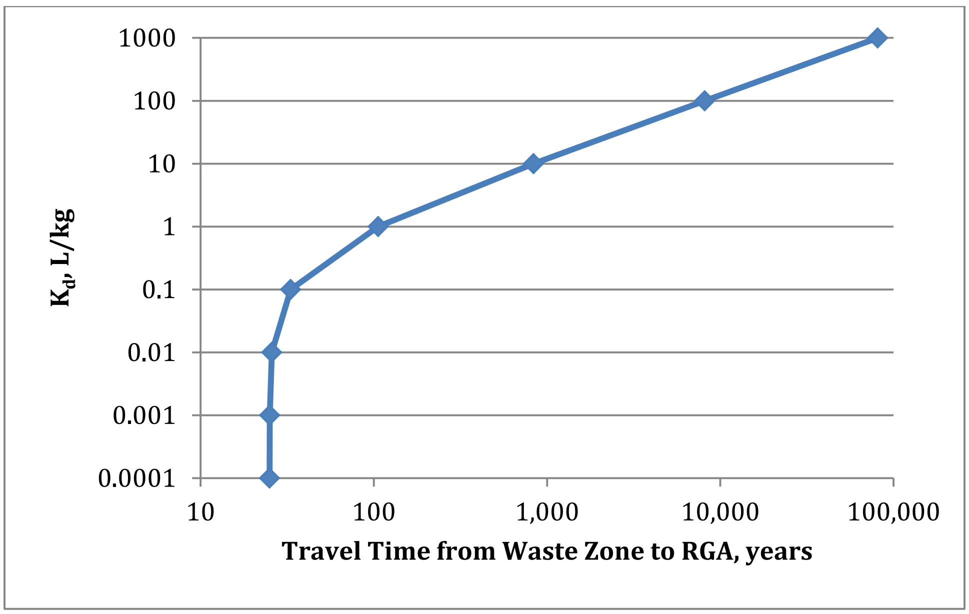

Figure B.1. K_d and Travel Time Relationship

B.3.1.1 Naphthalene

Naphthalene was identified as a COC based on contribution to the noncancer hazard for residential use of RGA groundwater by a future child resident at SWMU 2. Naphthalene was detected in the two sediment samples (SWMU2-15 and SWMU2-6), where high molecular weight polycyclic aromatic hydrocarbons also were present suggesting the presence of a mixture that will limit dissolution of naphthalene.

Biodegradation of naphthalene has been demonstrated to occur under both aerobic and anaerobic conditions, with rates that are more rapid under aerobic conditions. Howard et al. (1991) reports naphthalene half-lives in soil from 16.6 to 48 days based upon a soil die-away test and in groundwater from 24 hours (aerobic) to 258 days (anaerobic).

Naphthalene has a K_d of 0.953 [calculated from the soil organic carbon/water partition coefficient K_{oc} of 1,191 L/kg and the fraction of organic carbon (f_{oc}) of 0.0008 used in the SESOIL modeling for the BGOU RI]. Based on a K_d value of approximately 1, the travel time of dissolved naphthalene from the UCRS waste zone to the RGA is approximately 100 years (Figure B.1). The biological half-life of 257 days (SESOIL chemical data base) corresponds to the slower rate of degradation expected in anaerobic groundwater, a condition that occurs in the UCRS at some locations. Using a concentration of 31 mg/L, the solubility of naphthalene, 100 years biodegradation will reduce naphthalene concentrations to < 0.00001 mg/L before it reaches the RGA, and the concentration would be below the groundwater NAL of 0.176 µg/L (DOE 2011) in fewer than 13 years. The maximum dissolved naphthalene concentration will be much less than its solubility limit; thus, the dissolved concentration prediction for water at the point of migration to the RGA, as presented here, is much higher than reasonably would be expected. This finding is consistent with the observation that naphthalene was not detected in 168 RGA groundwater samples analyzed from 1995–2010.

Naphthalene was not analyzed in subsurface soils at SWMU 2; however, it was not detected in any of the 179 subsurface soil samples analyzed at the BGOU SWMUs, including SWMUs 5, 6, 7, and 30. This is consistent with predicted attenuation during the 100-year travel time to the RGA reducing concentrations such that no exceedances of the groundwater NAL would be expected. In addition, RGA groundwater is aerobic, a condition under which more rapid degradation would be expected. Based on these factors, naphthalene is not considered a COC, and PRGs are not required to address this chemical in this FS.

B.3.2.2 PCBs

Polychlorinated biphenyls (PCBs) detected during the BGOU RI were the higher molecular weight (lower mobility) Aroclors, PCB-1254 and PCB-1260, identified as COCs for residential use of groundwater at SWMUs 2 and 7. Total PCBs typically were detected most frequently and at the highest concentrations in surface soils. Total PCBs were not detected in any of over 200 subsurface soil samples at SWMUs 2, 3, 7, and 30 at depths greater than 20 ft.

The K_d values for these PCBs range from 34 (PCB-1254) to 166 (PCB-1260) (DOE 2010). Consistent with the low mobility of PCBs and lack of presence in deeper soils, Total PCBs are not predicted to reach the RGA within 1,000 years (Figure B.1), and further SESOIL modeling is not required to demonstrate no load to the RGA.

B.3.3 DEVELOPMENT OF PRGs FOR PROTECTION OF GROUNDWATER

The evaluation of the RI identified COCs (Table B.4) (see Section 1.6 of the main text) reduced the number of COCs requiring further evaluation and potential development of soil PRGs to the analytes listed in Table B.6.

The UCRS soil PRG is the maximum soil contaminant concentration that if left in place would not result in RGA groundwater concentrations above MCLs. All of the COCs above have MCLs. These PRGs would allow target RGA groundwater concentrations (MCLs) to be met at the SWMU boundary for containment remedies or beneath the waste for excavation/treatment scenarios.

Table B.6. COCs Identified in this FS for Potential Development of Soil PRGs for the Protection of Groundwater

SWMU	COCs*
2	**Arsenic; TCE; *cis*-1,2-DCE**; Tc-99; Uranium; U-234; U-235; U-238; Total PCBs
3	**Tc-99**; U-234; U-235; U-238; Uranium; TCE; Arsenic
7	**TCE; Vinyl chloride; 1,1-DCE;** *cis*-1,2-DCE; **Tc-99**; Arsenic; Manganese; Uranium; U-234; U-235; U-238
30	TCE; 1,1-DCE; Tc-99; Uranium; U-234; U-235; U-238

*COCs listed in bold were modeled to have the potential to exceed the MCL at the SWMU boundary.

COCs that exceeded the MCL at the SWMU boundary require development of PRGs and further evaluation of alternatives in this FS. In addition, the maximum soil concentration of those COCs that are predicted to be below the MCL at the SWMU boundary are compared to an SSL derived based on meeting the MCL beneath the waste, and if exceeded, require further evaluation of alternatives in this FS. Those risk-based COCs identified in the BHHRA that do not exceed the MCLs at the SWMU boundary and do not have any soil concentrations above a soil screening level protective of the RGA beneath the waste, do not require further evaluation in this FS.

The PRGs for the constituents are derived applying the formulas presented in the following section.

B.3.4 SCREENING PRGs

SSLs protective of groundwater were determined in the Soils OU RI (DOE 2013a). These SSLs were determined using the EPA-established formulas listed below. These formulas and inputs are consistent with those used in the Risk Methods Document (DOE 2013b). If an MCL is established for the chemical, then the SSLs are based on the MCL; if not, then they are based on the residential NAL for groundwater use.

For inorganic compounds,

$$C_t = C_w\left(K_d + \frac{\theta_w + \theta_a H'}{\rho_b}\right)$$

Where:
C_t = screening level in soil (mg/kg)
C_w = target soil leachate concentration (mg/L) (MCL or residential NAL × 58 DAF)
K_d = soil-water partition coefficient (L/kg) [chemical-specific, Soils OU RI Table C1.1 (DOE 2013a)]
θ_w = water-filled soil porosity (L_{water}/L_{soil}) (0.3) (EPA 1996)
θ_a = air-filled soil porosity (L_{air}/L_{soil}) (0.13) (EPA 1996)
ρ_b = dry soil bulk density (kg/L) (1.5) (EPA 1996)
H' = dimensionless Henry's law constant [chemical-specific × 41 (conversion factor)] (value taken from EPA Web site http://www.epa.gov/safewater/consumer/pdf/mcl.pdf)

For organic compounds,

$$C_t = C_w\left((K_{oc}\, f_{oc}) + \frac{\theta_w + \theta_a H'}{\rho_b}\right)$$

Where:
C_t = screening level in soil (mg/kg)
C_w = target soil leachate concentration (mg/L) (MCL or residential NAL x 58 DAF)

K_{oc} = soil organic carbon-water partition coefficient (L/kg) (chemical-specific, taken from EPA Web site)
f_{oc} = organic carbon content of soil (kg/kg) (0.002) (EPA 1996)
θ_w = water-filled soil porosity (L_{water}/L_{soil}) (0.3) (EPA 1996)
θ_a = air-filled soil porosity (L_{air}/L_{soil}) (0.13) (EPA 1996)
ρ_b = dry soil bulk density (kg/L) (1.5) (EPA 1996)
H' = dimensionless Henry's law constant [chemical-specific x 41 (conversion factor)] (value taken from EPA Web site http://www.epa.gov/safewater/consumer/pdf/mcl.pdf)

The DAF reflects the mixing of UCRS and the upper portions of the RGA below a source area. The "Soils Operable Unit Dilution Attenuation Factor Evaluation" used a deterministic approach to identify a DAF of 58—a value similar to previously used values at PGDP (DOE 2013a). This screening incorporated a DAF of 58 into the derivation of the PRGs for the protection of groundwater. As was noted in the Soils OU RI Report, the DAF equations indicate that as long as hydraulic conductivity, hydraulic gradient, and the infiltration rate remain constant, the DAF will be constant regardless of the size of the source area undergoing evaluation (DOE 2013a). A DAF of 59 was calculated for the Southwest Plume source areas at the site; therefore, it is reasonable to use a DAF of 58 for the BGOU SWMUs 2, 3, 7, and 30.

B.3.4.1 Arsenic

Arsenic was retained as a COC for SWMUs 2 and 7. The EPA MCL-based SSL for protection of groundwater (DAF 1) for arsenic is 0.292 mg/kg (Risk Methods Document Table A.7a; DOE 2011). Using the PGDP DAF of 58, the SSL for a DAF 58 is 16.9 mg/kg, slightly above the surface-soil background concentration of 12 mg/kg; therefore, the arsenic PRG for protection of groundwater for SWMUs 2 and 7 is identified as 16.9 mg/kg.

B.3.4.2 Technetium-99

Tc-99 was identified in the RI as a COC at SWMUs 2, 3, 7, and 30 because modeling identified the potential for Tc-99 to exceed the MCL at the SWMU boundary for SWMUs 3 and 7. EPA has derived SSLs for radionuclides for the soil to groundwater pathway for radionuclides[1] and for Tc-99. The MCL-based SSL of 3.73 pCi/L was derived using the SSL equation shown above and using default assumptions. These include a DAF of 20, K_d of 0.007 L/kg and bulk density (BD) of 1.5 kg/L. For the derivation of the BGOU PRG, site-specific inputs were used, as follows:

- DAF of 58
- BD = 1.46 kg/L (used in the UCRS modeling)
- K_d of 0.2 L/kg

While Tc-99 can be highly mobile, the groundwater monitoring data collected for SWMUs 3 and 7 do not indicate any SWMU-related exceedances of the Tc-99 MCL.

The BGOU soils data show that Tc-99 concentrations are highest in the surface soils, with 12 of 90 surface samples having concentrations above 16 pCi/g. Only 1 of 329 subsurface soil samples had a concentration above this level, suggesting Tc-99 is retained at the surface, which is further supported by the K_d determination in the next section.

Table B.7 illustrates the impact of K_d on the travel time of Tc-99 and the calculated SSL associated with that K_d assumption. The velocity in the pore water is shown for an infiltration rate of 4.2 and

[1] http://epa-prgs.ornl.gov/radionuclides/download/res_soil2GW_rad_prg_august_2010.pdf

Table B.7. Illustration of Time for Migration of Tc-99 Through Surface Soils as a Function of K_d

K_d L/kg	Retardation Factor	Time (years) to Migrate 1 ft		SSL pCi/g
		Vpw = 14 inch/year	Vpw= 22 inch/year	
0.007	1	0.86	0.55	11.1
0.2	2	1.7	1.1	21.2
0.5	3.5	3.0	1.9	36.8
1	6	5.2	3.3	63
3	16	13.8	8.8	167

The SSL was calculated using n = 0.3 and BD = 1.46 kg/L.
Pore water velocities (Vpw) correspond to infiltration rate assumptions of 4.2 and 6.6 inches/year.

6.6 inches/year. With a low K_d (0.007 L/kg), mobile Tc-99 would be removed from the 0–1 ft interval in less than one year. Using the K_d of 0.2 L/kg (used in the BGOU RI modeling) it also would migrate to subsurface soils fairly rapidly (less than two years). This K_d value, used in the BGOU RI modeling, is consistent with K_d values derived in a document that presents results of a geochemical model to estimate values of distribution coefficients for nine metal contaminants at PGDP (BJC 2002).

For consistency with the BGOU RI modeling, a K_d of 0.2 L/kg is used in the screening analysis for the PRG. The PRG for Tc-99 is 21.2 pCi/g.

One or more samples exceed this PRG in SWMUs 3, 7, and 30—almost exclusively in surface soil. Given the preponderance of the exceedances in surface soil, it is apparent that the K_d of 0.2 L/g greatly overestimates the BGOU migration potential. Tc-99 is not retained as a COC requiring action in this FS at SWMU 2 because modeling did not identify a potential to exceed the MCL at the SWMU boundary, and the maximum concentration detected in soil of 14.6 pCi/L is below the PRG of 21.2 pCi/g.

B.3.5 SUMMARY OF PRGs FOR PROTECTION OF GROUNDWATER

Table B.8 summarizes the UCRS soil PRGs for the COCs present within the BGOU that are protective of RGA groundwater. The PRGs represent the maximum soil contaminant concentration that can be left in place at the BGOU SWMUs, so that the leachate associated with the soil contamination when entering the RGA will not result in groundwater concentrations above MCLs or risk-based concentrations for residential use of groundwater in the absence of MCLs. These PRGs assume that the precipitation infiltration regime remains constant.

Table B.8. Soil PRGs for Protection of RGA Groundwater

SWMU	COC	MCL or NAL[a]	Groundwater Protective PRG for Soil [b]
2	Arsenic	0.01 mg/L	16.9 mg/kg
	Uranium	0.03 mg/L	783 mg/kg
	cis-1,2-DCE	0.07 mg/L	1.19 mg/kg
	TCE	0.005 mg/L	0.103 mg/kg
	Total PCBs	0.0005 mg/L	4.54 mg/kg [d]
	Technetium-99	900 pCi/L	21.2 pCi/g
	Uranium-234[c]	10.24 pCi/L	4,880,000 pCi/g
	Uranium-235 [c]	0.466 pCi/L	50,700 pCi/g
	Uranium-238 [c]	9.99 pCi/L	264 pCi/g

Table B.8. Soil PRGs for Protection of RGA Groundwater (Continued)

SWMU	COC	MCL or NAL[a]	Groundwater Protective PRG for Soil
3	TCE	0.005 mg/L	0.103 mg/kg
	Arsenic	0.01 mg/L	16.9 mg/kg
	Uranium	0.03 mg/L	783 mg/kg
	Technetium-99	900 pCi/L	21.2 pCi/g
	Uranium-234[c]	10.24 pCi/L	4,880,000 pCi/g
	Uranium-235[c]	0.466 pCi/L	50,700 pCi/g
	Uranium-238[c]	9.99 pCi/L	264 pCi/g
7	1,1-DCE	0.007 mg/L	0.146 mg/kg
	cis-1,2-DCE	0.07 mg/L	1.19 mg/kg
	Arsenic	0.01 mg/L	16.9 mg/kg
	Manganese	0.0245 mg/L	92.8 mg/kg
	Uranium	0.03 mg/L	783 mg/kg
	TCE	0.005 mg/L	0.103 mg/kg
	Total PCBs	0.0005 mg/L	4.54 mg/kg[d]
	Technetium-99	900 pCi/L	21.2 pCi/g
	Uranium-234[c]	10.24 pCi/L	4,880,000 pCi/g
	Uranium-235[c]	0.466 pCi/L	50,700 pCi/g
	Uranium-238[c]	9.99 pCi/L	264 pCi/g
	Vinyl chloride	0.002 mg/L	0.0397 mg/kg
30	1,1-DCE	0.007 mg/L	0.146 mg/kg
	TCE	0.005 mg/L	0.103 mg/kg
	Uranium	0.03 mg/L	783 mg/kg
	Technetium-99	900 pCi/L	21.2 pCi/g
	Uranium-234[c]	10.24 pCi/L	4,880,000 pCi/g
	Uranium-235[c]	0.466 pCi/L	50,700 pCi/g
	Uranium-238[c]	9.99 pCi/L	264 pCi/g

[a] MCLs and NALs are found in Table C1.2 of the Soils OU RI Report (DOE 2013a).
The MCL listed above for Tc-99 is based on 4 mrem/year, using historical dosimetry assumptions.
[b] Groundwater protective PRGs for soil are found in Table C1.2 of the Soils OU RI Report (DOE 2013a).
[c] Uranium radionuclide MCLs from Risk Methods Document (DOE 2013b).
[d] A groundwater protective PRG does not apply, because BGOU RI modeling indicated PCBs did not reach the water table in 1,000 years for SWMU 2 or SWMU 7. For SWMU 3, PCBs did not pass screening and therefore did not require modeling. For SWMU 30, modeling for PCBs showed that PCBs exhibited groundwater concentrations that were less than the groundwater child no action levels.

B.4. CONCLUSIONS

PRGs for the protection of groundwater at BGOU SWMUs 2, 3, 7, and 30 are presented utilizing the SSLs determined for the Soils OU RI. The COCs identified in the BGOU BHHRA included several constituents that are present at a level consistent with background concentrations, immobile, or would attenuate so that impacts from these COCs would not result in concentrations in the RGA groundwater exceeding MCLs, or in the absence of an MCL, a risk-based concentration for residential use of groundwater. Other COCs identified based on risk are not predicted to cause an exceedance of an MCL in RGA groundwater. MCLs are the target groundwater concentrations used to evaluate potential actions in this FS.

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APPENDIX C

DEVELOPMENT OF PRELIMINARY REMEDIATION GOALS FOR SOIL THAT ENSURE PROTECTION OF FUTURE INDUSTRIAL AND FUTURE EXCAVATION WORKERS

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CONTENTS

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TABLES

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ACRONYMS

BGOU	Burial Grounds Operable Unit
BHHRA	baseline human health risk assessment
COC	contaminant of concern
COPC	chemical of potential concern
DOE	U.S. Department of Energy
ELCR	excess lifetime cancer risk
EPA	U.S. Environmental Protection Agency
FS	feasibility study
GI	gastrointestinal
HI	hazard index
HQ	hazard quotient
IRIS	Integrated Risk Information System
NAL	no action level
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PGDP	Paducah Gaseous Diffusion Plant
POC	point of contact
PRG	preliminary remediation goal
RAIS	Risk Assessment Information System
RAGS	Risk Assessment Guidance for Superfund
RAO	remedial action objective
RfD	reference dose
RGA	Regional Gravel Aquifer
RI	remedial investigation
RSL	regional screening goals
SWMU	solid waste management unit
SWOU	Surface Water Operable Unit
UCL	upper confidence level
WAG	waste area grouping
XRF	X-ray fluorescence spectrometer

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C.1. INTRODUCTION

This appendix accompanies the *Feasibility Study for Solid Waste Management Units 2, 3, 7, and 30 of the Burial Grounds Operable Unit at the Paducah Gaseous Diffusion Plant, Paducah, Kentucky,* DOE/LX/07-1274&D2, which has been prepared to evaluate remedial alternatives for Solid Waste Management Units (SWMUs) 2, 3, 7, and 30 of the Burial Grounds Operable Unit (BGOU) at the U.S. Department of Energy (DOE) Paducah Gaseous Diffusion Plant (PGDP). The feasibility study (FS) will support remedy selection for these SWMUs in accordance with regulatory guidance and consistent with the scope of the BGOU FS. Appendix C details the approach taken to address the following general remedial action objective (RAO):

- Prevent exposure to waste and contaminated soils that present an unacceptable risk from direct contact.

The BGOU FS addresses impacts associated with exposure to wastes and media affected by these wastes. This appendix addresses the potential for impacts associated with soils to evaluate risks to support taking actions, as necessary, for protection of human health and the environment including addressing releases or potential releases from these source areas that may (or may have) affected soils and/or the surface water drainageways. Remedial decisions to address sediments located adjacent to the BGOU SWMUs primarily fall within the scope of the Surface Water Operable Unit (SWOU) Strategic Initiative. Thus, although ditches will be addressed as part of the post-PGDP shutdown activities for surface water, any indications that the BGOU SWMUs are sources to these ditches will be addressed in this FS.

Based on reasonably anticipated future use of the PGDP, the industrial workers are the only receptors likely to encounter the surface soils in these SWMUs; however, to support the evaluation of potential threats from direct contact with subsurface soils and buried waste in SWMUs 2, 3, 7, and 30, the impacts from potential exposure by excavation workers also were evaluated. Under both scenarios, future industrial and future excavation workers were evaluated for their potential to encounter contaminants of concern (COCs). These workers ultimately can be protected from undue exposure either by reducing the mass/volume of the COCs in these media or by reducing the workers' potential for exposure to the COCs, or a combination of both. Even if the excavation worker scenario does not identify unacceptable risk from contact with affected soils, direct contact with waste remaining in SWMUs 2, 3, 7, and 30 will have to be controlled through administrative or engineering controls to address the uncertainty associated with the lack of information about the waste source term.

Identifying soil preliminary remediation goals (PRGs) is one method that supports an evaluation of achieving the RAO because the PRGs identify concentrations of COCs in soil that do not pose unacceptable risk under defined exposure scenarios. In addition, a PRG can be used to support treatment and/or removal alternatives by establishing where treatment/removal would be required. For this FS, achieving the SWMU-specific RAO is based on meeting the following target cumulative excess lifetime cancer risks (ELCRs) and cumulative noncancer hazard indices (HIs) for the future industrial and future excavation worker receptors.

- Surface Soil: Cumulative ELCR $< 1E\text{-}05$ and cumulative HI ≤ 1 for a future industrial worker

- Surface and Subsurface Soil: Cumulative ELCR $< 1E\text{-}05$ and cumulative HI ≤ 1 for a future excavation worker

This appendix describes the development of PRGs that are protective of future industrial workers from direct contact with surface soil and future excavation workers from direct contact with surface and subsurface soil at SWMUs 2, 3, 7, and 30. The COCs identified in the baseline human health risk assessment (BHHRA) for these receptors are the constituents for which PRGs are to be developed. Evaluation of potential alternatives to meet this RAO and corresponding development of soil PRGs protective for future workers have the following additional considerations.

- PRGs will not be developed for COCs that are at/below background concentrations.

- The direct contact COCs for the future industrial and excavation workers were identified in the Waste Area Grouping (WAG) 22 RI (DOE 1998) for SWMUs 7 and 30 and the WAG 22 RI Addendum (DOE 1994) for SWMUs 2 and 3. Where updated toxicity information indicates the chemical would not be a COC using current assumptions, no PRG would be required for that chemical for the remedy to be protective and meet the RAO.

- The BHHRA identified risks to the excavation worker based on contact with contaminants in surface and subsurface soils (0–16 ft). To meet the RAO as stated, the PRGs for the excavation worker would be derived for those COCs present in the surface and subsurface soil [0–16 ft below ground surface (bgs)]. PRGs for surface soil (0–1 ft) are to be based on the future industrial worker given the target cumulative ELCR 1E-05 and cumulative HI ≤ 1.

PRGs are developed for the COCs that are not eliminated by the previous considerations. These soil contaminants present above the PRGs must be addressed by remedial alternatives developed in the FS. During the FS process, candidate remedial actions are examined in the context of their effectiveness in meeting the RAOs.

C.1.1 SUMMARY OF COCs FOR THE FS

Once the previous evaluations are considered, the COC list carried forward in the FS is as shown in Table C.1. These represent the chemicals and radionuclides for which PRGs will be developed. As indicated previously, the COCs for SWMUs 2 and 3 are applicable to both the surface and subsurface soils. Additional information regarding these COCs is available in Sections 1.5 and 1.6 of this FS.

Table C.1. COCs over all Media by SWMU

Media	SWMU 2	SWMU 3	SWMU 7	SWMU 30
Surface Soil See COCs for the "Future industrial worker at current concentrations (soil)" scenarios in Tables 1.5 through 1.8 in the main text of this FS report. List of COCs were updated based on information in Section 1.6 of this FS.	Arsenic U-234 U-235 U-238	Arsenic U-234 U-235 U-238	Total PAHs Arsenic Cobalt Iron Manganese Mercury Uranium Np-237 U-234 U-235 U-238	Total PAHs Total PCBs Uranium Np-237 U-234 U-235 U-238

Table C.1. COCs over all Media by SWMU (Continued)

Media	SWMU 2	SWMU 3	SWMU 7	SWMU 30
Subsurface Soil and Waste See COCs for the "Future industrial worker at current concentrations (soil)" scenarios on Tables 1.5 and 1.6 and COCs for the "Future Excavation Worker" scenarios on Tables 1.7 and 1.8 in the main text of this FS report. Lists of COCs were updated based on information in Section 1.6 of this FS.	*cis*-1,2-DCE TCE Total PCBs Arsenic Uranium Tc-99 U-234 U-235 U-238	*cis*-1,2-DCE TCE Total PCBs Arsenic Uranium Tc-99 U-234 U-235 U-238	Total PAHs Arsenic Cobalt Iron Manganese Nickel Uranium U-234 U-235 U-238	Total PAHs Total PCBs Uranium U-234 U-235 U-238
Protection of Groundwater See COCs for Total ELCR for the "Future adult rural resident at modeled concentrations (RGA groundwater drawn at plant boundary)" and for Total HI for the "Future child rural resident at modeled concentrations (RGA groundwater drawn at plant boundary)" scenarios in Tables 1.5 through 1.8 in the main text of this FS report. Lists of COCs were updated based on information in Section 1.6 of this FS.	*cis*-1,2-DCE TCE Total PCBs Arsenic Uranium Tc-99 U-234 U-235 U-238	TCE Arsenic Uranium Tc-99 U-234 U-235 U-238	1,1-DCE *cis*-1,2-DCE TCE Vinyl chloride Total PCBs Arsenic Manganese Uranium Tc-99 U-234 U-235 U-238	1,1-DCE TCE Uranium Tc-99 U-234 U-235 U-238

These have been confirmed to be the primary COCs that will identify locations that may require actions. These are shown on figures for each SWMU in Appendix A. To address the uncertainties associated with data collected after the risk assessment was completed, the concentrations of the additional radionuclides detected in samples at SWMU 2 and Total PCB concentrations in SWMU 7 are included in these figures.

C.2. IDENTIFICATION OF SOIL PRGS THAT ENSURE PROTECTION OF FUTURE INDUSTRIAL AND FUTURE EXCAVATION WORKERS

The RAO for SWMUs 2, 3, 7, and 30 is "Prevent exposure to waste and contaminated soils that presents an unacceptable risk from direct contact." The COCs identified in Section 1.6 to be addressed in this FS are contaminants in soils, recognizing that preventing exposure to waste also is necessary. Achieving the RAO for COCs in soils is based on meeting the following target cumulative ELCRs and cumulative noncancer HIs for the future industrial and future excavation worker receptors:

- Surface Soil: Cumulative ELCR $< 1E\text{-}05$ and cumulative HI ≤ 1 for a future industrial worker
- Surface and Subsurface Soil: Cumulative ELCR $< 1E\text{-}05$ and cumulative HI ≤ 1 for a future excavation worker

In this section, soil PRGs are developed for the COCs identified above. These PRGs for contaminated surface and subsurface soils are used in Section 3 to identify those media-specific COCs that pose a threat that must be addressed by the remediation alternatives developed in this FS. PRGs protective of groundwater in the RGA beneath the SWMU from potential leaching of COCs from soil are identified in Appendix B. The COCs for the leaching pathway are identified based on unacceptable risks from residential use of groundwater at the SWMU boundary and, thus, focus on a range of more mobile analytes.

To guide the evaluation of alternatives, numeric criteria for each of the COCs are developed. These PRGs (Tables C.2 and C.3) provide “not-to-exceed” concentrations for surface and/or subsurface soils such that if these concentrations were met for the specified medium as a result of implementation of an alternative, the residual risk for these exposure units would meet the RAO.[1]

C.2.1 CUMULATIVE RISK AND HAZARDS

In the risk assessment process, total risks (cumulative ELCR) and hazards (HI) are estimated for the exposure unit and receptors. For carcinogenic compounds, the chemical-specific risk for worker exposures to contaminants in soils represents the sum of the risks from ingestion, inhalation, and dermal absorption routes of exposure posed by that chemical at the defined soil concentration. The total or cumulative ELCR represents the sum of the risks posed by individual constituents. Similarly, for noncancer effects, the hazards posed by these routes of exposure for each constituent are summed to estimate the HI for the exposure unit.

Default assumptions for estimating soil contaminant intakes by future industrial workers and future excavation workers are conservative in terms of protecting human health, for example assumptions of 250 days/year for 25 years for an industrial worker (see Section C.2.2) and 185 days/year for 5 years for an excavation worker (see Section C.2.3). Therefore, an exposure point concentration is defined to represent an estimate of the average concentration over the exposure unit to which that worker may be exposed over the time period assumed for that exposure scenario.

Assuming the area within the SWMU boundaries are the appropriate exposure units for estimating residual risks for these potential future workers, an appropriate ELCR and HI would be calculated using the estimated average concentration remaining following any remedy implementation.

C.2.2 TARGET PRGs FOR THE FUTURE INDUSTRIAL WORKER

The industrial worker NALs from the 2013 Risk Methods Document (DOE 2013a) were derived using default assumptions for exposures to workers from all routes of exposure: (1) incidental ingestion, (2) inhalation, (3) dermal absorption, and (for radionuclides) external exposure to ionizing radiation. These numeric criteria are based on a target risk for carcinogens of 1E-06 and a HI of 0.1.

The PRGs, shown on Table C.2, for each COC (with the exception of Total PCBs) are set at one-half the target cumulative ELCR and HI as follows.

- **Surface soils.** PRG concentration is set at five times the industrial worker NAL. This corresponds to a risk of 5E-06 for carcinogenic COCs and a noncancer HQ of 0.5.

[1] Important to note is that actual cleanup goals will appear in the Record of Decision. Contaminant concentrations that will guide cleanup will appear in the Remedial Action Work Plan, appropriate to the remedy.

Table C.2. SWMUs 2, 3, 7, and 30 FS Preliminary Remediation Goals for Surface Soil

SWMU	COC	Units	Background[a]	Direct Contact PRG[b]	Groundwater-Protective PRG[c]	PRG for Surface Soil[d]
2	Arsenic	mg/kg	1.20E+01	1.91E+01	1.69E+01	1.69E+01
2	U-234	pCi/g	1.20E+00	3.06E+02	4.88E+06	3.06E+02
2	U-235	pCi/g	6.00E-02	9.20E+00	5.07E+04	9.20E+00
2	U-238	pCi/g	1.20E+00	3.74E+01	2.64E+02	3.74E+01
3	Arsenic	mg/kg	1.20E+01	1.91E+01	1.69E+01	1.69E+01
3	U-234	pCi/g	1.20E+00	3.06E+02	4.88E+06	3.06E+02
3	U-235	pCi/g	6.00E-02	9.20E+00	5.07E+04	9.20E+00
3	U-238	pCi/g	1.20E+00	3.74E+01	2.64E+02	3.74E+01
7	Total PAHs[f]	mg/kg	N/A	3.92E+00	2.51E-01	2.51E-01
7	Arsenic	mg/kg	1.20E+01	1.91E+01	1.69E+01	1.69E+01
7	Cobalt	mg/kg	1.40E+01	3.02E+02	8.18E-01	1.40E+01
7	Iron	mg/kg	2.80E+04	5.00E+05	1.07E+03	2.80E+04
7	Manganese	mg/kg	1.50E+03	2.11E+04	9.28E+01	1.50E+03
7	Mercury	mg/kg	2.00E-01	3.07E+02	6.03E+00	6.03E+00
7	Uranium[g]	mg/kg	4.90E+00	2.99E+03	7.83E+02	7.83E+02
7	Np-237	pCi/g	1.00E-01	6.05E+00	2.61E-01	2.61E-01
7	U-234	pCi/g	1.20E+00	3.06E+02	4.88E+06	3.06E+02
7	U-235	pCi/g	6.00E-02	9.20E+00	5.07E+04	9.20E+00
7	U-238	pCi/g	1.20E+00	3.74E+01	2.64E+02	3.74E+01
30	Total PAHs[f]	mg/kg	N/A	3.92E+00	2.51E-01	2.51E-01
30	Total PCBs	mg/kg	N/A	1.43E+01	4.54E+00[h]	1.00E+01[e]
30	Uranium[g]	mg/kg	4.90E+00	2.99E+03	7.83E+02	7.83E+02
30	Np-237	pCi/g	1.00E-01	6.05E+00	2.61E-01	2.61E-01
30	U-234	pCi/g	1.20E+00	3.06E+02	4.88E+06	3.06E+02
30	U-235	pCi/g	6.00E-02	9.20E+00	5.07E+04	9.20E+00
30	U-238	pCi/g	1.20E+00	3.74E+01	2.64E+02	3.74E+01

N/A = not available

[a] Background concentrations taken from Table A.12 of the 2013 Risk Methods Document (DOE 2013a).

[b] Direct contact PRGs are taken from 5 times the industrial worker NAL from Table A.4 of the 2013 Risk Methods Document (DOE 2013a). This value corresponds to the lesser of an ELCR of 5E-06 for carcinogenic COCs and an HI of 0.5 for noncarcinogenic COCs for chemical-specific targets in order to ensure that the residual cumulative ELCR will be equal to or below the ELCR target of 1E-05, and the residual cumulative HI will be equal to or below the HI target of 1.

[c] Groundwater PRGs are the soil screening level for the maximum contaminant level (MCL) or residential NAL using a dilution attenuation factor of 58 [see Table C1.2 of the Soils OU RI Report (DOE 2013b)].

[d] PRG for surface soil is the lower of the direct contact PRG and groundwater protective PRG for soil. If the risk-based value is less than background, then background becomes the revised PRG for surface soil. Shading indicates the revised PRG is set at background.

[e] Determined during June 2009 BGOU FS scoping meeting.

[f] Direct contact PRGs are based on total carcinogenic PAHs. The groundwater protective PRG is based on values for benz(a)anthracene.

[g] Direct contact PRGs are based on uranium, soluble salts.

[h] A groundwater protective PRG does not apply, because BGOU RI modeling indicated PCBs exhibited groundwater concentrations that were less than the groundwater child no action level.

Table C.3. SWMUs 2, 3, 7, and 30 FS Preliminary Remediation Goals for Subsurface Soil

SWMU	COC	Units	Background[a]	Direct Contact PRG[b]	Groundwater-Protective PRG[c]	PRG for Subsurface Soil[d]
2	*cis*-1,2-DCE	mg/kg	N/A	2.88E+02	1.19E+00	1.19E+00
2	TCE	mg/kg	N/A	1.18E+01	1.03E-01	1.03E-01
2	Total PCBs	mg/kg	N/A	4.25E+00	4.54E+00[f]	1.00E+01[e]
2	Arsenic	mg/kg	7.90E+00	1.04E+01	1.69E+01	1.04E+01
2	Uranium	mg/kg	4.60E+00	4.31E+02	7.83E+02	4.31E+02
2	Tc-99	pCi/g	2.80E+00	7.73E+03	2.12E+01	2.12E+01
2	U-234	pCi/g	1.20E+00	2.18E+02	4.88E+06	2.18E+02
2	U-235	pCi/g	6.00E-02	1.21E+01	5.07E+04	1.21E+01
2	U-238	pCi/g	1.20E+00	4.53E+01	2.64E+02	4.53E+01
3	*cis*-1,2-DCE	mg/kg	N/A	2.88E+02	1.19E+00	1.19E+00
3	TCE	mg/kg	N/A	1.18E+01	1.03E-01	1.03E-01
3	Total PCBs	mg/kg	N/A	4.25E+00	4.54E+00[f]	1.00E+01[e]
3	Arsenic	mg/kg	7.90E+00	1.04E+01	1.69E+01	1.04E+01
3	Uranium	mg/kg	4.60E+00	4.31E+02	7.83E+02	4.31E+02
3	Tc-99	pCi/g	2.80E+00	7.73E+03	2.12E+01	2.12E+01
3	U-234	pCi/g	1.20E+00	2.18E+02	4.88E+06	2.18E+02
3	U-235	pCi/g	6.00E-02	1.21E+01	5.07E+04	1.21E+01
3	U-238	pCi/g	1.20E+00	4.53E+01	2.64E+02	4.53E+01
7	Total PAHs[g]	mg/kg	N/A	1.22E+00	2.51E-01	2.51E-01
7	Arsenic	mg/kg	7.90E+00	1.04E+01	1.69E+01	1.04E+01
7	Cobalt	mg/kg	1.30E+01	4.31E+01	8.18E-01	1.30E+01
7	Iron	mg/kg	2.80E+04	1.01E+05	1.07E+03	2.80E+04
7	Manganese	mg/kg	8.20E+02	3.40E+03	9.28E+01	8.20E+02
7	Nickel	mg/kg	2.20E+01	2.86E+03	7.89E+01	7.89E+01
7	Uranium[h]	mg/kg	4.60E+00	4.31E+02	7.83E+02	4.31E+02
7	U-234	pCi/g	1.20E+00	2.18E+02	4.88E+06	2.18E+02
7	U-235	pCi/g	6.00E-02	1.21E+01	5.07E+04	1.21E+01
7	U-238	pCi/g	1.20E+00	4.53E+01	2.64E+02	4.53E+01
30	Total PAHs[g]	mg/kg	N/A	1.22E+00	2.51E-01	2.51E-01
30	Total PCBs	mg/kg	N/A	4.25E+00	4.54E+00[f]	1.00E+01[e]
30	Uranium[h]	mg/kg	4.60E+00	4.31E+02	7.83E+02	4.31E+02
30	U-234	pCi/g	1.20E+00	2.18E+02	4.88E+06	2.18E+02
30	U-235	pCi/g	6.00E-02	1.21E+01	5.07E+04	1.21E+01
30	U-238	pCi/g	1.20E+00	4.53E+01	2.64E+02	4.53E+01

N/A = not available

[a] Background concentrations taken from Table A.12 of the 2013 Risk Methods Document (DOE 2013a).

[b] Direct contact PRGs are derived for a future excavation worker receptor scenario corresponding to an ELCR of 5E-06 for carcinogenic COCs and an HI of 0.5 for noncarcinogenic COCs for chemical-specific targets in order to ensure that the residual cumulative ELCR will be equal to or below the ELCR target of 1E-05, and the residual cumulative HI will be equal to or below the HI target of 1.

[c] Groundwater PRGs are the soil screening level for the MCL or residential NAL using a dilution attenuation factor of 58 [see Table C1.2 of the Soils OU RI Report (DOE 2013b)].

[d] PRG for subsurface soil is the lower of the direct contact PRG and groundwater protective PRG for soil. If the risk-based value is less than background, then background becomes the revised PRG for subsurface soil. Shading indicates the revised PRG is set at background.

[e] Determined during June 2009 BGOU FS scoping meeting.

[f] A groundwater protective PRG does not apply, because BGOU RI modeling indicated PCBs exhibited groundwater concentrations that were less than the groundwater child no action level for SWMU 30 and did not reach the water table in 1,000 years for SWMU 2. For SWMU 3, PCBs did not pass screening and therefore did not require modeling.

[g] Direct contact PRGs are based on total carcinogenic PAHs. The groundwater protective PRG is based on values for benz(a)anthracene.

[h] Direct contact PRGs are based on uranium, soluble salts.

The following sections provide supporting information on the protectiveness of these PRGs for decision making and the derivation of these values.

Where PCBs were identified as COCs for future industrial and future excavation workers, the 10 ppm value for Total PCBs in soil is the value jointly agreed upon by representatives of EPA Region 4, Kentucky Department for Environmental Protection, and DOE (during a June 2009 BGOU FS scoping meeting). This value was considered to be sufficiently protective of potential direct contact risk that could occur at the BGOU, when used to identify potential hot spots of PCBs. This is considered protective for cumulative risks for these exposure scenarios.

In some cases, multiple carcinogenic COCs were identified. Any sample where even one of the COCs is present at concentrations above the PRGs would require further evaluation. Using the approach for setting the PRG at half the target risk has been used at PGDP and demonstrated to achieve RAOs.

There is a potential uncertainty associated with the case where multiple COCs are each present below the PRGs, but the cumulative ELCR still could exceed 1E-05. To address this uncertainty, any SWMU medium that has identified multiple COCs, but does not exceed the target risk threshold, will be reevaluated to ensure that this has not occurred.

The attainment of cleanup objectives following a response action will be based on ELCR and HI calculations using concentrations measured in samples collected to verify that RAOs have been met at a SWMU. This will follow the same approach described in the Risk Methods Document (DOE 2013a) and will be consistent with EPA (1991) guidance.

The analytical results for uranium-235 are reported in the WAG 22 (SWMU 7 and 30) risk assessment either as uranium-235 or uranium-235/236 in some soil samples from SWMUs 7 and 30 (DOE 1998). The identification of combined uranium-235/236 isotopes for some samples is due to the difficulty of differentiating between uranium-235 activity and uranium-236 activity. This uncertainty is expected to be minor because the same PRG value is calculated for uranium-235 and uranium-235/236 in the risk assessment (DOE 1998) and the same applicable PRG for soil was developed for both. The trace amounts of uranium-236 at PGDP originated from reactor recycled uranium; less than 10% of the material handled at PGDP was reactor recycled uranium; 0.002% of the reactor recycled uranium would be uranium-236. The important isotopes in assessing risk at PGDP are uranium-234, uranium-235, and uranium-238; therefore, these are the critical uranium isotopes that must be analyzed for in material at PGDP.

C.2.3 TARGET PRGs FOR THE FUTURE EXCAVATION WORKER

The Paducah Risk Methods Document states that a duration of one to five years is likely to reflect the potential exposures at the site for an excavation worker scenario (DOE 2013a). A duration of five years was used to calculate PRGs for SWMUs 2, 3, 7, and 30. The PRGs, shown on Table C.3, for each COC (with the exception of Total PCBs) are set at one-half (i.e., 0.5) the target cumulative ELCR and HI as follows.

- **Surface and Subsurface Soils.** PRG concentration is set at five times the excavation worker NAL. This corresponds to an ELCR of 5E-06 for carcinogenic COCs and a noncancer HQ of 0.5.

The NALs for the outdoor worker in the 2013 Risk Methods Document (DOE 2013a) were used to calculate PRGs for the excavation worker based on a five-year duration. Table C.4 shows the calculated values.

Table C.4. SWMUs 2, 3, 7, and 30 Calculated Excavation Worker PRGs[a]

SWMU	COC	Units	Carcinogenic PRG ELCR=5E-06	Noncarcinogenic PRG HI=0.5	Direct Contact PRG for Subsurface Soil[b]
2	*cis*-1,2-DCE	mg/kg	-	2.88E+02	2.88E+02
2	TCE	mg/kg	1.55E+02	1.18E+01	1.18E+01
2	Total PCBs	mg/kg	4.25E+00	-	4.25E+00
2	Arsenic	mg/kg	1.04E+01	3.34E+01	1.04E+01
2	Uranium	mg/kg	-	4.31E+02	4.31E+02
2	Tc-99	pCi/g	7.73E+03	-	7.73E+03
2	U-234	pCi/g	2.18E+02	-	2.18E+02
2	U-235	pCi/g	1.21E+01	-	1.21E+01
2	U-238	pCi/g	4.53E+01	-	4.53E+01
3	*cis*-1,2-DCE	mg/kg	-	2.88E+02	2.88E+02
3	TCE	mg/kg	1.55E+02	1.18E+01	1.18E+01
3	Total PCBs	mg/kg	4.25E+00	-	4.25E+00
3	Arsenic	mg/kg	1.04E+01	3.34E+01	1.04E+01
3	Uranium	mg/kg	-	4.31E+02	4.31E+02
3	Tc-99	pCi/g	7.73E+03	-	7.73E+03
3	U-234	pCi/g	2.18E+02	-	2.18E+02
3	U-235	pCi/g	1.21E+01	-	1.21E+01
3	U-238	pCi/g	4.53E+01	-	4.53E+01
7	Total PAHs[c]	mg/kg	1.22E+00	-	1.22E+00
7	Arsenic	mg/kg	1.04E+01	3.34E+01	1.04E+01
7	Cobalt	mg/kg	6.25E+04	4.31E+01	4.31E+01
7	Iron	mg/kg	-	1.01E+05	1.01E+05
7	Manganese	mg/kg	-	3.40E+03	3.40E+03
7	Nickel	mg/kg	2.17E+06	2.86E+03	2.86E+03
7	Uranium[d]	mg/kg	-	4.31E+02	4.31E+02
7	U-234	pCi/g	2.18E+02	-	2.18E+02
7	U-235	pCi/g	1.21E+01	-	1.21E+01
7	U-238	pCi/g	4.53E+01	-	4.53E+01
30	Total PAHs[c]	mg/kg	1.22E+00	-	1.22E+00
30	Total PCBs	mg/kg	4.25E+00	-	4.25E+00
30	Uranium[d]	mg/kg	-	4.31E+02	4.31E+02
30	U-234	pCi/g	2.18E+02	-	2.18E+02
30	U-235	pCi/g	1.21E+01	-	1.21E+01
30	U-238	pCi/g	4.53E+01	-	4.53E+01

N/A = not available
[a] The NALs for the outdoor worker (Table A.4 of DOE 2013a) were used to determine these values.
[b] The PRG is the lesser of the carcinogenic PRG and the noncarcinogenic PRG.
[c] Direct contact PRGs are calculated using benzo(a)pyrene.
[d] Direct contact PRGs are based on uranium, soluble salts.

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APPENDIX D

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APPENDIX E

COST ESTIMATES

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CONTENTS

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E.1. SWMU 2 COST ESTIMATES

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COST ESTIMATE
BGOU SWMU 2
Alternative 3—Containment, LUCs, Monitoring

Cost Estimate Summary									
Capital Cost	**Quantity**	**Units**	**Unit Price**	**Total**					
1.0 Remedial Design	1	LS	$1,211,000	$1,211,000					
2.0 Other Project Plans	1	LS	$807,000	$807,000					
3.0 Remedial Design Site Investigation (RDSI)	1	LS	$689,000	$689,000					
4.0 Hydraulic Isolation	1	LS	$2,138,000	$2,138,000					
5.0 Surface Soils Consolidation	1	LS	$39,000	$39,000					
6.0 Subtitle C Cap Construction	1	LS	$1,263,000	$1,263,000					
7.0 Riprap Cover	1	LS	$782,000	$782,000					
Subproject Management	1	LS	$692,900	$693,000					Subproject Management = 10%
Management Reserve	1	LS	$1,143,300	$1,143,000					Contractor MR = 15%
Fee	1	LS	$613,550	$614,000					Fee = 7%
Contingency	1	LS	$1,875,800	$1,876,000					Contingency = 20%
	SUBTOTAL CAPITAL COST			**$11,255,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Inspections	1000	EA	$21,000	$21,000,000			7.59E+17		Quarterly for 1,000 years
Weed Removal and Cover Inspection	900	EA	$11,000	$9,900,000			3.98E+17		Semiannually following initial 100 years.
Groundwater Storage Tank Collection & Disposal	1000	EA	$4,000	$4,000,000			1.45E+17		Annually for 1,000 years.
Extraction Well Pump Replacement	200	EA	$176,000	$35,200,000			1.34E+18		Every 5 years for 1,000 years
Sign Replacement	33	EA	$3,000	$100,000			3.98E+15		Every 30 years for 1,000 years
Above Grade Groundwater Component Replacement and Redevelop Wells	20	EA	$415,000	$8,300,000			5.46E+17		Every 50 years for 1,000 years
Extraction Well Replacement	10	EA	$524,000	$5,240,000			5.51E+17		Every 100 years for 1,000 years
Groundwater Monitoring - First 5 years	5	EA	$64,000	$320,000			3.48E+05		Semi-annually for first 5 years
Groundwater Monitoring - Years 6 through 1000	995	EA	$32,000	$31,840,000			1.16E+18		Annually for years 6 through 1,000
Five-Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
	SUBTOTAL ANNUAL COST			**$125,900,000**			**5.28E+18**		
			TOTAL	**$137,155,000**					

COST ESTIMATE
BGOU SWMU 2
Alternative 3—Containment, LUCs, Monitoring

Present Worth Value										
		Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
	Total Capital Cost	1	LS	$11,255,000	$11,255,000				**$11,255,000**	
	Inspections	1000	EA	$21,000	$21,000,000				**$1,909,057**	1.1% discount rate
	Weed Removal and Cover Inspection	900	EA	$11,000	$9,900,000				**$334,859**	1.1% discount rate
	Groundwater Storage Tank Collection & Disposal	1000	EA	$4,000	$4,000,000				**$363,630**	1.1% discount rate
	Extraction Well Pump Replacement	200	EA	$176,000	$35,200,000				**$3,130,315**	1.1% discount rate
	Sign Replacement	33	EA	$3,000	$100,000				**$7,723**	1.1% discount rate
	Above Grade Groundwater Component Replacement and Redevelop Wells	20	EA	$415,000	$8,300,000				**$570,001**	1.1% discount rate
	Extraction Well Replacement	10	EA	$524,000	$5,240,000				**$263,819**	1.1% discount rate
	Groundwater Monitoring - First 5 years	5	EA	$64,000	$320,000				**$309,705**	1.1% discount rate
	Groundwater Monitoring - Years 6 through 1000	995	EA	$32,000	$31,840,000				**$2,754,187**	1.1% discount rate
	Five-Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
								Capital Costs	**$11,255,000**	
							Present	**Annual**	**$10,533,000**	
							Worth	**Avg. Annual**	**$10,533**	
							Values	**Total**	**$21,788,000**	
This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.										
Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.										

CAPITAL COSTS

		Material/Equipment/Subcontractors/ODCs				**Labor**				
	Task Description	**Qty**	**Unit**	**Unit Price**	**Total**	**Hours**	**Rate**	**Total**	**Total Cost**	**Basis of Estimate**
1.0 Remedial Design										
Refer to the Success reports for detailed cost and resources.										
	RDWP/RDSI Work Plan					3184		$282,863		
	Remedial Design Report					6664		$617,211		
	Civil Surveying					160		$16,902		
	Procurement					300		$24,232		
	Work Packages/Readiness					1128		$98,096		
	Training	1	LS	$68,800	$68,800	1320		$102,736		$68,800 includes subcontractor training and pyrophoric training
	TASK TOTAL				**$68,800**	**12756**		**$1,142,040**	**$1,211,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 3—Containment, LUCs, Monitoring

2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					4164		$377,545		
O&M Plan					700		$66,863		
SAP/QAPP					840		$73,002		
Waste Management Plan					616		$58,809		
RACR					1900		$179,749		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**8804**		**$806,693**	**$807,000**	
3.0 Remedial Design Site Investigation (RDSI)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Drilling									
Prime Contractor Labor					2250		$183,785		
Subcontractors	1	LS	$57,550	$57,550					Local quote from existing drilling sub.
Materials	1	LS	$42,648	$42,648					
Vehicles and Equipment	1	LS	$4,360	$4,360					
Sampling									
Prime Contractor Labor					1000		$73,042		
Materials	1	LS	$17,661	$17,661					
Analytical									
Prime Contractor Labor					300		$28,445		
Materials	1	LS	$271,861	$271,861					
Excavation									
Prime Contractor Labor	1				100		$7,610		
Materials	1	LS	$1,063	$1,063					
Equipment	1	LS	$1,076	$1,076					
TASK TOTAL				**$ 396,219**	**3650**		**$ 292,882**	**$689,000**	
4.0 Hydraulic Isolation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Slurry Wall Construction									
Prime Contractor Labor					2599		$201,714		
Subcontractors	1	LS	$1,023,369	$1,023,369					
Materials	1	LS	$17,011	$17,011					
Vehicles and Equipment	1	LS	$32,732	$32,732					
Well Construction									
Prime Contractor Labor					800		$64,952		
Subcontractors	1	LS	$465,318	$465,318					Local quote from existing drilling sub.
Materials	1	LS	$14,161	$14,161					
Vehicles and Equipment	1	LS	$1,744	$1,744					
Tank and Piping									
Prime Contractor Labor					800		$59,803		
Subcontractors	1	LS	$157,479	$157,479					
Materials	1	LS	$29,819	$29,819					

COST ESTIMATE
BGOU SWMU 2
Alternative 3—Containment, LUCs, Monitoring

Electrical				$0					
Prime Contractor Labor					401		$29,901		
Subcontractors	1	LS	$27,904	$27,904					
Materials	1	LS	$11,617	$11,617					
TASK TOTALS				**$1,781,154**	**4,600**		**$356,370**	**$2,138,000**	
5.0 Surface Soils Consolidation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Surveying and Marking									
Prime Contractor Labor					160		$14,145		
Materials	1	LS	$744	$744					
Soil Consolidation									
Prime Contractor Labor					120		$8,810		
Materials	1	LS	$744	$744					
Subcontractors	1	LS	$14,244	$14,244					
TASK TOTALS				**$15,732**	**280**		**$22,955**	**$39,000**	
6.0 Subtitle C Cap Construction									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Surveying, Marking, Testing									
Prime Contractor Labor					280		$28,905		
Subcontractors	1	LS	$80,102	$80,102					Local engineering firm
Materials	1	LS	$744	$744					
Cap Construction									
Prime Contractor Labor					3930		$313,495		
Subcontractors	1	LS	$663,439	$663,439					
Materials	1	LS	$14,880	$14,880					
Vehicles and Equipment	1	LS	$13,952	$13,952					
Monitoring Well Installation									
Prime Contractor Labor					992		$79,246		
Subcontractors	1	LS	$64,720	$64,720					Local quote from existing drilling sub.
Materials	1	LS	$2,232	$2,232					
Vehicles and Equipment	1	LS	$1,744	$1,744					
TASK TOTAL				**$ 841,813**	**5202**		**$421,646**	**$1,263,000**	
7.0 Riprap Cover									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Bedding Layer									
Prime Contractor Labor					879		$74,808		
Subcontractors	1	LS	$145,871	$145,871					
Materials	1	LS	$2,232	$2,232					
Vehicles and Equipment	1	LS	$1,744	$1,744					

COST ESTIMATE
BGOU SWMU 2
Alternative 3—Containment, LUCs, Monitoring

Riprap Layer									Includes 2 ft soil cover
Prime Contractor Labor					1632		$136,991		
Subcontractors	1	LS	$413,114	$413,114					
Materials	1	LS	$3,528	$3,528					
Vehicles and Equipment	1	LS	$3,488	$3,488					
TASK TOTAL				**$569,977**	**2511**		**$211,799**	**$782,000**	
							SUBTOTAL CAPITAL COST	**$6,929,000**	
ANNUAL COSTS									
Inspections									
Duration: Occurs quarterly for 1,000 years.									
Prime Contractor Labor					240		$20,180		
Materials	1	LS	$540	$540					
Vehicles and Equipment	1	LS	$436	$436					
TASK TOTAL				**$976**	**240**		**$20,180**	**$21,000**	ANNUAL COST
Weed Removal and Cover Inspection									
Duration: Semiannually following the first 100 years.									
Prime Contractor Labor					120		$10,090		
Materials	1	LS	$270	$270					
Vehicles and Equipment	1	LS	$218	$218					
TASK TOTAL				**$488**			**$10,090**	**$11,000**	ANNUAL COST
Groundwater Storage Tank Collection & Disposal									
Duration: Annually for 1,000 years.									
Prime Contractor Labor					50		$3,815		
Materials	1	LS	$108	$108					
Vehicles and Equipment	1	LS	$109	$109					
TASK TOTAL				**$217**			**$3,815**	**$4,000**	ANNUAL COST
Extraction Well Pump Replacement									
Duration: Every 5 years.									
Prime Contractor Labor					100		$7,745		
Subcontractors	1	LS	$168,131	$168,131					Local quote from existing drilling sub.
TASK TOTAL				**$168,131**			**$7,745**	**$176,000**	EVERY 5 YEARS
Sign Replacement									
Duration: Every 30 years.									
Prime Contractor Labor					30		$2,392		
Materials	1	LS	$108	$54					
Vehicles and Equipment	1	LS	$109	$109					
TASK TOTAL				**$163**			**$2,392**	**$3,000**	EVERY 30 YEARS
Above Grade Groundwater Component Replacement and Redevelop Wells									
Duration: Every 50 years.									
Prime Contractor Labor					800		$59,803		
Subcontractors	1	LS	$323,512	$323,512					RSMeans and local quote
Materials	1	LS	$28,259	$28,259					
Vehicles and Equipment	1	LS	$3,488	$3,488					
TASK TOTAL				**$355,259**			**$59,803**	**$415,000**	EVERY 50 YEARS
Extraction Well Replacement									

COST ESTIMATE
BGOU SWMU 2
Alternative 3—Containment, LUCs, Monitoring

Duration: Every 100 years.									
Prime Contractor Labor					640		$53,598		
Subcontractors	1	LS	$465,319	$465,319					
Materials	1	LS	$3,147	$3,147					
Vehicles and Equipment	1	LS	$1,744	$1,744					
TASK TOTAL				**$470,210**			**$53,598**	**$524,000**	EVERY 100 YEARS
Groundwater Monitoring - First 5 years									
Duration: Semiannually for the first 5 years.									
Prime Contractor Labor					640		$50,330		
Laboratory	1	LS	$12,033	$12,033					
Materials	1	LS	$1,080	$1,080					
Vehicles and Equipment	1	LS	$872	$872					
TASK TOTAL				**$13,985**			**$50,330**	**$64,000**	ANNUAL COST
Groundwater Monitoring - Years 6 through 1000									
Duration: Annually for years 6 through 1000									
Prime Contractor Labor					320		$25,165		
Laboratory	1	LS	$6,016	$6,016					
Materials	1	LS	$540	$540					
Vehicles and Equipment	1	LS	$436	$436					
TASK TOTAL				**$6,992**			**$25,165**	**$32,000**	ANNUAL COST
Five-Year Review									
Duration: Every 5 years.									
Prime Contractor Labor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study

Reported From: SWMU 2 Alternative 3
Report Total: $8,227,756

Author
Manager

LEVEL	QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups		
	SWMU 2 Alternative 3		**$8,227,756**
	Capital Costs		**$6,928,081**
	Remedial Desgin		**$1,210,840**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	282,863	$1.00	$282,863
Memo: 3,184 HOURS				

TOTAL RDWP/RDSI Work Plan **$282,863**

	Estimate Tree Structure Rollups		
	SWMU 2 Alternative 3		**$8,227,756**
	Capital Costs		**$6,928,081**
	Remedial Desgin		**$1,210,840**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	617,211	$1.00	$617,211
Memo: 6,664 HOURS				

TOTAL RDR **$617,211**

	Estimate Tree Structure Rollups		
	SWMU 2 Alternative 3		**$8,227,756**
	Capital Costs		**$6,928,081**
	Remedial Desgin		**$1,210,840**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	16,902	$1.00	$16,902
Memo: 160 HOURS				

TOTAL Civil Surveying **$16,902**

	Estimate Tree Structure Rollups		
	SWMU 2 Alternative 3		**$8,227,756**
	Capital Costs		**$6,928,081**
	Remedial Desgin		**$1,210,840**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	24,232	$1.00	$24,232
Memo: 300 HOURS				

TOTAL Procurement **$24,232**

	Estimate Tree Structure Rollups		
	SWMU 2 Alternative 3		**$8,227,756**
	Capital Costs		**$6,928,081**
	Remedial Desgin		**$1,210,840**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	98,096	$1.00	$98,096
Memo: 1,128 HOURS				

TOTAL Work Packages/Readiness Review **$98,096**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 3			**$8,227,756**
	Capital Costs			**$6,928,081**
	Remedial Desgin			**$1,210,840**

Training

Tree Depth= 5

LEVEL		QTY	UNIT COST	TOTAL
	Pyrophoric U Training per Person	16	$800.00	$12,800
Memo: Assume $800 per person. This is consistent with the previous FS submittal.				
	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
Memo: Assume 80 hours of training per person. Assume 10 people or 800 hours.				
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training — **$171,536**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 3			**$8,227,756**
	Capital Costs			**$6,928,081**
	Other Project Plans			**$806,693**

RAWP

Tree Depth= 5

LEVEL		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	377,545	$1.00	$377,545
Memo: 4,164 HOURS				

TOTAL RAWP — **$377,545**

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 3			**$8,227,756**
	Capital Costs			**$6,928,081**
	Other Project Plans			**$806,693**

O&M Plan

Tree Depth= 5

LEVEL		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan — **$66,863**

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 3			**$8,227,756**
	Capital Costs			**$6,928,081**
	Other Project Plans			**$806,693**

SAP/QAPP

Tree Depth= 5

LEVEL		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	73,002	$1.00	$73,002
Memo: 840 HOURS				

TOTAL SAP/QAPP — **$73,002**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Capital Costs				**$6,928,081**
	Other Project Plans				**$806,693**

Waste Management Plan

Tree Depth= 5

		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	58,809		$1.00	$58,809
Memo: 616 HOURS					

TOTAL Waste Management Plan **$58,809**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Capital Costs				**$6,928,081**
	Other Project Plans				**$806,693**

RACR

Tree Depth= 5

		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	179,749		$1.00	$179,749
Memo: 1,900 HOURS					

TOTAL RACR **$179,749**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Capital Costs				**$6,928,081**
	Other Project Plans				**$806,693**

LUCIP

Tree Depth= 5

		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Capital Costs				**$6,928,081**
	RDSI				**$689,102**

Drilling

Tree Depth= 5

		QTY		UNIT COST	TOTAL
	Mob/Demob for DPT subcontractor	1		$8,500.00	$8,500
	DPT Borings to 40 feet	30		$1,635.00	$49,050
Memo: 2 borings per day - 15 days of borings plus 1 week for mob and 1 week for demob.					
	1/2 TON 4WD TRUCKS, LARGE VANS	800	hrs	$5.45	$4,360
Memo: 4 LATAKY vehicles.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	ST-90 CONTAINER DELIVERED	2		$1,770.63	$3,541
Memo: 2 ST-90 box for PPE/Trash.					
	PORTABLE TOILET & HAND WASH PER MONTH	1		$227.21	$227
Memo: Rent for 1 month.					
	LAUNDRY 2 CHANGES COST PER HOUR	2,900	hrs	$2.70	$7,830
Memo: LATAKY personnel plus assume 5 drillers.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	2,900		$5.19	$15,051

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Capital Costs				**$6,928,081**
	RDSI				**$689,102**

Drilling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	PPE 2 c/o per day 10 hr day cost per hr	2,900		$1.95	$5,655
	MSA OptiFilter HEPA per hour	2,900		$3.45	$10,005
LABOR	PRIME CONTRACTOR LABOR	183,785		$1.00	$183,785
Memo: 2,250 HOURS					

TOTAL Drilling **$288,343**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Capital Costs				**$6,928,081**
	RDSI				**$689,102**

Sampling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	5 gram EN CORE SAMPLER	500		$6.94	$3,470
	Niton XRF Rental One Month	2		$4,500.00	$9,000
	PCB Test Kits	1		$541.00	$541
	LAUNDRY 2 CHANGES COST PER HOUR	1,000	hrs	$2.70	$2,700
	PPE 2 c/o per day 10 hr day cost per hr	1,000	hr	$1.95	$1,950
LABOR	PRIME CONTRACTOR LABOR	73,042		$1.00	$73,042
Memo: 1,000 HOURS					

TOTAL Sampling **$90,703**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Capital Costs				**$6,928,081**
	RDSI				**$689,102**

Analytical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RDSI Soil Sampling Analytical	1		$262,775.00	$262,775
Memo: 8 samples from 30 borings = 240 samples.					
	Overnight Shipment per Cooler	31		$251.97	$7,811
Memo: Assume 2 shipments per day for 15 days plus 1 shipment later for the waste water.					
	RDSI Geophysical Sampling Analytical	1		$1,275.00	$1,275
Memo: 3 Geophysical samples taken for particle size and atterberg limits.					
LABOR	PRIME CONTRACTOR LABOR	28,445		$1.00	$28,445
Memo: 300 HOURS					

TOTAL Analytical **$300,306**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Capital Costs				**$6,928,081**
	RDSI				**$689,102**

Excavation

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	JOHN DEERE 624E 4WD ARTICULATED WHEEL LOADER	20	hr	$18.23	$365
	KOMATSU WB142-5 BACKHOE cost per hour	20	hr	$35.58	$712
	PPE 2 c/o per day 10 hr day cost per hr	80	hr	$1.95	$156
	LAUNDRY 2 CHANGES COST PER HOUR	80	hrs	$2.70	$216
	MSA OptiFilter HEPA per hour	80		$3.45	$276
	Resp cleaning 10 hr day 2 C/O per day cost per hr	80		$5.19	$415
LABOR Memo: 100 HOURS	PRIME CONTRACTOR LABOR	7,610		$1.00	$7,610

TOTAL Excavation **$9,749**

Memo: Excavator will dig potholes until conduit duct bank is found. Duct bank will be broken up and removed in two places where the slurry wall will be placed.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 3		**$8,227,756**
Capital Costs		**$6,928,081**
Hydraulic Isolation		**$2,137,523**

Slurry Wall Construction

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	C7 R.S.Means Crew	32,000	S.F.	$21.10	$675,221
Memo: 4 LATAKY vehicles.	1/2 TON 4WD TRUCKS, LARGE VANS	1,288	hrs	$5.45	$7,020
	LAUNDRY 2 CHANGES COST PER HOUR	1,280	hrs	$2.70	$3,456
	CATERPILLAR 345B CRAWLER MOUNTED SHEAR HEAD EXCAVATOR	320	hr	$62.12	$19,878
	JOHN DEERE 624E 4WD ARTICULATED WHEEL LOADER	320	hr	$18.23	$5,834
	PPE 2 c/o per day 10 hr day cost per hr	1,280	hr	$1.95	$2,496
	MSA OptiFilter HEPA per hour	1,280		$3.45	$4,416
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,280		$5.19	$6,643
LABOR Memo: 2,599 HOURS	PRIME CONTRACTOR LABOR	201,714		$1.00	$201,714

Subtotal	$926,678
1st Layer Markups assigned to Detail Items	$348,148

TOTAL Slurry Wall Construction **$1,274,826**

Memo: Assume wall is approx. 200' x 200' or 800 LF 800 LF x 40' deep = 32,000 SF.
Assume 25 linear feet per day: 800 / 25 = 32 days assume 2 months due to weather delays and equipment repairs.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Capital Costs				**$6,928,081**
	Hydraulic Isolation				**$2,137,523**

Well Construction

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	Extraction Well Subcontractor Mob/Demob	1		$34,878.49	$34,878
	Extraction Well Installation & Development	4		$65,577.27	$262,309
	Extraction Well Pump Installation	4		$42,032.80	$168,131
	LAUNDRY 2 CHANGES COST PER HOUR	1,040	hrs	$2.70	$2,808
Memo: LATAKY personnel plus assume 5 drillers.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	1,040	hr	$1.95	$2,028
	MSA OptiFilter HEPA per hour	1,040		$3.45	$3,588
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,040		$5.19	$5,398
LABOR	PRIME CONTRACTOR LABOR	64,952		$1.00	$64,952
Memo: 800 HOURS					

TOTAL Well Construction **$546,175**
Memo: 4 week duration.

	Estimate Tree Structure Rollups		
	SWMU 2 Alternative 3		**$8,227,756**
	Capital Costs		**$6,928,081**
	Hydraulic Isolation		**$2,137,523**

Tank & Piping

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	1,000 Gallon Water Tank	1		$1,100.00	$1,100
	Q1 R.S.Means Crew	5,000	L.F.	$22.36	$111,775
	LAUNDRY 2 CHANGES COST PER HOUR	800	hrs	$2.70	$2,160
	Pump House Building Pre Fab	1		$24,999.00	$24,999
Memo: Tank structure.					
	PPE 2 c/o per day 10 hr day cost per hr	800		$1.95	$1,560
LABOR	PRIME CONTRACTOR LABOR	59,803		$1.00	$59,803
Memo: 800 HOURS					

Subtotal $201,397
1st Layer Markups assigned to Detail Items $45,704

TOTAL Tank & Piping **$247,101**

	Estimate Tree Structure Rollups		
	SWMU 2 Alternative 3		**$8,227,756**
	Capital Costs		**$6,928,081**
	Hydraulic Isolation		**$2,137,523**

Electrical

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	RSMeans D5010 120 0220 Electrical Service	1		$2,417.00	$2,417
Memo: Includes O&P.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Capital Costs				**$6,928,081**
	Hydraulic Isolation				**$2,137,523**

Electrical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	R3 R.S.Means Crew	5	Ea.	$1,024.44	$5,122
	1/0 Triplex Service Wire per foot	2,000		$3.67	$7,340
	Electricians	5	Ea.	$298.89	$1,494
	Electricians	500	L.F.	$10.39	$5,193
	Electricians	20	C.L.F.	$52.34	$1,047
	Electricians	2	Ea.	$305.84	$612
Memo: (2) 1,500 Watt heater per tank x 1 tanks = 2 heaters.					
	Electricians	800	L.F.	$8.14	$6,509
	Electricians	4	Ea.	$288.89	$1,156
	Electricians	4	C.L.F.	$93.39	$374
	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780
LABOR	PRIME CONTRACTOR LABOR	29,901		$1.00	$29,901
Memo: 401 HOURS					

Subtotal $63,024
1st Layer Markups assigned to Detail Items $6,397

TOTAL Electrical **$69,421**
Memo: Assumes 1 metering point. Secondary service wire ran to 4 wells and the tank on poles.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 3		**$8,227,756**
Capital Costs		**$6,928,081**
Surface Soils Consolidation		**$38,688**

Surveying and Marking

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
	PPE 2 c/o per day 10 hr day cost per hr	160	hr	$1.95	$312
LABOR	PRIME CONTRACTOR LABOR	14,145		$1.00	$14,145
Memo: 160 HOURS					

TOTAL Surveying and Marking **$14,889**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 3		**$8,227,756**
Capital Costs		**$6,928,081**
Surface Soils Consolidation		**$38,688**

Soil Consolidation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B10L R.S.Means Crew	270	B.C.Y.	$15.21	$4,106
	B10G R.S.Means Crew	270	E.C.Y.	$0.69	$187
	Water Truck 10k Gallon cost per hr	40	hrs	$208.34	$8,334
	PPE 2 c/o per day 10 hr day cost per hr	160	hr	$1.95	$312
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Capital Costs				**$6,928,081**
	Surface Soils Consolidation				**$38,688**

Soil Consolidation

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	8,810		$1.00	$8,810
Memo: 120 HOURS					
Subtotal					$22,180
1st Layer Markups assigned to Detail Items					$1,618

TOTAL Soil Consolidation **$23,799**

Memo: Assume depth of 2 feet. 25% of area outside cap or 270 CY.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Capital Costs				**$6,928,081**
	Cap Construction				**$1,263,460**

Surveying, Marking, Testing

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
	Geotechnical Testing Technician per hour	960		$52.19	$50,102
Memo: Construction 2 FTE. Geotechnical testing, data recording, surveying, and reporting.					
	Geotechnical Testing Density Testing per hour	600		$50.00	$30,000
Memo: Construction Nuclear Density testing per hour. Estimated 60 days.					
	PPE 2 c/o per day 10 hr day cost per hr	160	hr	$1.95	$312
LABOR	PRIME CONTRACTOR LABOR	28,905		$1.00	$28,905
Memo: 280 HOURS					

TOTAL Surveying, Marking, Testing **$109,751**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Capital Costs				**$6,928,081**
	Cap Construction				**$1,263,460**

Cap Construction

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	B15 R.S.Means Crew	1,630	C.Y.	$16.49	$26,885
Memo: Estimated average of 12" soil needed to bring low spots up to the high point. SOURCE = RSMEANS.					
	B10G R.S.Means Crew	1,630	E.C.Y.	$1.25	$2,029
Memo: Compaction of Leveling Layer.					
	B15 R.S.Means Crew	3,585	C.Y.	$29.84	$106,991
Memo: CLAY LINER LAYER: 24" clay layer.					
	B10G R.S.Means Crew	3,585	E.C.Y.	$1.25	$4,463
Memo: Compaction of Clay Liner Layer.					
	Skilled Workers Average (35 trades)	52.90	M.S.F.	$1,156.55	$61,181
	B15 R.S.Means Crew	2,133	C.Y.	$23.34	$49,793
Memo: DRAINAGE LAYER: 12" sand layer.					
	B10G R.S.Means Crew	2,133	E.C.Y.	$1.25	$2,655
Memo: Compaction of Sand Layer.					
	Common Building Laborers	57,600	S.Y.	$2.09	$120,321

SWMUs 2,3,7&30 Feasibility Study **Reported From: SWMU 2 Alternative 3**
Report Total: $8,227,756

Author
Manager

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Capital Costs				**$6,928,081**
	Cap Construction				**$1,263,460**

Cap Construction

Tree Depth= 5

	B15 R.S.Means Crew	4,630	C.Y.	$27.34	$126,603
Memo: Topsoil Layer - Assume 2 feet of protective soil (62,500 * 2) / 27 = 4,630 CY.					
	B10G R.S.Means Crew	4,630	E.C.Y.	$1.25	$5,764
Memo: Compaction of the 2 feet of protective soil.					
	B34K R.S.Means Crew	4	Ea.	$423.07	$1,692
Memo: Mob/Demob for 2 dozers and 2 compactors.					
	1/2 TON 4WD TRUCKS, LARGE VANS	2,560	hrs	$5.45	$13,952
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	3,200	hrs	$2.70	$8,640
	Corner Monuments	4		$20,000.00	$80,000
	PPE 2 c/o per day 10 hr day cost per hr	3,200	hr	$1.95	$6,240
LABOR	PRIME CONTRACTOR LABOR	313,495		$1.00	$313,495
Memo: 3,930 HOURS					

Subtotal	$930,704
1st Layer Markups assigned to Detail Items	$75,062

TOTAL Cap Construction **$1,005,766**

Memo: Assume 4 month duration. 3 months for dirt work and 1 month for mob/demob and HDPE liner installation.
Cap area is 44,000 SF. Assume perimeter increases by a linear 10 feet for every layer.
Layer 1: Leveling Layer - Assume 1 foot of soil to form a base. (44,000 *1) / 27 = 1,630 CY.
Layer 2: Clay Liner - Assume 2 feet of clay. (48,400 * 2) / 27 = 3,585 CY.
Layer 3: Geomembrane - Assume 52,900 SF
Layer 4: Drainage Layer - Assume 1 feet of sand. (57,600 * 1) / 27 = 2,133 CY.
Layer 5: Geotextile Fabric. 57,600 SF.
Layer 6: Topsoil Layer - Assume 2 feet of protective soil (62,500 * 2) / 27 = 4,630 CY.

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 3	**$8,227,756**
	Capital Costs	**$6,928,081**
	Cap Construction	**$1,263,460**

Monitoring Well Installation

Tree Depth= 5

	Monitoring Well	4		$16,180.00	$64,720
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	480		$1.95	$936
LABOR	PRIME CONTRACTOR LABOR	79,246		$1.00	$79,246
Memo: 992 HOURS					

TOTAL Monitoring Well Installation **$147,942**

Memo: 4 monitoring wells installed.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Capital Costs				**$6,928,081**
	Riprap Cover				**$781,776**

Bedding Layer

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
	Skilled Workers Average (35 trades)	68.75	M.S.F.	$1,156.55	$79,513
Memo: 62,500 SF + 10% for waste = 68,750.					
	B15 R.S.Means Crew	1,158	C.Y.	$23.34	$27,032
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	PPE 2 c/o per day 10 hr day cost per hr	480	hr	$1.95	$936
LABOR	PRIME CONTRACTOR LABOR	74,808		$1.00	$74,808
Memo: 879 HOURS					
Subtotal					$185,329
1st Layer Markups assigned to Detail Items					$39,325

TOTAL Bedding Layer **$224,654**

Memo: Assume bedding layer 250' x 250' or 62,500 SF. Layer will be 6" sand overlaying geotextile.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Capital Costs				**$6,928,081**
	Riprap Cover				**$781,776**

Riprap Layer

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
	B12G R.S.Means Crew	4,630	L.C.Y.	$55.68	$257,793
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	PPE 2 c/o per day 10 hr day cost per hr	480	hr	$1.95	$936
	B15 R.S.Means Crew	4,630	C.Y.	$17.69	$81,924
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	B81 R.S.Means Crew	62.50	M.S.F.	$56.24	$3,515
	B10G R.S.Means Crew	2,315	E.C.Y.	$1.25	$2,882
Memo: Compaction of 1 foot.					
LABOR	PRIME CONTRACTOR LABOR	136,991		$1.00	$136,991
Memo: 1,632 HOURS					
Subtotal					$490,120
1st Layer Markups assigned to Detail Items					$67,001

TOTAL Riprap Layer **$557,121**

Memo: Assume riprap layer is 250' x 250' or 62,500 SF at 2 feet thick or 4,630 CY. 2 foot of soil cover the same.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Inspections

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	20,180		$1.00	$20,180
Memo: 240 HOURS					

TOTAL Inspections **$21,156**

Memo: Annual Cost. General inspections of the action. Quarterly.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 3		**$8,227,756**
Annual Costs		**$1,299,675**
Operations & Maintenance		**$1,153,066**

Weed Removal and Cover Inspection

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	10,090		$1.00	$10,090
Memo: 120 HOURS					

TOTAL Weed Removal and Cover Inspection **$10,578**

Memo: Annual Cost. Semiannual following the initial 100 years.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 3		**$8,227,756**
Annual Costs		**$1,299,675**
Operations & Maintenance		**$1,153,066**

Groundwater Storage Tank Collection/Disposal

Tree Depth= 5

	1/2 TON 4WD TRUCKS, LARGE VANS	20	hrs	$5.45	$109
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	40	hrs	$2.70	$108
LABOR	PRIME CONTRACTOR LABOR	3,815		$1.00	$3,815
Memo: 50 HOURS					

TOTAL Groundwater Storage Tank Collection/Disposal **$4,032**

Memo: Annual Cost. Occurs once every year.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 3		**$8,227,756**
Annual Costs		**$1,299,675**
Operations & Maintenance		**$1,153,066**

Extraction Well Pump Replacement

Tree Depth= 5

	Extraction Well Pump Installation	4	$42,032.80	$168,131

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study

Reported From: SWMU 2 Alternative 3
Report Total: $8,227,756

Author
Manager

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Extraction Well Pump Replacement

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	7,745		$1.00	$7,745
Memo: 100 HOURS					

TOTAL Extraction Well Pump Replacement **$175,876**
Memo: Occurs every 5 years.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Sign Replacement

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	20	hrs	$2.70	$54
	1/2 TON 4WD TRUCKS, LARGE VANS	20	hrs	$5.45	$109
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	2,392		$1.00	$2,392
Memo: 30 HOURS					

TOTAL Sign Replacement **$2,555**
Memo: Occurs every 30 years.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Above Grade Groundwater Components Replacement

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	1,000 Gallon Water Tank	1		$1,100.00	$1,100
	Q1 R.S.Means Crew	5,000	L.F.	$22.36	$111,775
	LAUNDRY 2 CHANGES COST PER HOUR	800	hrs	$2.70	$2,160
	Pump House Building Pre Fab	1		$24,999.00	$24,999
Memo: Tank structure.					
	Extraction Well Subcontractor Mob/Demob	1		$34,878.49	$34,878
	Extraction Well Installation & Development	2		$65,577.27	$131,155
Memo: Assume quantity of 2 to represent total of 4 well re-develop.					
	1/2 TON 4WD TRUCKS, LARGE VANS	640	hrs	$5.45	$3,488
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	59,803		$1.00	$59,803
Memo: 800 HOURS					

Subtotal	$369,358
1st Layer Markups assigned to Detail Items	$45,704

TOTAL Above Grade Groundwater Components Replacement **$415,062**
Memo: Occurs every 50 years.

Company

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Extraction Well Replacement

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Extraction Well Subcontractor Mob/Demob	1		$34,878.49	$34,878
	Extraction Well Installation & Development	4		$65,577.27	$262,309
	Extraction Well Pump Installation	4		$42,032.80	$168,131
	LAUNDRY 2 CHANGES COST PER HOUR	1,040	hrs	$2.70	$2,808
Memo: LATAKY personnel plus assume 5 drillers.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	53,598		$1.00	$53,598
Memo: 640 HOURS					

TOTAL Extraction Well Replacement **$523,807**
Memo: Occurs every 100 years.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Annual Costs				**$1,299,675**
	Groundwater Monitoring				**$96,472**
	Semiannual Monitoring				**$64,315**

Monitoring Well Sampling

Tree Depth= 6

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	8		$689.05	$5,512
LABOR	PRIME CONTRACTOR LABOR	25,165		$1.00	$25,165
Memo: 320 HOURS					

TOTAL Monitoring Well Sampling **$32,157**
Memo: 4 monitoring wells sampled semiannually. 5 hours per well.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Annual Costs				**$1,299,675**
	Groundwater Monitoring				**$96,472**
	Semiannual Monitoring				**$64,315**

Extraction Well Sampling

Tree Depth= 6

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	8		$689.05	$5,512

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Annual Costs				**$1,299,675**
	Groundwater Monitoring				**$96,472**
	Semiannual Monitoring				**$64,315**

Extraction Well Sampling

Tree Depth= 6

LEVEL		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	25,165		$1.00	$25,165
Memo: 320 HOURS					

TOTAL Extraction Well Sampling **$32,157**

Memo: 4 extraction wells sampled semiannually. 5 hours per well.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Annual Costs				**$1,299,675**
	Groundwater Monitoring				**$96,472**
	Annual Monitoring				**$32,157**

Monitoring Well Sampling

Tree Depth= 6

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	4		$689.05	$2,756
LABOR	PRIME CONTRACTOR LABOR	12,582.50		$1.00	$12,583
Memo: 160 HOURS					

TOTAL Monitoring Well Sampling **$16,079**

Memo: 4 monitoring wells sampled annually. 5 hours per well.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 3				**$8,227,756**
	Annual Costs				**$1,299,675**
	Groundwater Monitoring				**$96,472**
	Annual Monitoring				**$32,157**

Extraction Well Sampling

Tree Depth= 6

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	4		$689.05	$2,756
LABOR	PRIME CONTRACTOR LABOR	12,582.50		$1.00	$12,583
Memo: 160 HOURS					

TOTAL Extraction Well Sampling **$16,079**

Memo: 4 extraction wells sampled annually. 5 hours per well.

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 3			**$8,227,756**
	Annual Costs			**$1,299,675**
	Five Year Reviews			**$50,137**

Five Year Reviews

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,137	$1.00	$50,137
Memo: 500 HOURS				

TOTAL Five Year Reviews **$50,137**

COST ESTIMATE
BGOU SWMU 2
Alternative 4(CI)—Containment, Chemical Injection, Surface Controls, LUCs, Monitoring

Cost Estimate Summary

Capital Cost	Quantity	Units	Unit Price	Total					
1.0 Remedial Design	1	ls	$1,296,000	$1,296,000					
2.0 Other Project Plans	1	ls	$863,000	$863,000					
3.0 Remedial Design Site Investigation (RDSI)	1	ls	$1,157,000	$1,157,000					
4.0 Chemical Injection	1	ls	$1,866,000	$1,866,000					
5.0 Hydraulic Isolation	1	ls	$2,138,000	$2,138,000					
6.0 Surface Soils Consolidation	1	ls	$39,000	$39,000					
7.0 Subtitle C Cap Construction	1	ls	$1,116,000	$1,116,000					
8.0 Riprap Cover	1	ls	$782,000	$782,000					
Subproject Management	1	ls	$925,700	$926,000					Subproject Management = 10%
Management Reserve	1	ls	$1,527,450	$1,527,000					Contractor MR = 15%
Fee	1	ls	$819,700	$820,000					Fee = 7%
Contingency	1	ls	$2,506,000	$2,506,000					Contingency = 20%
	SUBTOTAL CAPITAL COST			**$15,036,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Inspections	1000	EA	$21,000	$21,000,000			7.59E+17		Quarterly for 1,000 years
Weed Removal and Cover Inspection	900	EA	$11,000	$9,900,000			3.98E+17		Semiannually following initial 100 years.
Groundwater Storage Tank Collection & Disposal	1000	EA	$4,000	$4,000,000			1.45E+17		Annually for 1,000 years
Extraction Well Pump Replacement	200	EA	$176,000	$35,200,000			1.34E+18		Every 5 years for 1,000 years
Sign Replacement	33	EA	$3,000	$100,000			2.33E+17		Every 30 years for 1,000 years
Above Grade Groundwater Component Replacement and Redevelop Wells	20	EA	$415,000	$8,300,000			2.31E+17		Every 50 years for 1,000 years
Extraction Well Replacement	10	EA	$524,000	$5,240,000			1.85E+17		Every 100 years for 1,000 years
Groundwater Monitoring - First 5 years	5	EA	$64,000	$320,000			3.48E+05		Semi-annually for first 5 years
Groundwater Monitoring - Years 6 through 1000	995	EA	$32,000	$31,840,000			1.16E+18		Annually for years 6 through 1,000
Five Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
	SUBTOTAL ANNUAL COST			**$125,900,000**			**4.83E+18**		
			TOTAL	**$140,936,000**					

COST ESTIMATE
BGOU SWMU 2
Alternative 4(CI)—Containment, Chemical Injection, Surface Controls, LUCs, Monitoring

Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	ls	$15,036,000	$15,036,000				**$15,036,000**	
Inspections	1000	EA	$21,000	$21,000,000				**$1,909,057**	1.1% discount rate
Weed Removal and Cover Inspection	900	EA	$11,000	$9,900,000				**$334,859**	1.1% discount rate
Groundwater Storage Tank Collection & Disposal	1000	EA	$4,000	$4,000,000				**$363,630**	1.1% discount rate
Extraction Well Pump Replacement	200	EA	$176,000	$35,200,000				**$3,130,315**	1.1% discount rate
Sign Replacement	33	EA	$3,000	$100,000				**$7,723**	1.1% discount rate
Above Grade Groundwater Component Replacement and Redevelop Wells	20	EA	$415,000	$8,300,000				**$570,001**	1.1% discount rate
Extraction Well Replacement	10	EA	$524,000	$5,240,000				**$263,819**	1.1% discount rate
Groundwater Monitoring - First 5 years	5	EA	$64,000	$320,000				**$309,705**	1.1% discount rate
Groundwater Monitoring - Years 6 through 1000	995	EA	$32,000	$31,840,000				**$2,754,187**	1.1% discount rate
Five Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$15,036,000**	
						Present Worth Values	**Annual**	**$10,533,000**	
							Avg. Annual	**$10,533**	
							Total	**$25,569,000**	
This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.									
Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.									
CAPITAL COSTS									
	Material/Equipment/Subcontractors/ODCs				**Labor**				
Task Description	**Qty**	**Unit**	**Unit Price**	**Total**	**Hours**	**Rate**	**Total**	**Total Cost**	**Basis of Estimate**
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					3444		$306,203		
Remedial Design Report					7184		$663,892		
Civil Surveying					192		$20,283		
Procurement					440		$36,198		
Work Packages/Readiness					1128		$98,096		
Training	1	LS	$68,800	$68,800	1320		$102,736		$68,800 includes subcontractor training and pyrophoric training
TASK TOTAL				**$68,800**	**13708**		**$1,227,408**	**$1,296,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					4489		$406,721		
O&M Plan					700		$66,863		
SAP/QAPP					970		$84,602		
Waste Management Plan					616		$58,809		
RACR					2065		$195,210		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**9424**		**$862,930**	**$863,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 4(CI)—Containment, Chemical Injection, Surface Controls, LUCs, Monitoring

3.0 Remedial Design Site Investigation (RDSI)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Drilling									
Prime Contractor Labor					3550		$289,640		
Subcontractors	1	LS	$101,506	$101,506					Local quote from existing drilling sub.
Materials	1	LS	$63,687	$63,687					
Vehicles and Equipment	1	LS	$6,976	$6,976					
Sampling									
Prime Contractor Labor					1600		$116,867		
Materials	1	LS	$21,145	$21,145					
Analytical									
Prime Contractor Labor					300		$28,445		
Materials	1	LS	$518,653	$518,653					
Excavation									
Prime Contractor Labor	1				100		$7,610		
Materials	1	LS	$1,063	$1,063					
Equipment	1	LS	$1,076	$1,076					
TASK TOTAL				**$ 714,106**	**5550**		**$ 442,562**	**$1,157,000**	
4.0 Chemical Injection									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Soil Mixing									
Prime Contractor Labor					427		$35,028		
Subcontractors	1	LS	$779,000	$779,000					frtr.gov
Materials	1	LS	$5,582	$5,582					
Vehicles and Equipment	1	LS	$1,526	$1,526					
Jet Grouting									
Prime Contractor Labor					976		$80,065		
Subcontractors	1	LS	$953,000	$953,000					STANTEC
Materials	1	LS	$8,506	$8,506					
Vehicles and Equipment	1	LS	$3,488	$3,488					
TASK TOTALS				**$1,751,101**	**1,403**		**$115,093**	**$1,866,000**	
5.0 Hydraulic Isolation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Slurry Wall Construction									
Prime Contractor Labor					2599		$201,714		
Subcontractors	1	LS	$1,023,369	$1,023,369					
Materials	1	LS	$17,011	$17,011					
Vehicles and Equipment	1	LS	$32,732	$32,732					
Well Construction									
Prime Contractor Labor					800		$64,952		
Subcontractors	1	LS	$465,318	$465,318					Local quote from existing drilling sub.
Materials	1	LS	$14,161	$14,161					
Vehicles and Equipment	1	LS	$1,744	$1,744					
Tank and Piping									
Prime Contractor Labor					800		$59,803		
Subcontractors	1	LS	$157,479	$157,479					
Materials	1	LS	$29,819	$29,819					

Electrical				$0					
Prime Contractor Labor					401		$29,901		
Subcontractors	1	LS	$27,904	$27,904					
Materials	1	LS	$11,617	$11,617					
TASK TOTALS				**$1,781,154**	**4,600**		**$356,370**	**$2,138,000**	
6.0 Surface Soils Consolidation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Surveying and Marking									
Prime Contractor Labor					160		$14,145		
Materials	1	LS	$744	$744					
Soil Consolidation									
Prime Contractor Labor					120		$8,810		
Materials	1	LS	$744	$744					
Subcontractors	1	LS	$14,244	$14,244					
TASK TOTALS				**$15,732**	**280**		**$22,955**	**$39,000**	
7.0 Subtitle C Cap Construction									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Surveying, Marking, Testing									
Prime Contractor Labor					280		$28,905		
Subcontractors	1	LS	$80,102	$80,102					Local engineering firm
Materials	1	LS	$744	$744					
Cap Construction									
Prime Contractor Labor					3930		$313,495		
Subcontractors	1	LS	$663,439	$663,439					
Materials	1	LS	$14,880	$14,880					
Vehicles and Equipment	1	LS	$13,952	$13,952					
TASK TOTAL				**$ 773,117**	**4210**		**$342,400**	**$1,116,000**	
8.0 Riprap Cover									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Bedding Layer									
Prime Contractor Labor					879		$74,808		
Subcontractors	1	LS	$145,871	$145,871					
Materials	1	LS	$2,232	$2,232					
Vehicles and Equipment	1	LS	$1,744	$1,744					
Riprap Layer									Includes 2 ft soil cover
Prime Contractor Labor					1632		$136,991		
Subcontractors	1	LS	$413,114	$413,114					
Materials	1	LS	$3,528	$3,528					
Vehicles and Equipment	1	LS	$3,488	$3,488					
TASK TOTAL				**$569,977**	**2511**		**$211,799**	**$782,000**	
							SUBTOTAL CAPITAL COST	**$9,257,000**	
ANNUAL COSTS									
Inspections									
Duration: Occurs quarterly for 1,000 years.									
Prime Contractor Labor					240		$20,180		
Materials	1	LS	$540	$540					
Vehicles and Equipment	1	LS	$436	$436					
TASK TOTAL				**$976**	**240**		**$20,180**	**$21,000**	ANNUAL COST

COST ESTIMATE
BGOU SWMU 2
Alternative 4(CI)—Containment, Chemical Injection, Surface Controls, LUCs, Monitoring

Weed Removal and Cover Inspection										
Duration: Semiannualy following the first 100 years.										
	Prime Contractor Labor					120		$10,090		
	Materials	1	LS	$270	$270					
	Vehicles and Equipment	1	LS	$218	$218					
	TASK TOTAL				**$488**			**$10,090**	**$11,000**	ANNUAL COST
Groundwater Storage Tank Collection & Disposal										
Duration: Annually for 1,000 years.										
	Prime Contractor Labor					50		$3,815		
	Materials	1	LS	$108	$108					
	Vehicles and Equipment	1	LS	$109	$109					
	TASK TOTAL				**$217**			**$3,815**	**$4,000**	ANNUAL COST
Extraction Well Pump Replacement										
Duration: Every 5 years.										
	Prime Contractor Labor					100		$7,745		
	Subcontractors	1	LS	$168,131	$168,131					Local quote from existing drilling sub.
	TASK TOTAL				**$168,131**			**$7,745**	**$176,000**	EVERY 5 YEARS
Sign Replacement										
Duration: Every 30 years.										
	Prime Contractor Labor					30		$2,392		
	Materials	1	LS	$108	$54					
	Vehicles and Equipment	1	LS	$109	$109					
	TASK TOTAL				**$163**			**$2,392**	**$3,000**	EVERY 30 YEARS
Above Grade Groundwater Component Replacement and Redevelop Wells										
Duration: Every 50 years.										
	Prime Contractor Labor					800		$59,803		
	Subcontractors	1	LS	$323,512	$323,512					RSMeans and local quote
	Materials	1	LS	$28,259	$28,259					
	Vehicles and Equipment	1	LS	$3,488	$3,488					
	TASK TOTAL				**$355,259**			**$59,803**	**$415,000**	EVERY 50 YEARS
Extraction Well Replacement										
Duration: Every 100 years.										
	Prime Contractor Labor					640		$53,598		
	Subcontractors	1	LS	$465,319	$465,319					
	Materials	1	LS	$3,147	$3,147					
	Vehicles and Equipment	1	LS	$1,744	$1,744					
	TASK TOTAL				**$470,210**			**$53,598**	**$524,000**	EVERY 100 YEARS
Groundwater Monitoring - First 5 years										
Duration: Semiannualy for the first 5 years.										
	Prime Contractor Labor					640		$50,330		
	Laboratory	1	LS	$12,033	$12,033					
	Materials	1	LS	$1,080	$1,080					
	Vehicles and Equipment	1	LS	$872	$872					
	TASK TOTAL				**$13,985**			**$50,330**	**$64,000**	ANNUAL COST
Groundwater Monitoring - Years 6 through 1000										
Duration: Annualy for years 6 through 1000										
	Prime Contractor Labor					320		$25,165		
	Laboratory	1	LS	$6,016	$6,016					
	Materials	1	LS	$540	$540					
	Vehicles and Equipment	1	LS	$436	$436					
	TASK TOTAL				**$6,992**			**$25,165**	**$32,000**	ANNUAL COST

COST ESTIMATE
BGOU SWMU 2
Alternative 4(CI)—Containment, Chemical Injection, Surface Controls, LUCs, Monitoring

Five Year Review									
Duration: Every 5 years.									
Prime Contractor Labor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study

Reported From: SWMU 2 Alternative 4(CI)
Report Total: $10,555,181

Author
Manager

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 4(CI)			**$10,555,181**
	Capital Costs			**$9,255,506**
	Remedial Desgin			**$1,296,208**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	306,203	$1.00	$306,203
Memo: 3,444 HOURS				

TOTAL RDWP/RDSI Work Plan **$306,203**

Estimate Tree Structure Rollups			
SWMU 2 Alternative 4(CI)			**$10,555,181**
Capital Costs			**$9,255,506**
Remedial Desgin			**$1,296,208**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	663,892	$1.00	$663,892
Memo: 7,184 HOURS				

TOTAL RDR **$663,892**

Estimate Tree Structure Rollups			
SWMU 2 Alternative 4(CI)			**$10,555,181**
Capital Costs			**$9,255,506**
Remedial Desgin			**$1,296,208**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	20,283	$1.00	$20,283
Memo: 192 HOURS				

TOTAL Civil Surveying **$20,283**

Estimate Tree Structure Rollups			
SWMU 2 Alternative 4(CI)			**$10,555,181**
Capital Costs			**$9,255,506**
Remedial Desgin			**$1,296,208**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	36,198	$1.00	$36,198
Memo: 440 HOURS				

TOTAL Procurement **$36,198**

Estimate Tree Structure Rollups			
SWMU 2 Alternative 4(CI)			**$10,555,181**
Capital Costs			**$9,255,506**
Remedial Desgin			**$1,296,208**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	98,096	$1.00	$98,096
Memo: 1,128 HOURS				

TOTAL Work Packages/Readiness Review **$98,096**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 4(CI)			**$10,555,181**
	Capital Costs			**$9,255,506**
	Remedial Desgin			**$1,296,208**

Training

Tree Depth= 5

		QTY	UNIT COST	TOTAL
	Pyrophoric U Training per Person	16	$800.00	$12,800
Memo: Assume $800 per person. This is consistent with the previous FS submittal.				
	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
Memo: Assume 80 hours of training per person. Assume 10 people or 800 hours.				
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training **$171,536**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 4(CI)			**$10,555,181**
	Capital Costs			**$9,255,506**
	Other Project Plans			**$862,930**

RAWP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	406,721	$1.00	$406,721
Memo: 4,489 HOURS				

TOTAL RAWP **$406,721**

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 4(CI)			**$10,555,181**
	Capital Costs			**$9,255,506**
	Other Project Plans			**$862,930**

O&M Plan

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan **$66,863**

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 4(CI)			**$10,555,181**
	Capital Costs			**$9,255,506**
	Other Project Plans			**$862,930**

SAP/QAPP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	84,602	$1.00	$84,602
Memo: 970 HOURS				

TOTAL SAP/QAPP **$84,602**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	Other Project Plans				**$862,930**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	58,809		$1.00	$58,809
Memo: 616 HOURS					

TOTAL Waste Management Plan **$58,809**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 4(CI)		**$10,555,181**
Capital Costs		**$9,255,506**
Other Project Plans		**$862,930**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	195,210		$1.00	$195,210
Memo: 2,065 HOURS					

TOTAL RACR **$195,210**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 4(CI)		**$10,555,181**
Capital Costs		**$9,255,506**
Other Project Plans		**$862,930**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 4(CI)		**$10,555,181**
Capital Costs		**$9,255,506**
RDSI		**$1,156,669**

Drilling

Tree Depth= 5

	Mob/Demob for DPT subcontractor	1		$8,500.00	$8,500
	DPT Borings to 40 feet	30		$1,635.00	$49,050
Memo: 2 borings per day - 15 days of borings plus 1 week for mob and 1 week for demob.					
	1/2 TON 4WD TRUCKS, LARGE VANS	1,280	hrs	$5.45	$6,976
Memo: 4 LATAKY vehicles.					
	55 GALLON DRUM	6		$84.68	$508
Memo: 6 drums for drill cuttings.					
	ST-90 CONTAINER DELIVERED	3		$1,770.63	$5,312
Memo: 3 ST-90 box for PPE/Trash.					
	PORTABLE TOILET & HAND WASH PER MONTH	2		$227.21	$454
Memo: Rent for 2 months.					
	LAUNDRY 2 CHANGES COST PER HOUR	4,320	hrs	$2.70	$11,664
Memo: LATAKY personnel plus assume 5 drillers.					
	DPT Borings to 65 feet	12		$2,573.00	$30,876
Memo: Angled borings - assume 65 feet deep.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	RDSI				**$1,156,669**

Drilling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	DPT Borings to 40 feet	8		$1,635.00	$13,080
Memo: 8 additional borings following waste stabilization.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	4,320		$5.19	$22,421
	PPE 2 c/o per day 10 hr day cost per hr	4,320		$1.95	$8,424
	MSA OptiFilter HEPA per hour	4,320		$3.45	$14,904
LABOR	PRIME CONTRACTOR LABOR	289,640		$1.00	$289,640
Memo: 3,550 HOURS					

TOTAL Drilling **$461,809**

Memo: Same as alternative 3 but added 12 angled borings and 8 additional vertical borings. Assume 8 weeks.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	RDSI				**$1,156,669**

Sampling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	5 gram EN CORE SAMPLER	600		$6.94	$4,164
	Niton XRF Rental One Month	2		$4,500.00	$9,000
	PCB Test Kits	1		$541.00	$541
	LAUNDRY 2 CHANGES COST PER HOUR	1,600	hrs	$2.70	$4,320
	PPE 2 c/o per day 10 hr day cost per hr	1,600		$1.95	$3,120
LABOR	PRIME CONTRACTOR LABOR	116,867		$1.00	$116,867
Memo: 1,600 HOURS					

TOTAL Sampling **$138,012**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	RDSI				**$1,156,669**

Analytical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Overnight Shipment per Cooler	51		$251.97	$12,850
Memo: Assume 2 shipments per day for 25 days plus 1 shipment later for the waste water.					
	RDSI Geophysical Sampling Analytical	1		$1,275.00	$1,275
Memo: 3 Geophysical samples taken for particle size and atterberg limits.					
	RDSI Soil Sampling Analytical	1		$262,775.00	$262,775
Memo: 8 samples from 30 borings = 240 samples.					
	RDSI Soil Sampling Analytical	0.92		$262,775.00	$241,753
Memo: 8 samples from 8 additional borings = 64 samples. 13 samples from 12 angled borings = 156 samples. Total of 220 samples. 220/240 = .92					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	RDSI				**$1,156,669**

Analytical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
LABOR Memo: 300 HOURS	PRIME CONTRACTOR LABOR	28,445		$1.00	$28,445
TOTAL Analytical					**$547,098**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	RDSI				**$1,156,669**

Excavation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	JOHN DEERE 624E 4WD ARTICULATED WHEEL LOADER	20	hr	$18.23	$365
	KOMATSU WB142-5 BACKHOE cost per hour	20	hr	$35.58	$712
	PPE 2 c/o per day 10 hr day cost per hr	80		$1.95	$156
	MSA OptiFilter HEPA per hour	80		$3.45	$276
	Resp cleaning 10 hr day 2 C/O per day cost per hr	80		$5.19	$415
LABOR Memo: 100 HOURS	PRIME CONTRACTOR LABOR	7,610		$1.00	$7,610
	LAUNDRY 2 CHANGES COST PER HOUR	80	hrs	$2.70	$216
TOTAL Excavation					**$9,749**

Memo: Excavator will dig potholes until conduit duct bank is found. Duct bank will be broken up and removed in two places where the slurry wall will be placed. Assumed self performed with GFE equipment.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	Chemical Injection				**$1,866,194**

Soil Mixing

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
Memo: Reference frtr.gov	Soil Mixing w/ Cement Grouting per CY	1,080	CY	$125.00	$135,000
	Soil Mixing Mob/DeMob	1		$500,000.00	$500,000
Memo: Adder for using ZVI. Assume $6 per treated CF.	Zero Valient Iron cost per CF	24,000	CF	$6.00	$144,000
Memo: 4 LATAKY vehicles.	1/2 TON 4WD TRUCKS, LARGE VANS	280	hrs	$5.45	$1,526
	LAUNDRY 2 CHANGES COST PER HOUR	420	hrs	$2.70	$1,134
	Resp cleaning 10 hr day 2 C/O per day cost per hr	420		$5.19	$2,180
	PPE 2 c/o per day 10 hr day cost per hr	420		$1.95	$819
	MSA OptiFilter HEPA per hour	420		$3.45	$1,449

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	Chemical Injection				**$1,866,194**

Soil Mixing

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	35,028		$1.00	$35,028
Memo: 427 HOURS					

TOTAL Soil Mixing **$821,136**

Memo: 2 treatment area: 20' x 20' and 20' x 40' or 1,200 total SF. 20 feet deep makes it 24,000 CF or 900 CY. Assume 20% overlap so 900 X 1.2 = 1080 CY mixed. Each hole is 37.3 CY so 1,080 / 37.3 CY = 29 holes. Assume 6 holes per day or 5 days plus assume 2 days of delays - 7 days.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 4(CI)		**$10,555,181**
Capital Costs		**$9,255,506**
Chemical Injection		**$1,866,194**

Jet Grouting

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Jet Grouting w/ Cement Grouting per CY	1,800	CY	$300.00	$540,000
Memo: Reference STANTEC.					
	Jet Grouting Mob/DeMob	1		$125,000.00	$125,000
	Zero Valient Iron cost per CF	48,000	CF	$6.00	$288,000
Memo: Adder for using ZVI. Assume $6 per treated CF.					
	1/2 TON 4WD TRUCKS, LARGE VANS	640	hrs	$5.45	$3,488
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	640	hrs	$2.70	$1,728
	Resp cleaning 10 hr day 2 C/O per day cost per hr	640		$5.19	$3,322
	PPE 2 c/o per day 10 hr day cost per hr	640		$1.95	$1,248
	MSA OptiFilter HEPA per hour	640		$3.45	$2,208
LABOR	PRIME CONTRACTOR LABOR	80,065		$1.00	$80,065
Memo: 976 HOURS					

TOTAL Jet Grouting **$1,045,059**

Memo: 2 waste areas. 20' x 20' or 400 SF and 20' x 40' or 800 SF. Total of 1,200 SF. Treatment from 20' BGS to 60' BGS. 1,200 SF x 40' = 48,000 CF or 1,800 CY. Assume 1 month duration.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 4(CI)		**$10,555,181**
Capital Costs		**$9,255,506**
Hydraulic Isolation		**$2,137,523**

Slurry Wall Construction

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	C7 R.S.Means Crew	32,000	S.F.	$21.10	$675,221
	1/2 TON 4WD TRUCKS, LARGE VANS	1,288	hrs	$5.45	$7,020
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,280	hrs	$2.70	$3,456
	CATERPILLAR 345B CRAWLER MOUNTED SHEAR HEAD EXCAVATOR	320	hr	$62.12	$19,878

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	Hydraulic Isolation				**$2,137,523**

Slurry Wall Construction

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	JOHN DEERE 624E 4WD ARTICULATED WHEEL LOADER	320	hr	$18.23	$5,834
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,280		$5.19	$6,643
	PPE 2 c/o per day 10 hr day cost per hr	1,280		$1.95	$2,496
	MSA OptiFilter HEPA per hour	1,280		$3.45	$4,416
LABOR Memo: 2,599 HOURS	PRIME CONTRACTOR LABOR	201,714		$1.00	$201,714
Subtotal					$926,678
1st Layer Markups assigned to Detail Items					$348,148
TOTAL Slurry Wall Construction					**$1,274,826**

Memo: Assume wall is approx. 200' x 200' or 800 LF 800 LF x 40' deep = 32,000 SF.
Assume 25 linear feet per day: 800 / 25 = 32 days assume 2 months due to weather delays and equipment repairs.

Estimate Tree Structure Rollups			
SWMU 2 Alternative 4(CI)			**$10,555,181**
Capital Costs			**$9,255,506**
Hydraulic Isolation			**$2,137,523**

Well Construction

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Extraction Well Subcontractor Mob/Demob	1		$34,878.49	$34,878
	Extraction Well Installation & Development	4		$65,577.27	$262,309
	Extraction Well Pump Installation	4		$42,032.80	$168,131
	LAUNDRY 2 CHANGES COST PER HOUR Memo: LATAKY personnel plus assume 5 drillers.	1,040	hrs	$2.70	$2,808
	55 GALLON DRUM Memo: 4 drums for drill cuttings.	4		$84.68	$339
	1/2 TON 4WD TRUCKS, LARGE VANS Memo: 2 LATAKY vehicles.	320	hrs	$5.45	$1,744
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,040		$5.19	$5,398
	PPE 2 c/o per day 10 hr day cost per hr	1,040		$1.95	$2,028
	MSA OptiFilter HEPA per hour	1,040		$3.45	$3,588
LABOR Memo: 800 HOURS	PRIME CONTRACTOR LABOR	64,952		$1.00	$64,952
TOTAL Well Construction					**$546,175**

Memo: 4 week duration.

Estimate Tree Structure Rollups			
SWMU 2 Alternative 4(CI)			**$10,555,181**
Capital Costs			**$9,255,506**
Hydraulic Isolation			**$2,137,523**

Tank & Piping

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	1,000 Gallon Water Tank	1		$1,100.00	$1,100

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	Hydraulic Isolation				**$2,137,523**

Tank & Piping

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Q1 R.S.Means Crew	5,000	L.F.	$22.36	$111,775
	LAUNDRY 2 CHANGES COST PER HOUR	800	hrs	$2.70	$2,160
	Pump House Building Pre Fab	1		$24,999.00	$24,999
Memo: Tank structure.					
	PPE 2 c/o per day 10 hr day cost per hr	800		$1.95	$1,560
LABOR	PRIME CONTRACTOR LABOR	59,803		$1.00	$59,803
Memo: 800 HOURS					
Subtotal					$201,397
1st Layer Markups assigned to Detail Items					$45,704
TOTAL Tank & Piping					**$247,101**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	Hydraulic Isolation				**$2,137,523**

Electrical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans D5010 120 0220 Electrical Service	1		$2,417.00	$2,417
Memo: Includes O&P.					
	R3 R.S.Means Crew	5	Ea.	$1,024.44	$5,122
	1/0 Triplex Service Wire per foot	2,000		$3.67	$7,340
	Electricians	5	Ea.	$298.89	$1,494
	Electricians	500	L.F.	$10.39	$5,193
	Electricians	20	C.L.F.	$52.34	$1,047
	Electricians	2	Ea.	$305.84	$612
Memo: (2) 1,500 Watt heater per tank x 1 tanks = 2 heaters.					
	Electricians	800	L.F.	$8.14	$6,509
	Electricians	4	Ea.	$288.89	$1,156
	Electricians	4	C.L.F.	$93.39	$374
	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780
LABOR	PRIME CONTRACTOR LABOR	29,901		$1.00	$29,901
Memo: 401 HOURS					
Subtotal					$63,024
1st Layer Markups assigned to Detail Items					$6,397
TOTAL Electrical					**$69,421**

Memo: Assumes 1 metering point. Secondary service wire ran to 4 wells and the tank on poles.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	Surface Soils Consolidation				**$38,688**

Surveying and Marking

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
LABOR Memo: 160 HOURS	PRIME CONTRACTOR LABOR	14,145		$1.00	$14,145

TOTAL Surveying and Marking **$14,889**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	Surface Soils Consolidation				**$38,688**

Soil Consolidation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B10L R.S.Means Crew	270	B.C.Y.	$15.21	$4,106
	B10G R.S.Means Crew	270	E.C.Y.	$0.69	$187
	Water Truck 10k Gallon cost per hr	40	hrs	$208.34	$8,334
	PPE 2 c/o per day 10 hr day cost per hr	160	hr	$1.95	$312
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
LABOR Memo: 120 HOURS	PRIME CONTRACTOR LABOR	8,810		$1.00	$8,810

Subtotal $22,180
1st Layer Markups assigned to Detail Items $1,618

TOTAL Soil Consolidation **$23,799**
Memo: Assume depth of 2 feet. 25% of area outside cap or 270 CY.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	Cap Construction				**$1,115,518**

Surveying, Marking, Testing

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
Memo: Construction 2 FTE. Geotechnical testing, data recording, surveying, and reporting.	Geotechnical Testing Technician per hour	960		$52.19	$50,102
Memo: Construction Nuclear Density testing per hour. Estimated 60 days.	Geotechnical Testing Density Testing per hour	600		$50.00	$30,000
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
LABOR Memo: 280 HOURS	PRIME CONTRACTOR LABOR	28,905		$1.00	$28,905

TOTAL Surveying, Marking, Testing **$109,751**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	Cap Construction				**$1,115,518**

Cap Construction

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	B15 R.S.Means Crew	1,630	C.Y.	$16.49	$26,885
Memo: Estimated average of 12" soil needed to bring low spots up to the high point. SOURCE = RSMEANS.					
	B10G R.S.Means Crew	1,630	E.C.Y.	$1.25	$2,029
Memo: Compaction of Leveling Layer.					
	B15 R.S.Means Crew	3,585	C.Y.	$29.84	$106,991
Memo: CLAY LINER LAYER: 24" clay layer.					
	B10G R.S.Means Crew	3,585	E.C.Y.	$1.25	$4,463
Memo: Compaction of Clay Liner Layer.					
	Skilled Workers Average (35 trades)	52.90	M.S.F.	$1,156.55	$61,181
	B15 R.S.Means Crew	2,133	C.Y.	$23.34	$49,793
Memo: DRAINAGE LAYER: 12" sand layer.					
	B10G R.S.Means Crew	2,133	E.C.Y.	$1.25	$2,655
Memo: Compaction of Sand Layer.					
	Common Building Laborers	57,600	S.Y.	$2.09	$120,321
	B15 R.S.Means Crew	4,630	C.Y.	$27.34	$126,603
Memo: Topsoil Layer - Assume 2 feet of protective soil (62,500 * 2) / 27 = 4,630 CY.					
	B10G R.S.Means Crew	4,630	E.C.Y.	$1.25	$5,764
Memo: Compaction of the 2 feet of protective soil.					
	B34K R.S.Means Crew	4	Ea.	$423.07	$1,692
Memo: Mob/Demob for 2 dozers and 2 compactors.					
	1/2 TON 4WD TRUCKS, LARGE VANS	2,560	hrs	$5.45	$13,952
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	3,200	hrs	$2.70	$8,640
	Corner Monuments	4		$20,000.00	$80,000
	PPE 2 c/o per day 10 hr day cost per hr	3,200		$1.95	$6,240
LABOR	PRIME CONTRACTOR LABOR	313,495		$1.00	$313,495
Memo: 3,930 HOURS					
Subtotal					$930,704
1st Layer Markups assigned to Detail Items					$75,062
TOTAL Cap Construction					**$1,005,766**

Memo: Assume 4 month duration. 3 months for dirt work and 1 month for mob/demob and HDPE liner installation.
Cap area is 44,000 SF. Assume perimeter increases by a linear 10 feet for every layer.
Layer 1: Leveling Layer - Assume 1 foot of soil to form a base. (44,000 *1) / 27 = 1,630 CY.
Layer 2: Clay Liner - Assume 2 feet of clay. (48,400 * 2) / 27 = 3,585 CY.
Layer 3: Geomembrane - Assume 52,900 SF
Layer 4: Drainage Layer - Assume 1 feet of sand. (57,600 * 1) / 27 = 2,133 CY.
Layer 5: Geotextile Fabric. 57,600 SF.
Layer 6: Topsoil Layer - Assume 2 feet of protective soil (62,500 * 2) / 27 = 4,630 CY.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	Riprap Cover				**$781,776**

Bedding Layer

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Skilled Workers Average (35 trades)	68.75	M.S.F.	$1,156.55	$79,513
Memo: 62,500 SF + 10% for waste = 68,750.					
	B15 R.S.Means Crew	1,158	C.Y.	$23.34	$27,032
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	PPE 2 c/o per day 10 hr day cost per hr	480	hr	$1.95	$936
LABOR	PRIME CONTRACTOR LABOR	74,808		$1.00	$74,808
Memo: 879 HOURS					
Subtotal					$185,329
1st Layer Markups assigned to Detail Items					$39,325
TOTAL Bedding Layer					**$224,654**

Memo: Assume bedding layer 250' x 250' or 62,500 SF. Layer will be 6" sand overlaying geotextile.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Capital Costs				**$9,255,506**
	Riprap Cover				**$781,776**

Riprap Layer

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B12G R.S.Means Crew	4,630	L.C.Y.	$55.68	$257,793
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	PPE 2 c/o per day 10 hr day cost per hr	480	hr	$1.95	$936
	B15 R.S.Means Crew	4,630	C.Y.	$17.69	$81,924
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	B81 R.S.Means Crew	62.50	M.S.F.	$56.24	$3,515
	B10G R.S.Means Crew	2,315	E.C.Y.	$1.25	$2,882
Memo: Compaction of 1 foot.					
LABOR	PRIME CONTRACTOR LABOR	136,991		$1.00	$136,991
Memo: 1,632 HOURS					
Subtotal					$490,120
1st Layer Markups assigned to Detail Items					$67,001
TOTAL Riprap Layer					**$557,121**

Memo: Assume riprap layer is 250' x 250' or 62,500 SF at 2 feet thick or 4,630 CY. 2 foot of soil cover the same.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Inspections

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	20,180		$1.00	$20,180
Memo: 240 HOURS					

TOTAL Inspections **$21,156**
Memo: Annual Cost. General inspections of the action. Quarterly.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Weed Removal and Cover Inspection

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	10,090		$1.00	$10,090
Memo: 120 HOURS					

TOTAL Weed Removal and Cover Inspection **$10,578**
Memo: Annual Cost. Semiannual following the initial 100 years.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Groundwater Storage Tank Collection/Disposal

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	1/2 TON 4WD TRUCKS, LARGE VANS	20	hrs	$5.45	$109
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	40	hrs	$2.70	$108
LABOR	PRIME CONTRACTOR LABOR	3,815		$1.00	$3,815
Memo: 50 HOURS					

TOTAL Groundwater Storage Tank Collection/Disposal **$4,032**
Memo: Annual Cost. Occurs once every year.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Extraction Well Pump Replacement

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Extraction Well Pump Installation	4		$42,032.80	$168,131

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Extraction Well Pump Replacement

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	7,745		$1.00	$7,745
Memo: 100 HOURS					

TOTAL Extraction Well Pump Replacement **$175,876**

Memo: Occurs every 5 years.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Sign Replacement

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	20	hrs	$2.70	$54
	1/2 TON 4WD TRUCKS, LARGE VANS	20	hrs	$5.45	$109
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	2,392		$1.00	$2,392
Memo: 30 HOURS					

TOTAL Sign Replacement **$2,555**

Memo: Occurs every 30 years.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Above Grade Groundwater Components Replacement

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	1,000 Gallon Water Tank	1		$1,100.00	$1,100
	Q1 R.S.Means Crew	5,000	L.F.	$22.36	$111,775
	LAUNDRY 2 CHANGES COST PER HOUR	800	hrs	$2.70	$2,160
	Pump House Building Pre Fab	1		$24,999.00	$24,999
Memo: Tank structure.					
	Extraction Well Subcontractor Mob/Demob	1		$34,878.49	$34,878
	Extraction Well Installation & Development	2		$65,577.27	$131,155
Memo: Assume quantity of 2 to represent total of 4 well re-develop.					
	1/2 TON 4WD TRUCKS, LARGE VANS	640	hrs	$5.45	$3,488
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	59,803		$1.00	$59,803
Memo: 800 HOURS					
Subtotal					$369,358
1st Layer Markups assigned to Detail Items					$45,704

TOTAL Above Grade Groundwater Components Replacement **$415,062**

Memo: Occurs every 50 years.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Extraction Well Replacement

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Extraction Well Subcontractor Mob/Demob	1		$34,878.49	$34,878
	Extraction Well Installation & Development	4		$65,577.27	$262,309
	Extraction Well Pump Installation	4		$42,032.80	$168,131
	LAUNDRY 2 CHANGES COST PER HOUR	1,040	hrs	$2.70	$2,808
Memo: LATAKY personnel plus assume 5 drillers.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	53,598		$1.00	$53,598
Memo: 640 HOURS					

TOTAL Extraction Well Replacement **$523,807**
Memo: Occurs every 100 years.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 4(CI)	**$10,555,181**
Annual Costs	**$1,299,675**
Groundwater Monitoring	**$96,472**
Semiannual Monitoring	**$64,315**

Monitoring Well Sampling

Tree Depth= 6

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	8		$689.05	$5,512
LABOR	PRIME CONTRACTOR LABOR	25,165		$1.00	$25,165
Memo: 320 HOURS					

TOTAL Monitoring Well Sampling **$32,157**
Memo: 4 monitoring wells sampled semiannually. 5 hours per well.

Estimate Tree Structure Rollups	
SWMU 2 Alternative 4(CI)	**$10,555,181**
Annual Costs	**$1,299,675**
Groundwater Monitoring	**$96,472**
Semiannual Monitoring	**$64,315**

Extraction Well Sampling

Tree Depth= 6

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	8		$689.05	$5,512

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(CI)				**$10,555,181**
	Annual Costs				**$1,299,675**
	Groundwater Monitoring				**$96,472**
	Semiannual Monitoring				**$64,315**

Extraction Well Sampling

Tree Depth= 6

LABOR	PRIME CONTRACTOR LABOR	25,165		$1.00	$25,165
Memo: 320 HOURS					

TOTAL Extraction Well Sampling **$32,157**
Memo: 4 extraction wells sampled semiannually. 5 hours per well.

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 4(CI)	**$10,555,181**
	Annual Costs	**$1,299,675**
	Groundwater Monitoring	**$96,472**
	Annual Monitoring	**$32,157**

Monitoring Well Sampling

Tree Depth= 6

	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	4		$689.05	$2,756
LABOR	PRIME CONTRACTOR LABOR	12,582.50		$1.00	$12,583
Memo: 160 HOURS					

TOTAL Monitoring Well Sampling **$16,079**
Memo: 4 monitoring wells sampled annually. 5 hours per well.

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 4(CI)	**$10,555,181**
	Annual Costs	**$1,299,675**
	Groundwater Monitoring	**$96,472**
	Annual Monitoring	**$32,157**

Extraction Well Sampling

Tree Depth= 6

	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	4		$689.05	$2,756
LABOR	PRIME CONTRACTOR LABOR	12,582.50		$1.00	$12,583
Memo: 160 HOURS					

TOTAL Extraction Well Sampling **$16,079**
Memo: 4 extraction wells sampled annually. 5 hours per well.

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 4(CI)			**$10,555,181**
	Annual Costs			**$1,299,675**
	Five Year Reviews			**$50,137**

Five Year Reviews

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,137	$1.00	$50,137
Memo: 500 HOURS				

TOTAL Five Year Reviews **$50,137**

COST ESTIMATE
BGOU SWMU 2
Alternative 4(SS)—Containment, Stabilization/Solidification, Surface Controls, LUCs, Monitoring

Cost Estimate Summary									
Capital Cost	**Quantity**	**Units**	**Unit Price**	**Total**					
1.0 Remedial Design	1	LS	$1,296,000	$1,296,000					
2.0 Other Project Plans	1	LS	$863,000	$863,000					
3.0 Remedial Design Site Investigation (RDSI)	1	LS	$1,157,000	$1,157,000					
4.0 Stabilization	1	LS	$5,674,000	$5,674,000					
5.0 Hydraulic Isolation	1	LS	$2,138,000	$2,138,000					
6.0 Surface Soils Consolidation	1	LS	$39,000	$39,000					
7.0 Subtitle C Cap Construction	1	LS	$1,116,000	$1,116,000					
8.0 Riprap Cover	1	LS	$782,000	$782,000					
Subproject Management	1	LS	$1,306,500	$1,307,000					Subproject Management = 10%
Management Reserve	1	LS	$2,155,800	$2,156,000					Contractor MR = 15%
Fee	1	LS	$1,156,960	$1,157,000					Fee = 7%
Contingency	1	LS	$3,537,000	$3,537,000					Contingency = 20%
	SUBTOTAL CAPITAL COST			**$21,222,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Inspections	1000	EA	$21,000	$21,000,000			7.59E+17		Quarterly for 1,000 years
Weed Removal and Cover Inspection	900	EA	$11,000	$9,900,000			3.98E+17		Semiannually following initial 100 years.
Groundwater Storage Tank Collection & Disposal	1000	EA	$4,000	$4,000,000			1.45E+17		Annually for 1,000 years.
Extraction Well Pump Replacement	200	EA	$176,000	$35,200,000			1.34E+18		Every 5 years for 1,000 years
Sign Replacement	33	EA	$3,000	$100,000			3.98E+15		Every 30 years for 1,000 years
Above Grade Groundwater Component Replacement and Redevelop Wells	20	EA	$415,000	$8,300,000			5.46E+17		Every 50 years for 1,000 years
Extraction Well Replacement	10	EA	$524,000	$5,240,000			5.51E+17		Every 100 years for 1,000 years
Groundwater Monitoring - First 5 years	5	EA	$64,000	$320,000			3.48E+05		Semiannually for first 5 years
Groundwater Monitoring - Years 6 through 1000	995	EA	$32,000	$31,840,000			1.16E+18		Annually for years 6 through 1,000
Five Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
	SUBTOTAL ANNUAL COST			**$125,900,000**			**5.28E+18**		
			TOTAL	**$147,122,000**					

COST ESTIMATE
BGOU SWMU 2
Alternative 4(SS)—Containment, Stabilization/Solidification, Surface Controls, LUCs, Monitoring

Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	LS	$21,222,000	$21,222,000				**$21,222,000**	
Inspections	1000	EA	$21,000	$21,000,000				**$1,909,057**	1.1% discount rate
Weed Removal and Cover Inspection	900	EA	$11,000	$9,900,000				**$334,859**	1.1% discount rate
Groundwater Storage Tank Collection & Disposal	1000	EA	$4,000	$4,000,000				**$363,630**	1.1% discount rate
Extraction Well Pump Replacement	200	EA	$176,000	$35,200,000				**$3,130,315**	1.1% discount rate
Sign Replacement	33	EA	$3,000	$100,000				**$7,723**	1.1% discount rate
Above Grade Groundwater Component Replacement and Redevelop Wells	20	EA	$415,000	$8,300,000				**$570,001**	1.1% discount rate
Extraction Well Replacement	10	EA	$524,000	$5,240,000				**$263,819**	1.1% discount rate
Groundwater Monitoring - First 5 years	5	EA	$64,000	$320,000				**$309,705**	1.1% discount rate
Groundwater Monitoring - Years 6 through 1000	995	EA	$32,000	$31,840,000				**$2,754,187**	1.1% discount rate
Five Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$21,222,000**	
						Present Worth Values	**Annual**	**$10,533,000**	
							Avg. Annual	**$10,533**	
							Total	**$31,755,000**	
This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.									
Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.									
CAPITAL COSTS									
	Material/Equipment/Subcontractors/ODCs				**Labor**				
Task Description	**Qty**	**Unit**	**Unit Price**	**Total**	**Hours**	**Rate**	**Total**	**Total Cost**	**Basis of Estimate**
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					3444		$306,203		
Remedial Design Report					7184		$663,892		
Civil Surveying					192		$20,283		
Procurement					440		$36,198		
Work Packages/Readiness					1128		$98,096		
Training	1	LS	$68,800	$68,800	1320		$102,736		$68,800 includes subcontractor training and pyrophoric training
TASK TOTAL				**$68,800**	**13708**		**$1,227,408**	**$1,296,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					4489		$406,721		
O&M Plan					700		$66,863		
SAP/QAPP					970		$84,602		
Waste Management Plan					616		$58,809		
RACR					2065		$195,210		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**9424**		**$862,930**	**$863,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 4(SS)—Containment, Stabilization/Solidification, Surface Controls, LUCs, Monitoring

3.0 Remedial Design Site Investigation (RDSI)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Drilling									
Prime Contractor Labor					3550		$289,640		
Subcontractors	1	LS	$101,506	$101,506					Local quote from existing drilling sub.
Materials	1	LS	$63,687	$63,687					
Vehicles and Equipment	1	LS	$6,976	$6,976					
Sampling									
Prime Contractor Labor					1600		$116,867		
Materials	1	LS	$21,145	$21,145					
Analytical									
Prime Contractor Labor					300		$28,445		
Materials	1	LS	$518,653	$518,653					
Excavation									
Prime Contractor Labor	1				100		$7,610		
Materials	1	LS	$1,063	$1,063					
Equipment	1	LS	$1,076	$1,076					
TASK TOTAL				**$ 714,106**	**5550**		**$ 442,562**	**$1,157,000**	
4.0 Stabilization									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Soil Mixing									
Prime Contractor Labor					8662		$710,577		
Subcontractors	1	LS	$4,100,000	$4,100,000					frtr.gov
Materials	1	LS	$75,487	$75,487					
Vehicles and Equipment	1	LS	$30,956	$30,956					
Jet Grouting									
Prime Contractor Labor					976		$80,065		
Subcontractors	1	LS	$665,000	$665,000					STANTEC
Materials	1	LS	$8,506	$8,506					
Vehicles and Equipment	1	LS	$3,488	$3,488					
TASK TOTALS				**$4,883,437**	**9,638**		**$790,642**	**$5,674,000**	
5.0 Hydraulic Isolation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Slurry Wall Construction									
Prime Contractor Labor					2599		$201,714		
Subcontractors	1	LS	$1,023,369	$1,023,369					
Materials	1	LS	$17,011	$17,011					
Vehicles and Equipment	1	LS	$32,732	$32,732					
Well Construction									
Prime Contractor Labor					800		$64,952		
Subcontractors	1	LS	$465,318	$465,318					Local quote from existing drilling sub.
Materials	1	LS	$14,161	$14,161					
Vehicles and Equipment	1	LS	$1,744	$1,744					
Tank and Piping									
Prime Contractor Labor					800		$59,803		
Subcontractors	1	LS	$157,479	$157,479					
Materials	1	LS	$29,819	$29,819					

COST ESTIMATE
BGOU SWMU 2
Alternative 4(SS)—Containment, Stabilization/Solidification, Surface Controls, LUCs, Monitoring

Electrical				$0					
Prime Contractor Labor					401		$29,901		
Subcontractors	1	LS	$27,904	$27,904					
Materials	1	LS	$11,617	$11,617					
TASK TOTALS				**$1,781,154**	**4,600**		**$356,370**	**$2,138,000**	
6.0 Surface Soils Consolidation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Surveying and Marking									
Prime Contractor Labor					160		$14,145		
Materials	1	LS	$744	$744					
Soil Consolidation									
Prime Contractor Labor					120		$8,810		
Materials	1	LS	$744	$744					
Subcontractors	1	LS	$14,244	$14,244					
TASK TOTALS				**$15,732**	**280**		**$22,955**	**$39,000**	
7.0 Subtitle C Cap Construction									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Surveying, Marking, Testing									
Prime Contractor Labor					280		$28,905		
Subcontractors	1	LS	$80,102	$80,102					Local engineering firm
Materials	1	LS	$744	$744					
Cap Construction									
Prime Contractor Labor					3930		$313,495		
Subcontractors	1	LS	$663,439	$663,439					
Materials	1	LS	$14,880	$14,880					
Vehicles and Equipment	1	LS	$13,952	$13,952					
TASK TOTAL				**$ 773,117**	**4210**		**$342,400**	**$1,116,000**	
8.0 Riprap Cover									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Bedding Layer									
Prime Contractor Labor					879		$74,808		
Subcontractors	1	LS	$145,871	$145,871					
Materials	1	LS	$2,232	$2,232					
Vehicles and Equipment	1	LS	$1,744	$1,744					
Riprap Layer									Includes 2 ft soil cover
Prime Contractor Labor					1632		$136,991		
Subcontractors	1	LS	$413,114	$413,114					
Materials	1	LS	$3,528	$3,528					
Vehicles and Equipment	1	LS	$3,488	$3,488					
TASK TOTAL				**$569,977**	**2511**		**$211,799**	**$782,000**	
							SUBTOTAL CAPITAL COST	**$13,065,000**	
ANNUAL COSTS									
Inspections									
Duration: Occurs quarterly for 1,000 years.									
Prime Contractor Labor					240		$20,180		
Materials	1	LS	$540	$540					
Vehicles and Equipment	1	LS	$436	$436					
TASK TOTAL				**$976**	**240**		**$20,180**	**$21,000**	ANNUAL COST

COST ESTIMATE
BGOU SWMU 2
Alternative 4(SS)—Containment, Stabilization/Solidification, Surface Controls, LUCs, Monitoring

Weed Removal and Cover Inspection									
Duration: Semiannualy following the first 100 years.									
Prime Contractor Labor					120		$10,090		
Materials	1	LS	$270	$270					
Vehicles and Equipment	1	LS	$218	$218					
TASK TOTAL				**$488**			**$10,090**	**$11,000**	ANNUAL COST
Groundwater Storage Tank Collection & Disposal									
Duration: Annually for 1,000 years.									
Prime Contractor Labor					50		$3,815		
Materials	1	LS	$108	$108					
Vehicles and Equipment	1	LS	$109	$109					
TASK TOTAL				**$217**			**$3,815**	**$4,000**	ANNUAL COST
Extraction Well Pump Replacement									
Duration: Every 5 years.									
Prime Contractor Labor					100		$7,745		
Subcontractors	1	LS	$168,131	$168,131					Local quote from existing drilling sub.
TASK TOTAL				**$168,131**			**$7,745**	**$176,000**	EVERY 5 YEARS
Sign Replacement									
Duration: Every 30 years.									
Prime Contractor Labor					30		$2,392		
Materials	1	LS	$108	$54					
Vehicles and Equipment	1	LS	$109	$109					
TASK TOTAL				**$163**			**$2,392**	**$3,000**	EVERY 30 YEARS
Above Grade Groundwater Component Replacement and Redevelop Wells									
Duration: Every 50 years.									
Prime Contractor Labor					800		$59,803		
Subcontractors	1	LS	$323,512	$323,512					RSMeans and local quote
Materials	1	LS	$28,259	$28,259					
Vehicles and Equipment	1	LS	$3,488	$3,488					
TASK TOTAL				**$355,259**			**$59,803**	**$415,000**	EVERY 50 YEARS
Extraction Well Replacement									
Duration: Every 100 years.									
Prime Contractor Labor					640		$53,598		
Subcontractors	1	LS	$465,319	$465,319					
Materials	1	LS	$3,147	$3,147					
Vehicles and Equipment	1	LS	$1,744	$1,744					
TASK TOTAL				**$470,210**			**$53,598**	**$524,000**	EVERY 100 YEARS
Groundwater Monitoring - First 5 years									
Duration: Semiannualy for the first 5 years.									
Prime Contractor Labor					640		$50,330		
Laboratory	1	LS	$12,033	$12,033					
Materials	1	LS	$1,080	$1,080					
Vehicles and Equipment	1	LS	$872	$872					
TASK TOTAL				**$13,985**			**$50,330**	**$64,000**	ANNUAL COST
Groundwater Monitoring - Years 6 through 1000									
Duration: Annualy for years 6 through 1000									
Prime Contractor Labor					320		$25,165		
Laboratory	1	LS	$6,016	$6,016					
Materials	1	LS	$540	$540					
Vehicles and Equipment	1	LS	$436	$436					
TASK TOTAL				**$6,992**			**$25,165**	**$32,000**	ANNUAL COST

COST ESTIMATE
BGOU SWMU 2
Alternative 4(SS)—Containment, Stabilization/Solidification, Surface Controls, LUCs, Monitoring

Five Year Review									
Duration: Every 5 years.									
Prime Contractor Labor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 4(SS)			**$14,363,065**
	Capital Costs			**$13,063,390**
	Remedial Desgin			**$1,296,208**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	306,203	$1.00	$306,203
Memo: 3,444 HOURS				

TOTAL RDWP/RDSI Work Plan **$306,203**

Estimate Tree Structure Rollups			
SWMU 2 Alternative 4(SS)			**$14,363,065**
Capital Costs			**$13,063,390**
Remedial Desgin			**$1,296,208**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	663,892	$1.00	$663,892
Memo: 7,184 HOURS				

TOTAL RDR **$663,892**

Estimate Tree Structure Rollups			
SWMU 2 Alternative 4(SS)			**$14,363,065**
Capital Costs			**$13,063,390**
Remedial Desgin			**$1,296,208**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	20,283	$1.00	$20,283
Memo: 192 HOURS				

TOTAL Civil Surveying **$20,283**

Estimate Tree Structure Rollups			
SWMU 2 Alternative 4(SS)			**$14,363,065**
Capital Costs			**$13,063,390**
Remedial Desgin			**$1,296,208**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	36,198	$1.00	$36,198
Memo: 440 HOURS				

TOTAL Procurement **$36,198**

Estimate Tree Structure Rollups			
SWMU 2 Alternative 4(SS)			**$14,363,065**
Capital Costs			**$13,063,390**
Remedial Desgin			**$1,296,208**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	98,096	$1.00	$98,096
Memo: 1,128 HOURS				

TOTAL Work Packages/Readiness Review **$98,096**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 4(SS)			**$14,363,065**
	Capital Costs			**$13,063,390**
	Remedial Desgin			**$1,296,208**

Training

Tree Depth= 5

		QTY	UNIT COST	TOTAL
	Pyrophoric U Training per Person	16	$800.00	$12,800
Memo: Assume $800 per person. This is consistent with the previous FS submittal.				
	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
Memo: Assume 80 hours of training per person. Assume 10 people or 800 hours.				
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training **$171,536**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 4(SS)			**$14,363,065**
	Capital Costs			**$13,063,390**
	Other Project Plans			**$862,930**

RAWP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	406,721	$1.00	$406,721
Memo: 4,489 HOURS				

TOTAL RAWP **$406,721**

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 4(SS)			**$14,363,065**
	Capital Costs			**$13,063,390**
	Other Project Plans			**$862,930**

O&M Plan

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan **$66,863**

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 4(SS)			**$14,363,065**
	Capital Costs			**$13,063,390**
	Other Project Plans			**$862,930**

SAP/QAPP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	84,602	$1.00	$84,602
Memo: 970 HOURS				

TOTAL SAP/QAPP **$84,602**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	Other Project Plans				**$862,930**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	58,809		$1.00	$58,809
Memo: 616 HOURS					

TOTAL Waste Management Plan **$58,809**

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 4(SS)	**$14,363,065**
	Capital Costs	**$13,063,390**
	Other Project Plans	**$862,930**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	195,210		$1.00	$195,210
Memo: 2,065 HOURS					

TOTAL RACR **$195,210**

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 4(SS)	**$14,363,065**
	Capital Costs	**$13,063,390**
	Other Project Plans	**$862,930**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 4(SS)	**$14,363,065**
	Capital Costs	**$13,063,390**
	RDSI	**$1,156,669**

Drilling

Tree Depth= 5

	Mob/Demob for DPT subcontractor	1		$8,500.00	$8,500
	DPT Borings to 40 feet	30		$1,635.00	$49,050
Memo: 2 borings per day - 15 days of borings plus 1 week for mob and 1 week for demob.					
	1/2 TON 4WD TRUCKS, LARGE VANS	1,280	hrs	$5.45	$6,976
Memo: 4 LATAKY vehicles.					
	55 GALLON DRUM	6		$84.68	$508
Memo: 6 drums for drill cuttings.					
	ST-90 CONTAINER DELIVERED	3		$1,770.63	$5,312
Memo: 3 ST-90 box for PPE/Trash.					
	PORTABLE TOILET & HAND WASH PER MONTH	2		$227.21	$454
Memo: Rent for 2 months.					
	LAUNDRY 2 CHANGES COST PER HOUR	4,320	hrs	$2.70	$11,664
Memo: LATAKY personnel plus assume 5 drillers.					
	DPT Borings to 65 feet	12		$2,573.00	$30,876
Memo: Angled borings - assume 65 feet deep.					

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study — **Reported From: SWMU 2 Alternative 4(SS)**
Report Total: $14,363,065

Author
Manager

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	RDSI				**$1,156,669**

Drilling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	DPT Borings to 40 feet	8		$1,635.00	$13,080
Memo: 8 additional borings following waste stabilization.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	4,320		$5.19	$22,421
	PPE 2 c/o per day 10 hr day cost per hr	4,320		$1.95	$8,424
	MSA OptiFilter HEPA per hour	4,320		$3.45	$14,904
LABOR	PRIME CONTRACTOR LABOR	289,640		$1.00	$289,640
Memo: 3,550 HOURS					

TOTAL Drilling **$461,809**

Memo: Same as alternative 3 but added 12 angled borings and 8 additional vertical borings. Assume 8 weeks.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	RDSI				**$1,156,669**

Sampling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	5 gram EN CORE SAMPLER	600		$6.94	$4,164
	Niton XRF Rental One Month	2		$4,500.00	$9,000
	PCB Test Kits	1		$541.00	$541
	LAUNDRY 2 CHANGES COST PER HOUR	1,600	hrs	$2.70	$4,320
	PPE 2 c/o per day 10 hr day cost per hr	1,600		$1.95	$3,120
LABOR	PRIME CONTRACTOR LABOR	116,867		$1.00	$116,867
Memo: 1600 HOURS					

TOTAL Sampling **$138,012**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	RDSI				**$1,156,669**

Analytical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Overnight Shipment per Cooler	51		$251.97	$12,850
Memo: Assume 2 shipments per day for 25 days plus 1 shipment later for the waste water.					
	RDSI Geophysical Sampling Analytical	1		$1,275.00	$1,275
Memo: 3 Geophysical samples taken for particle size and atterberg limits.					
	RDSI Soil Sampling Analytical	1		$262,775.00	$262,775
Memo: 8 samples from 30 borings = 240 samples.					
	RDSI Soil Sampling Analytical	0.92		$262,775.00	$241,753
Memo: 8 samples from 8 additional borings = 64 samples. 13 samples from 12 angled borings = 156 samples. Total of 220 samples. 220/240 = .92					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	RDSI				**$1,156,669**

Analytical

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	28,445		$1.00	$28,445
Memo: 300 HOURS					

TOTAL Analytical **$547,098**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 4(SS)		**$14,363,065**
Capital Costs		**$13,063,390**
RDSI		**$1,156,669**

Excavation

Tree Depth= 5

	JOHN DEERE 624E 4WD ARTICULATED WHEEL LOADER	20	hr	$18.23	$365
	KOMATSU WB142-5 BACKHOE cost per hour	20	hr	$35.58	$712
	LAUNDRY 2 CHANGES COST PER HOUR	80	hrs	$2.70	$216
	PPE 2 c/o per day 10 hr day cost per hr	80		$1.95	$156
	MSA OptiFilter HEPA per hour	80		$3.45	$276
	Resp cleaning 10 hr day 2 C/O per day cost per hr	80		$5.19	$415
LABOR	PRIME CONTRACTOR LABOR	7,610		$1.00	$7,610
Memo: 100 HOURS					

TOTAL Excavation **$9,749**

Memo: Excavator will dig potholes until conduit duct bank is found. Duct bank will be broken up and removed in two places where the slurry wall will be placed.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 4(SS)		**$14,363,065**
Capital Costs		**$13,063,390**
Stabilization		**$5,674,079**

Soil Mixing

Tree Depth= 5

	Soil Mixing w/ Cement Grouting per CY	28,800	CY	$125.00	$3,600,000
Memo: Reference frtr.gov					
	Soil Mixing Mob/DeMob	1		$500,000.00	$500,000
	1/2 TON 4WD TRUCKS, LARGE VANS	5,680	hrs	$5.45	$30,956
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	5,680	hrs	$2.70	$15,336
	Resp cleaning 10 hr day 2 C/O per day cost per hr	5,680		$5.19	$29,479
	PPE 2 c/o per day 10 hr day cost per hr	5,680		$1.95	$11,076
	MSA OptiFilter HEPA per hour	5,680		$3.45	$19,596

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	Stabilization				**$5,674,079**

Soil Mixing

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	710,577		$1.00	$710,577
Memo: 8,662 HOURS					

TOTAL Soil Mixing **$4,917,020**

Memo: Treatment area is 160' x 200' or 32,000 SF. 20 feet deep makes it 24,000 CY. Assume 20% overlap so 24,000 X 1.2 = 28,800 CY mixed. Each hole is 37.3 CY so 28,800 / 37.3 CY = 772 holes. Assume 6 holes per day or 128 days plus assume 14 days of delays - 142 days.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	Stabilization				**$5,674,079**

Jet Grouting

Tree Depth= 5

	Jet Grouting w/ Cement Grouting per CY	1,800	CY	$300.00	$540,000
Memo: Reference STANTEC.					
	Jet Grouting Mob/DeMob	1		$125,000.00	$125,000
	1/2 TON 4WD TRUCKS, LARGE VANS	640	hrs	$5.45	$3,488
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	640	hrs	$2.70	$1,728
	Resp cleaning 10 hr day 2 C/O per day cost per hr	640		$5.19	$3,322
	PPE 2 c/o per day 10 hr day cost per hr	640		$1.95	$1,248
	MSA OptiFilter HEPA per hour	640		$3.45	$2,208
LABOR	PRIME CONTRACTOR LABOR	80,065		$1.00	$80,065
Memo: 976 HOURS					

TOTAL Jet Grouting **$757,059**

Memo: 2 waste areas. 20' x 20' or 400 SF and 20' x 40' or 800 SF. Total of 1,200 SF. Treatment from 20' BGS to 60' BGS. 1,200 SF x 40' = 48,000 CF or 1,800 CY. Assume 1 month duration.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	Hydraulic Isolation				**$2,137,523**

Slurry Wall Construction

Tree Depth= 5

	C7 R.S.Means Crew	32,000	S.F.	$21.10	$675,221
	1/2 TON 4WD TRUCKS, LARGE VANS	1,288	hrs	$5.45	$7,020
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,280	hrs	$2.70	$3,456
	CATERPILLAR 345B CRAWLER MOUNTED SHEAR HEAD EXCAVATOR	320	hr	$62.12	$19,878
	JOHN DEERE 624E 4WD ARTICULATED WHEEL LOADER	320	hr	$18.23	$5,834

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	Hydraulic Isolation				**$2,137,523**

Slurry Wall Construction

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,280		$5.19	$6,643
	PPE 2 c/o per day 10 hr day cost per hr	1,280		$1.95	$2,496
	MSA OptiFilter HEPA per hour	1,280		$3.45	$4,416
LABOR Memo: 2,599 HOURS	PRIME CONTRACTOR LABOR	201,714		$1.00	$201,714
Subtotal					$926,678
1st Layer Markups assigned to Detail Items					$348,148
TOTAL Slurry Wall Construction					**$1,274,826**

Memo: Assume wall is approx. 200' x 200' or 800 LF 800 LF x 40' deep = 32,000 SF.
Assume 25 linear feet per day: 800 / 25 = 32 days assume 2 months due to weather delays and equipment repairs.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	Hydraulic Isolation				**$2,137,523**

Well Construction

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Extraction Well Subcontractor Mob/Demob	1		$34,878.49	$34,878
	Extraction Well Installation & Development	4		$65,577.27	$262,309
	Extraction Well Pump Installation	4		$42,032.80	$168,131
Memo: LATAKY personnel plus assume 5 drillers.	LAUNDRY 2 CHANGES COST PER HOUR	1,040	hrs	$2.70	$2,808
Memo: 4 drums for drill cuttings.	55 GALLON DRUM	4		$84.68	$339
Memo: 2 LATAKY vehicles.	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,040		$5.19	$5,398
	PPE 2 c/o per day 10 hr day cost per hr	1,040		$1.95	$2,028
	MSA OptiFilter HEPA per hour	1,040		$3.45	$3,588
LABOR Memo: 800 HOURS	PRIME CONTRACTOR LABOR	64,952		$1.00	$64,952
TOTAL Well Construction					**$546,175**

Memo: 4 week duration.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	Hydraulic Isolation				**$2,137,523**

Tank & Piping

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	1,000 Gallon Water Tank	1		$1,100.00	$1,100
	Q1 R.S.Means Crew	5,000	L.F.	$22.36	$111,775

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	Hydraulic Isolation				**$2,137,523**

Tank & Piping

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	800	hrs	$2.70	$2,160
	Pump House Building Pre Fab	1		$24,999.00	$24,999
Memo: Tank structure.					
	PPE 2 c/o per day 10 hr day cost per hr	800		$1.95	$1,560
LABOR	PRIME CONTRACTOR LABOR	59,803		$1.00	$59,803
Memo: 800 HOURS					
Subtotal					$201,397
1st Layer Markups assigned to Detail Items					$45,704
TOTAL Tank & Piping					**$247,101**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	Hydraulic Isolation				**$2,137,523**

Electrical

Tree Depth= 5

	RSMeans D5010 120 0220 Electrical Service	1		$2,417.00	$2,417
Memo: Includes O&P.					
	R3 R.S.Means Crew	5	Ea.	$1,024.44	$5,122
	1/0 Triplex Service Wire per foot	2,000		$3.67	$7,340
	Electricians	5	Ea.	$298.89	$1,494
	Electricians	500	L.F.	$10.39	$5,193
	Electricians	20	C.L.F.	$52.34	$1,047
	Electricians	2	Ea.	$305.84	$612
Memo: (2) 1,500 Watt heater per tank x 1 tanks = 2 heaters.					
	Electricians	800	L.F.	$8.14	$6,509
	Electricians	4	Ea.	$288.89	$1,156
	Electricians	4	C.L.F.	$93.39	$374
	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780
LABOR	PRIME CONTRACTOR LABOR	29,901		$1.00	$29,901
Memo: 401 HOURS					
Subtotal					$63,024
1st Layer Markups assigned to Detail Items					$6,397
TOTAL Electrical					**$69,421**

Memo: Assumes 1 metering point. Secondary service wire ran to 4 wells and the tank on poles.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	Surface Soils Consolidation				**$38,688**

Surveying and Marking

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
LABOR Memo: 160 HOURS	PRIME CONTRACTOR LABOR	14,145		$1.00	$14,145

TOTAL Surveying and Marking **$14,889**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	Surface Soils Consolidation				**$38,688**

Soil Consolidation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B10L R.S.Means Crew	270	B.C.Y.	$15.21	$4,106
	B10G R.S.Means Crew	270	E.C.Y.	$0.69	$187
	Water Truck 10k Gallon cost per hr	40	hrs	$208.34	$8,334
	PPE 2 c/o per day 10 hr day cost per hr	160	hr	$1.95	$312
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
LABOR Memo: 120 HOURS	PRIME CONTRACTOR LABOR	8,810		$1.00	$8,810
Subtotal					$22,180
1st Layer Markups assigned to Detail Items					$1,618

TOTAL Soil Consolidation **$23,799**
Memo: Assume depth of 2 feet. 25% of area outside cap or 270 CY.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	Cap Construction				**$1,115,518**

Surveying, Marking, Testing

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
Memo: Construction 2 FTE. Geotechnical testing, data recording, surveying, and reporting.	Geotechnical Testing Technician per hour	960		$52.19	$50,102
Memo: Construction Nuclear Density testing per hour. Estimated 60 days.	Geotechnical Testing Density Testing per hour	600		$50.00	$30,000
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
LABOR Memo: 280 HOURS	PRIME CONTRACTOR LABOR	28,905		$1.00	$28,905

TOTAL Surveying, Marking, Testing **$109,751**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	Cap Construction				**$1,115,518**

Cap Construction

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
	B15 R.S.Means Crew	1,630	C.Y.	$16.49	$26,885
Memo: Estimated average of 12" soil needed to bring low spots up to the high point. SOURCE = RSMEANS.					
	B10G R.S.Means Crew	1,630	E.C.Y.	$1.25	$2,029
Memo: Compaction of Leveling Layer.					
	B15 R.S.Means Crew	3,585	C.Y.	$29.84	$106,991
Memo: CLAY LINER LAYER: 24" clay layer.					
	B10G R.S.Means Crew	3,585	E.C.Y.	$1.25	$4,463
Memo: Compaction of Clay Liner Layer.					
	Skilled Workers Average (35 trades)	52.90	M.S.F.	$1,156.55	$61,181
	B15 R.S.Means Crew	2,133	C.Y.	$23.34	$49,793
Memo: DRAINAGE LAYER: 12" sand layer.					
	B10G R.S.Means Crew	2,133	E.C.Y.	$1.25	$2,655
Memo: Compaction of Sand Layer.					
	Common Building Laborers	57,600	S.Y.	$2.09	$120,321
	B15 R.S.Means Crew	4,630	C.Y.	$27.34	$126,603
Memo: Topsoil Layer - Assume 2 feet of protective soil (62,500 * 2) / 27 = 4,630 CY.					
	B10G R.S.Means Crew	4,630	E.C.Y.	$1.25	$5,764
Memo: Compaction of the 2 feet of protective soil.					
	B34K R.S.Means Crew	4	Ea.	$423.07	$1,692
Memo: Mob/Demob for 2 dozers and 2 compactors.					
	1/2 TON 4WD TRUCKS, LARGE VANS	2,560	hrs	$5.45	$13,952
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	3,200	hrs	$2.70	$8,640
	Corner Monuments	4		$20,000.00	$80,000
	PPE 2 c/o per day 10 hr day cost per hr	3,200		$1.95	$6,240
LABOR	PRIME CONTRACTOR LABOR	313,495		$1.00	$313,495
Memo: 3,930 HOURS					
Subtotal					$930,704
1st Layer Markups assigned to Detail Items					$75,062
TOTAL Cap Construction					**$1,005,766**

Memo: Assume 4 month duration. 3 months for dirt work and 1 month for mob/demob and HDPE liner installation.
Cap area is 44,000 SF. Assume perimeter increases by a linear 10 feet for every layer.
Layer 1: Leveling Layer - Assume 1 foot of soil to form a base. (44,000 *1) / 27 = 1,630 CY.
Layer 2: Clay Liner - Assume 2 feet of clay. (48,400 * 2) / 27 = 3,585 CY.
Layer 3: Geomembrane - Assume 52,900 SF
Layer 4: Drainage Layer - Assume 1 feet of sand. (57,600 * 1) / 27 = 2,133 CY.
Layer 5: Geotextile Fabric. 57,600 SF.
Layer 6: Topsoil Layer - Assume 2 feet of protective soil (62,500 * 2) / 27 = 4,630 CY.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	Riprap Cover				**$781,776**

Bedding Layer

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Skilled Workers Average (35 trades)	68.75	M.S.F.	$1,156.55	$79,513
Memo: 62,500 SF + 10% for waste = 68,750.					
	B15 R.S.Means Crew	1,158	C.Y.	$23.34	$27,032
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	PPE 2 c/o per day 10 hr day cost per hr	480	hr	$1.95	$936
LABOR	PRIME CONTRACTOR LABOR	74,808		$1.00	$74,808
Memo: 879 HOURS					
Subtotal					$185,329
1st Layer Markups assigned to Detail Items					$39,325
TOTAL Bedding Layer					**$224,654**

Memo: Assume bedding layer 250' x 250' or 62,500 SF. Layer will be 6" sand overlaying geotextile.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Capital Costs				**$13,063,390**
	Riprap Cover				**$781,776**

Riprap Layer

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B12G R.S.Means Crew	4,630	L.C.Y.	$55.68	$257,793
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	PPE 2 c/o per day 10 hr day cost per hr	480	hr	$1.95	$936
	B15 R.S.Means Crew	4,630	C.Y.	$17.69	$81,924
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	B81 R.S.Means Crew	62.50	M.S.F.	$56.24	$3,515
	B10G R.S.Means Crew	2,315	E.C.Y.	$1.25	$2,882
Memo: Compaction of 1 foot.					
LABOR	PRIME CONTRACTOR LABOR	136,991		$1.00	$136,991
Memo: 1,632 HOURS					
Subtotal					$490,120
1st Layer Markups assigned to Detail Items					$67,001
TOTAL Riprap Layer					**$557,121**

Memo: Assume riprap layer is 250' x 250' or 62,500 SF at 2 feet thick or 4,630 CY. 2 foot of soil cover the same.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Inspections

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	20,180		$1.00	$20,180
Memo: 240 HOURS					

TOTAL Inspections **$21,156**

Memo: Annual Cost. General inspections of the action. Quarterly.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Weed Removal and Cover Inspection

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	10,090		$1.00	$10,090
Memo: 120 HOURS					

TOTAL Weed Removal and Cover Inspection **$10,578**

Memo: Annual Cost. Semiannual following the initial 100 years.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Groundwater Storage Tank Collection/Disposal

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	1/2 TON 4WD TRUCKS, LARGE VANS	20	hrs	$5.45	$109
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	40	hrs	$2.70	$108
LABOR	PRIME CONTRACTOR LABOR	3,815		$1.00	$3,815
Memo: 50 HOURS					

TOTAL Groundwater Storage Tank Collection/Disposal **$4,032**

Memo: Annual Cost. Occurs once every year.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Extraction Well Pump Replacement

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Extraction Well Pump Installation	4		$42,032.80	$168,131

LEVEL		QTY		UNIT COST	TOTAL

Estimate Tree Structure Rollups
SWMU 2 Alternative 4(SS) **$14,363,065**
Annual Costs **$1,299,675**
Operations & Maintenance **$1,153,066**

Extraction Well Pump Replacement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	7,745		$1.00	$7,745
Memo: 100 HOURS					

TOTAL Extraction Well Pump Replacement **$175,876**
Memo: Occurs every 5 years.

Estimate Tree Structure Rollups
SWMU 2 Alternative 4(SS) **$14,363,065**
Annual Costs **$1,299,675**
Operations & Maintenance **$1,153,066**

Sign Replacement

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	20	hrs	$2.70	$54
	1/2 TON 4WD TRUCKS, LARGE VANS	20	hrs	$5.45	$109
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	2,392		$1.00	$2,392
Memo: 30 HOURS					

TOTAL Sign Replacement **$2,555**
Memo: Occurs every 30 years.

Estimate Tree Structure Rollups
SWMU 2 Alternative 4(SS) **$14,363,065**
Annual Costs **$1,299,675**
Operations & Maintenance **$1,153,066**

Above Grade Groundwater Components Replacement

Tree Depth= 5

	1,000 Gallon Water Tank	1		$1,100.00	$1,100
	Q1 R.S.Means Crew	5,000	L.F.	$22.36	$111,775
	LAUNDRY 2 CHANGES COST PER HOUR	800	hrs	$2.70	$2,160
	Pump House Building Pre Fab	1		$24,999.00	$24,999
Memo: Tank structure.					
	Extraction Well Subcontractor Mob/Demob	1		$34,878.49	$34,878
	Extraction Well Installation & Development	2		$65,577.27	$131,155
Memo: Assume quantity of 2 to represent total of 4 well re-develop.					
	1/2 TON 4WD TRUCKS, LARGE VANS	640	hrs	$5.45	$3,488
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	59,803		$1.00	$59,803
Memo: 800 HOURS					

Subtotal	$369,358
1st Layer Markups assigned to Detail Items	$45,704

TOTAL Above Grade Groundwater Components Replacement **$415,062**
Memo: Occurs every 50 years.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Extraction Well Replacement

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Extraction Well Subcontractor Mob/Demob	1		$34,878.49	$34,878
	Extraction Well Installation & Development	4		$65,577.27	$262,309
	Extraction Well Pump Installation	4		$42,032.80	$168,131
	LAUNDRY 2 CHANGES COST PER HOUR	1,040	hrs	$2.70	$2,808
Memo: LATAKY personnel plus assume 5 drillers.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	53,598		$1.00	$53,598
Memo: 640 HOURS					

TOTAL Extraction Well Replacement **$523,807**
Memo: Occurs every 100 years.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 4(SS)		**$14,363,065**
Annual Costs		**$1,299,675**
Groundwater Monitoring		**$96,472**
Semiannual Monitoring		**$64,315**

Monitoring Well Sampling

Tree Depth= 6

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	8		$689.05	$5,512
LABOR	PRIME CONTRACTOR LABOR	25,165		$1.00	$25,165
Memo: 320 HOURS					

TOTAL Monitoring Well Sampling **$32,157**
Memo: 4 monitoring wells sampled semiannually. 5 hours per well.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 4(SS)		**$14,363,065**
Annual Costs		**$1,299,675**
Groundwater Monitoring		**$96,472**
Semiannual Monitoring		**$64,315**

Extraction Well Sampling

Tree Depth= 6

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	8		$689.05	$5,512

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Annual Costs				**$1,299,675**
	Groundwater Monitoring				**$96,472**
	Semiannual Monitoring				**$64,315**

Extraction Well Sampling

Tree Depth= 6

LABOR	PRIME CONTRACTOR LABOR	25,165		$1.00	$25,165
Memo: 320 HOURS					

TOTAL Extraction Well Sampling **$32,157**
Memo: 4 extraction wells sampled semiannually. 5 hours per well.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Annual Costs				**$1,299,675**
	Groundwater Monitoring				**$96,472**
	Annual Monitoring				**$32,157**

Monitoring Well Sampling

Tree Depth= 6

	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	4		$689.05	$2,756
LABOR	PRIME CONTRACTOR LABOR	12,582.50		$1.00	$12,583
Memo: 160 HOURS					

TOTAL Monitoring Well Sampling **$16,079**
Memo: 4 monitoring wells sampled annually. 5 hours per well.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 4(SS)				**$14,363,065**
	Annual Costs				**$1,299,675**
	Groundwater Monitoring				**$96,472**
	Annual Monitoring				**$32,157**

Extraction Well Sampling

Tree Depth= 6

	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	4		$689.05	$2,756
LABOR	PRIME CONTRACTOR LABOR	12,582.50		$1.00	$12,583
Memo: 160 HOURS					

TOTAL Extraction Well Sampling **$16,079**
Memo: 4 extraction wells sampled annually. 5 hours per well.

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 4(SS)			**$14,363,065**
	Annual Costs			**$1,299,675**
	Five Year Reviews			**$50,137**

Five Year Reviews

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,137	$1.00	$50,137
Memo: 500 HOURS				

TOTAL Five Year Reviews **$50,137**

COST ESTIMATE
BGOU SWMU 2
Alternative 5—Excavation, Disposal, and LUCs

Cost Estimate Summary									
Capital Cost	**Quantity**	**Units**	**Unit Price**	**Total**					
1.0 Remedial Design	1	LS	$1,574,000	$1,574,000					
2.0 Other Project Plans	1	LS	$1,038,000	$1,038,000					
3.0 Remedial Design Site Investigation (RDSI)	1	LS	$1,650,000	$1,650,000					
4.0 Shoring	1	LS	$1,518,000	$1,518,000					
5.0 Excavation	1	LS	$1,785,000	$1,785,000					
6.0 Treat and Dispose of Water	1	LS	$412,000	$412,000					
7.0 Post Remediation Sampling	1	LS	$101,000	$101,000					
8.0 Waste Handling, Treatment, Disposal, and Transportation	1	LS	$48,042,000	$48,042,000					
9.0 Excavation Backfill	1	LS	$1,519,000	$1,519,000					
10.0 Chemical Treatment	1	LS	$3,824,000	$3,824,000					
Subproject Management	1	LS	$6,146,300	$6,146,000					Subproject Management = 10%
Management Reserve	1	LS	$10,141,350	$10,141,000					Contractor MR = 15%
Fee	1	LS	$5,442,500	$5,443,000					Fee = 7%
Contingency	1	LS	$16,638,600	$16,639,000					Contingency = 20%
			SUBTOTAL CAPITAL COST	**$99,832,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Five Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
			SUBTOTAL ANNUAL COST	**$10,000,000**			**3.82E+17**		
			TOTAL	**$109,832,000**					
Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	ls	$99,832,000	$99,832,000				**$99,832,000**	
Five Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$99,832,000**	
						Present Worth Values	**Annual**	**$889,000**	
							Avg. Annual	**$889**	
							Total	**$100,721,000**	
This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.									
Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.									

COST ESTIMATE
BGOU SWMU 2
Alternative 5—Excavation, Disposal, and LUCs

CAPITAL COSTS									
	Material/Equipment/Subcontractors/ODCs				Labor				
Task Description	Qty	Unit	Unit Price	Total	Hours	Rate	Total	Total Cost	Basis of Estimate
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					4224		$376,224		
Remedial Design Report					8744		$803,933		
Civil Surveying					216		$22,818		
Procurement					634		$52,676		
Work Packages/Readiness					1688		$146,788		
Training	1	LS	$68,800	$68,800	1320		$102,736		$68,800 includes subcontractor training and pyrophoric training
TASK TOTAL				**$68,800**	**16826**		**$1,505,175**	**$1,574,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					5724		$517,587		
O&M Plan					700		$66,863		
SAP/QAPP					1100		$96,201		
Waste Management Plan					1020		$94,190		
RACR					2274		$212,751		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**11402**		**$1,038,317**	**$1,038,000**	
3.0 Remedial Design Site Investigation (RDSI)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Drilling									
Prime Contractor Labor					4440		$362,305		
Subcontractors	1	LS	$168,834	$168,834					Local quote from existing drilling sub.
Materials	1	LS	$80,208	$80,208					
Vehicles and Equipment	1	LS	$8,720	$8,720					
Sampling									
Prime Contractor Labor					2000		$146,084		
Materials	1	LS	$29,434	$29,434					
Analytical									
Prime Contractor Labor					412		$39,228		
Materials	1	LS	$815,013	$815,013					
Excavation									
Prime Contractor Labor	0				0		$0		
Equipment	0	LS	$0	$0					
TASK TOTAL				**$ 1,102,209**	**6852**		**$ 547,617**	**$1,650,000**	
4.0 Shoring									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Sheet Piling									
Prime Contractor Labor					2913		$243,228		
Subcontractors	1	LS	$1,252,396	$1,252,396					
Materials	1	LS	$16,325	$16,325					
Vehicles and Equipment	1	LS	$5,668	$5,668					
TASK TOTALS				**$1,274,389**	**2,913**		**$243,228**	**$1,518,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 5—Excavation, Disposal, and LUCs

5.0 Excavation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Overburden									
Prime Contractor Labor					3888		$334,664		
Subcontractors	1	LS	$233,552	$233,552					
Materials	1	LS	$22,327	$22,327					
Vehicles and Equipment	1	LS	$5,232	$5,232					
Pyrophoric U									
Prime Contractor Labor					1296		$111,555		
Subcontractors	1	LS	$61,183	$61,183					
Materials	1	LS	$8,506	$8,506					
Vehicles and Equipment	1	LS	$1,744	$1,744					
TCE									
Prime Contractor Labor					405		$34,861		
Subcontractors	1	LS	$19,120	$19,120					
Materials	1	LS	$2,658	$2,658					
Vehicles and Equipment	1	LS	$545	$545					
Uranyl Fluoride									
Prime Contractor Labor					243		$20,916		
Subcontractors	1	LS	$11,472	$11,472					
Materials	1	LS	$1,595	$1,595					
Vehicles and Equipment	1	LS	$327	$327					
Balance of Soils									
Prime Contractor Labor					6480		$557,773		
Subcontractors	1	LS	$305,920	$305,920					
Materials	1	LS	$42,528	$42,528					
Vehicles and Equipment	1	LS	$8,720	$8,720					
TASK TOTALS				**$725,429**	**12,312**		**$1,059,769**	**$1,785,000**	
6.0 Treat and Dispose of Water									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Water Treatment									
Prime Contractor Labor					1824		$129,814		
Subcontractors	1	LS	$229,291	$229,291					Rainforrent.com and RSMeans
Materials	1	LS	$8,482	$8,482					
Vehicles and Equipment	1	LS	$3,314	$3,314					
Water Disposal									
Prime Contractor Labor					40		$2,275		
Characterization Sampling	1	LS	$30,163	$30,163					
Vehicles and Equipment	1	LS	$8,334	$8,334					
TASK TOTALS				**$279,584**	**1,864**		**$132,089**	**$412,000**	
7.0 Post Remediation Sampling									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Sampling									
Prime Contractor Labor					200		$14,608		
Materials	1	LS	$8,934	$8,934					
Analytical									
Prime Contractor Labor					56		$5,103		
Materials	1	LS	$72,209	$72,209					
TASK TOTAL				**$ 81,143**	**256**		**$19,711**	**$101,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 5—Excavation, Disposal, and LUCs

8.0 Waste Handling, Treatment, Disposal, and Transportation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Overburden									
Prime Contractor Labor					6072		$397,499		
Materials	1	LS	$26,292	$26,292					
Characterization Sampling	1	LS	$184,268	$184,268					
Vehicles and Equipment	1	LS	$247,086	$247,086					
Pyrophoric U									
Prime Contractor Labor					62774		$4,413,663		
Subcontractors	1	LS	$210,007	$210,007					RSMeans - Stabilization Facility
Materials	1	LS	$468,234	$468,234					
Characterization Sampling	1	LS	$1,075,897	$1,075,897					
Vehicles and Equipment	1	LS	$463,650	$463,650					
Stabilization	1	LS	$5,338,920	$5,338,920					
Transportation	1	LS	$14,645,880	$14,645,880					
TCE									
Prime Contractor Labor					3262		$234,069		
Materials	1	LS	$330,328	$330,328					
Characterization Sampling	1	LS	$36,596	$36,596					
Vehicles and Equipment	1	LS	$19,577	$19,577					
Treatment	1	LS	$1,008,625	$1,008,625					
Disposal	1	LS	$1,121,271	$1,121,271					
Transportation	1	LS	$388,110	$388,110					
Potential PCB Oil									
Prime Contractor Labor					724		$51,533		
Materials	1	LS	$21,019	$21,019					
Characterization Sampling	1	LS	$28,308	$28,308					
Vehicles and Equipment	1	LS	$5,964	$5,964					
Treatment/Disposal	1	LS	$1,471,800	$1,471,800					
Transportation	1	LS	$19,296	$19,296					
Uranyl Fluoride									
Prime Contractor Labor					1620		$116,348		
Materials	1	LS	$165,632	$165,632					
Characterization Sampling	1	LS	$18,872	$18,872					
Vehicles and Equipment	1	LS	$7,610	$7,610					
Treatment	1	LS	$508,021	$508,021					
Disposal	1	LS	$564,758	$564,758					
Transportation	1	LS	$197,860	$197,860					
Balance of Soils									
Prime Contractor Labor					26800		$1,903,491		
Materials	1	LS	$888,585	$888,585					
Characterization Sampling	1	LS	$516,207	$516,207					
Vehicles and Equipment	1	LS	$283,287	$283,287					
Disposal	1	LS	$4,064,742	$4,064,742					
Transportation	1	LS	$6,598,585	$6,598,585					
TASK TOTALS				**$40,925,287**	**101,252**		**$7,116,603**	**$48,042,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 5—Excavation, Disposal, and LUCs

9.0 Excavation Backfill									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Backfill									
Prime Contractor Labor					3600		$302,175		
Subcontractors	1	LS	$1,206,414	$1,206,414					RSMeans and local engineering firm
Materials	1	LS	$8,316	$8,316					
Vehicles and Equipment	1	LS	$1,744	$1,744					
TASK TOTAL				**$1,216,474**	**3600**		**$302,175**	**$1,519,000**	
10.0 Chemical Treatment									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Jet Grouting									
Prime Contractor Labor					2928		$240,195		
Subcontractors	1	LS	$3,548,000	$3,548,000					
Materials	1	LS	$25,517	$25,517					
Vehicles and Equipment	1	LS	$10,464	$10,464					
TASK TOTAL				**$3,583,981**	**2928**		**$240,195**	**$3,824,000**	
							SUBTOTAL CAPITAL COST	**$61,463,000**	
ANNUAL COSTS									
Five Year Review									
Duration: Every 5 years.									
Prime Contractor Labor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study

Reported From: SWMU 2 Alternative 5
Report Total: $61,512,310

Author
Manager

LEVEL	QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups		
	SWMU 2 Alternative 5		**$61,512,310**
	Capital Costs		**$61,462,173**
	Remedial Desgin		**$1,573,975**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	376,224	$1.00	$376,224
Memo: 4,224 HOURS				

TOTAL RDWP/RDSI Work Plan **$376,224**

	Estimate Tree Structure Rollups		
	SWMU 2 Alternative 5		**$61,512,310**
	Capital Costs		**$61,462,173**
	Remedial Desgin		**$1,573,975**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	803,933	$1.00	$803,933
Memo: 8,744 HOURS				

TOTAL RDR **$803,933**

	Estimate Tree Structure Rollups		
	SWMU 2 Alternative 5		**$61,512,310**
	Capital Costs		**$61,462,173**
	Remedial Desgin		**$1,573,975**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	22,818	$1.00	$22,818
Memo: 216 HOURS				

TOTAL Civil Surveying **$22,818**

	Estimate Tree Structure Rollups		
	SWMU 2 Alternative 5		**$61,512,310**
	Capital Costs		**$61,462,173**
	Remedial Desgin		**$1,573,975**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	52,676	$1.00	$52,676
Memo: 634 HOURS				

TOTAL Procurement **$52,676**

	Estimate Tree Structure Rollups		
	SWMU 2 Alternative 5		**$61,512,310**
	Capital Costs		**$61,462,173**
	Remedial Desgin		**$1,573,975**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	146,788	$1.00	$146,788
Memo: 1,688 HOURS				

TOTAL Work Packages/Readiness Review **$146,788**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 5			**$61,512,310**
	Capital Costs			**$61,462,173**
	Remedial Desgin			**$1,573,975**

Training

Tree Depth= 5

		QTY	UNIT COST	TOTAL
	Pyrophoric U Training per Person	16	$800.00	$12,800
Memo: Assume $800 per person. This is consistent with the previous FS submittal.				
Memo:	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
Assume 80 hours of training per person. Assume 10 people or 800 hours.				
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training **$171,536**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 5			**$61,512,310**
	Capital Costs			**$61,462,173**
	Other Project Plans			**$1,038,317**

RAWP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	517,587	$1.00	$517,587
Memo: 5,724 HOURS				

TOTAL RAWP **$517,587**

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 5			**$61,512,310**
	Capital Costs			**$61,462,173**
	Other Project Plans			**$1,038,317**

O&M Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan **$66,863**

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 5			**$61,512,310**
	Capital Costs			**$61,462,173**
	Other Project Plans			**$1,038,317**

SAP/QAPP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	96,201	$1.00	$96,201
Memo: 1,100 HOURS				

TOTAL SAP/QAPP **$96,201**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Other Project Plans				**$1,038,317**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	94,190		$1.00	$94,190
Memo: 1,020 HOURS					

TOTAL Waste Management Plan **$94,190**

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 5	**$61,512,310**
	Capital Costs	**$61,462,173**
	Other Project Plans	**$1,038,317**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	212,751		$1.00	$212,751
Memo: 2,274 HOURS					

TOTAL RACR **$212,751**

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 5	**$61,512,310**
	Capital Costs	**$61,462,173**
	Other Project Plans	**$1,038,317**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 5	**$61,512,310**
	Capital Costs	**$61,462,173**
	RDSI	**$1,649,826**

Drilling

Tree Depth= 5

	Mob/Demob for DPT subcontractor	1		$8,500.00	$8,500
	DPT Borings to 40 feet	30		$1,635.00	$49,050
Memo: 2 borings per day - 15 days of borings plus 1 week for mob and 1 week for demob.					
	1/2 TON 4WD TRUCKS, LARGE VANS	1,600	hrs	$5.45	$8,720
Memo: 4 LATAKY vehicles.					
	55 GALLON DRUM	8		$84.68	$677
Memo: 8 drums for drill cuttings.					
	ST-90 CONTAINER DELIVERED	4		$1,770.63	$7,083
Memo: 4 ST-90 box for PPE/Trash.					
	PORTABLE TOILET & HAND WASH PER MONTH	3		$227.21	$682
Memo: Rent for 3 months.					
	LAUNDRY 2 CHANGES COST PER HOUR	5,400	hrs	$2.70	$14,580
Memo: LATAKY personnel plus assume 5 drillers.					
	DPT Borings to 65 feet	12		$2,573.00	$30,876
Memo: Angled borings - assume 65 feet deep.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	RDSI				**$1,649,826**

Drilling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	DPT Borings to 40 feet	8		$1,635.00	$13,080
Memo: 8 additional borings following waste stabilization.					
	DPT Borings to 65 feet	16		$2,573.00	$41,168
Memo: 16 additional borings from grade, around the perimeter of the 2 additional sites.					
	DPT Borings to 40 feet	16		$1,635.00	$26,160
Memo: 16 additional borings from bottom of excavation, at the 2 additional sites.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	5,400		$5.19	$28,026
	PPE 2 c/o per day 10 hr day cost per hr	5,400		$1.95	$10,530
	MSA OptiFilter HEPA per hour	5,400		$3.45	$18,630
LABOR	PRIME CONTRACTOR LABOR	362,305		$1.00	$362,305
Memo: 4,440 HOURS					

TOTAL Drilling **$620,067**

Memo: Same as alternative 4B but added 8 borings at the bottom of the excavation and 8 borings outside the excavation area. This is at 2 sites so 32 total additional borings. Assume 10 weeks.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	RDSI				**$1,649,826**

Sampling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	5 gram EN CORE SAMPLER	800		$6.94	$5,552
	Niton XRF Rental One Month	3		$4,500.00	$13,500
	PCB Test Kits	2		$541.00	$1,082
	LAUNDRY 2 CHANGES COST PER HOUR	2,000	hrs	$2.70	$5,400
	PPE 2 c/o per day 10 hr day cost per hr	2,000		$1.95	$3,900
LABOR	PRIME CONTRACTOR LABOR	146,084		$1.00	$146,084
Memo: 2,000 HOURS					

TOTAL Sampling **$175,518**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	RDSI				**$1,649,826**

Analytical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Overnight Shipment per Cooler	80		$251.97	$20,158
Memo: Assume 2 shipments per day for 39 days plus 1 shipment later for the waste water.					
	RDSI Geophysical Sampling Analytical	1		$1,275.00	$1,275
Memo: 3 Geophysical samples taken for particle size and atterberg limits.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	RDSI				**$1,649,826**

Analytical

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
	RDSI Soil Sampling Analytical	1		$262,775.00	$262,775
Memo: 8 samples from 30 borings = 240 samples.					
	RDSI Soil Sampling Analytical	0.92		$262,775.00	$241,753
Memo: 8 samples from 8 additional borings = 64 samples. 13 samples from 12 angled borings = 156 samples. Total of 220 samples. 220/240 = .92					
	RDSI Soil Sampling Analytical	1.10		$262,775.00	$289,053
Memo: 8 samples from 32 additional borings = 256 samples. 256/240 = 1.1					
LABOR	PRIME CONTRACTOR LABOR	39,228		$1.00	$39,228
Memo: 412 HOURS					

TOTAL Analytical **$854,241**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Shoring				**$1,517,618**

Sheet Piling

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
	B40 R.S.Means Crew	575	Ton	$1,054.32	$606,234
	RSMeans Crew B-43 cost per day	24		$5,600.00	$134,400
	Tieback Materials	1		$336,000.00	$336,000
	1/2 TON 4WD TRUCKS, LARGE VANS	1,040	hrs	$5.45	$5,668
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,820	hrs	$2.70	$4,914
	Mob/Demob of Subcontractor and Equipment	1		$40,000.00	$40,000
	Resp cleaning 10 hr day 2 C/O per day cost per hr	910		$5.19	$4,723
	PPE 2 c/o per day 10 hr day cost per hr	1,820		$1.95	$3,549
	MSA OptiFilter HEPA per hour	910		$3.45	$3,140
LABOR	PRIME CONTRACTOR LABOR	243,228		$1.00	$243,228
Memo: 2,913 HOURS					
Subtotal					$1,381,855
1st Layer Markups assigned to Detail Items					$135,763

TOTAL Sheet Piling **$1,517,618**

Memo: 800 LF x 40' depth = 575 tons of piling. Tiebacks every 2 piles so 400. Pile driving, extract, and salvage is 12.5 tons per day = 47 days. Tiebacks are 18 per day so 23 days + 5% failure rate = 24 days. Assume 5 day overlap so 52 day duration.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Excavation				**$1,785,199**

Overburden

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	48		$1,470.00	$70,560
	RSMeans Crew B-12C cost per day	48		$2,354.00	$112,992
	Mob/Demob of Subcontractor and Equipment	1	LS	$50,000.00	$50,000
	LAUNDRY 2 CHANGES COST PER HOUR	1,680	hrs	$2.70	$4,536
	1/2 TON 4WD TRUCKS, LARGE VANS	960	hrs	$5.45	$5,232
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,680		$5.19	$8,719
	PPE 2 c/o per day 10 hr day cost per hr	1,680		$1.95	$3,276
	MSA OptiFilter HEPA per hour	1,680		$3.45	$5,796
LABOR	PRIME CONTRACTOR LABOR	334,664		$1.00	$334,664
Memo: 3,888 HOURS					

TOTAL Overburden **$595,775**
Memo: 37,800 SF. 9,800 BCY. Assume 225 CY per day so 43 days + weather/delays. Assume 48 day duration.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Excavation				**$1,785,199**

Pyrophoric U

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	16		$1,470.00	$23,520
	RSMeans Crew B-12C cost per day	16		$2,354.00	$37,664
	LAUNDRY 2 CHANGES COST PER HOUR	640	hrs	$2.70	$1,728
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	640		$5.19	$3,322
	PPE 2 c/o per day 10 hr day cost per hr	640		$1.95	$1,248
	MSA OptiFilter HEPA per hour	640		$3.45	$2,208
LABOR	PRIME CONTRACTOR LABOR	111,555		$1.00	$111,555
Memo: 1,296 HOURS					

TOTAL Pyrophoric U **$182,989**
Memo: 1,330 BCY. Excavating and moving a 100 CY per day, so 14 days plus weather/delays is 16 days.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Excavation				**$1,785,199**

TCE

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	5		$1,470.00	$7,350

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Excavation				**$1,785,199**

TCE

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-12C cost per day	5		$2,354.00	$11,770
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	100	hrs	$5.45	$545
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	200		$5.19	$1,038
	PPE 2 c/o per day 10 hr day cost per hr	200		$1.95	$390
	MSA OptiFilter HEPA per hour	200		$3.45	$690
LABOR	PRIME CONTRACTOR LABOR	34,861		$1.00	$34,861
Memo: 405 HOURS					

TOTAL TCE **$57,184**

Memo: 385 BCY. Excavating and moving a 100 CY per day, so 4 days plus weather/delays is 5 days.

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 5	**$61,512,310**
	Capital Costs	**$61,462,173**
	Excavation	**$1,785,199**

Uranyl Fluoride

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	3		$1,470.00	$4,410
	RSMeans Crew B-12C cost per day	3		$2,354.00	$7,062
	LAUNDRY 2 CHANGES COST PER HOUR	120	hrs	$2.70	$324
	1/2 TON 4WD TRUCKS, LARGE VANS	60	hrs	$5.45	$327
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	120		$5.19	$623
	PPE 2 c/o per day 10 hr day cost per hr	120		$1.95	$234
	MSA OptiFilter HEPA per hour	120		$3.45	$414
LABOR	PRIME CONTRACTOR LABOR	20,916		$1.00	$20,916
Memo: 243 HOURS					

TOTAL Uranyl Fluoride **$34,310**

Memo: 193 BCY. Excavating and moving a 100 CY per day, so 2 days plus weather/delays is 3 days.

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 5	**$61,512,310**
	Capital Costs	**$61,462,173**
	Excavation	**$1,785,199**

Balance of Soils

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	80		$1,470.00	$117,600
	RSMeans Crew B-12C cost per day	80		$2,354.00	$188,320
	LAUNDRY 2 CHANGES COST PER HOUR	3,200	hrs	$2.70	$8,640

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Excavation				**$1,785,199**

Balance of Soils

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	1/2 TON 4WD TRUCKS, LARGE VANS	1,600	hrs	$5.45	$8,720
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	3,200		$5.19	$16,608
	PPE 2 c/o per day 10 hr day cost per hr	3,200		$1.95	$6,240
	MSA OptiFilter HEPA per hour	3,200		$3.45	$11,040
LABOR	PRIME CONTRACTOR LABOR	557,773		$1.00	$557,773
Memo: 6,480 HOURS					

TOTAL Balance of Soils **$914,941**

Memo: 16,292 BCY. Excavating and moving a 225 CY per day, so 72 days plus weather/delays is 80 days.

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 5	**$61,512,310**
	Capital Costs	**$61,462,173**
	Treat and Dispose of Water	**$411,672**

Water Treatment

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B10H R.S.Means Crew	152	Day	$581.53	$88,393
	Water Treatment System w/ Tanks per month	7		$12,825.00	$89,775
Memo: Packaged system with 5 frac tanks.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,824	hrs	$2.70	$4,925
	1/2 TON 4WD TRUCKS, LARGE VANS	608	hrs	$5.45	$3,314
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	1,824		$1.95	$3,557
LABOR	PRIME CONTRACTOR LABOR	129,814		$1.00	$129,814
Memo: 1,824 HOURS					
Subtotal					$319,777
1st Layer Markups assigned to Detail Items					$51,123

TOTAL Water Treatment **$370,900**

Memo: 7 months

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 5	**$61,512,310**
	Capital Costs	**$61,462,173**
	Treat and Dispose of Water	**$411,672**

Water Disposal

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Water Truck 10k Gallon cost per hr	40	hr	$208.34	$8,334
	Overnight Shipment per Cooler	4		$251.97	$1,008
Memo: Assume 10 samples per cooler.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Treat and Dispose of Water				**$411,672**

Water Disposal

Tree Depth= 5

Memo:	Characterization Sampling Water Cost per Sample	35		$833.00	$29,155
	Assume Frac tanks will be emptied every 2 months. 3.5 * 5 tanks * 20,000 gallons = 350,000 gallons. Assume a water sample will be taken from each water truck (10,000 gallons). 350,000 gallons / 10,000 = 35 samples.				
LABOR Memo: 40 HOURS	PRIME CONTRACTOR LABOR	2,275		$1.00	$2,275

TOTAL Water Disposal **$40,771**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Post Remediation Sampling				**$100,854**

Sampling

Tree Depth= 5

	5 gram EN CORE SAMPLER	100		$6.94	$694
	Niton XRF Rental One Month	1		$4,500.00	$4,500
	PCB Test Kits	2		$541.00	$1,082
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	Resp cleaning 10 hr day 2 C/O per day cost per hr	200		$5.19	$1,038
	PPE 2 c/o per day 10 hr day cost per hr	200		$1.95	$390
	MSA OptiFilter HEPA per hour	200		$3.45	$690
LABOR Memo: 200 HOURS	PRIME CONTRACTOR LABOR	14,608		$1.00	$14,608

TOTAL Sampling **$23,542**
Memo: 25 foot grid. Assume 64 total samples. 1 week duration.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Post Remediation Sampling				**$100,854**

Analytical

Tree Depth= 5

	Overnight Shipment per Cooler	5		$251.97	$1,260
	RDSI Soil Sampling Analytical	0.27		$262,775.00	$70,949
Memo:	From Alt. 3: 8 samples from 30 borings = 240 samples. 64 / 240 = .27				
LABOR Memo: 56 HOURS	PRIME CONTRACTOR LABOR	5,103		$1.00	$5,103

TOTAL Analytical **$77,312**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Waste Handling/Treatment/Disposal/Transportation				**$48,041,888**

Overburden

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	5,565	hrs	$2.70	$15,026
	1/2 TON 4WD TRUCKS, LARGE VANS	1,060	hrs	$5.45	$5,777
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	2,650	hr	$91.06	$241,309
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	262		$43.00	$11,266
	Overnight Shipment per Cooler	16		$251.97	$4,032
Memo: Assume 10 samples per cooler.					
Memo: 11,760 LCY / 15 CY = 784. Assume 20% sampling rate. 784 / 5 = 157 samples.	Characterization Sampling Soil Cost per Sample	157		$1,148.00	$180,236
LABOR	PRIME CONTRACTOR LABOR	397,499		$1.00	$397,499
Memo: 6,072 HOURS					

TOTAL Overburden **$855,144**

Memo: U Landfill WAC Compliant. 9,800 BCY x 1.2 = 11,760 LCY.
Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 53 days.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Waste Handling/Treatment/Disposal/Transportation				**$48,041,888**

Pyrophoric U

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	52,200	hrs	$2.70	$140,940
	1/2 TON 4WD TRUCKS, LARGE VANS	9,000	hrs	$5.45	$49,050
Memo: 3 LATAKY vehicles.					
	RSMeans Assembly A1030-120-4560 per SF	10,000		$13.84	$138,400
Memo: 100' x 100' concrete slab for stabilization operations.					
	B-12 Half-High Container	4,582		$1,050.00	$4,811,100
	E2 R.S.Means Crew	10,000	SF Flr.	$12.52	$125,219
	Skid Steer per hour	3,000	hr	$32.54	$97,620
	Concret Mixing Plant	1		$52,350.00	$52,350
	Generator 150kW per hour	3,000	hr	$73.00	$219,000
	Concrete Mix per CY	4,836		$80.00	$386,880
	18,000 lb Fork Lift per hour	3,000	hr	$32.66	$97,980
	Transportation to NNSS by Truck	1,528		$9,585.00	$14,645,880
Memo: Assume 3 boxes per truck. 4582 /3 = 1,528 trips.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	26,100		$5.19	$135,459
	PPE 2 c/o per day 10 hr day cost per hr	52,200		$1.95	$101,790
	MSA OptiFilter HEPA per hour	26,100		$3.45	$90,045
	Overnight Shipment per Cooler	92		$251.97	$23,181
Memo: Assume 10 samples per cooler.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Waste Handling/Treatment/Disposal/Transportation				**$48,041,888**

Pyrophoric U

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
Memo:	Characterization Sampling Soil Cost per Sample	917		$1,148.00	$1,052,716
	Assume 20% sampling rate. 4,582 / 5 = 917 samples.				
LABOR	PRIME CONTRACTOR LABOR	4,413,663		$1.00	$4,413,663
Memo: 62,774 HOURS					
Subtotal					$26,581,273
1st Layer Markups assigned to Detail Items					$34,978
TOTAL Pyrophoric U					**$26,616,252**

Memo: 1,330 BCY x 1.2 = 1,596 LCY. Disposition volume after stabilization is 6,448 CY. Ship to NNSS.
Plant can make 16 boxes per day. Total of 4,582 boxes.
4,582 / 16 = 287 days. Add days for down time so 300 days.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Waste Handling/Treatment/Disposal/Transportation				**$48,041,888**

TCE

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	2,520	hrs	$2.70	$6,804
	1/2 TON 4WD TRUCKS, LARGE VANS	360	hrs	$5.45	$1,962
Memo: 2 LATAKY vehicles.					
	Skid Steer per hour	180	hr	$32.54	$5,857
	18,000 lb Fork Lift per hour	360	hr	$32.66	$11,758
	ST-90 CONTAINER DELIVERED	153		$1,770.63	$270,906
Memo: 462 LCY / 3 CY per box = 153 boxes.					
	MLLW Soil Disposal at ES ST90 by Truck per CY	1,088		$1,030.58	$1,121,271
Memo: 153 boxes x 96 CF per box = 14,688 CF / 27 = 544 CY. Double volume so 1,088 CY.					
	Absorbent 50lb bag delivered cost per bag	153		$240.64	$36,818
	MLLW Treatment at ES ST90 per CY	544		$1,854.09	$1,008,625
Memo: 153 boxes x 96 CF per box = 14,688 CF / 27 = 544 CY.					
	Transportation to ES by Truck	51		$7,610.00	$388,110
Memo: Assume 3 boxes per truck. 153 / 3 = 51 trips.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,260		$5.19	$6,539
	PPE 2 c/o per day 10 hr day cost per hr	2,520		$1.95	$4,914
	MSA OptiFilter HEPA per hour	1,260		$3.45	$4,347
	Overnight Shipment per Cooler	4		$251.97	$1,008
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	31		$1,148.00	$35,588
	Assume 20% sampling rate. 153 / 5 = 31 samples.				

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Waste Handling/Treatment/Disposal/Transportation				**$48,041,888**

TCE

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	234,069		$1.00	$234,069
Memo: 3,262 HOURS					

TOTAL TCE **$3,138,576**

Memo: 385 BCY x 1.2 = 462 LCY. Load into ST-90 boxes and ship to ES for treatment and disposal. Assume can load 10 boxes per day. 153 boxes / 10 = 16 days plus delays/weather = 18 days.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 5		**$61,512,310**
Capital Costs		**$61,462,173**
Waste Handling/Treatment/Disposal/Transportation		**$48,041,888**

Potential PCB Oil

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
	Skid Steer per hour	40	hr	$32.54	$1,302
	18,000 lb Fork Lift per hour	40	hr	$32.66	$1,306
	55 gallon drum cost per drum delivered	120		$145.26	$17,431
	Generator 150kW per hour	40	hr	$73.00	$2,920
	Treatment and Disposal per Drum	120		$12,265.00	$1,471,800
	Transportation to DSSI by Truck	12		$1,608.00	$19,296
	Resp cleaning 10 hr day 2 C/O per day cost per hr	200		$5.19	$1,038
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780
	MSA OptiFilter HEPA per hour	200		$3.45	$690
	Overnight Shipment per Cooler	3		$251.97	$756
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	24		$1,148.00	$27,552
Assume 20% sampling rate. 120 / 5 = 24 samples.					
LABOR	PRIME CONTRACTOR LABOR	51,533		$1.00	$51,533
Memo: 724 HOURS					

TOTAL Potential PCB Oil **$1,597,920**

Memo: 5,982 gallons / 50 gallons per drum = 120 drums. Ship to DSSI for treatment and disposal. 1 week duration.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 5		**$61,512,310**
Capital Costs		**$61,462,173**
Waste Handling/Treatment/Disposal/Transportation		**$48,041,888**

Uranyl Fluoride

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	1,200	hrs	$2.70	$3,240

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Waste Handling/Treatment/Disposal/Transportation				**$48,041,888**

Uranyl Fluoride

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
	1/2 TON 4WD TRUCKS, LARGE VANS	200	hrs	$5.45	$1,090
Memo: 2 LATAKY vehicles.					
	Skid Steer per hour	100	hr	$32.54	$3,254
	18,000 lb Fork Lift per hour	100	hr	$32.66	$3,266
	ST-90 CONTAINER DELIVERED	77		$1,770.63	$136,339
Memo: 231 LCY / 3 CY per box = 77 boxes.					
	MLLW Soil Disposal at ES ST90 by Truck per CY	548		$1,030.58	$564,758
Memo: 77 boxes x 96 CF per box = 7,392 CF / 27 = 274 CY. Double volume so 548 CY.					
	Absorbent 50lb bag delivered cost per bag	77		$240.64	$18,529
	MLLW Treatment at ES ST90 per CY	274		$1,854.09	$508,021
Memo: 77 boxes x 96 CF per box = 7,392 CF / 27 = 274 CY.					
	Transportation to ES by Truck	26		$7,610.00	$197,860
Memo: Assume 3 boxes per truck. 77 / 3 = 26 trips.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	600		$5.19	$3,114
	PPE 2 c/o per day 10 hr day cost per hr	1,200		$1.95	$2,340
	MSA OptiFilter HEPA per hour	600		$3.45	$2,070
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	16		$1,148.00	$18,368
Memo: Assume 20% sampling rate. 77 / 5 = 16 samples.					
LABOR	PRIME CONTRACTOR LABOR	116,348		$1.00	$116,348
Memo: 1,620 HOURS					

TOTAL Uranyl Fluoride **$1,579,100**

Memo: 193 BCY x 1.2 = 231 LCY. Load into ST-90 boxes and ship to ES for treatment and disposal. Assume can load 10 boxes per day. 77 boxes / 10 = 8 days plus delays/weather = 10 days.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Waste Handling/Treatment/Disposal/Transportation				**$48,041,888**

Balance of Soils

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	18,850	hrs	$2.70	$50,895
	1/2 TON 4WD TRUCKS, LARGE VANS	2,900	hrs	$5.45	$15,805
Memo: 2 LATAKY vehicles.					
	Lift Liner Bags 9 CY	2,200		$300.00	$660,000
	Loading or Lifting Frames per month	119		$500.00	$59,500
Memo: Rent for 7 months. 11 loading frames and 6 lifting frames. 17 x 7 months = 119.					
	Skid Steer per hour	1,450	hr	$32.54	$47,183
	18,000 lb Fork Lift per hour	2,900	hr	$32.66	$94,714
	Flat Bed Truck per hour	1,450	hr	$45.74	$66,323

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Waste Handling/Treatment/Disposal/Transportation				**$48,041,888**

Balance of Soils

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	30' IC Scissor Lift Rent per hour	1,450	hr	$14.88	$21,576
	65 Ton Link-Belt Crane GFE cost per hr	1,450	hr	$25.99	$37,686
Memo:	LLW Soil Disposal at ES in Bags by Rail per CY	19,800		$205.29	$4,064,742
	2,200 bags x 9 CY = 19,800				
	Transportation to ES by Gondola	245		$26,933.00	$6,598,585
Memo:	Assume 9 bags per car. 2,200 / 9 = 245 gons.				
	Resp cleaning 10 hr day 2 C/O per day cost per hr	9,425		$5.19	$48,916
	PPE 2 c/o per day 10 hr day cost per hr	18,850		$1.95	$36,758
	MSA OptiFilter HEPA per hour	9,425		$3.45	$32,516
	Overnight Shipment per Cooler	44		$251.97	$11,087
Memo:	Assume 10 samples per cooler.				
Memo:	Characterization Sampling Soil Cost per Sample	440		$1,148.00	$505,120
	Assume 20% sampling rate. 2,200 / 5 = 440 samples.				
LABOR	PRIME CONTRACTOR LABOR	1,903,491		$1.00	$1,903,491
Memo:	26,800 HOURS				

TOTAL Balance of Soils **$14,254,896**

Memo: 16,292 BCY x 1.2 = 19,551 LCY. Loaded into 9CY bags = 2,200 bags at 16 per day = 138 days plus weather/delays is 145 days. Shipped to Energy Solutions by rail.

		TOTAL
	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 5	**$61,512,310**
	Capital Costs	**$61,462,173**
	Excavation Backfill	**$1,518,649**

Backfill

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	B10D R.S.Means Crew	33,600	E.C.Y.	$2.67	$89,626
	B34C R.S.Means Crew	33,600	L.C.Y.	$7.98	$268,103
	Backfill Delivered per CY	33,600		$16.00	$537,600
	LAUNDRY 2 CHANGES COST PER HOUR	3,600	hrs	$2.70	$9,720
	1/2 TON 4WD TRUCKS, LARGE VANS	900	hrs	$5.45	$4,905
Memo:	2 LATAKY vehicles.				
	Geotechnical Testing Technician per hour	450		$52.19	$23,486
	Geotechnical Testing Density Testing per hour	450		$50.00	$22,500
	RSMeans Crew B-10W cost per day	45		$1,470.00	$66,150
	RSMeans Crew B-10P cost per day	45		$2,129.00	$95,805
	PPE 2 c/o per day 10 hr day cost per hr	3,600		$1.95	$7,020

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5				**$61,512,310**
	Capital Costs				**$61,462,173**
	Excavation Backfill				**$1,518,649**

Backfill

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	302,175		$1.00	$302,175
Memo: 3,600 HOURS					
Subtotal					$1,427,089
1st Layer Markups assigned to Detail Items					$91,559
TOTAL Backfill					**$1,518,649**

Memo: 28,000 BCY total removed. 28,000 x 1.2 = 33,600 CY of fill needed. Assume 750 CY filled per day. 33,600 / 750 = 45 days. Fill is stockpiled during other activities and transfered to site as needed.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 5		**$61,512,310**
Capital Costs		**$61,462,173**
Chemical Treatment		**$3,824,176**

Jet Grouting

Tree Depth= 5

	Jet Grouting w/ Cement Grouting per CY	7,410	CY	$300.00	$2,223,000
Memo: Reference STANTEC.					
	Jet Grouting Mob/DeMob	1		$125,000.00	$125,000
	Zero Valient Iron cost per CF	200,000	CF	$6.00	$1,200,000
Memo: Adder for using ZVI. Assume $6 per treated CF.					
	1/2 TON 4WD TRUCKS, LARGE VANS	1,920	hrs	$5.45	$10,464
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,920	hrs	$2.70	$5,184
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,920		$5.19	$9,965
	PPE 2 c/o per day 10 hr day cost per hr	1,920		$1.95	$3,744
	MSA OptiFilter HEPA per hour	1,920		$3.45	$6,624
LABOR	PRIME CONTRACTOR LABOR	240,195		$1.00	$240,195
Memo: 2,928 HOURS					
TOTAL Jet Grouting					**$3,824,176**

Memo: 2 waste areas. 50' x 50' or 2,500 SF and 50' x 50' or 2,500 SF. Total of 5,000 SF. Treatment from 20' BGS to 60' BGS. 5,000 SF x 40' = 200,000 CF or 7,410 CY. Assume 3 month duration.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 5		**$61,512,310**
Annual Costs		**$50,137**
Five Year Reviews		**$50,137**

Five Year Reviews

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,137		$1.00	$50,137
Memo: 500 HOURS					
TOTAL Five Year Reviews					**$50,137**

COST ESTIMATE
BGOU SWMU 2
Alternative 5WDF—Excavation, Disposal, and LUCs

Cost Estimate Summary									
Capital Cost	**Quantity**	**Units**	**Unit Price**	**Total**					
1.0 Remedial Design	1	LS	$1,574,000	$1,574,000					
2.0 Other Project Plans	1	LS	$1,038,000	$1,038,000					
3.0 Remedial Design Site Investigation (RDSI)	1	LS	$1,650,000	$1,650,000					
4.0 Shoring	1	LS	$1,518,000	$1,518,000					
5.0 Excavation	1	LS	$1,785,000	$1,785,000					
6.0 Treat and Dispose of Water	1	LS	$412,000	$412,000					
7.0 Post Remediation Sampling	1	LS	$101,000	$101,000					
8.0 Waste Handling, Treatment, Disposal, and Transportation	1	LS	$21,477,000	$21,477,000					
9.0 Excavation Backfill	1	LS	$1,519,000	$1,519,000					
10.0 Chemical Treatment	1	LS	$3,824,000	$3,824,000					
Subproject Management	1	LS	$3,489,800	$3,490,000					Subproject Management = 10%
Management Reserve	1	LS	$5,758,200	$5,758,000					Contractor MR = 15%
Fee	1	LS	$3,090,220	$3,090,000					Fee = 7%
Contingency	1	LS	$9,447,200	$9,447,000					Contingency = 20%
			SUBTOTAL CAPITAL COST	**$56,683,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Five-Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
			SUBTOTAL ANNUAL COST	**$10,000,000**			**3.82E+17**		
			TOTAL	**$66,683,000**					
Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	LS	$56,683,000	$56,683,000				**$56,683,000**	
Five-Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$56,683,000**	
						Present Worth Values	**Annual**	**$889,000**	
							Avg. Annual	**$889**	
							Total	**$57,572,000**	

This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.

COST ESTIMATE
BGOU SWMU 2
Alternative 5WDF—Excavation, Disposal, and LUCs

CAPITAL COSTS									
	Material/Equipment/Subcontractors/ODCs				Labor				
Task Description	Qty	Unit	Unit Price	Total	Hours	Rate	Total	Total Cost	Basis of Estimate
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					4224		$376,224		
Remedial Design Report					8744		$803,933		
Civil Surveying					216		$22,818		
Procurement					634		$52,676		
Work Packages/Readiness					1688		$146,788		
Training	1	LS	$68,800	$68,800	1320		$102,736		$68,800 includes subcontractor training and pyrophoric training
TASK TOTAL				**$68,800**	**16826**		**$1,505,175**	**$1,574,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					5724		$517,587		
O&M Plan					700		$66,863		
SAP/QAPP					1100		$96,201		
Waste Management Plan					1020		$94,190		
RACR					2274		$212,751		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**11402**		**$1,038,317**	**$1,038,000**	
3.0 Remedial Design Site Investigation (RDSI)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Drilling									
Prime Contractor Labor					4440		$362,305		
Subcontractors	1	LS	$168,834	$168,834					Local quote from existing drilling sub.
Materials	1	LS	$80,208	$80,208					
Vehicles and Equipment	1	LS	$8,720	$8,720					
Sampling									
Prime Contractor Labor					2000		$146,084		
Materials	1	LS	$29,434	$29,434					
Analytical									
Prime Contractor Labor					412		$39,228		
Materials	1	LS	$815,013	$815,013					
Excavation									
Prime Contractor Labor	0				0		$0		
Equipment	0	LS	$0	$0					
TASK TOTAL				**$ 1,102,209**	**6852**		**$ 547,617**	**$1,650,000**	
4.0 Shoring									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Sheet Piling									
Prime Contractor Labor					2913		$243,228		
Subcontractors	1	LS	$1,252,396	$1,252,396					
Materials	1	LS	$16,325	$16,325					
Vehicles and Equipment	1	LS	$5,668	$5,668					
TASK TOTALS				**$1,274,389**	**2,913**		**$243,228**	**$1,518,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 5WDF—Excavation, Disposal, and LUCs

5.0 Excavation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Overburden									
Prime Contractor Labor					3888		$334,664		
Subcontractors	1	LS	$233,552	$233,552					
Materials	1	LS	$22,327	$22,327					
Vehicles and Equipment	1	LS	$5,232	$5,232					
Pyrophoric U									
Prime Contractor Labor					1296		$111,555		
Subcontractors	1	LS	$61,183	$61,183					
Materials	1	LS	$8,506	$8,506					
Vehicles and Equipment	1	LS	$1,744	$1,744					
TCE									
Prime Contractor Labor					405		$34,861		
Subcontractors	1	LS	$19,120	$19,120					
Materials	1	LS	$2,658	$2,658					
Vehicles and Equipment	1	LS	$545	$545					
Uranyl Fluoride									
Prime Contractor Labor					243		$20,916		
Subcontractors	1	LS	$11,472	$11,472					
Materials	1	LS	$1,595	$1,595					
Vehicles and Equipment	1	LS	$327	$327					
Balance of Soils									
Prime Contractor Labor					6480		$557,773		
Subcontractors	1	LS	$305,920	$305,920					
Materials	1	LS	$42,528	$42,528					
Vehicles and Equipment	1	LS	$8,720	$8,720					
TASK TOTALS				**$725,429**	**12,312**		**$1,059,769**	**$1,785,000**	
6.0 Treat and Dispose of Water									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Water Treatment									
Prime Contractor Labor					1824		$129,814		
Subcontractors	1	LS	$229,291	$229,291					Rainforrent.com and RSMeans
Materials	1	LS	$8,482	$8,482					
Vehicles and Equipment	1	LS	$3,314	$3,314					
Water Disposal									
Prime Contractor Labor					40		$2,275		
Characterization Sampling	1	LS	$30,163	$30,163					
Vehicles and Equipment	1	LS	$8,334	$8,334					
TASK TOTALS				**$279,584**	**1,864**		**$132,089**	**$412,000**	
7.0 Post Remediation Sampling									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Sampling									
Prime Contractor Labor					200		$14,608		
Materials	1	LS	$8,934	$8,934					
Analytical									
Prime Contractor Labor					56		$5,103		
Materials	1	LS	$72,209	$72,209					
TASK TOTAL				**$ 81,143**	**256**		**$19,711**	**$101,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 5WDF—Excavation, Disposal, and LUCs

8.0 Waste Handling, Treatment, Disposal, and Transportation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Overburden									
Prime Contractor Labor					6072		$397,499		
Materials	1	LS	$26,292	$26,292					
Characterization Sampling	1	LS	$184,268	$184,268					
Vehicles and Equipment	1	LS	$247,086	$247,086					
Pyrophoric U									
Prime Contractor Labor					65474		$4,533,846		
Subcontractors	1	LS	$210,007	$210,007					RSMeans - Stabilization Facility
Materials	1	LS	$468,234	$468,234					
Characterization Sampling	1	LS	$1,075,897	$1,075,897					
Vehicles and Equipment	1	LS	$738,090	$738,090					
Stabilization	1	LS	$5,338,920	$5,338,920					
Transportation	1	LS	$0	$0					Costs contained in LATA Kentucky equipment and labor
TCE									
Prime Contractor Labor					3262		$234,069		
Materials	1	LS	$330,328	$330,328					
Characterization Sampling	1	LS	$36,596	$36,596					
Vehicles and Equipment	1	LS	$19,577	$19,577					
Treatment	1	LS	$1,008,625	$1,008,625					
Disposal	1	LS	$1,121,271	$1,121,271					
Transportation	1	LS	$388,110	$388,110					
Potential PCB Oil									
Prime Contractor Labor					724		$51,533		
Materials	1	LS	$21,019	$21,019					
Characterization Sampling	1	LS	$28,308	$28,308					
Vehicles and Equipment	1	LS	$5,964	$5,964					
Treatment/Disposal	1	LS	$1,471,800	$1,471,800					
Transportation	1	LS	$19,296	$19,296					
Uranyl Fluoride									
Prime Contractor Labor					1620		$116,348		
Materials	1	LS	$165,632	$165,632					
Characterization Sampling	1	LS	$18,872	$18,872					
Vehicles and Equipment	1	LS	$7,610	$7,610					
Treatment	1	LS	$508,021	$508,021					
Disposal	1	LS	$564,758	$564,758					
Transportation	1	LS	$197,860	$197,860					
Balance of Soils									
Prime Contractor Labor					16592		$1,130,645		
Materials	1	LS	$55,155	$55,155					
Characterization Sampling	1	LS	$306,431	$306,431					
Vehicles and Equipment	1	LS	$448,866	$448,866					
Disposal	1	LS	$0	$0					
Transportation	1	LS	$0	$0					Costs contained in LATA Kentucky equipment and labor
TASK TOTALS				**$15,012,893**	**93,744**		**$6,463,940**	**$21,477,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 5WDF—Excavation, Disposal, and LUCs

9.0 Excavation Backfill										
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated										
and therefore includes labor, material, and equipment where applicable.										
Backfill										
	Prime Contractor Labor					3600		$302,175		
	Subcontractors	1	LS	$1,206,414	$1,206,414					RSMeans and local engineering firm
	Materials	1	LS	$8,316	$8,316					
	Vehicles and Equipment	1	LS	$1,744	$1,744					
	TASK TOTAL				**$1,216,474**	**3600**		**$302,175**	**$1,519,000**	
10.0 Chemical Treatment										
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated										
and therefore includes labor, material, and equipment where applicable.										
Jet Grouting										
	Prime Contractor Labor					2928		$240,195		
	Subcontractors	1	LS	$3,548,000	$3,548,000					
	Materials	1	LS	$25,517	$25,517					
	Vehicles and Equipment	1	LS	$10,464	$10,464					
	TASK TOTAL				**$3,583,981**	**2928**		**$240,195**	**$3,824,000**	
								SUBTOTAL CAPITAL COST	**$34,898,000**	
ANNUAL COSTS										
Five-Year Review										
Duration: Every 5 years.										
	Prime Contractor Labor					500		$50,137		
	TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study **Reported From: SWMU 2 Alternative 5WDF**
Report Total: $34,947,254

Author
Manager

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 5WDF			**$34,947,254**
	Capital Costs			**$34,897,117**
	Remedial Desgin			**$1,573,975**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	376,224	$1.00	$376,224
Memo: 4,224 HOURS				

TOTAL RDWP/RDSI Work Plan **$376,224**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 5WDF	**$34,947,254**
Capital Costs	**$34,897,117**
Remedial Desgin	**$1,573,975**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	803,933	$1.00	$803,933
Memo: 8,744 HOURS				

TOTAL RDR **$803,933**

Estimate Tree Structure Rollups	
SWMU 2 Alternative 5WDF	**$34,947,254**
Capital Costs	**$34,897,117**
Remedial Desgin	**$1,573,975**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	22,818	$1.00	$22,818
Memo: 216 HOURS				

TOTAL Civil Surveying **$22,818**

Estimate Tree Structure Rollups	
SWMU 2 Alternative 5WDF	**$34,947,254**
Capital Costs	**$34,897,117**
Remedial Desgin	**$1,573,975**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	52,676	$1.00	$52,676
Memo: 634 HOURS				

TOTAL Procurement **$52,676**

Estimate Tree Structure Rollups	
SWMU 2 Alternative 5WDF	**$34,947,254**
Capital Costs	**$34,897,117**
Remedial Desgin	**$1,573,975**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	146,788	$1.00	$146,788
Memo: 1,688 HOURS				

TOTAL Work Packages/Readiness Review **$146,788**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 5WDF			**$34,947,254**
	Capital Costs			**$34,897,117**
	Remedial Desgin			**$1,573,975**

Training

Tree Depth= 5

		QTY	UNIT COST	TOTAL
	Pyrophoric U Training per Person	16	$800.00	$12,800
Memo: Assume $800 per person. This is consistent with the previous FS submittal.				
Memo:	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
Assume 80 hours of training per person. Assume 10 people or 800 hours.				
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training **$171,536**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

		TOTAL
	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 5WDF	**$34,947,254**
	Capital Costs	**$34,897,117**
	Other Project Plans	**$1,038,317**

RAWP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	517,587	$1.00	$517,587
Memo: 5,724 HOURS				

TOTAL RAWP **$517,587**

		TOTAL
	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 5WDF	**$34,947,254**
	Capital Costs	**$34,897,117**
	Other Project Plans	**$1,038,317**

O&M Plan

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan **$66,863**

		TOTAL
	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 5WDF	**$34,947,254**
	Capital Costs	**$34,897,117**
	Other Project Plans	**$1,038,317**

SAP/QAPP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	96,201	$1.00	$96,201
Memo: 1,100 HOURS				

TOTAL SAP/QAPP **$96,201**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Other Project Plans				**$1,038,317**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	94,190		$1.00	$94,190
Memo: 1,020 HOURS					

TOTAL Waste Management Plan **$94,190**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Other Project Plans				**$1,038,317**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	212,751		$1.00	$212,751
Memo: 2,274 HOURS					

TOTAL RACR **$212,751**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Other Project Plans				**$1,038,317**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	RDSI				**$1,649,826**

Drilling

Tree Depth= 5

	Mob/Demob for DPT subcontractor	1		$8,500.00	$8,500
	DPT Borings to 40 feet	30		$1,635.00	$49,050
Memo: 2 borings per day - 15 days of borings plus 1 week for mob and 1 week for demob.					
	1/2 TON 4WD TRUCKS, LARGE VANS	1,600	hrs	$5.45	$8,720
Memo: 4 LATAKY vehicles.					
	55 GALLON DRUM	8		$84.68	$677
Memo: 8 drums for drill cuttings.					
	ST-90 CONTAINER DELIVERED	4		$1,770.63	$7,083
Memo: 4 ST-90 box for PPE/Trash.					
	PORTABLE TOILET & HAND WASH PER MONTH	3		$227.21	$682
Memo: Rent for 3 months.					
	LAUNDRY 2 CHANGES COST PER HOUR	5,400	hrs	$2.70	$14,580
Memo: LATAKY personnel plus assume 5 drillers.					
	DPT Borings to 65 feet	12		$2,573.00	$30,876
Memo: Angled borings - assume 65 feet deep.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	RDSI				**$1,649,826**

Drilling

Tree Depth= 5

LEVEL	Description	QTY		UNIT COST	TOTAL
	DPT Borings to 40 feet	8		$1,635.00	$13,080
Memo:	8 additional borings following waste stabilization.				
	DPT Borings to 65 feet	16		$2,573.00	$41,168
Memo:	16 additional borings from grade, around the perimeter of the 2 additional sites.				
	DPT Borings to 40 feet	16		$1,635.00	$26,160
Memo:	16 additional borings from bottom of excavation, at the 2 additional sites.				
	Resp cleaning 10 hr day 2 C/O per day cost per hr	5,400		$5.19	$28,026
	PPE 2 c/o per day 10 hr day cost per hr	5,400		$1.95	$10,530
	MSA OptiFilter HEPA per hour	5,400		$3.45	$18,630
LABOR	PRIME CONTRACTOR LABOR	362,305		$1.00	$362,305
Memo:	4,440 HOURS				

TOTAL Drilling **$620,067**

Memo: Same as alternative 4B but added 8 borings at the bottom of the excavation and 8 borings outside the excavation area. This is at 2 sites so 32 total additional borings. Assume 10 weeks.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	RDSI				**$1,649,826**

Sampling

Tree Depth= 5

LEVEL	Description	QTY		UNIT COST	TOTAL
	5 gram EN CORE SAMPLER	800		$6.94	$5,552
	Niton XRF Rental One Month	3		$4,500.00	$13,500
	PCB Test Kits	2		$541.00	$1,082
	LAUNDRY 2 CHANGES COST PER HOUR	2,000	hrs	$2.70	$5,400
	PPE 2 c/o per day 10 hr day cost per hr	2,000		$1.95	$3,900
LABOR	PRIME CONTRACTOR LABOR	146,084		$1.00	$146,084
Memo:	2,000 HOURS				

TOTAL Sampling **$175,518**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	RDSI				**$1,649,826**

Analytical

Tree Depth= 5

LEVEL	Description	QTY		UNIT COST	TOTAL
	Overnight Shipment per Cooler	80		$251.97	$20,158
Memo:	Assume 2 shipments per day for 39 days plus 1 shipment later for the waste water.				
	RDSI Geophysical Sampling Analytical	1		$1,275.00	$1,275
Memo:	3 Geophysical samples taken for particle size and atterberg limits.				

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	RDSI				**$1,649,826**

Analytical

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	RDSI Soil Sampling Analytical	1		$262,775.00	$262,775
Memo: 8 samples from 30 borings = 240 samples.					
	RDSI Soil Sampling Analytical	0.92		$262,775.00	$241,753
Memo: 8 samples from 8 additional borings = 64 samples. 13 samples from 12 angled borings = 156 samples. Total of 220 samples. 220/240 = .92					
	RDSI Soil Sampling Analytical	1.10		$262,775.00	$289,053
Memo: 8 samples from 32 additional borings = 256 samples. 256/240 = 1.1					
LABOR	PRIME CONTRACTOR LABOR	39,228		$1.00	$39,228
Memo: 412 HOURS					

TOTAL Analytical **$854,241**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 5WDF		**$34,947,254**
Capital Costs		**$34,897,117**
Shoring		**$1,517,618**

Sheet Piling

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	B40 R.S.Means Crew	575	Ton	$1,054.32	$606,234
	RSMeans Crew B-43 cost per day	24		$5,600.00	$134,400
	Tieback Materials	1		$336,000.00	$336,000
	1/2 TON 4WD TRUCKS, LARGE VANS	1,040	hrs	$5.45	$5,668
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,820	hrs	$2.70	$4,914
	Mob/Demob of Subcontractor and Equipment	1		$40,000.00	$40,000
	Resp cleaning 10 hr day 2 C/O per day cost per hr	910		$5.19	$4,723
	PPE 2 c/o per day 10 hr day cost per hr	1,820		$1.95	$3,549
	MSA OptiFilter HEPA per hour	910		$3.45	$3,140
LABOR	PRIME CONTRACTOR LABOR	243,228		$1.00	$243,228
Memo: 2,913 HOURS					
Subtotal					$1,381,855
1st Layer Markups assigned to Detail Items					$135,763

TOTAL Sheet Piling **$1,517,618**

Memo: 800 LF x 40' depth = 575 tons of piling. Tiebacks every 2 piles so 400. Pile driving, extract, and salvage is 12.5 tons per day = 47 days. Tiebacks are 18 per day so 23 days + 5% failure rate = 24 days. Assume 5 day overlap so 52 day duration.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Excavation				**$1,785,199**

Overburden

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	48		$1,470.00	$70,560
	RSMeans Crew B-12C cost per day	48		$2,354.00	$112,992
	Mob/Demob of Subcontractor and Equipment	1	LS	$50,000.00	$50,000
	LAUNDRY 2 CHANGES COST PER HOUR	1,680	hrs	$2.70	$4,536
	1/2 TON 4WD TRUCKS, LARGE VANS	960	hrs	$5.45	$5,232
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,680		$5.19	$8,719
	PPE 2 c/o per day 10 hr day cost per hr	1,680		$1.95	$3,276
	MSA OptiFilter HEPA per hour	1,680		$3.45	$5,796
LABOR	PRIME CONTRACTOR LABOR	334,664		$1.00	$334,664
Memo: 3,888 HOURS					

TOTAL Overburden **$595,775**
Memo: 37,800 SF. 9,600 BCY. Assume 225 CY per day so 43 days + weather/delays. Assume 48 day duration.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Excavation				**$1,785,199**

Pyrophoric U

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	16		$1,470.00	$23,520
	RSMeans Crew B-12C cost per day	16		$2,354.00	$37,664
	LAUNDRY 2 CHANGES COST PER HOUR	640	hrs	$2.70	$1,728
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	640		$5.19	$3,322
	PPE 2 c/o per day 10 hr day cost per hr	640		$1.95	$1,248
	MSA OptiFilter HEPA per hour	640		$3.45	$2,208
LABOR	PRIME CONTRACTOR LABOR	111,555		$1.00	$111,555
Memo: 1,296 HOURS					

TOTAL Pyrophoric U **$182,989**
Memo: 1,330 BCY. Excavating and moving a 100 CY per day, so 14 days plus weather/delays is 16 days.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Excavation				**$1,785,199**

TCE

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	5		$1,470.00	$7,350

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Excavation				**$1,785,199**

TCE

Tree Depth= 5

	RSMeans Crew B-12C cost per day	5		$2,354.00	$11,770
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	100	hrs	$5.45	$545
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	200		$5.19	$1,038
	PPE 2 c/o per day 10 hr day cost per hr	200		$1.95	$390
	MSA OptiFilter HEPA per hour	200		$3.45	$690
LABOR	PRIME CONTRACTOR LABOR	34,861		$1.00	$34,861
Memo: 405 HOURS					

TOTAL TCE **$57,184**

Memo: 385 BCY. Excavating and moving a 100 CY per day, so 4 days plus weather/delays is 5 days.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 5WDF		**$34,947,254**
Capital Costs		**$34,897,117**
Excavation		**$1,785,199**

Uranyl Fluoride

Tree Depth= 5

	RSMeans Crew B-10W cost per day	3		$1,470.00	$4,410
	RSMeans Crew B-12C cost per day	3		$2,354.00	$7,062
	LAUNDRY 2 CHANGES COST PER HOUR	120	hrs	$2.70	$324
	1/2 TON 4WD TRUCKS, LARGE VANS	60	hrs	$5.45	$327
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	120		$5.19	$623
	PPE 2 c/o per day 10 hr day cost per hr	120		$1.95	$234
	MSA OptiFilter HEPA per hour	120		$3.45	$414
LABOR	PRIME CONTRACTOR LABOR	20,916		$1.00	$20,916
Memo: 243 HOURS					

TOTAL Uranyl Fluoride **$34,310**

Memo: 193 BCY. Excavating and moving a 100 CY per day, so 2 days plus weather/delays is 3 days.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 5WDF		**$34,947,254**
Capital Costs		**$34,897,117**
Excavation		**$1,785,199**

Balance of Soils

Tree Depth= 5

	RSMeans Crew B-10W cost per day	80		$1,470.00	$117,600
	RSMeans Crew B-12C cost per day	80		$2,354.00	$188,320
	LAUNDRY 2 CHANGES COST PER HOUR	3,200	hrs	$2.70	$8,640

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Excavation				**$1,785,199**

Balance of Soils

Tree Depth= 5

	1/2 TON 4WD TRUCKS, LARGE VANS	1,600	hrs	$5.45	$8,720
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	3,200		$5.19	$16,608
	PPE 2 c/o per day 10 hr day cost per hr	3,200		$1.95	$6,240
	MSA OptiFilter HEPA per hour	3,200		$3.45	$11,040
LABOR	PRIME CONTRACTOR LABOR	557,773		$1.00	$557,773
Memo: 6,480 HOURS					

TOTAL Balance of Soils **$914,941**

Memo: 16,292 BCY. Excavating and moving a 225 CY per day, so 72 days plus weather/delays is 80 days.

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 5WDF	**$34,947,254**
	Capital Costs	**$34,897,117**
	Treat and Dispose of Water	**$411,672**

Water Treatment

Tree Depth= 5

	B10H R.S.Means Crew	152	Day	$581.53	$88,393
	Water Treatment System w/ Tanks per month	7		$12,825.00	$89,775
Memo: Packaged system with 5 frac tanks.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,824	hrs	$2.70	$4,925
	1/2 TON 4WD TRUCKS, LARGE VANS	608	hrs	$5.45	$3,314
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	1,824		$1.95	$3,557
LABOR	PRIME CONTRACTOR LABOR	129,814		$1.00	$129,814
Memo: 1,824 HOURS					

Subtotal	$319,777
1st Layer Markups assigned to Detail Items	$51,123

TOTAL Water Treatment **$370,900**

Memo: 7 months

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 5WDF	**$34,947,254**
	Capital Costs	**$34,897,117**
	Treat and Dispose of Water	**$411,672**

Water Disposal

Tree Depth= 5

	Water Truck 10k Gallon cost per hr	40	hr	$208.34	$8,334
	Overnight Shipment per Cooler	4		$251.97	$1,008
Memo: Assume 10 samples per cooler.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Treat and Dispose of Water				**$411,672**

Water Disposal

Tree Depth= 5

Memo:	Characterization Sampling Water Cost per Sample	35		$833.00	$29,155
	Assume Frac tanks will be emptied every 2 months. 3.5 * 5 tanks * 20,000 gallons = 350,000 gallons. Assume a water sample will be taken from each water truck (10,000 gallons). 350,000 gallons / 10,000 = 35 samples.				
LABOR Memo: 40 HOURS	PRIME CONTRACTOR LABOR	2,275		$1.00	$2,275

TOTAL Water Disposal **$40,771**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Post Remediation Sampling				**$100,854**

Sampling

Tree Depth= 5

	5 gram EN CORE SAMPLER	100		$6.94	$694
	Niton XRF Rental One Month	1		$4,500.00	$4,500
	PCB Test Kits	2		$541.00	$1,082
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	Resp cleaning 10 hr day 2 C/O per day cost per hr	200		$5.19	$1,038
	PPE 2 c/o per day 10 hr day cost per hr	200		$1.95	$390
	MSA OptiFilter HEPA per hour	200		$3.45	$690
LABOR Memo: 200 HOURS	PRIME CONTRACTOR LABOR	14,608		$1.00	$14,608

TOTAL Sampling **$23,542**
Memo: 25 foot grid. Assume 64 total samples. 1 week duration.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Post Remediation Sampling				**$100,854**

Analytical

Tree Depth= 5

	Overnight Shipment per Cooler	5		$251.97	$1,260
	RDSI Soil Sampling Analytical	0.27		$262,775.00	$70,949
Memo:	From Alt. 3: 8 samples from 30 borings = 240 samples. 64 / 240 = .27				
LABOR Memo: 56 HOURS	PRIME CONTRACTOR LABOR	5,103		$1.00	$5,103

TOTAL Analytical **$77,312**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Waste Handling/Treatment/Disposal/Transportation				**$21,476,833**

Overburden

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	5,565	hrs	$2.70	$15,026
	1/2 TON 4WD TRUCKS, LARGE VANS	1,060	hrs	$5.45	$5,777
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	2,650	hr	$91.06	$241,309
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	262		$43.00	$11,266
	Overnight Shipment per Cooler	16		$251.97	$4,032
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	157		$1,148.00	$180,236
11,760 LCY / 15 CY = 784. Assume 20% sampling rate. 784 / 5 = 157 samples.					
LABOR	PRIME CONTRACTOR LABOR	397,499		$1.00	$397,499
Memo: 6,072 HOURS					

TOTAL Overburden **$855,144**

Memo: U Landfill WAC Compliant. 9,800 BCY x 1.2 = 11,760 LCY.
Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 53 days.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Waste Handling/Treatment/Disposal/Transportation				**$21,476,833**

Pyrophoric U

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	52,200	hrs	$2.70	$140,940
	1/2 TON 4WD TRUCKS, LARGE VANS	9,000	hrs	$5.45	$49,050
Memo: 3 LATAKY vehicles.					
	RSMeans Assembly A1030-120-4560 per SF	10,000		$13.84	$138,400
Memo: 100' x 100' concrete slab for stabilization operations.					
	B-12 Half-High Container	4,582		$1,050.00	$4,811,100
	E2 R.S.Means Crew	10,000	SF Flr.	$12.52	$125,219
	Skid Steer per hour	3,000	hr	$32.54	$97,620
	Concret Mixing Plant	1		$52,350.00	$52,350
	Generator 150kW per hour	3,000	hr	$73.00	$219,000
	Concrete Mix per CY	4,836		$80.00	$386,880
	18,000 lb Fork Lift per hour	3,000	hr	$32.66	$97,980
	Flat Bed Truck per hour	6,000	hr	$45.74	$274,440
Memo: 2 trucks.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	26,100		$5.19	$135,459
	PPE 2 c/o per day 10 hr day cost per hr	52,200		$1.95	$101,790
	MSA OptiFilter HEPA per hour	26,100		$3.45	$90,045
	Overnight Shipment per Cooler	92		$251.97	$23,181
Memo: Assume 10 samples per cooler.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Waste Handling/Treatment/Disposal/Transportation				**$21,476,833**

Pyrophoric U

Tree Depth= 5

Memo:	Characterization Sampling Soil Cost per Sample Assume 20% sampling rate. 4,582 / 5 = 917 samples.	917		$1,148.00	$1,052,716
LABOR	PRIME CONTRACTOR LABOR Memo: 65,474 HOURS	4,533,846		$1.00	$4,533,846

Subtotal	$12,330,016
1st Layer Markups assigned to Detail Items	$34,978

TOTAL Pyrophoric U **$12,364,995**

Memo: 1,330 BCY x 1.2 = 1,596 LCY. Disposition volume after stabilization is 6,448 CY. Ship to OSWDF
Plant can make 16 boxes per day. Total of 4,582 boxes.
4,582 / 16 = 287 days. Add days for down time so 300 days.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 5WDF		**$34,947,254**
Capital Costs		**$34,897,117**
Waste Handling/Treatment/Disposal/Transportation		**$21,476,833**

TCE

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	2,520	hrs	$2.70	$6,804
	1/2 TON 4WD TRUCKS, LARGE VANS Memo: 2 LATAKY vehicles.	360	hrs	$5.45	$1,962
	Skid Steer per hour	180	hr	$32.54	$5,857
	18,000 lb Fork Lift per hour	360	hr	$32.66	$11,758
	ST-90 CONTAINER DELIVERED Memo: 462 LCY / 3 CY per box = 153 boxes.	153		$1,770.63	$270,906
	MLLW Soil Disposal at ES ST90 by Truck per CY Memo: 153 boxes x 96 CF per box = 14,688 CF / 27 = 544 CY. Double volume so 1,088 CY.	1,088		$1,030.58	$1,121,271
	Absorbent 50lb bag delivered cost per bag	153		$240.64	$36,818
	MLLW Treatment at ES ST90 per CY Memo: 153 boxes x 96 CF per box = 14,688 CF / 27 = 544 CY.	544		$1,854.09	$1,008,625
	Transportation to ES by Truck Memo: Assume 3 boxes per truck. 153 / 3 = 51 trips.	51		$7,610.00	$388,110
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,260		$5.19	$6,539
	PPE 2 c/o per day 10 hr day cost per hr	2,520		$1.95	$4,914
	MSA OptiFilter HEPA per hour	1,260		$3.45	$4,347
	Overnight Shipment per Cooler Memo: Assume 10 samples per cooler.	4		$251.97	$1,008
Memo:	Characterization Sampling Soil Cost per Sample Assume 20% sampling rate. 153 / 5 = 31 samples.	31		$1,148.00	$35,588

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Waste Handling/Treatment/Disposal/Transportation				**$21,476,833**

TCE

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	234,069		$1.00	$234,069
Memo: 3,262 HOURS					

TOTAL TCE **$3,138,576**

Memo: 385 BCY x 1.2 = 462 LCY. Load into ST-90 boxes and ship to ES for treatment and disposal. Assume can load 10 boxes per day. 153 boxes / 10 = 16 days plus delays/weather = 18 days.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 5WDF		**$34,947,254**
Capital Costs		**$34,897,117**
Waste Handling/Treatment/Disposal/Transportation		**$21,476,833**

Potential PCB Oil

Tree Depth= 5

		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
	Skid Steer per hour	40	hr	$32.54	$1,302
	18,000 lb Fork Lift per hour	40	hr	$32.66	$1,306
	55 gallon drum cost per drum delivered	120		$145.26	$17,431
	Generator 150kW per hour	40	hr	$73.00	$2,920
	Treatment and Disposal per Drum	120		$12,265.00	$1,471,800
	Transportation to DSSI by Truck	12		$1,608.00	$19,296
	Resp cleaning 10 hr day 2 C/O per day cost per hr	200		$5.19	$1,038
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780
	MSA OptiFilter HEPA per hour	200		$3.45	$690
	Overnight Shipment per Cooler	3		$251.97	$756
Memo: Assume 10 samples per cooler.					
Memo: Assume 20% sampling rate. 120 / 5 = 24 samples.	Characterization Sampling Soil Cost per Sample	24		$1,148.00	$27,552
LABOR	PRIME CONTRACTOR LABOR	51,533		$1.00	$51,533
Memo: 724 HOURS					

TOTAL Potential PCB Oil **$1,597,920**

Memo: 5,982 gallons / 50 gallons per drum = 120 drums. Ship to DSSI for treatment and disposal. 1 week duration.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 5WDF		**$34,947,254**
Capital Costs		**$34,897,117**
Waste Handling/Treatment/Disposal/Transportation		**$21,476,833**

Uranyl Fluoride

Tree Depth= 5

		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	1,200	hrs	$2.70	$3,240

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Waste Handling/Treatment/Disposal/Transportation				**$21,476,833**

Uranyl Fluoride

Tree Depth= 5

	1/2 TON 4WD TRUCKS, LARGE VANS	200	hrs	$5.45	$1,090
Memo: 2 LATAKY vehicles.					
	Skid Steer per hour	100	hr	$32.54	$3,254
	18,000 lb Fork Lift per hour	100	hr	$32.66	$3,266
	ST-90 CONTAINER DELIVERED	77		$1,770.63	$136,339
Memo: 231 LCY / 3 CY per box = 77 boxes.					
	MLLW Soil Disposal at ES ST90 by Truck per CY	548		$1,030.58	$564,758
Memo: 77 boxes x 96 CF per box = 7,392 CF / 27 = 274 CY. Double volume so 548 CY.					
	Absorbent 50lb bag delivered cost per bag	77		$240.64	$18,529
	MLLW Treatment at ES ST90 per CY	274		$1,854.09	$508,021
Memo: 77 boxes x 96 CF per box = 7,392 CF / 27 = 274 CY.					
	Transportation to ES by Truck	26		$7,610.00	$197,860
Memo: Assume 3 boxes per truck. 77 / 3 = 26 trips.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	600		$5.19	$3,114
	PPE 2 c/o per day 10 hr day cost per hr	1,200		$1.95	$2,340
	MSA OptiFilter HEPA per hour	600		$3.45	$2,070
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	16		$1,148.00	$18,368
Memo: Assume 20% sampling rate. 77 / 5 = 16 samples.					
LABOR	PRIME CONTRACTOR LABOR	116,348		$1.00	$116,348
Memo: 1,620 HOURS					

TOTAL Uranyl Fluoride **$1,579,100**

Memo: 193 BCY x 1.2 = 231 LCY. Load into ST-90 boxes and ship to ES for treatment and disposal. Assume can load 10 boxes per day. 77 boxes / 10 = 8 days plus delays/weather = 10 days.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 5WDF		**$34,947,254**
Capital Costs		**$34,897,117**
Waste Handling/Treatment/Disposal/Transportation		**$21,476,833**

Balance of Soils

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	13,500	hrs	$2.70	$36,450
	1/2 TON 4WD TRUCKS, LARGE VANS	1,800	hrs	$5.45	$9,810
Memo: 2 LATAKY vehicles.					
	Skid Steer per hour	900	hr	$32.54	$29,286
	15 CY Dump Truck per hour	4,500	hr	$91.06	$409,770
Memo: 5 trucks for 7 days.					
	Dump Truck Liner	435		$43.00	$18,705
	Overnight Shipment per Cooler	27		$251.97	$6,803
Memo: Assume 10 samples per cooler.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Waste Handling/Treatment/Disposal/Transportation				**$21,476,833**

Balance of Soils

Tree Depth= 5

Memo:	Characterization Sampling Soil Cost per Sample	261		$1,148.00	$299,628
19,551 LCY / 15 CY = 1,303. Assume 20% sampling rate. 1,303 / 5 = 261 samples.					
LABOR	PRIME CONTRACTOR LABOR	1,130,645		$1.00	$1,130,645
Memo: 16,592 HOURS					

TOTAL Balance of Soils **$1,941,097**

Memo: 16,292 BCY x 1.2 = 19,551 LCY. Ship to OSWDF for disposal using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 87 days plus weather/delays = 90 days.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 5WDF		**$34,947,254**
Capital Costs		**$34,897,117**
Excavation Backfill		**$1,518,649**

Backfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B10D R.S.Means Crew	33,600	E.C.Y.	$2.67	$89,626
	B34C R.S.Means Crew	33,600	L.C.Y.	$7.98	$268,103
	Backfill Delivered per CY	33,600		$16.00	$537,600
	LAUNDRY 2 CHANGES COST PER HOUR	3,600	hrs	$2.70	$9,720
	1/2 TON 4WD TRUCKS, LARGE VANS	900	hrs	$5.45	$4,905
Memo: 2 LATAKY vehicles.					
	Geotechnical Testing Technician per hour	450		$52.19	$23,486
	Geotechnical Testing Density Testing per hour	450		$50.00	$22,500
	RSMeans Crew B-10W cost per day	45		$1,470.00	$66,150
	RSMeans Crew B-10P cost per day	45		$2,129.00	$95,805
	PPE 2 c/o per day 10 hr day cost per hr	3,600		$1.95	$7,020
LABOR	PRIME CONTRACTOR LABOR	302,175		$1.00	$302,175
Memo: 3,600 HOURS					
Subtotal					$1,427,089
1st Layer Markups assigned to Detail Items					$91,559

TOTAL Backfill **$1,518,649**

Memo: 28,000 BCY total removed. 28,000 x 1.2 = 33,600 CY of fill needed. Assume 750 CY filled per day. 33,600 / 750 = 45 days. Fill is stockpiled during other activities and transfered to site as needed.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 5WDF		**$34,947,254**
Capital Costs		**$34,897,117**
Chemical Treatment		**$3,824,176**

Jet Grouting

Tree Depth= 5

	Jet Grouting w/ Cement Grouting per CY	7,410	CY	$300.00	$2,223,000
Memo: Reference STANTEC.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 5WDF				**$34,947,254**
	Capital Costs				**$34,897,117**
	Chemical Treatment				**$3,824,176**

Jet Grouting

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	Jet Grouting Mob/DeMob	1		$125,000.00	$125,000
	Zero Valient Iron cost per CF	200,000	CF	$6.00	$1,200,000
Memo: Adder for using ZVI. Assume $6 per treated CF.					
	1/2 TON 4WD TRUCKS, LARGE VANS	1,920	hrs	$5.45	$10,464
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,920	hrs	$2.70	$5,184
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,920		$5.19	$9,965
	PPE 2 c/o per day 10 hr day cost per hr	1,920		$1.95	$3,744
	MSA OptiFilter HEPA per hour	1,920		$3.45	$6,624
LABOR	PRIME CONTRACTOR LABOR	240,195		$1.00	$240,195
Memo: 2,928 HOURS					

TOTAL Jet Grouting **$3,824,176**

Memo: 2 waste areas. 50' x 50' or 2,500 SF and 50' x 50' or 2,500 SF. Total of 5,000 SF. Treatment from 20' BGS to 60' BGS. 5,000 SF x 40' = 200,000 CF or 7,410 CY. Assume 3 month duration.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 5WDF		**$34,947,254**
Annual Costs		**$50,137**
Five Year Reviews		**$50,137**

Five Year Reviews

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	50,137		$1.00	$50,137
Memo: 500 HOURS					

TOTAL Five Year Reviews **$50,137**

COST ESTIMATE
BGOU SWMU 2
Alternative 6—Targeted Excavation, Disposal, Containment, LUCs, and Monitoring

Cost Estimate Summary

Capital Cost	Quantity	Units	Unit Price	Total					
1.0 Remedial Design	1	LS	$1,574,000	$1,574,000					
2.0 Other Project Plans	1	LS	$1,038,000	$1,038,000					
3.0 Remedial Design Site Investigation (RDSI)	1	LS	$1,650,000	$1,650,000					
4.0 Shoring	1	LS	$582,000	$582,000					
5.0 Excavation	1	LS	$439,000	$439,000					
6.0 Treat and Dispose of Water	1	LS	$98,000	$98,000					
7.0 Post Remediation Sampling	1	LS	$20,000	$20,000					
8.0 Waste Handling, Treatment, Disposal, and Transportation	1	LS	$8,066,000	$8,066,000					
9.0 Excavation Backfill	1	LS	$240,000	$240,000					
10.0 Chemical Treatment	1	LS	$1,045,000	$1,045,000					
11.0 Hydraulic Isolation	1	LS	$2,138,000	$2,138,000					
12.0 Surface Soils Consolidation	1	LS	$39,000	$39,000					
13.0 Subtitle C Cap Construction	1	LS	$1,116,000	$1,116,000					
14.0 Riprap Cover	1	LS	$782,000	$782,000					
Subproject Management	1	LS	$1,882,700	$1,883,000					Subproject Management = 10%
Management Reserve	1	LS	$3,106,500	$3,107,000					Contractor MR = 15%
Fee	1	LS	$1,667,190	$1,667,000					Fee = 7%
Contingency	1	LS	$5,096,800	$5,097,000					Contingency = 20%
		SUBTOTAL CAPITAL COST		**$30,581,000**					

COST ESTIMATE
BGOU SWMU 2
Alternative 6—Targeted Excavation, Disposal, Containment, LUCs, and Monitoring

Annual Cost				Unescalated			Escalated (2.8%)		
Inspections	1000	EA	$21,000	$21,000,000			7.59E+17		Quarterly for 1,000 years
Weed Removal and Cover Inspection	900	EA	$11,000	$9,900,000			3.98E+17		Semiannually following initial 100 years.
Groundwater Storage Tank Collection & Disposal	1000	EA	$4,000	$4,000,000			1.45E+17		Annually for 1,000 years.
Extraction Well Pump Replacement	200	EA	$176,000	$35,200,000			1.34E+18		Every 5 years for 1,000 years
Sign Replacement	33	EA	$3,000	$100,000			3.98E+15		Every 30 years for 1,000 years
Above Grade Groundwater Component Replacement and Redevelop Wells	20	EA	$415,000	$8,300,000			5.46E+17		Every 50 years for 1,000 years
Extraction Well Replacement	10	EA	$524,000	$5,240,000			5.51E+17		Every 100 years for 1,000 years
Groundwater Monitoring - First 5 years	5	EA	$64,000	$320,000			3.48E+05		Semiannually for first 5 years
Groundwater Monitoring - Years 6 through 1000	995	EA	$32,000	$31,840,000			1.16E+18		Annually for years 6 through 1,000
Five-Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
			SUBTOTAL ANNUAL COST	**$125,900,000**			**5.28E+18**		
			TOTAL	**$156,481,000**					
Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	LS	$30,581,000	$30,581,000				**$30,581,000**	
Inspections	1000	EA	$21,000	$21,000,000				**$1,909,057**	1.1% discount rate
Weed Removal and Cover Inspection	900	EA	$11,000	$9,900,000				**$334,859**	1.1% discount rate
Groundwater Storage Tank Collection & Disposal	1000	EA	$4,000	$4,000,000				**$363,630**	1.1% discount rate
Extraction Well Pump Replacement	200	EA	$176,000	$35,200,000				**$3,130,315**	1.1% discount rate
Sign Replacement	33	EA	$3,000	$100,000				**$7,723**	1.1% discount rate
Above Grade Groundwater Component Replacement and Redevelop Wells	20	EA	$415,000	$8,300,000				**$570,001**	1.1% discount rate
Extraction Well Replacement	10	EA	$524,000	$5,240,000				**$263,809**	1.1% discount rate
Groundwater Monitoring - First 5 years	5	EA	$64,000	$320,000				**$309,705**	1.1% discount rate
Groundwater Monitoring - Years 6 through 1000	995	EA	$32,000	$31,840,000				**$2,754,187**	1.1% discount rate
Five-Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$30,581,000**	
						Present Worth Values	**Annual**	**$10,533,000**	
							Avg. Annual	**$10,533**	
							Total	**$41,114,000**	
This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.									
Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.									

COST ESTIMATE
BGOU SWMU 2
Alternative 6—Targeted Excavation, Disposal, Containment, LUCs, and Monitoring

Task Description	Material/Equipment/Subcontractors/ODCs				Labor				
	Qty	Unit	Unit Price	Total	Hours	Rate	Total	Total Cost	Basis of Estimate
CAPITAL COSTS									
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					4224		$376,224		
Remedial Design Report					8744		$803,933		
Civil Surveying					216		$22,818		
Procurement					634		$52,676		
Work Packages/Readiness					1688		$146,788		
Training	1	LS	$68,800	$68,800	1320		$102,736		$68,800 includes subcontractor training and pyrophoric training
TASK TOTAL				**$68,800**	**16826**		**$1,505,175**	**$1,574,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					5724		$517,587		
O&M Plan					700		$66,863		
SAP/QAPP					1100		$96,201		
Waste Management Plan					1020		$94,190		
RACR					2274		$212,751		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**11402**		**$1,038,317**	**$1,038,000**	
3.0 Remedial Design Site Investigation (RDSI)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Drilling									
Prime Contractor					4440		$362,305		
Subcontractors	1	LS	$168,834	$168,834					Local quote from existing drilling sub.
Materials	1	LS	$80,208	$80,208					
Vehicles and Equipment	1	LS	$8,720	$8,720					
Sampling									
Prime Contractor					2000		$146,084		
Materials	1	LS	$29,434	$29,434					
Analytical									
Prime Contractor					412		$39,228		
Materials	1	LS	$815,013	$815,013					
Excavation									
Prime Contractor	0				0		$0		
Equipment	0	LS	$0	$0					
TASK TOTAL				**$ 1,102,209**	**6852**		**$ 547,617**	**$1,650,000**	
4.0 Shoring									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Sheet Piling									
Prime Contractor					1345		$112,259		
Subcontractors	1	LS	$459,999	$459,999					
Materials	1	LS	$7,535	$7,535					
Vehicles and Equipment	1	LS	$2,616	$2,616					
TASK TOTALS				**$470,150**	**1,345**		**$112,259**	**$582,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 6—Targeted Excavation, Disposal, Containment, LUCs, and Monitoring

5.0 Excavation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Overburden and Ramps									
Prime Contractor					1134		$97,610		
Subcontractors	1	LS	$103,537	$103,537					
Materials	1	LS	$7,442	$7,442					
Vehicles and Equipment	1	LS	$1,526	$1,526					
Cells 6 & 8 TCE Waste									
Prime Contractor					405		$34,861		
Subcontractors	1	LS	$19,120	$19,120					
Materials	1	LS	$2,658	$2,658					
Vehicles and Equipment	1	LS	$545	$545					
Cells 1,4,7,10, & 15 Incidental									
Prime Contractor					972		$83,666		
Subcontractors	1	LS	$45,888	$45,888					
Materials	1	LS	$6,379	$6,379					
Vehicles and Equipment	1	LS	$1,308	$1,308					
Cell 9									
Prime Contractor					243		$20,916		
Subcontractors	1	LS	$11,472	$11,472					
Materials	1	LS	$1,595	$1,595					
Vehicles and Equipment	1	LS	$327	$327					
TASK TOTALS				**$201,797**	**2,754**		**$237,053**	**$439,000**	
6.0 Treat and Dispose of Water									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Water Treatment									
Prime Contractor					408		$29,037		
Subcontractors	1	LS	$46,778	$46,778					Rainforrent.com and RSMeans
Materials	1	LS	$1,898	$1,898					
Vehicles and Equipment	1	LS	$741	$741					
Water Disposal									
Prime Contractor					40		$2,275		
Characterization Sampling	1	LS	$8,582	$8,582					
Vehicles and Equipment	1	LS	$8,334	$8,334					
TASK TOTALS				**$66,333**	**448**		**$31,312**	**$98,000**	
7.0 Post Remediation Sampling									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Sampling									
Prime Contractor					50		$3,652		
Materials	1	LS	$5,879	$5,879					
Analytical									
Prime Contractor					20		$1,839		
Materials	1	LS	$8,924	$8,924					
TASK TOTAL				**$ 14,803**	**70**		**$5,491**	**$20,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 6—Targeted Excavation, Disposal, Containment, LUCs, and Monitoring

8.0 Waste Handling, Treatment, Disposal, and Transportation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Overburden and Ramps									
Prime Contractor					1962		$130,925		
Materials	1	LS	$7,924	$7,924					
Characterization Sampling	1	LS	$49,476	$49,476					
Vehicles and Equipment	1	LS	$65,268	$65,268					
Cells 6 & 8 TCE Waste									
Prime Contractor					3246		$232,987		
Materials	1	LS	$332,340	$332,340					
Characterization Sampling	1	LS	$36,596	$36,596					
Vehicles and Equipment	1	LS	$19,577	$19,577					
Disposal	1	LS	$1,129,516	$1,129,516					
Treatment	1	LS	$1,016,041	$1,016,041					
Transportation	1	LS	$395,720	$395,720					
Cells 1,4,7,10, & 15 Incidental									
Prime Contractor					7082		$508,833		
Materials	1	LS	$821,701	$821,701					
Characterization Sampling	1	LS	$90,412	$90,412					
Vehicles and Equipment	1	LS	$47,854	$47,854					
Disposal	1	LS	$1,410,864	$1,410,864					
Transportation	1	LS	$981,690	$981,690					
Cell 9									
Prime Contractor					1620		$116,349		
Materials	1	LS	$165,632	$165,632					
Characterization Sampling	1	LS	$18,872	$18,872					
Vehicles and Equipment	1	LS	$7,610	$7,610					
Disposal	1	LS	$282,379	$282,379					
Transportation	1	LS	$197,860	$197,860					
TASK TOTALS				**$7,077,332**	**13,910**		**$989,094**	**$8,066,000**	
9.0 Excavation Backfill									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Backfill									
Prime Contractor					639		$53,720		
Subcontractors	1	LS	$183,150	$183,150					RSMeans and local engineering firm
Materials	1	LS	$2,232	$2,232					
Vehicles and Equipment	1	LS	$872	$872					
TASK TOTAL				**$186,254**	**639**		**$53,720**	**$240,000**	
10.0 Chemical Treatment									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Jet Grouting									
Prime Contractor					976		$80,065		
Subcontractors	1	LS	$953,000	$953,000					
Materials	1	LS	$8,506	$8,506					
Vehicles and Equipment	1	LS	$3,488	$3,488					
TASK TOTAL				**$964,994**	**976**		**$80,065**	**$1,045,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 6—Targeted Excavation, Disposal, Containment, LUCs, and Monitoring

11.0 Hydraulic Isolation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Slurry Wall Construction									
Prime Contractor					2599		$201,714		
Subcontractors	1	LS	$1,023,369	$1,023,369					
Materials	1	LS	$17,011	$17,011					
Vehicles and Equipment	1	LS	$32,732	$32,732					
Well Construction									
Prime Contractor					800		$64,952		
Subcontractors	1	LS	$465,318	$465,318					Local quote from existing drilling sub.
Materials	1	LS	$14,161	$14,161					
Vehicles and Equipment	1	LS	$1,744	$1,744					
Tank and Piping									
Prime Contractor					800		$59,803		
Subcontractors	1	LS	$157,479	$157,479					
Materials	1	LS	$29,819	$29,819					
Electrical				$0					
Prime Contractor					401		$29,901		
Subcontractors	1	LS	$27,904	$27,904					
Materials	1	LS	$11,617	$11,617					
TASK TOTALS				**$1,781,154**	**4,600**		**$356,370**	**$2,138,000**	
12.0 Surface Soils Consolidation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Surveying and Marking									
Prime Contractor					160		$14,145		
Materials	1	LS	$744	$744					
Soil Consolidation									
Prime Contractor					120		$8,810		
Subcontractors	1	LS	$14,988	$14,988					
TASK TOTALS				**$15,732**	**280**		**$22,955**	**$39,000**	
13.0 Subtitle C Cap Construction									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Surveying, Marking, Testing									
Prime Contractor					280		$28,905		
Subcontractors	1	LS	$80,102	$80,102					Local engineering firm
Materials	1	LS	$744	$744					
Cap Construction									
Prime Contractor					3930		$313,495		
Subcontractors	1	LS	$663,439	$663,439					
Materials	1	LS	$14,880	$14,880					
Vehicles and Equipment	1	LS	$13,952	$13,952					
TASK TOTAL				**$ 773,117**	**4210**		**$342,400**	**$1,116,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 6—Targeted Excavation, Disposal, Containment, LUCs, and Monitoring

14.0 Riprap Cover									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Bedding Layer									
Prime Contractor					879		$74,808		
Subcontractors	1	LS	$145,871	$145,871					
Materials	1	LS	$2,232	$2,232					
Vehicles and Equipment	1	LS	$1,744	$1,744					
Riprap Layer									Includes 2 ft soil cover
Prime Contractor					1632		$136,991		
Subcontractors	1	LS	$413,114	$413,114					
Materials	1	LS	$3,528	$3,528					
Vehicles and Equipment	1	LS	$3,488	$3,488					
TASK TOTAL				**$569,977**	**2511**		**$211,799**	**$782,000**	
						SUBTOTAL CAPITAL COST		**$18,827,000**	
ANNUAL COSTS									
Inspections									
Duration: Occurs quarterly for 1,000 years.									
Prime Contractor					240		$20,180		
Materials	1	LS	$540	$540					
Vehicles and Equipment	1	LS	$436	$436					
TASK TOTAL				**$976**	**240**		**$20,180**	**$21,000**	ANNUAL COST
Weed Removal and Cover Inspection									
Duration: Semiannually following the first 100 years.									
Prime Contractor					120		$10,090		
Materials	1	LS	$270	$270					
Vehicles and Equipment	1	LS	$218	$218					
TASK TOTAL				**$488**			**$10,090**	**$11,000**	ANNUAL COST
Groundwater Storage Tank Collection & Disposal									
Duration: Annually for 1,000 years.									
Prime Contractor					50		$3,815		
Materials	1	LS	$108	$108					
Vehicles and Equipment	1	LS	$109	$109					
TASK TOTAL				**$217**			**$3,815**	**$4,000**	ANNUAL COST
Extraction Well Pump Replacement									
Duration: Every 5 years.									
Prime Contractor					100		$7,745		
Subcontractors	1	LS	$168,131	$168,131					Local quote from existing drilling sub.
TASK TOTAL				**$168,131**			**$7,745**	**$176,000**	EVERY 5 YEARS
Sign Replacement									
Duration: Every 30 years.									
Prime Contractor					30		$2,392		
Materials	1	LS	$108	$54					
Vehicles and Equipment	1	LS	$109	$109					
TASK TOTAL				**$163**			**$2,392**	**$3,000**	EVERY 30 YEARS
Above Grade Groundwater Component Replacement and Redevelop Wells									
Duration: Every 50 years.									
Prime Contractor					800		$59,803		
Subcontractors	1	LS	$323,512	$323,512					RSMeans and local quote

COST ESTIMATE
BGOU SWMU 2
Alternative 6—Targeted Excavation, Disposal, Containment, LUCs, and Monitoring

Materials	1	LS	$28,259	$28,259					
Vehicles and Equipment	1	LS	$3,488	$3,488					
TASK TOTAL				**$355,259**			**$59,803**	**$415,000**	EVERY 50 YEARS
Extraction Well Replacement									
Duration: Every 100 years.									
Prime Contractor					640		$53,598		
Subcontractors	1	LS	$465,319	$465,319					
Materials	1	LS	$3,147	$3,147					
Vehicles and Equipment	1	LS	$1,744	$1,744					
TASK TOTAL				**$470,210**			**$53,598**	**$524,000**	EVERY 100 YEARS
Groundwater Monitoring - First 5 years									
Duration: Semiannually for the first 5 years.									
Prime Contractor					640		$50,330		
Laboratory	1	LS	$12,033	$12,033					
Materials	1	LS	$1,080	$1,080					
Vehicles and Equipment	1	LS	$872	$872					
TASK TOTAL				**$13,985**			**$50,330**	**$64,000**	ANNUAL COST
Groundwater Monitoring - Years 6 through 1000									
Duration: Annually for years 6 through 1000									
Prime Contractor					320		$25,165		
Laboratory	1	LS	$6,016	$6,016					
Materials	1	LS	$540	$540					
Vehicles and Equipment	1	LS	$436	$436					
TASK TOTAL				**$6,992**			**$25,165**	**$32,000**	ANNUAL COST
Five-Year Review									
Duration: Every 5 years.									
Prime Contractor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study

Reported From: SWMU 2 Alternative 6
Report Total: $20,125,950

Author
Manager

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 6			**$20,125,950**
	Capital Costs			**$18,826,274**
	Remedial Desgin			**$1,573,975**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	376,224	$1.00	$376,224

Memo: 4,224 HOURS

TOTAL RDWP/RDSI Work Plan **$376,224**

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 6			**$20,125,950**
	Capital Costs			**$18,826,274**
	Remedial Desgin			**$1,573,975**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	803,933	$1.00	$803,933

Memo: 8,744 HOURS

TOTAL RDR **$803,933**

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 6			**$20,125,950**
	Capital Costs			**$18,826,274**
	Remedial Desgin			**$1,573,975**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	22,818	$1.00	$22,818

Memo: 216 HOURS

TOTAL Civil Surveying **$22,818**

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 6			**$20,125,950**
	Capital Costs			**$18,826,274**
	Remedial Desgin			**$1,573,975**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	52,676	$1.00	$52,676

Memo: 634 HOURS

TOTAL Procurement **$52,676**

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 6			**$20,125,950**
	Capital Costs			**$18,826,274**
	Remedial Desgin			**$1,573,975**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	146,788	$1.00	$146,788

Memo: 1,688 HOURS

TOTAL Work Packages/Readiness Review **$146,788**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 6			**$20,125,950**
	Capital Costs			**$18,826,274**
	Remedial Desgin			**$1,573,975**

Training

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT COST	TOTAL
	Pyrophoric U Training per Person	16	$800.00	$12,800
Memo: Assume $800 per person. This is consistent with the previous FS submittal.				
	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
Memo: Assume 80 hours of training per person. Assume 10 people or 800 hours.				
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training **$171,536**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 6			**$20,125,950**
	Capital Costs			**$18,826,274**
	Other Project Plans			**$1,038,317**

RAWP

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	517,587	$1.00	$517,587
Memo: 5,724 HOURS				

TOTAL RAWP **$517,587**

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 6			**$20,125,950**
	Capital Costs			**$18,826,274**
	Other Project Plans			**$1,038,317**

O&M Plan

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan **$66,863**

	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 6			**$20,125,950**
	Capital Costs			**$18,826,274**
	Other Project Plans			**$1,038,317**

SAP/QAPP

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	96,201	$1.00	$96,201
Memo: 1,100 HOURS				

TOTAL SAP/QAPP **$96,201**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Other Project Plans				**$1,038,317**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	94,190		$1.00	$94,190
Memo: 1,020 HOURS					

TOTAL Waste Management Plan **$94,190**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6		**$20,125,950**
Capital Costs		**$18,826,274**
Other Project Plans		**$1,038,317**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	212,751		$1.00	$212,751
Memo: 2,274 HOURS					

TOTAL RACR **$212,751**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6		**$20,125,950**
Capital Costs		**$18,826,274**
Other Project Plans		**$1,038,317**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6		**$20,125,950**
Capital Costs		**$18,826,274**
RDSI		**$1,649,826**

Drilling

Tree Depth= 5

	Mob/Demob for DPT subcontractor	1		$8,500.00	$8,500
	DPT Borings to 40 feet	30		$1,635.00	$49,050
Memo: 2 borings per day - 15 days of borings plus 1 week for mob and 1 week for demob.					
	1/2 TON 4WD TRUCKS, LARGE VANS	1,600	hrs	$5.45	$8,720
Memo: 4 LATAKY vehicles.					
	55 GALLON DRUM	8		$84.68	$677
Memo: 8 drums for drill cuttings.					
	ST-90 CONTAINER DELIVERED	4		$1,770.63	$7,083
Memo: 4 ST-90 box for PPE/Trash.					
	PORTABLE TOILET & HAND WASH PER MONTH	3		$227.21	$682
Memo: Rent for 3 months.					
	LAUNDRY 2 CHANGES COST PER HOUR	5,400	hrs	$2.70	$14,580
Memo: LATAKY personnel plus assume 5 drillers.					
	DPT Borings to 65 feet	12		$2,573.00	$30,876
Memo: Angled borings - assume 65 feet deep.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	RDSI				**$1,649,826**

Drilling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	DPT Borings to 40 feet	8		$1,635.00	$13,080
Memo: 8 additional borings following waste stabilization.					
	DPT Borings to 65 feet	16		$2,573.00	$41,168
Memo: 16 additional borings from grade, around the perimeter of the 2 additional sites.					
	DPT Borings to 40 feet	16		$1,635.00	$26,160
Memo: 16 additional borings from bottom of excavation, at the 2 additional sites.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	5,400		$5.19	$28,026
	PPE 2 c/o per day 10 hr day cost per hr	5,400		$1.95	$10,530
	MSA OptiFilter HEPA per hour	5,400		$3.45	$18,630
LABOR	PRIME CONTRACTOR LABOR	362,305		$1.00	$362,305
Memo: 4,440 HOURS					

TOTAL Drilling **$620,067**

Memo: Same as alternative 4B but added 8 borings at the bottom of the excavation and 8 borings outside the excavation area. This is at 2 sites so 32 total additional borings. Assume 10 weeks.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	RDSI				**$1,649,826**

Sampling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	5 gram EN CORE SAMPLER	800		$6.94	$5,552
	Niton XRF Rental One Month	3		$4,500.00	$13,500
	PCB Test Kits	2		$541.00	$1,082
	LAUNDRY 2 CHANGES COST PER HOUR	2,000	hrs	$2.70	$5,400
	PPE 2 c/o per day 10 hr day cost per hr	2,000		$1.95	$3,900
LABOR	PRIME CONTRACTOR LABOR	146,084		$1.00	$146,084
Memo: 2,000 HOURS					

TOTAL Sampling **$175,518**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	RDSI				**$1,649,826**

Analytical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Overnight Shipment per Cooler	80		$251.97	$20,158
Memo: Assume 2 shipments per day for 39 days plus 1 shipment later for the waste water.					
	RDSI Geophysical Sampling Analytical	1		$1,275.00	$1,275
Memo: 3 Geophysical samples taken for particle size and atterberg limits.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	RDSI				**$1,649,826**

Analytical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RDSI Soil Sampling Analytical	1		$262,775.00	$262,775
Memo: 8 samples from 30 borings = 240 samples.					
	RDSI Soil Sampling Analytical	0.92		$262,775.00	$241,753
Memo: 8 samples from 8 additional borings = 64 samples. 13 samples from 12 angled borings = 156 samples. Total of 220 samples. 220/240 = .92					
	RDSI Soil Sampling Analytical	1.10		$262,775.00	$289,053
Memo: 8 samples from 32 additional borings = 256 samples. 256/240 = 1.1					
LABOR	PRIME CONTRACTOR LABOR	39,228		$1.00	$39,228
Memo: 412 HOURS					

TOTAL Analytical **$854,241**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Shoring				**$582,408**

Sheet Piling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B40 R.S.Means Crew	230	Ton	$1,054.32	$242,494
	RSMeans Crew B-43 cost per day	7		$5,600.00	$39,200
	Tieback Materials	0.25		$336,000.00	$84,000
Memo: Backup is for 400 tiebacks so 25%.					
	1/2 TON 4WD TRUCKS, LARGE VANS	480	hrs	$5.45	$2,616
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	840	hrs	$2.70	$2,268
	Mob/Demob of Subcontractor and Equipment	1		$40,000.00	$40,000
	Resp cleaning 10 hr day 2 C/O per day cost per hr	420		$5.19	$2,180
	PPE 2 c/o per day 10 hr day cost per hr	840		$1.95	$1,638
	MSA OptiFilter HEPA per hour	420		$3.45	$1,449
LABOR	PRIME CONTRACTOR LABOR	112,259		$1.00	$112,259
Memo: 1,345 HOURS					
Subtotal					$528,103
1st Layer Markups assigned to Detail Items					$54,305

TOTAL Sheet Piling **$582,408**

Memo: 230 tons of piling. Tiebacks every 2 piles on the deeper piles so 100. Pile driving, extract, and salvage is 12.5 tons per day = 19 days. Tiebacks are 18 per day so 6 days + 5% failure rate = 7 days. Assume 5 day overlap so 24 day duration.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Excavation				**$438,849**

Overburden and Ramps

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	14		$1,470.00	$20,580
	RSMeans Crew B-12C cost per day	14		$2,354.00	$32,956
	Mob/Demob of Subcontractor and Equipment	1	LS	$50,000.00	$50,000
	LAUNDRY 2 CHANGES COST PER HOUR	560	hrs	$2.70	$1,512
	1/2 TON 4WD TRUCKS, LARGE VANS	280	hrs	$5.45	$1,526
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	560		$5.19	$2,906
	PPE 2 c/o per day 10 hr day cost per hr	560		$1.95	$1,092
	MSA OptiFilter HEPA per hour	560		$3.45	$1,932
LABOR	PRIME CONTRACTOR LABOR	97,610		$1.00	$97,610
Memo: 1,134 HOURS					

TOTAL Overburden and Ramps **$210,114**

Memo: 2605 BCY. Assume 225 CY per day so 12 days + weather/delays. Assume 14 day duration.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Excavation				**$438,849**

Cells 6 & 8 TCE Waste

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	5		$1,470.00	$7,350
	RSMeans Crew B-12C cost per day	5		$2,354.00	$11,770
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	100	hrs	$5.45	$545
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	200		$5.19	$1,038
	PPE 2 c/o per day 10 hr day cost per hr	200		$1.95	$390
	MSA OptiFilter HEPA per hour	200		$3.45	$690
LABOR	PRIME CONTRACTOR LABOR	34,861		$1.00	$34,861
Memo: 405 HOURS					

TOTAL Cells 6 & 8 TCE Waste **$57,184**

Memo: 385 BCY. Excavating and moving a 100 CY per day, so 4 days plus weather/delays is 5 days.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Excavation				**$438,849**

Cells 1,4,7,10, & 15 Incidental Waste

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	12		$1,470.00	$17,640

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Excavation				**$438,849**

Cells 1,4,7,10, & 15 Incidental Waste

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-12C cost per day	12		$2,354.00	$28,248
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	1/2 TON 4WD TRUCKS, LARGE VANS	240	hrs	$5.45	$1,308
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	480		$5.19	$2,491
	PPE 2 c/o per day 10 hr day cost per hr	480		$1.95	$936
	MSA OptiFilter HEPA per hour	480		$3.45	$1,656
LABOR	PRIME CONTRACTOR LABOR	83,666		$1.00	$83,666
Memo: 972 HOURS					

TOTAL Cells 1,4,7,10, & 15 Incidental Waste **$137,241**
Memo: 962 BCY. Excavating and moving a 100 CY per day, so 10 days plus weather/delays is 12 days.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Excavation				**$438,849**

Cell 9

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	3		$1,470.00	$4,410
	RSMeans Crew B-12C cost per day	3		$2,354.00	$7,062
	LAUNDRY 2 CHANGES COST PER HOUR	120	hrs	$2.70	$324
	1/2 TON 4WD TRUCKS, LARGE VANS	60	hrs	$5.45	$327
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	120		$5.19	$623
	PPE 2 c/o per day 10 hr day cost per hr	120		$1.95	$234
	MSA OptiFilter HEPA per hour	120		$3.45	$414
LABOR	PRIME CONTRACTOR LABOR	20,916		$1.00	$20,916
Memo: 243 HOURS					

TOTAL Cell 9 **$34,310**
Memo: 192 BCY. Excavating and moving a 100 CY per day, so 2 days plus weather/delays is 3 days.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Treat and Dispose of Water				**$97,644**

Water Treatment

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B10H R.S.Means Crew	34	Day	$581.53	$19,772
	Water Treatment System w/ Tanks per month	2		$7,785.00	$15,570
Memo: Packaged system with 2 frac tanks.					
	LAUNDRY 2 CHANGES COST PER HOUR	408	hrs	$2.70	$1,102

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Treat and Dispose of Water				**$97,644**

Water Treatment

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	1/2 TON 4WD TRUCKS, LARGE VANS	136	hrs	$5.45	$741
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	408		$1.95	$796
LABOR	PRIME CONTRACTOR LABOR	29,037		$1.00	$29,037
Memo: 408 HOURS					
Subtotal					$67,018
1st Layer Markups assigned to Detail Items					$11,435
TOTAL Water Treatment					**$78,453**
Memo: 2 months					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Treat and Dispose of Water				**$97,644**

Water Disposal

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Water Truck 10k Gallon cost per hr	40	hr	$208.34	$8,334
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Water Cost per Sample	10		$833.00	$8,330
Memo: Assume Frac tanks will be emptied every 2 months. 1 * 5 tanks * 20,000 gallons = 100,000 gallons. Assume a water sample will be taken from each water truck (10,000 gallons). 100,000 gallons / 10,000 = 10 samples.					
LABOR	PRIME CONTRACTOR LABOR	2,275		$1.00	$2,275
Memo: 40 HOURS					
TOTAL Water Disposal					**$19,191**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Post Remediation Sampling				**$20,294**

Sampling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	5 gram EN CORE SAMPLER	25		$6.94	$174
	Niton XRF Rental One Month	1		$4,500.00	$4,500
	PCB Test Kits	1		$541.00	$541
	LAUNDRY 2 CHANGES COST PER HOUR	50	hrs	$2.70	$135
	Resp cleaning 10 hr day 2 C/O per day cost per hr	50		$5.19	$260
	PPE 2 c/o per day 10 hr day cost per hr	50		$1.95	$98
	MSA OptiFilter HEPA per hour	50		$3.45	$173

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Post Remediation Sampling				**$20,294**

Sampling

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	3,652		$1.00	$3,652
Memo: 50 HOURS					

TOTAL Sampling **$9,531**
Memo: 25 foot grid. Assume 8 total samples. 1 day duration.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Post Remediation Sampling				**$20,294**

Analytical

Tree Depth= 5

	Overnight Shipment per Cooler	1		$251.97	$252
	RDSI Soil Sampling Analytical	0.03		$289,052.67	$8,672
Memo: From Alt. 3: 8 samples from 30 borings = 240 samples. 8 / 240 = .033					
LABOR	PRIME CONTRACTOR LABOR	1,839		$1.00	$1,839
Memo: 20 HOURS					

TOTAL Analytical **$10,763**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Waste Handling/Treatment/Disposal/Transportation				**$8,066,425**

Overburden and Ramps

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	1,820	hrs	$2.70	$4,914
	1/2 TON 4WD TRUCKS, LARGE VANS	280	hrs	$5.45	$1,526
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	700	hr	$91.06	$63,742
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	70		$43.00	$3,010
	Overnight Shipment per Cooler	5		$251.97	$1,260
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	42		$1,148.00	$48,216
3,126 LCY / 15 CY = 208. Assume 20% sampling rate. 208 / 5 = 42 samples.					
LABOR	PRIME CONTRACTOR LABOR	130,925		$1.00	$130,925
Memo: 1,962 HOURS					

TOTAL Overburden and Ramps **$253,593**
Memo: U Landfill WAC Compliant. 2,605 BCY x 1.2 = 3,126 LCY.
Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 14 days.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Waste Handling/Treatment/Disposal/Transportation				**$8,066,425**

Cells 6 & 8 TCE Waste

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	2,520	hrs	$2.70	$6,804
	1/2 TON 4WD TRUCKS, LARGE VANS	360	hrs	$5.45	$1,962
Memo: 2 LATAKY vehicles.					
	Skid Steer per hour	180	hr	$32.54	$5,857
	18,000 lb Fork Lift per hour	360	hr	$32.66	$11,758
	ST-90 CONTAINER DELIVERED	154		$1,770.63	$272,677
Memo: 462 LCY / 3 CY per box = 154 boxes.					
	MLLW Soil Disposal at ES ST90 by Truck per CY	1,096		$1,030.58	$1,129,516
Memo: 154 boxes x 96 CF per box = 14,784 CF / 27 = 548 CY. Double volume so 1,096 CY.					
	Absorbent 50lb bag delivered cost per bag	154		$240.64	$37,059
	MLLW Treatment at ES ST90 per CY	548		$1,854.09	$1,016,041
Memo: 154 boxes x 96 CF per box = 14,784 CF / 27 = 548 CY.					
	Transportation to ES by Truck	52		$7,610.00	$395,720
Memo: Assume 3 boxes per truck. 154 / 3 = 52 trips.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,260		$5.19	$6,539
	PPE 2 c/o per day 10 hr day cost per hr	2,520		$1.95	$4,914
	MSA OptiFilter HEPA per hour	1,260		$3.45	$4,347
	Overnight Shipment per Cooler	4		$251.97	$1,008
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	31		$1,148.00	$35,588
Memo: Assume 20% sampling rate. 154 / 5 = 31 samples.					
LABOR	PRIME CONTRACTOR LABOR	232,987		$1.00	$232,987
Memo: 3,246 HOURS					

TOTAL Cells 6 & 8 TCE Waste **$3,162,777**

Memo: 385 BCY x 1.2 = 462 LCY. Ship to ES for treatment and disposal using ST-90 boxes. Assume can load 10 boxes per day. 154 boxes / 10 = 16 days plus delays/weather = 18 days.

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 6	**$20,125,950**
	Capital Costs	**$18,826,274**
	Waste Handling/Treatment/Disposal/Transportation	**$8,066,425**

Cells 1,4,7,10 & 15 Incidental Waste

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	5,280	hrs	$2.70	$14,256
	1/2 TON 4WD TRUCKS, LARGE VANS	880	hrs	$5.45	$4,796
Memo: 2 LATAKY vehicles.					
	Skid Steer per hour	440	hr	$32.54	$14,318
	18,000 lb Fork Lift per hour	880	hr	$32.66	$28,741
	ST-90 CONTAINER DELIVERED	385		$1,770.63	$681,693
Memo: 1,155 LCY / 3 CY per box = 385 boxes.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Waste Handling/Treatment/Disposal/Transportation				**$8,066,425**

Cells 1,4,7,10 & 15 Incidental Waste

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	MLLW Soil Disposal at ES ST90 by Truck per CY	1,369		$1,030.58	$1,410,864
Memo: 385 boxes x 96 CF per box = 36,960 CF / 27 = 1369 CY.					
	Absorbent 50lb bag delivered cost per bag	385		$240.64	$92,646
	Transportation to ES by Truck	129		$7,610.00	$981,690
Memo: Assume 3 boxes per truck. 385 / 3 = 129 trips.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	2,640		$5.19	$13,702
	PPE 2 c/o per day 10 hr day cost per hr	5,280		$1.95	$10,296
	MSA OptiFilter HEPA per hour	2,640		$3.45	$9,108
	Overnight Shipment per Cooler	8		$251.97	$2,016
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	77		$1,148.00	$88,396
Memo: Assume 20% sampling rate. 385 / 5 = 77 samples.					
LABOR	PRIME CONTRACTOR LABOR	508,833		$1.00	$508,833
Memo: 7,082 HOURS					

TOTAL Cells 1,4,7,10 & 15 Incidental Waste **$3,861,354**

Memo: 962 BCY x 1.2 = 1,155 LCY. Ship to ES for disposal using ST-90 boxes. Assume can load 10 boxes per day. 385 boxes / 10 = 39 days plus delays/weather = 44 days.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Waste Handling/Treatment/Disposal/Transportation				**$8,066,425**

Cell 9

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	1,200	hrs	$2.70	$3,240
	1/2 TON 4WD TRUCKS, LARGE VANS	200	hrs	$5.45	$1,090
Memo: 2 LATAKY vehicles.					
	Skid Steer per hour	100	hr	$32.54	$3,254
	18,000 lb Fork Lift per hour	100	hr	$32.66	$3,266
	ST-90 CONTAINER DELIVERED	77		$1,770.63	$136,339
Memo: 231 LCY / 3 CY per box = 77 boxes.					
	MLLW Soil Disposal at ES ST90 by Truck per CY	274		$1,030.58	$282,379
Memo: 77 boxes x 96 CF per box = 7,392 CF / 27 = 274 CY.					
	Absorbent 50lb bag delivered cost per bag	77		$240.64	$18,529
	Transportation to ES by Truck	26		$7,610.00	$197,860
Memo: Assume 3 boxes per truck. 77 / 3 = 26 trips.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	600		$5.19	$3,114
	PPE 2 c/o per day 10 hr day cost per hr	1,200		$1.95	$2,340
	MSA OptiFilter HEPA per hour	600		$3.45	$2,070
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 10 samples per cooler.					

LEVEL		QTY		UNIT COST	TOTAL

Estimate Tree Structure Rollups
SWMU 2 Alternative 6 — **$20,125,950**
Capital Costs — **$18,826,274**
Waste Handling/Treatment/Disposal/Transportation — **$8,066,425**

Cell 9

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	Characterization Sampling Soil Cost per Sample	16		$1,148.00	$18,368
Memo: Assume 20% sampling rate. 77 / 5 = 16 samples.					
LABOR	PRIME CONTRACTOR LABOR	116,349		$1.00	$116,349
Memo: 1,620 HOURS					

TOTAL Cell 9 — **$788,702**
Memo: 192 BCY x 1.2 = 230 LCY. Load into ST-90 boxes and ship to ES for treatment and disposal. Assume can load 10 boxes per day. 77 boxes / 10 = 8 days plus delays/weather = 10 days.

Estimate Tree Structure Rollups
SWMU 2 Alternative 6 — **$20,125,950**
Capital Costs — **$18,826,274**
Excavation Backfill — **$239,974**

Backfill

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	B10D R.S.Means Crew	4,977	E.C.Y.	$2.67	$13,276
	B34C R.S.Means Crew	4,977	L.C.Y.	$7.98	$39,713
	Backfill Delivered per CY	4,977		$16.00	$79,632
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	1/2 TON 4WD TRUCKS, LARGE VANS	160	hrs	$5.45	$872
Memo: 2 LATAKY vehicles.					
	Geotechnical Testing Technician per hour	80		$52.19	$4,175
	Geotechnical Testing Density Testing per hour	80		$50.00	$4,000
	RSMeans Crew B-10W cost per day	8		$1,470.00	$11,760
	RSMeans Crew B-10P cost per day	8		$2,129.00	$17,032
	PPE 2 c/o per day 10 hr day cost per hr	480		$1.95	$936
LABOR	PRIME CONTRACTOR LABOR	53,720		$1.00	$53,720
Memo: 639 HOURS					
Subtotal					$226,412
1st Layer Markups assigned to Detail Items					$13,562

TOTAL Backfill — **$239,974**
Memo: 4,147 BCY total removed. 4,147 x 1.2 = 4,977 CY of fill needed. Assume 750 CY filled per day. 4,977 / 750 = 7 days + weather/delays = 8 days. Fill is stockpiled during other activities and transfered to site as needed.

Estimate Tree Structure Rollups
SWMU 2 Alternative 6 — **$20,125,950**
Capital Costs — **$18,826,274**
Chemical Treatment — **$1,045,059**

Jet Grouting

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	Jet Grouting w/ Cement Grouting per CY	1,800	CY	$300.00	$540,000
Memo: Reference STANTEC.					
	Jet Grouting Mob/DeMob	1		$125,000.00	$125,000

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Chemical Treatment				**$1,045,059**

Jet Grouting

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Zero Valient Iron cost per CF	48,000	CF	$6.00	$288,000
Memo: Adder for using ZVI. Assume $6 per treated CF.					
	1/2 TON 4WD TRUCKS, LARGE VANS	640	hrs	$5.45	$3,488
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	640	hrs	$2.70	$1,728
	Resp cleaning 10 hr day 2 C/O per day cost per hr	640		$5.19	$3,322
	PPE 2 c/o per day 10 hr day cost per hr	640		$1.95	$1,248
	MSA OptiFilter HEPA per hour	640		$3.45	$2,208
LABOR	PRIME CONTRACTOR LABOR	80,065		$1.00	$80,065
Memo: 976 HOURS					

TOTAL Jet Grouting **$1,045,059**

Memo: 2 waste areas. 20' x 20' or 400 SF and 20' x 40' or 800 SF. Total of 1,200 SF. Treatment from 20' BGS to 60' BGS. 1,200 SF x 40' = 48,000 CF or 1,800 CY. Assume 1 month duration.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Hydraulic Isolation				**$2,137,523**

Slurry Wall Construction

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	C7 R.S.Means Crew	32,000	S.F.	$21.10	$675,221
	1/2 TON 4WD TRUCKS, LARGE VANS	1,288	hrs	$5.45	$7,020
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,280	hrs	$2.70	$3,456
	CATERPILLAR 345B CRAWLER MOUNTED SHEAR HEAD EXCAVATOR	320	hr	$62.12	$19,878
	JOHN DEERE 624E 4WD ARTICULATED WHEEL LOADER	320	hr	$18.23	$5,834
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,280		$5.19	$6,643
	PPE 2 c/o per day 10 hr day cost per hr	1,280		$1.95	$2,496
	MSA OptiFilter HEPA per hour	1,280		$3.45	$4,416
LABOR	PRIME CONTRACTOR LABOR	201,714		$1.00	$201,714
Memo: 2,599 HOURS					
Subtotal					$926,678
1st Layer Markups assigned to Detail Items					$348,148

TOTAL Slurry Wall Construction **$1,274,826**

Memo: Assume wall is approx. 200' x 200' or 800 LF 800 LF x 40' deep = 32,000 SF. Assume 25 linear feet per day: 800 / 25 = 32 days assume 2 months due to weather delays and equipment repairs.

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study — **Reported From: SWMU 2 Alternative 6**
Report Total: $20,125,950

Author
Manager

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Hydraulic Isolation				**$2,137,523**

Well Construction

Tree Depth= 5

LEVEL	Item	QTY	Unit	UNIT COST	TOTAL
	Extraction Well Subcontractor Mob/Demob	1		$34,878.49	$34,878
	Extraction Well Installation & Development	4		$65,577.27	$262,309
	Extraction Well Pump Installation	4		$42,032.80	$168,131
	LAUNDRY 2 CHANGES COST PER HOUR	1,040	hrs	$2.70	$2,808
Memo: LATAKY personnel plus assume 5 drillers.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,040		$5.19	$5,398
	PPE 2 c/o per day 10 hr day cost per hr	1,040		$1.95	$2,028
	MSA OptiFilter HEPA per hour	1,040		$3.45	$3,588
LABOR	PRIME CONTRACTOR LABOR	64,952		$1.00	$64,952
Memo: 800 HOURS					

TOTAL Well Construction **$546,175**
Memo: 4 week duration.

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 6	**$20,125,950**
	Capital Costs	**$18,826,274**
	Hydraulic Isolation	**$2,137,523**

Tank & Piping

Tree Depth= 5

LEVEL	Item	QTY	Unit	UNIT COST	TOTAL
	1,000 Gallon Water Tank	1		$1,100.00	$1,100
	Q1 R.S.Means Crew	5,000	L.F.	$22.36	$111,775
	LAUNDRY 2 CHANGES COST PER HOUR	800	hrs	$2.70	$2,160
	Pump House Building Pre Fab	1		$24,999.00	$24,999
Memo: Tank structure.					
	PPE 2 c/o per day 10 hr day cost per hr	800		$1.95	$1,560
LABOR	PRIME CONTRACTOR LABOR	59,803		$1.00	$59,803
Memo: 800 HOURS					

Subtotal $201,397
1st Layer Markups assigned to Detail Items $45,704

TOTAL Tank & Piping **$247,101**

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 6	**$20,125,950**
	Capital Costs	**$18,826,274**
	Hydraulic Isolation	**$2,137,523**

Electrical

Tree Depth= 5

LEVEL	Item	QTY	Unit	UNIT COST	TOTAL
	RSMeans D5010 120 0220 Electrical Service	1		$2,417.00	$2,417
Memo: Includes O&P.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Hydraulic Isolation				**$2,137,523**

Electrical

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	R3 R.S.Means Crew	5	Ea.	$1,024.44	$5,122
	1/0 Triplex Service Wire per foot	2,000		$3.67	$7,340
	Electricians	5	Ea.	$298.89	$1,494
	Electricians	500	L.F.	$10.39	$5,193
	Electricians	20	C.L.F.	$52.34	$1,047
	Electricians	2	Ea.	$305.84	$612
Memo: (2) 1,500 Watt heater per tank x 1 tanks = 2 heaters.					
	Electricians	800	L.F.	$8.14	$6,509
	Electricians	4	Ea.	$288.89	$1,156
	Electricians	4	C.L.F.	$93.39	$374
	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780
LABOR	PRIME CONTRACTOR LABOR	29,901		$1.00	$29,901
Memo: 401 HOURS					

Subtotal $63,024
1st Layer Markups assigned to Detail Items $6,397

TOTAL Electrical **$69,421**

Memo: Assumes 1 metering point. Secondary service wire ran to 4 wells and the tank on poles.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6		**$20,125,950**
Capital Costs		**$18,826,274**
Surface Soils Consolidation		**$38,688**

Surveying and Marking

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
LABOR	PRIME CONTRACTOR LABOR	14,145		$1.00	$14,145
Memo: 160 HOURS					

TOTAL Surveying and Marking **$14,889**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6		**$20,125,950**
Capital Costs		**$18,826,274**
Surface Soils Consolidation		**$38,688**

Soil Consolidation

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	B10L R.S.Means Crew	270	B.C.Y.	$15.21	$4,106
	B10G R.S.Means Crew	270	E.C.Y.	$0.69	$187
	Water Truck 10k Gallon cost per hr	40	hrs	$208.34	$8,334
	PPE 2 c/o per day 10 hr day cost per hr	160	hr	$1.95	$312
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Surface Soils Consolidation				**$38,688**

Soil Consolidation

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	8,810		$1.00	$8,810
Memo: 120 HOURS					
Subtotal					$22,180
1st Layer Markups assigned to Detail Items					$1,618

TOTAL Soil Consolidation **$23,799**

Memo: Assume depth of 2 feet. 25% of area outside cap or 270 CY.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6		**$20,125,950**
Capital Costs		**$18,826,274**
Cap Construction		**$1,115,518**

Surveying, Marking, Testing

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
	Geotechnical Testing Technician per hour	960		$52.19	$50,102
Memo: Construction 2 FTE. Geotechnical testing, data recording, surveying, and reporting.					
	Geotechnical Testing Density Testing per hour	600		$50.00	$30,000
Memo: Construction Nuclear Density testing per hour. Estimated 60 days.					
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
LABOR	PRIME CONTRACTOR LABOR	28,905		$1.00	$28,905
Memo: 280 HOURS					

TOTAL Surveying, Marking, Testing **$109,751**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6		**$20,125,950**
Capital Costs		**$18,826,274**
Cap Construction		**$1,115,518**

Cap Construction

Tree Depth= 5

	B15 R.S.Means Crew	1,630	C.Y.	$16.49	$26,885
Memo: Estimated average of 12" soil needed to bring low spots up to the high point. SOURCE = RSMEANS.					
	B10G R.S.Means Crew	1,630	E.C.Y.	$1.25	$2,029
Memo: Compaction of Leveling Layer.					
	B15 R.S.Means Crew	3,585	C.Y.	$29.84	$106,991
Memo: CLAY LINER LAYER: 24" clay layer.					
	B10G R.S.Means Crew	3,585	E.C.Y.	$1.25	$4,463
Memo: Compaction of Clay Liner Layer.					
	Skilled Workers Average (35 trades)	52.90	M.S.F.	$1,156.55	$61,181
	B15 R.S.Means Crew	2,133	C.Y.	$23.34	$49,793
Memo: DRAINAGE LAYER: 12" sand layer.					
	B10G R.S.Means Crew	2,133	E.C.Y.	$1.25	$2,655
Memo: Compaction of Sand Layer.					
	Common Building Laborers	57,600	S.Y.	$2.09	$120,321

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Cap Construction				**$1,115,518**

Cap Construction

Tree Depth= 5

LEVEL	ITEM	QTY	UNIT	UNIT COST	TOTAL
	B15 R.S.Means Crew	4,630	C.Y.	$27.34	$126,603
Memo: Topsoil Layer - Assume 2 feet of protective soil (62,500 * 2) / 27 = 4,630 CY.					
	B10G R.S.Means Crew	4,630	E.C.Y.	$1.25	$5,764
Memo: Compaction of the 2 feet of protective soil.					
	B34K R.S.Means Crew	4	Ea.	$423.07	$1,692
Memo: Mob/Demob for 2 dozers and 2 compactors.					
	1/2 TON 4WD TRUCKS, LARGE VANS	2,560	hrs	$5.45	$13,952
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	3,200	hrs	$2.70	$8,640
	Corner Monuments	4		$20,000.00	$80,000
	PPE 2 c/o per day 10 hr day cost per hr	3,200		$1.95	$6,240
LABOR	PRIME CONTRACTOR LABOR	313,495		$1.00	$313,495
Memo: 3,930 HOURS					

Subtotal	$930,704
1st Layer Markups assigned to Detail Items	$75,062

TOTAL Cap Construction **$1,005,766**

Memo: Assume 4 month duration. 3 months for dirt work and 1 month for mob/demob and HDPE liner installation.
Cap area is 44,000 SF. Assume perimeter increases by a linear 10 feet for every layer.
Layer 1: Leveling Layer - Assume 1 foot of soil to form a base. (44,000 *1) / 27 = 1,630 CY.
Layer 2: Clay Liner - Assume 2 feet of clay. (48,400 * 2) / 27 = 3,585 CY.
Layer 3: Geomembrane - Assume 52,900 SF
Layer 4: Drainage Layer - Assume 1 feet of sand. (57,600 * 1) / 27 = 2,133 CY.
Layer 5: Geotextile Fabric. 57,600 SF.
Layer 6: Topsoil Layer - Assume 2 feet of protective soil (62,500 * 2) / 27 = 4,630 CY.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6		**$20,125,950**
Capital Costs		**$18,826,274**
Riprap Cover		**$781,776**

Bedding Layer

Tree Depth= 5

LEVEL	ITEM	QTY	UNIT	UNIT COST	TOTAL
	Skilled Workers Average (35 trades)	68.75	M.S.F.	$1,156.55	$79,513
Memo: 62,500 SF + 10% for waste = 68,750.					
	B15 R.S.Means Crew	1,158	C.Y.	$23.34	$27,032
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	PPE 2 c/o per day 10 hr day cost per hr	480	hr	$1.95	$936

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Capital Costs				**$18,826,274**
	Riprap Cover				**$781,776**

Bedding Layer

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	74,808		$1.00	$74,808
Memo: 879 HOURS					
Subtotal					$185,329
1st Layer Markups assigned to Detail Items					$39,325

TOTAL Bedding Layer **$224,654**

Memo: Assume bedding layer 250' x 250' or 62,500 SF. Layer will be 6" sand overlaying geotextile.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6		**$20,125,950**
Capital Costs		**$18,826,274**
Riprap Cover		**$781,776**

Riprap Layer

Tree Depth= 5

	B12G R.S.Means Crew	4,630	L.C.Y.	$55.68	$257,793
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	PPE 2 c/o per day 10 hr day cost per hr	480	hr	$1.95	$936
	B15 R.S.Means Crew	4,630	C.Y.	$17.69	$81,924
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	B81 R.S.Means Crew	62.50	M.S.F.	$56.24	$3,515
	B10G R.S.Means Crew	2,315	E.C.Y.	$1.25	$2,882
Memo: Compaction of 1 foot.					
LABOR	PRIME CONTRACTOR LABOR	136,991		$1.00	$136,991
Memo: 1,632 HOURS					
Subtotal					$490,120
1st Layer Markups assigned to Detail Items					$67,001

TOTAL Riprap Layer **$557,121**

Memo: Assume riprap layer is 250' x 250' or 62,500 SF at 2 feet thick or 4,630 CY. 2 foot of soil cover the same.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6		**$20,125,950**
Annual Costs		**$1,299,675**
Operations & Maintenance		**$1,153,066**

Inspections

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Inspections

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	20,180		$1.00	$20,180
Memo: 240 HOURS					

TOTAL Inspections **$21,156**
Memo: Annual Cost. General inspections of the action. Quarterly.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6		**$20,125,950**
Annual Costs		**$1,299,675**
Operations & Maintenance		**$1,153,066**

Weed Removal and Cover Inspection

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	10,090		$1.00	$10,090
Memo: 120 HOURS					

TOTAL Weed Removal and Cover Inspection **$10,578**
Memo: Annual Cost. Semiannual following the initial 100 years.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6		**$20,125,950**
Annual Costs		**$1,299,675**
Operations & Maintenance		**$1,153,066**

Groundwater Storage Tank Collection/Disposal

Tree Depth= 5

	1/2 TON 4WD TRUCKS, LARGE VANS	20	hrs	$5.45	$109
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	40	hrs	$2.70	$108
LABOR	PRIME CONTRACTOR LABOR	3,815		$1.00	$3,815
Memo: 50 HOURS					

TOTAL Groundwater Storage Tank Collection/Disposal **$4,032**
Memo: Annual Cost. Occurs once every year.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6		**$20,125,950**
Annual Costs		**$1,299,675**
Operations & Maintenance		**$1,153,066**

Extraction Well Pump Replacement

Tree Depth= 5

	Extraction Well Pump Installation	4	$42,032.80	$168,131

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Extraction Well Pump Replacement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	7,745		$1.00	$7,745
Memo: 100 HOURS					

TOTAL Extraction Well Pump Replacement **$175,876**
Memo: Occurs every 5 years.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Sign Replacement

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	20	hrs	$2.70	$54
	1/2 TON 4WD TRUCKS, LARGE VANS	20	hrs	$5.45	$109
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	2,392		$1.00	$2,392
Memo: 30 HOURS					

TOTAL Sign Replacement **$2,555**
Memo: Occurs every 30 years.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Above Grade Groundwater Components Replacement

Tree Depth= 5

	1,000 Gallon Water Tank	1		$1,100.00	$1,100
	Q1 R.S.Means Crew	5,000	L.F.	$22.36	$111,775
	LAUNDRY 2 CHANGES COST PER HOUR	800	hrs	$2.70	$2,160
	Pump House Building Pre Fab	1		$24,999.00	$24,999
Memo: Tank structure.					
	Extraction Well Subcontractor Mob/Demob	1		$34,878.49	$34,878
	Extraction Well Installation & Development	2		$65,577.27	$131,155
Memo: Assume quantity of 2 to represent total of 4 well re-develop.					
	1/2 TON 4WD TRUCKS, LARGE VANS	640	hrs	$5.45	$3,488
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	59,803		$1.00	$59,803
Memo: 800 HOURS					

Subtotal	$369,358
1st Layer Markups assigned to Detail Items	$45,704

TOTAL Above Grade Groundwater Components Replacement **$415,062**
Memo: Occurs every 50 years.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Extraction Well Replacement

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Extraction Well Subcontractor Mob/Demob	1		$34,878.49	$34,878
	Extraction Well Installation & Development	4		$65,577.27	$262,309
	Extraction Well Pump Installation	4		$42,032.80	$168,131
	LAUNDRY 2 CHANGES COST PER HOUR	1,040	hrs	$2.70	$2,808
Memo: LATAKY personnel plus assume 5 drillers.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	53,598		$1.00	$53,598
Memo: 640 HOURS					

TOTAL Extraction Well Replacement **$523,807**
Memo: Occurs every 100 years.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6		**$20,125,950**
Annual Costs		**$1,299,675**
Groundwater Monitoring		**$96,472**
Semiannual Monitoring		**$64,315**

Monitoring Well Sampling

Tree Depth= 6

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	8		$689.05	$5,512
LABOR	PRIME CONTRACTOR LABOR	25,165		$1.00	$25,165
Memo: 320 HOURS					

TOTAL Monitoring Well Sampling **$32,157**
Memo: 4 monitoring wells sampled semiannually. 5 hours per well.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6		**$20,125,950**
Annual Costs		**$1,299,675**
Groundwater Monitoring		**$96,472**
Semiannual Monitoring		**$64,315**

Extraction Well Sampling

Tree Depth= 6

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	8		$689.05	$5,512

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6				**$20,125,950**
	Annual Costs				**$1,299,675**
	Groundwater Monitoring				**$96,472**
	Semiannual Monitoring				**$64,315**

Extraction Well Sampling

Tree Depth= 6

LABOR	PRIME CONTRACTOR LABOR	25,165		$1.00	$25,165
Memo: 320 HOURS					

TOTAL Extraction Well Sampling **$32,157**
Memo: 4 extraction wells sampled semiannually. 5 hours per well.

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 6	**$20,125,950**
	Annual Costs	**$1,299,675**
	Groundwater Monitoring	**$96,472**
	Annual Monitoring	**$32,157**

Monitoring Well Sampling

Tree Depth= 6

	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	4		$689.05	$2,756
LABOR	PRIME CONTRACTOR LABOR	12,582.50		$1.00	$12,583
Memo: 160 HOURS					

TOTAL Monitoring Well Sampling **$16,079**
Memo: 4 monitoring wells sampled annually. 5 hours per well.

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 6	**$20,125,950**
	Annual Costs	**$1,299,675**
	Groundwater Monitoring	**$96,472**
	Annual Monitoring	**$32,157**

Extraction Well Sampling

Tree Depth= 6

	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	4		$689.05	$2,756
LABOR	PRIME CONTRACTOR LABOR	12,582.50		$1.00	$12,583
Memo: 160 HOURS					

TOTAL Extraction Well Sampling **$16,079**
Memo: 4 extraction wells sampled annually. 5 hours per well.

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 6			**$20,125,950**
	Annual Costs			**$1,299,675**
	Five Year Reviews			**$50,137**

Five Year Reviews

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,137	$1.00	$50,137
Memo: 500 HOURS				

TOTAL Five Year Reviews **$50,137**

COST ESTIMATE
BGOU SWMU 2
Alternative 6WDF—Targeted Excavation, Disposal, Containment, LUCs, and Monitoring

Cost Estimate Summary

	Capital Cost	Quantity	Units	Unit Price	Total					
	1.0 Remedial Design	1	LS	$1,574,000	$1,574,000					
	2.0 Other Project Plans	1	LS	$1,038,000	$1,038,000					
	3.0 Remedial Design Site Investigation (RDSI)	1	LS	$1,650,000	$1,650,000					
	4.0 Shoring	1	LS	$582,000	$582,000					
	5.0 Excavation	1	LS	$439,000	$439,000					
	6.0 Treat and Dispose of Water	1	LS	$98,000	$98,000					
	7.0 Post Remediation Sampling	1	LS	$20,000	$20,000					
	8.0 Waste Handling, Treatment, Disposal, and Transportation	1	LS	$3,610,000	$3,610,000					
	9.0 Excavation Backfill	1	LS	$240,000	$240,000					
	10.0 Chemical Treatment	1	LS	$1,045,000	$1,045,000					
	11.0 Hydraulic Isolation	1	LS	$2,138,000	$2,138,000					
	12.0 Surface Soils Consolidation	1	LS	$39,000	$39,000					
	13.0 Subtitle C Cap Construction	1	LS	$1,116,000	$1,116,000					
	14.0 Riprap Cover	1	LS	$782,000	$782,000					
	Subproject Management	1	LS	$1,437,100	$1,437,000					Subproject Management = 10%
	Management Reserve	1	LS	$2,371,200	$2,371,000					Contractor MR=15%
	Fee	1	LS	$1,272,530	$1,273,000					Fee = 7%.
	Contingency	1	LS	$3,890,400	$3,890,000					Contingency = 20%
			SUBTOTAL CAPITAL COST		**$23,342,000**					

COST ESTIMATE
BGOU SWMU 2
Alternative 6WDF—Targeted Excavation, Disposal, Containment, LUCs, and Monitoring

Annual Cost				Unescalated			Escalated (2.8%)		
Inspections	1000	EA	$21,000	$21,000,000			7.59E+17		Quarterly for 1,000 years
Weed Removal and Cover Inspection	900	EA	$11,000	$9,900,000			3.98E+17		Semi-annually following initial 100 years.
Groundwater Storage Tank Collection & Disposal	1000	EA	$4,000	$4,000,000			1.45E+17		Annually for 1,000 years.
Extraction Well Pump Replacement	200	EA	$176,000	$35,200,000			1.34E+18		Every 5 years for 1,000 years
Sign Replacement	33	EA	$3,000	$100,000			3.98E+15		Every 30 years for 1,000 years
Above Grade Groundwater Component Replacement and Redevelop Wells	20	EA	$415,000	$8,300,000			5.46E+17		Every 50 years for 1,000 years
Extraction Well Replacement	10	EA	$524,000	$5,240,000			5.51E+17		Every 100 years for 1,000 years
Groundwater Monitoring - First 5 years	5	EA	$64,000	$320,000			3.48E+05		Semi-annually for first 5 years
Groundwater Monitoring - Years 6 through 1000	995	EA	$32,000	$31,840,000			1.16E+18		Annually for years 6 through 1,000
Five-Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
	SUBTOTAL ANNUAL COST			**$125,900,000**			**5.28E+18**		
			TOTAL	**$149,242,000**					
Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	ls	$23,342,000	$23,342,000				**$23,342,000**	
Inspections	1000	EA	$21,000	$21,000,000				**$1,909,057**	1.1% discount rate
Weed Removal and Cover Inspection	900	EA	$11,000	$9,900,000				**$334,859**	1.1% discount rate
Groundwater Storage Tank Collection & Disposal	1000	EA	$4,000	$4,000,000				**$363,630**	1.1% discount rate
Extraction Well Pump Replacement	200	EA	$176,000	$35,200,000				**$3,130,315**	1.1% discount rate
Sign Replacement	33	EA	$3,000	$100,000				**$7,723**	1.1% discount rate
Above Grade Groundwater Component Replacement and Redevelop Wells	20	EA	$415,000	$8,300,000				**$570,001**	1.1% discount rate
Extraction Well Replacement	10	EA	$524,000	$5,240,000				**$263,809**	1.1% discount rate
Groundwater Monitoring - First 5 years	5	EA	$64,000	$320,000				**$309,705**	1.1% discount rate
Groundwater Monitoring - Years 6 through 1000	995	EA	$32,000	$31,840,000				**$2,754,187**	1.1% discount rate
Five-Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$23,342,000**	
						Present	**Annual**	**$10,533,000**	
						Worth	**Avg. Annual**	**$10,533**	
						Values	**Total**	**$33,875,000**	
This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.									
Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.									

COST ESTIMATE
BGOU SWMU 2
Alternative 6WDF—Targeted Excavation, Disposal, Containment, LUCs, and Monitoring

CAPITAL COSTS									
	Material/Equipment/Subcontractors/ODCs				Labor				
Task Description	**Qty**	**Unit**	**Unit Price**	**Total**	**Hours**	**Rate**	**Total**	**Total Cost**	**Basis of Estimate**
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					4224		$376,224		
Remedial Design Report					8744		$803,933		
Civil Surveying					216		$22,818		
Procurement					634		$52,676		
Work Packages/Readiness					1688		$146,788		
Training	1	LS	$68,800	$68,800	1320		$102,736		$68,800 includes subcontractor training and pyrophoric training
TASK TOTAL				**$68,800**	**16826**		**$1,505,175**	**$1,574,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					5724		$517,587		
O&M Plan					700		$66,863		
SAP/QAPP					1100		$96,201		
Waste Management Plan					1020		$94,190		
RACR					2274		$212,751		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**11402**		**$1,038,317**	**$1,038,000**	
3.0 Remedial Design Site Investigation (RDSI)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Drilling									
Prime Contractor Labor					4440		$362,305		
Subcontractors	1	LS	$168,834	$168,834					Local quote from existing drilling sub.
Materials	1	LS	$80,208	$80,208					
Vehicles and Equipment	1	LS	$8,720	$8,720					
Sampling									
Prime Contractor Labor					2000		$146,084		
Materials	1	LS	$29,434	$29,434					
Analytical									
Prime Contractor Labor					412		$39,228		
Materials	1	LS	$815,013	$815,013					
Excavation									
Prime Contractor Labor	0				0		$0		
Equipment	0	LS	$0	$0					
TASK TOTAL				**$ 1,102,209**	**6852**		**$ 547,617**	**$1,650,000**	
4.0 Shoring									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Sheet Piling									
Prime Contractor Labor					1345		$112,259		
Subcontractors	1	LS	$459,999	$459,999					
Materials	1	LS	$7,535	$7,535					
Vehicles and Equipment	1	LS	$2,616	$2,616					
TASK TOTALS				**$470,150**	**1,345**		**$112,259**	**$582,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 6WDF—Targeted Excavation, Disposal, Containment, LUCs, and Monitoring

5.0 Excavation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Overburden and Ramps									
Prime Contractor Labor					1134		$97,610		
Subcontractors	1	LS	$103,537	$103,537					
Materials	1	LS	$7,442	$7,442					
Vehicles and Equipment	1	LS	$1,526	$1,526					
Cells 6 & 8 TCE Waste									
Prime Contractor Labor					405		$34,861		
Subcontractors	1	LS	$19,120	$19,120					
Materials	1	LS	$2,658	$2,658					
Vehicles and Equipment	1	LS	$545	$545					
Cells 1,4,7,10, & 15 Incidental									
Prime Contractor Labor					972		$83,666		
Subcontractors	1	LS	$45,888	$45,888					
Materials	1	LS	$6,379	$6,379					
Vehicles and Equipment	1	LS	$1,308	$1,308					
Cell 9									
Prime Contractor Labor					243		$20,916		
Subcontractors	1	LS	$11,472	$11,472					
Materials	1	LS	$1,595	$1,595					
Vehicles and Equipment	1	LS	$327	$327					
TASK TOTALS				**$201,797**	**2,754**		**$237,053**	**$439,000**	
6.0 Treat and Dispose of Water									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Water Treatment									
Prime Contractor Labor					408		$29,037		
Subcontractors	1	LS	$46,778	$46,778					Rainforrent.com and RSMeans
Materials	1	LS	$1,898	$1,898					
Vehicles and Equipment	1	LS	$741	$741					
Water Disposal									
Prime Contractor Labor					40		$2,275		
Characterization Sampling	1	LS	$8,582	$8,582					
Vehicles and Equipment	1	LS	$8,334	$8,334					
TASK TOTALS				**$66,333**	**448**		**$31,312**	**$98,000**	
7.0 Post Remediation Sampling									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Sampling									
Prime Contractor Labor					50		$3,652		
Materials	1	LS	$5,879	$5,879					
Analytical									
Prime Contractor Labor					20		$1,839		
Materials	1	LS	$8,924	$8,924					
TASK TOTAL				**$ 14,803**	**70**		**$5,491**	**$20,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 6WDF—Targeted Excavation, Disposal, Containment, LUCs, and Monitoring

8.0 Waste Handling, Treatment, Disposal, and Transportation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Overburden and Ramps									
Prime Contractor Labor					1962		$130,925		
Materials	1	LS	$7,924	$7,924					
Characterization Sampling	1	LS	$49,476	$49,476					
Vehicles and Equipment	1	LS	$65,268	$65,268					
Cells 6 & 8 TCE Waste									
Prime Contractor Labor					3246		$232,987		
Materials	1	LS	$332,340	$332,340					
Characterization Sampling	1	LS	$36,596	$36,596					
Vehicles and Equipment	1	LS	$19,577	$19,577					
Disposal	1	LS	$1,129,516	$1,129,516					
Treatment	1	LS	$1,016,041	$1,016,041					
Transportation	1	LS	$395,720	$395,720					
Cells 1,4,7,10, & 15 Incidental									
Prime Contractor Labor					1279		$87,118		
Materials	1	LS	$10,537	$10,537					
Characterization Sampling	1	LS	$18,872	$18,872					
Vehicles and Equipment	1	LS	$34,912	$34,912					
Disposal	1	LS	$0	$0					
Transportation	1	LS	$0	$0					Costs contained in LATA Kentucky equipment and labor
Cell 9									
Prime Contractor Labor					364		$24,790		
Materials	1	LS	$2,949	$2,949					
Characterization Sampling	1	LS	$4,844	$4,844					
Vehicles and Equipment	1	LS	$9,975	$9,975					
Disposal	1	LS	$0	$0					
Transportation	1	LS	$0	$0					Costs contained in LATA Kentucky equipment and labor
TASK TOTALS				**$3,134,547**	**6,851**		**$475,820**	**$3,610,000**	
9.0 Excavation Backfill									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Backfill									
Prime Contractor Labor					639		$53,720		
Subcontractors	1	LS	$183,150	$183,150					RSMeans and local engineering firm
Materials	1	LS	$2,232	$2,232					
Vehicles and Equipment	1	LS	$872	$872					
TASK TOTAL				**$186,254**	**639**		**$53,720**	**$240,000**	
10.0 Chemical Treatment									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Jet Grouting									
Prime Contractor Labor					976		$80,065		
Subcontractors	1	LS	$953,000	$953,000					
Materials	1	LS	$8,506	$8,506					
Vehicles and Equipment	1	LS	$3,488	$3,488					
TASK TOTAL				**$964,994**	**976**		**$80,065**	**$1,045,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 6WDF—Targeted Excavation, Disposal, Containment, LUCs, and Monitoring

11.0 Hydraulic Isolation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Slurry Wall Construction									
Prime Contractor Labor					2599		$201,714		
Subcontractors	1	LS	$1,023,369	$1,023,369					
Materials	1	LS	$17,011	$17,011					
Vehicles and Equipment	1	LS	$32,732	$32,732					
Well Construction									
Prime Contractor Labor					800		$64,952		
Subcontractors	1	LS	$465,318	$465,318					Local quote from existing drilling sub.
Materials	1	LS	$14,161	$14,161					
Vehicles and Equipment	1	LS	$1,744	$1,744					
Tank and Piping									
Prime Contractor Labor					800		$59,803		
Subcontractors	1	LS	$157,479	$157,479					
Materials	1	LS	$29,819	$29,819					
Electrical				$0					
Prime Contractor Labor					401		$29,901		
Subcontractors	1	LS	$27,904	$27,904					
Materials	1	LS	$11,617	$11,617					
TASK TOTALS				**$1,781,154**	**4,600**		**$356,370**	**$2,138,000**	
12.0 Surface Soils Consolidation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Surveying and Marking									
Prime Contractor Labor					160		$14,145		
Materials	1	LS	$744	$744					
Soil Consolidation									
Prime Contractor Labor					120		$8,810		
Subcontractors	1	LS	$14,988	$14,988					
TASK TOTALS				**$15,732**	**280**		**$22,955**	**$39,000**	
13.0 Subtitle C Cap Construction									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Surveying, Marking, Testing									
Prime Contractor Labor					280		$28,905		
Subcontractors	1	LS	$80,102	$80,102					Local engineering firm
Materials	1	LS	$744	$744					
Cap Construction									
Prime Contractor Labor					3930		$313,495		
Subcontractors	1	LS	$663,439	$663,439					
Materials	1	LS	$14,880	$14,880					
Vehicles and Equipment	1	LS	$13,952	$13,952					
TASK TOTAL				**$ 773,117**	**4210**		**$342,400**	**$1,116,000**	

COST ESTIMATE
BGOU SWMU 2
Alternative 6WDF—Targeted Excavation, Disposal, Containment, LUCs, and Monitoring

14.0 Riprap Cover									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Bedding Layer									
Prime Contractor Labor					879		$74,808		
Subcontractors	1	LS	$145,871	$145,871					
Materials	1	LS	$2,232	$2,232					
Vehicles and Equipment	1	LS	$1,744	$1,744					
Riprap Layer									Includes 2' Soil Cover
Prime Contractor Labor					1632		$136,991		
Subcontractors	1	LS	$413,114	$413,114					
Materials	1	LS	$3,528	$3,528					
Vehicles and Equipment	1	LS	$3,488	$3,488					
TASK TOTAL				**$569,977**	**2511**		**$211,799**	**$782,000**	
						SUBTOTAL CAPITAL COST		**$14,371,000**	
ANNUAL COSTS									
Inspections									
Duration: Occurs quarterly for 1,000 years.									
Prime Contractor Labor					240		$20,180		
Materials	1	LS	$540	$540					
Vehicles and Equipment	1	LS	$436	$436					
TASK TOTAL				**$976**	**240**		**$20,180**	**$21,000**	ANNUAL COST
Weed Removal and Cover Inspection									
Duration: Semiannually following the first 100 years.									
Prime Contractor Labor					120		$10,090		
Materials	1	LS	$270	$270					
Vehicles and Equipment	1	LS	$218	$218					
TASK TOTAL				**$488**			**$10,090**	**$11,000**	ANNUAL COST
Groundwater Storage Tank Collection & Disposal									
Duration: Annually for 1,000 years.									
Prime Contractor Labor					50		$3,815		
Materials	1	LS	$108	$108					
Vehicles and Equipment	1	LS	$109	$109					
TASK TOTAL				**$217**			**$3,815**	**$4,000**	ANNUAL COST
Extraction Well Pump Replacement									
Duration: Every 5 years.									
Prime Contractor Labor					100		$7,745		
Subcontractors	1	LS	$168,131	$168,131					Local quote from existing drilling sub.
TASK TOTAL				**$168,131**			**$7,745**	**$176,000**	EVERY 5 YEARS
Sign Replacement									
Duration: Every 30 years.									
Prime Contractor Labor					30		$2,392		
Materials	1	LS	$108	$54					
Vehicles and Equipment	1	LS	$109	$109					
TASK TOTAL				**$163**			**$2,392**	**$3,000**	EVERY 30 YEARS
Above Grade Groundwater Component Replacement and Redevelop Wells									
Duration: Every 50 years.									
Prime Contractor Labor					800		$59,803		
Subcontractors	1	LS	$323,512	$323,512					RSMeans and local quote
Materials	1	LS	$28,259	$28,259					
Vehicles and Equipment	1	LS	$3,488	$3,488					
TASK TOTAL				**$355,259**			**$59,803**	**$415,000**	EVERY 50 YEARS

COST ESTIMATE
BGOU SWMU 2
Alternative 6WDF—Targeted Excavation, Disposal, Containment, LUCs, and Monitoring

Extraction Well Replacement									
Duration: Every 100 years.									
Prime Contractor Labor					640		$53,598		
Subcontractors	1	LS	$465,319	$465,319					
Materials	1	LS	$3,147	$3,147					
Vehicles and Equipment	1	LS	$1,744	$1,744					
TASK TOTAL				**$470,210**			**$53,598**	**$524,000**	EVERY 100 YEARS
Groundwater Monitoring - First 5 years									
Duration: Semiannually for the first 5 years.									
Prime Contractor Labor					640		$50,330		
Laboratory	1	LS	$12,033	$12,033					
Materials	1	LS	$1,080	$1,080					
Vehicles and Equipment	1	LS	$872	$872					
TASK TOTAL				**$13,985**			**$50,330**	**$64,000**	ANNUAL COST
Groundwater Monitoring - Years 6 through 1000									
Duration: Annually for years 6 through 1000									
Prime Contractor Labor					320		$25,165		
Laboratory	1	LS	$6,016	$6,016					
Materials	1	LS	$540	$540					
Vehicles and Equipment	1	LS	$436	$436					
TASK TOTAL				**$6,992**			**$25,165**	**$32,000**	ANNUAL COST
Five-Year Review									
Duration: Every 5 years.									
Prime Contractor Labor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study

Reported From: SWMU 2 Alternative 6WDF
Report Total: $15,669,890

Author
Manager

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 6WDF			**$15,669,890**
	Capital Costs			**$14,370,215**
	Remedial Desgin			**$1,573,975**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	376,224	$1.00	$376,224

Memo: 4,224 HOURS

TOTAL RDWP/RDSI Work Plan **$376,224**

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 6WDF	**$15,669,890**
	Capital Costs	**$14,370,215**
	Remedial Desgin	**$1,573,975**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	803,933	$1.00	$803,933

Memo: 8,744 HOURS

TOTAL RDR **$803,933**

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 6WDF	**$15,669,890**
	Capital Costs	**$14,370,215**
	Remedial Desgin	**$1,573,975**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	22,818	$1.00	$22,818

Memo: 216 HOURS

TOTAL Civil Surveying **$22,818**

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 6WDF	**$15,669,890**
	Capital Costs	**$14,370,215**
	Remedial Desgin	**$1,573,975**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	52,676	$1.00	$52,676

Memo: 634 HOURS

TOTAL Procurement **$52,676**

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 6WDF	**$15,669,890**
	Capital Costs	**$14,370,215**
	Remedial Desgin	**$1,573,975**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	146,788	$1.00	$146,788

Memo: 1,688 HOURS

TOTAL Work Packages/Readiness Review **$146,788**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 6WDF			**$15,669,890**
	Capital Costs			**$14,370,215**
	Remedial Desgin			**$1,573,975**

Training

Tree Depth= 5

LEVEL		QTY	UNIT COST	TOTAL
	Pyrophoric U Training per Person	16	$800.00	$12,800
Memo: Assume $800 per person. This is consistent with the previous FS submittal.				
	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
Memo: Assume 80 hours of training per person. Assume 10 people or 800 hours.				
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training **$171,536**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6WDF		**$15,669,890**
Capital Costs		**$14,370,215**
Other Project Plans		**$1,038,317**

RAWP

Tree Depth= 5

LEVEL		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	517,587	$1.00	$517,587
Memo: 5,724 HOURS				

TOTAL RAWP **$517,587**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6WDF		**$15,669,890**
Capital Costs		**$14,370,215**
Other Project Plans		**$1,038,317**

O&M Plan

Tree Depth= 5

LEVEL		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan **$66,863**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6WDF		**$15,669,890**
Capital Costs		**$14,370,215**
Other Project Plans		**$1,038,317**

SAP/QAPP

Tree Depth= 5

LEVEL		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	96,201	$1.00	$96,201
Memo: 1,100 HOURS				

TOTAL SAP/QAPP **$96,201**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Other Project Plans				**$1,038,317**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	94,190		$1.00	$94,190
Memo: 1,020 HOURS					

TOTAL Waste Management Plan **$94,190**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6WDF		**$15,669,890**
Capital Costs		**$14,370,215**
Other Project Plans		**$1,038,317**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	212,751		$1.00	$212,751
Memo: 2,274 HOURS					

TOTAL RACR **$212,751**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6WDF		**$15,669,890**
Capital Costs		**$14,370,215**
Other Project Plans		**$1,038,317**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6WDF		**$15,669,890**
Capital Costs		**$14,370,215**
RDSI		**$1,649,826**

Drilling

Tree Depth= 5

	Mob/Demob for DPT subcontractor	1		$8,500.00	$8,500
	DPT Borings to 40 feet	30		$1,635.00	$49,050
Memo: 2 borings per day - 15 days of borings plus 1 week for mob and 1 week for demob.					
	1/2 TON 4WD TRUCKS, LARGE VANS	1,600	hrs	$5.45	$8,720
Memo: 4 LATAKY vehicles.					
	55 GALLON DRUM	8		$84.68	$677
Memo: 8 drums for drill cuttings.					
	ST-90 CONTAINER DELIVERED	4		$1,770.63	$7,083
Memo: 4 ST-90 box for PPE/Trash.					
	PORTABLE TOILET & HAND WASH PER MONTH	3		$227.21	$682
Memo: Rent for 3 months.					
	LAUNDRY 2 CHANGES COST PER HOUR	5,400	hrs	$2.70	$14,580
Memo: LATAKY personnel plus assume 5 drillers.					
	DPT Borings to 65 feet	12		$2,573.00	$30,876
Memo: Angled borings - assume 65 feet deep.					

SWMUs 2,3,7&30 Feasibility Study

Reported From: SWMU 2 Alternative 6WDF
Report Total: $15,669,890

Author
Manager

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	RDSI				**$1,649,826**

Drilling

Tree Depth= 5

LEVEL	Description	QTY		UNIT COST	TOTAL
	DPT Borings to 40 feet	8		$1,635.00	$13,080
Memo:	8 additional borings following waste stabilization.				
	DPT Borings to 65 feet	16		$2,573.00	$41,168
Memo:	16 additional borings from grade, around the perimeter of the 2 additional sites.				
	DPT Borings to 40 feet	16		$1,635.00	$26,160
Memo:	16 additional borings from bottom of excavation, at the 2 additional sites.				
	Resp cleaning 10 hr day 2 C/O per day cost per hr	5,400		$5.19	$28,026
	PPE 2 c/o per day 10 hr day cost per hr	5,400		$1.95	$10,530
	MSA OptiFilter HEPA per hour	5,400		$3.45	$18,630
LABOR	PRIME CONTRACTOR LABOR	362,305		$1.00	$362,305
Memo:	4,440 HOURS				

TOTAL Drilling **$620,067**

Memo: Same as alternative 4B but added 8 borings at the bottom of the excavation and 8 borings outside the excavation area. This is at 2 sites so 32 total additional borings. Assume 10 weeks.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	RDSI				**$1,649,826**

Sampling

Tree Depth= 5

LEVEL	Description	QTY		UNIT COST	TOTAL
	5 gram EN CORE SAMPLER	800		$6.94	$5,552
	Niton XRF Rental One Month	3		$4,500.00	$13,500
	PCB Test Kits	2		$541.00	$1,082
	LAUNDRY 2 CHANGES COST PER HOUR	2,000	hrs	$2.70	$5,400
	PPE 2 c/o per day 10 hr day cost per hr	2,000		$1.95	$3,900
LABOR	PRIME CONTRACTOR LABOR	146,084		$1.00	$146,084
Memo:	2,000 HOURS				

TOTAL Sampling **$175,518**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	RDSI				**$1,649,826**

Analytical

Tree Depth= 5

LEVEL	Description	QTY		UNIT COST	TOTAL
	Overnight Shipment per Cooler	80		$251.97	$20,158
Memo:	Assume 2 shipments per day for 39 days plus 1 shipment later for the waste water.				
	RDSI Geophysical Sampling Analytical	1		$1,275.00	$1,275
Memo:	3 Geophysical samples taken for particle size and atterberg limits.				

Company

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	RDSI				**$1,649,826**

Analytical

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	RDSI Soil Sampling Analytical	1		$262,775.00	$262,775
Memo: 8 samples from 30 borings = 240 samples.					
	RDSI Soil Sampling Analytical	0.92		$262,775.00	$241,753
Memo: 8 samples from 8 additional borings = 64 samples. 13 samples from 12 angled borings = 156 samples. Total of 220 samples. 220/240 = .92					
	RDSI Soil Sampling Analytical	1.10		$262,775.00	$289,053
Memo: 8 samples from 32 additional borings = 256 samples. 256/240 = 1.1					
LABOR	PRIME CONTRACTOR LABOR	39,228		$1.00	$39,228
Memo: 412 HOURS					

TOTAL Analytical **$854,241**

	Estimate Tree Structure Rollups		
	SWMU 2 Alternative 6WDF		**$15,669,890**
	Capital Costs		**$14,370,215**
	Shoring		**$582,408**

Sheet Piling

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	B40 R.S.Means Crew	230	Ton	$1,054.32	$242,494
	RSMeans Crew B-43 cost per day	7		$5,600.00	$39,200
	Tieback Materials	0.25		$336,000.00	$84,000
Memo: Backup is for 400 tiebacks so 25%.					
	1/2 TON 4WD TRUCKS, LARGE VANS	480	hrs	$5.45	$2,616
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	840	hrs	$2.70	$2,268
	Mob/Demob of Subcontractor and Equipment	1		$40,000.00	$40,000
	Resp cleaning 10 hr day 2 C/O per day cost per hr	420		$5.19	$2,180
	PPE 2 c/o per day 10 hr day cost per hr	840		$1.95	$1,638
	MSA OptiFilter HEPA per hour	420		$3.45	$1,449
LABOR	PRIME CONTRACTOR LABOR	112,259		$1.00	$112,259
Memo: 1,345 HOURS					
Subtotal					$528,103
1st Layer Markups assigned to Detail Items					$54,305

TOTAL Sheet Piling **$582,408**

Memo: 230 tons of piling. Tiebacks every 2 piles on the deeper piles so 100. Pile driving, extract, and salvage is 12.5 tons per day = 19 days. Tiebacks are 18 per day so 6 days + 5% failure rate = 7 days. Assume 5 day overlap so 24 day duration.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Excavation				**$438,849**

Overburden and Ramps

Tree Depth= 5

	RSMeans Crew B-10W cost per day	14		$1,470.00	$20,580
	RSMeans Crew B-12C cost per day	14		$2,354.00	$32,956
	Mob/Demob of Subcontractor and Equipment	1	LS	$50,000.00	$50,000
	LAUNDRY 2 CHANGES COST PER HOUR	560	hrs	$2.70	$1,512
	1/2 TON 4WD TRUCKS, LARGE VANS	280	hrs	$5.45	$1,526
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	560		$5.19	$2,906
	PPE 2 c/o per day 10 hr day cost per hr	560		$1.95	$1,092
	MSA OptiFilter HEPA per hour	560		$3.45	$1,932
LABOR	PRIME CONTRACTOR LABOR	97,610		$1.00	$97,610
Memo: 1,134 HOURS					

TOTAL Overburden and Ramps **$210,114**

Memo: 2605 BCY. Assume 225 CY per day so 12 days + weather/delays. Assume 14 day duration.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6WDF	**$15,669,890**
Capital Costs	**$14,370,215**
Excavation	**$438,849**

Cells 6 & 8 TCE Waste

Tree Depth= 5

	RSMeans Crew B-10W cost per day	5		$1,470.00	$7,350
	RSMeans Crew B-12C cost per day	5		$2,354.00	$11,770
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	100	hrs	$5.45	$545
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	200		$5.19	$1,038
	PPE 2 c/o per day 10 hr day cost per hr	200		$1.95	$390
	MSA OptiFilter HEPA per hour	200		$3.45	$690
LABOR	PRIME CONTRACTOR LABOR	34,861		$1.00	$34,861
Memo: 405 HOURS					

TOTAL Cells 6 & 8 TCE Waste **$57,184**

Memo: 385 BCY. Excavating and moving a 100 CY per day, so 4 days plus weather/delays is 5 days.

Estimate Tree Structure Rollups	
SWMU 2 Alternative 6WDF	**$15,669,890**
Capital Costs	**$14,370,215**
Excavation	**$438,849**

Cells 1,4,7,10, & 15 Incidental Waste

Tree Depth= 5

	RSMeans Crew B-10W cost per day	12		$1,470.00	$17,640

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Excavation				**$438,849**

Cells 1,4,7,10, & 15 Incidental Waste

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-12C cost per day	12		$2,354.00	$28,248
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	1/2 TON 4WD TRUCKS, LARGE VANS	240	hrs	$5.45	$1,308
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	480		$5.19	$2,491
	PPE 2 c/o per day 10 hr day cost per hr	480		$1.95	$936
	MSA OptiFilter HEPA per hour	480		$3.45	$1,656
LABOR	PRIME CONTRACTOR LABOR	83,666		$1.00	$83,666
Memo: 972 HOURS					

TOTAL Cells 1,4,7,10, & 15 Incidental Waste **$137,241**

Memo: 962 BCY. Excavating and moving a 100 CY per day, so 10 days plus weather/delays is 12 days.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6WDF		**$15,669,890**
Capital Costs		**$14,370,215**
Excavation		**$438,849**

Cell 9

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	3		$1,470.00	$4,410
	RSMeans Crew B-12C cost per day	3		$2,354.00	$7,062
	LAUNDRY 2 CHANGES COST PER HOUR	120	hrs	$2.70	$324
	1/2 TON 4WD TRUCKS, LARGE VANS	60	hrs	$5.45	$327
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	120		$5.19	$623
	PPE 2 c/o per day 10 hr day cost per hr	120		$1.95	$234
	MSA OptiFilter HEPA per hour	120		$3.45	$414
LABOR	PRIME CONTRACTOR LABOR	20,916		$1.00	$20,916
Memo: 243 HOURS					

TOTAL Cell 9 **$34,310**

Memo: 192 BCY. Excavating and moving a 100 CY per day, so 2 days plus weather/delays is 3 days.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6WDF		**$15,669,890**
Capital Costs		**$14,370,215**
Treat and Dispose of Water		**$97,644**

Water Treatment

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B10H R.S.Means Crew	34	Day	$581.53	$19,772
	Water Treatment System w/ Tanks per month	2		$7,785.00	$15,570
Memo: Packaged system with 2 frac tanks.					
	LAUNDRY 2 CHANGES COST PER HOUR	408	hrs	$2.70	$1,102

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Treat and Dispose of Water				**$97,644**

Water Treatment

Tree Depth= 5

	1/2 TON 4WD TRUCKS, LARGE VANS	136	hrs	$5.45	$741
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	408		$1.95	$796
LABOR	PRIME CONTRACTOR LABOR	29,037		$1.00	$29,037
Memo: 408 HOURS					
Subtotal					$67,018
1st Layer Markups assigned to Detail Items					$11,435
TOTAL Water Treatment					**$78,453**
Memo: 2 months					

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Treat and Dispose of Water				**$97,644**

Water Disposal

Tree Depth= 5

	Water Truck 10k Gallon cost per hr	40	hr	$208.34	$8,334
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Water Cost per Sample	10		$833.00	$8,330
Memo:					
LABOR	PRIME CONTRACTOR LABOR	2,275		$1.00	$2,275
Memo: 40 HOURS					
TOTAL Water Disposal					**$19,191**

Assume Frac tanks will be emptied every 2 months.
1 * 5 tanks * 20,000 gallons = 100,000 gallons.
Assume a water sample will be taken from each water truck (10,000 gallons).
100,000 gallons / 10,000 = 10 samples.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Post Remediation Sampling				**$20,294**

Sampling

Tree Depth= 5

	5 gram EN CORE SAMPLER	25		$6.94	$174
	Niton XRF Rental One Month	1		$4,500.00	$4,500
	PCB Test Kits	1		$541.00	$541
	LAUNDRY 2 CHANGES COST PER HOUR	50	hrs	$2.70	$135
	Resp cleaning 10 hr day 2 C/O per day cost per hr	50		$5.19	$260
	PPE 2 c/o per day 10 hr day cost per hr	50		$1.95	$98
	MSA OptiFilter HEPA per hour	50		$3.45	$173

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Post Remediation Sampling				**$20,294**

Sampling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	3,652		$1.00	$3,652
Memo: 50 HOURS					

TOTAL Sampling **$9,531**
Memo: 25 foot grid. Assume 8 total samples. 1 day duration.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Post Remediation Sampling				**$20,294**

Analytical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Overnight Shipment per Cooler	1		$251.97	$252
	RDSI Soil Sampling Analytical	0.03		$289,052.67	$8,672
Memo: From Alt. 3: 8 samples from 30 borings = 240 samples. 8 / 240 = .033					
LABOR	PRIME CONTRACTOR LABOR	1,839		$1.00	$1,839
Memo: 20 HOURS					

TOTAL Analytical **$10,763**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Waste Handling/Treatment/Disposal/Transportation				**$3,610,366**

Overburden and Ramps

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	1,820	hrs	$2.70	$4,914
	1/2 TON 4WD TRUCKS, LARGE VANS	280	hrs	$5.45	$1,526
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	700	hr	$91.06	$63,742
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	70		$43.00	$3,010
	Overnight Shipment per Cooler	5		$251.97	$1,260
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	42		$1,148.00	$48,216
Memo: 3,126 LCY / 15 CY = 208. Assume 20% sampling rate. 208 / 5 = 42 samples.					
LABOR	PRIME CONTRACTOR LABOR	130,925		$1.00	$130,925
Memo: 1,962 HOURS					

TOTAL Overburden and Ramps **$253,593**
Memo: U Landfill WAC Compliant. 2,605 BCY x 1.2 = 3,126 LCY.
Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 14 days.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Waste Handling/Treatment/Disposal/Transportation				**$3,610,366**

Cells 6 & 8 TCE Waste

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	2,520	hrs	$2.70	$6,804
	1/2 TON 4WD TRUCKS, LARGE VANS	360	hrs	$5.45	$1,962
Memo: 2 LATAKY vehicles.					
	Skid Steer per hour	180	hr	$32.54	$5,857
	18,000 lb Fork Lift per hour	360	hr	$32.66	$11,758
	ST-90 CONTAINER DELIVERED	154		$1,770.63	$272,677
Memo: 462 LCY / 3 CY per box = 154 boxes.					
	MLLW Soil Disposal at ES ST90 by Truck per CY	1,096		$1,030.58	$1,129,516
Memo: 154 boxes x 96 CF per box = 14,784 CF / 27 = 548 CY. Double volume so 1,096 CY.					
	Absorbent 50lb bag delivered cost per bag	154		$240.64	$37,059
	MLLW Treatment at ES ST90 per CY	548		$1,854.09	$1,016,041
Memo: 154 boxes x 96 CF per box = 14,784 CF / 27 = 548 CY.					
	Transportation to ES by Truck	52		$7,610.00	$395,720
Memo: Assume 3 boxes per truck. 154 / 3 = 52 trips.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,260		$5.19	$6,539
	PPE 2 c/o per day 10 hr day cost per hr	2,520		$1.95	$4,914
	MSA OptiFilter HEPA per hour	1,260		$3.45	$4,347
	Overnight Shipment per Cooler	4		$251.97	$1,008
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	31		$1,148.00	$35,588
Memo: Assume 20% sampling rate. 154 / 5 = 31 samples.					
LABOR	PRIME CONTRACTOR LABOR	232,987		$1.00	$232,987
Memo: 3,246 HOURS					

TOTAL Cells 6 & 8 TCE Waste **$3,162,777**

Memo: 385 BCY x 1.2 = 462 LCY. Ship to ES for treatment and disposal using ST-90 boxes. Assume can load 10 boxes per day. 154 boxes / 10 = 16 days plus delays/weather = 18 days.

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 6WDF	**$15,669,890**
	Capital Costs	**$14,370,215**
	Waste Handling/Treatment/Disposal/Transportation	**$3,610,366**

Cells 1,4,7,10 & 15 Incidental Waste

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	1,050	hrs	$2.70	$2,835
	1/2 TON 4WD TRUCKS, LARGE VANS	140	hrs	$5.45	$763
Memo: 2 LATAKY vehicles.					
	Skid Steer per hour	70	hr	$32.54	$2,278
	15 CY Dump Truck per hour	350	hr	$91.06	$31,871
Memo: 5 trucks for 7 days.					
	Dump Truck Liner	26		$43.00	$1,118

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Waste Handling/Treatment/Disposal/Transportation				**$3,610,366**

Cells 1,4,7,10 & 15 Incidental Waste

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Resp cleaning 10 hr day 2 C/O per day cost per hr	525		$5.19	$2,725
	PPE 2 c/o per day 10 hr day cost per hr	1,050		$1.95	$2,048
	MSA OptiFilter HEPA per hour	525		$3.45	$1,811
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	16		$1,148.00	$18,368
Memo: 1,155 LCY / 15 CY = 77. Assume 20% sampling rate. 77 / 5 = 16 samples.					
LABOR	PRIME CONTRACTOR LABOR	87,118		$1.00	$87,118
Memo: 1,279 HOURS					

TOTAL Cells 1,4,7,10 & 15 Incidental Waste **$151,438**

Memo: 962 BCY x 1.2 = 1,155 LCY. Ship to OSWDF for disposal using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 6 days weather/delays = 7 days.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Waste Handling/Treatment/Disposal/Transportation				**$3,610,366**

Cell 9

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	300	hrs	$2.70	$810
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
	Skid Steer per hour	20	hr	$32.54	$651
	15 CY Dump Truck per hour	100	hr	$91.06	$9,106
Memo: 5 trucks for 7 days.					
	Dump Truck Liner	6		$43.00	$258
	Resp cleaning 10 hr day 2 C/O per day cost per hr	150		$5.19	$779
	PPE 2 c/o per day 10 hr day cost per hr	300		$1.95	$585
	MSA OptiFilter HEPA per hour	150		$3.45	$518
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	4		$1,148.00	$4,592
Memo: 230 LCY / 15 CY = 15.33 Assume 20% sampling rate. 15.33 / 5 = 4 samples.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Waste Handling/Treatment/Disposal/Transportation				**$3,610,366**

Cell 9

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	24,790		$1.00	$24,790
Memo: 364 HOURS					

TOTAL Cell 9 **$42,558**

Memo: 192 BCY x 1.2 = 230 LCY. Ship to OSWDF for disposal using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 2 days.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6WDF		**$15,669,890**
Capital Costs		**$14,370,215**
Excavation Backfill		**$239,974**

Backfill

Tree Depth= 5

	B10D R.S.Means Crew	4,977	E.C.Y.	$2.67	$13,276
	B34C R.S.Means Crew	4,977	L.C.Y.	$7.98	$39,713
	Backfill Delivered per CY	4,977		$16.00	$79,632
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	1/2 TON 4WD TRUCKS, LARGE VANS	160	hrs	$5.45	$872
Memo: 2 LATAKY vehicles.					
	Geotechnical Testing Technician per hour	80		$52.19	$4,175
	Geotechnical Testing Density Testing per hour	80		$50.00	$4,000
	RSMeans Crew B-10W cost per day	8		$1,470.00	$11,760
	RSMeans Crew B-10P cost per day	8		$2,129.00	$17,032
	PPE 2 c/o per day 10 hr day cost per hr	480		$1.95	$936
LABOR	PRIME CONTRACTOR LABOR	53,720		$1.00	$53,720
Memo: 639 HOURS					

Subtotal	$226,412
1st Layer Markups assigned to Detail Items	$13,562

TOTAL Backfill **$239,974**

Memo: 4,147 BCY total removed. 4,147 x 1.2 = 4,977 CY of fill needed. Assume 750 CY filled per day. 4,977 / 750 = 7 days + weather/delays = 8 days. Fill is stockpiled during other activities and transfered to site as needed.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6WDF		**$15,669,890**
Capital Costs		**$14,370,215**
Chemical Treatment		**$1,045,059**

Jet Grouting

Tree Depth= 5

	Jet Grouting w/ Cement Grouting per CY	1,800	CY	$300.00	$540,000
Memo: Reference STANTEC.					
	Jet Grouting Mob/DeMob	1		$125,000.00	$125,000
	Zero Valient Iron cost per CF	48,000	CF	$6.00	$288,000
Memo: Adder for using ZVI. Assume $6 per treated CF.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Chemical Treatment				**$1,045,059**

Jet Grouting

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	1/2 TON 4WD TRUCKS, LARGE VANS	640	hrs	$5.45	$3,488
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	640	hrs	$2.70	$1,728
	Resp cleaning 10 hr day 2 C/O per day cost per hr	640		$5.19	$3,322
	PPE 2 c/o per day 10 hr day cost per hr	640		$1.95	$1,248
	MSA OptiFilter HEPA per hour	640		$3.45	$2,208
LABOR	PRIME CONTRACTOR LABOR	80,065		$1.00	$80,065
Memo: 976 HOURS					

TOTAL Jet Grouting **$1,045,059**

Memo: 2 waste areas. 20' x 20' or 400 SF and 20' x 40' or 800 SF. Total of 1,200 SF. Treatment from 20' BGS to 60' BGS. 1,200 SF x 40' = 48,000 CF or 1,800 CY. Assume 1 month duration.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Hydraulic Isolation				**$2,137,523**

Slurry Wall Construction

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	C7 R.S.Means Crew	32,000	S.F.	$21.10	$675,221
	1/2 TON 4WD TRUCKS, LARGE VANS	1,288	hrs	$5.45	$7,020
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,280	hrs	$2.70	$3,456
	CATERPILLAR 345B CRAWLER MOUNTED SHEAR HEAD EXCAVATOR	320	hr	$62.12	$19,878
	JOHN DEERE 624E 4WD ARTICULATED WHEEL LOADER	320	hr	$18.23	$5,834
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,280		$5.19	$6,643
	PPE 2 c/o per day 10 hr day cost per hr	1,280		$1.95	$2,496
	MSA OptiFilter HEPA per hour	1,280		$3.45	$4,416
LABOR	PRIME CONTRACTOR LABOR	201,714		$1.00	$201,714
Memo: 2,599 HOURS					

Subtotal	$926,678
1st Layer Markups assigned to Detail Items	$348,148

TOTAL Slurry Wall Construction **$1,274,826**

Memo: Assume wall is approx. 200' x 200' or 800 LF 800 LF x 40' deep = 32,000 SF. Assume 25 linear feet per day: 800 / 25 = 32 days assume 2 months due to weather delays and equipment repairs.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Hydraulic Isolation				**$2,137,523**

Well Construction

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Extraction Well Subcontractor Mob/Demob	1		$34,878.49	$34,878
	Extraction Well Installation & Development	4		$65,577.27	$262,309
	Extraction Well Pump Installation	4		$42,032.80	$168,131
	LAUNDRY 2 CHANGES COST PER HOUR	1,040	hrs	$2.70	$2,808
Memo: LATAKY personnel plus assume 5 drillers.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,040		$5.19	$5,398
	PPE 2 c/o per day 10 hr day cost per hr	1,040		$1.95	$2,028
	MSA OptiFilter HEPA per hour	1,040		$3.45	$3,588
LABOR	PRIME CONTRACTOR LABOR	64,952		$1.00	$64,952
Memo: 800 HOURS					

TOTAL Well Construction **$546,175**
Memo: 4 week duration.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6WDF		**$15,669,890**
Capital Costs		**$14,370,215**
Hydraulic Isolation		**$2,137,523**

Tank & Piping

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	1,000 Gallon Water Tank	1		$1,100.00	$1,100
	Q1 R.S.Means Crew	5,000	L.F.	$22.36	$111,775
	LAUNDRY 2 CHANGES COST PER HOUR	800	hrs	$2.70	$2,160
	Pump House Building Pre Fab	1		$24,999.00	$24,999
Memo: Tank structure.					
	PPE 2 c/o per day 10 hr day cost per hr	800		$1.95	$1,560
LABOR	PRIME CONTRACTOR LABOR	59,803		$1.00	$59,803
Memo: 800 HOURS					
Subtotal					$201,397
1st Layer Markups assigned to Detail Items					$45,704

TOTAL Tank & Piping **$247,101**

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6WDF		**$15,669,890**
Capital Costs		**$14,370,215**
Hydraulic Isolation		**$2,137,523**

Electrical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans D5010 120 0220 Electrical Service	1		$2,417.00	$2,417
Memo: Includes O&P.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Hydraulic Isolation				**$2,137,523**

Electrical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	R3 R.S.Means Crew	5	Ea.	$1,024.44	$5,122
	1/0 Triplex Service Wire per foot	2,000		$3.67	$7,340
	Electricians	5	Ea.	$298.89	$1,494
	Electricians	500	L.F.	$10.39	$5,193
	Electricians	20	C.L.F.	$52.34	$1,047
	Electricians	2	Ea.	$305.84	$612
Memo: (2) 1,500 Watt heater per tank x 1 tanks = 2 heaters.					
	Electricians	800	L.F.	$8.14	$6,509
	Electricians	4	Ea.	$288.89	$1,156
	Electricians	4	C.L.F.	$93.39	$374
	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780
LABOR	PRIME CONTRACTOR LABOR	29,901		$1.00	$29,901
Memo: 401 HOURS					
Subtotal					$63,024
1st Layer Markups assigned to Detail Items					$6,397
TOTAL Electrical					**$69,421**

Memo: Assumes 1 metering point. Secondary service wire ran to 4 wells and the tank on poles.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Surface Soils Consolidation				**$38,688**

Surveying and Marking

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
LABOR	PRIME CONTRACTOR LABOR	14,145		$1.00	$14,145
Memo: 160 HOURS					
TOTAL Surveying and Marking					**$14,889**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Surface Soils Consolidation				**$38,688**

Soil Consolidation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B10L R.S.Means Crew	270	B.C.Y.	$15.21	$4,106
	B10G R.S.Means Crew	270	E.C.Y.	$0.69	$187
	Water Truck 10k Gallon cost per hr	40	hrs	$208.34	$8,334
	PPE 2 c/o per day 10 hr day cost per hr	160	hr	$1.95	$312
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Surface Soils Consolidation				**$38,688**

Soil Consolidation

Tree Depth= 5

		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	8,810		$1.00	$8,810
Memo: 120 HOURS					
Subtotal					$22,180
1st Layer Markups assigned to Detail Items					$1,618
TOTAL Soil Consolidation					**$23,799**

Memo: Assume depth of 2 feet. 25% of area outside cap or 270 CY.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Cap Construction				**$1,115,518**

Surveying, Marking, Testing

Tree Depth= 5

		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
	Geotechnical Testing Technician per hour	960		$52.19	$50,102
Memo: Construction 2 FTE. Geotechnical testing, data recording, surveying, and reporting.					
	Geotechnical Testing Density Testing per hour	600		$50.00	$30,000
Memo: Construction Nuclear Density testing per hour. Estimated 60 days.					
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
LABOR	PRIME CONTRACTOR LABOR	28,905		$1.00	$28,905
Memo: 280 HOURS					
TOTAL Surveying, Marking, Testing					**$109,751**

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Cap Construction				**$1,115,518**

Cap Construction

Tree Depth= 5

		QTY		UNIT COST	TOTAL
	B15 R.S.Means Crew	1,630	C.Y.	$16.49	$26,885
Memo: Estimated average of 12" soil needed to bring low spots up to the high point. SOURCE = RSMEANS.					
	B10G R.S.Means Crew	1,630	E.C.Y.	$1.25	$2,029
Memo: Compaction of Leveling Layer.					
	B15 R.S.Means Crew	3,585	C.Y.	$29.84	$106,991
Memo: CLAY LINER LAYER: 24" clay layer.					
	B10G R.S.Means Crew	3,585	E.C.Y.	$1.25	$4,463
Memo: Compaction of Clay Liner Layer.					
	Skilled Workers Average (35 trades)	52.90	M.S.F.	$1,156.55	$61,181
	B15 R.S.Means Crew	2,133	C.Y.	$23.34	$49,793
Memo: DRAINAGE LAYER: 12" sand layer.					
	B10G R.S.Means Crew	2,133	E.C.Y.	$1.25	$2,655
Memo: Compaction of Sand Layer.					
	Common Building Laborers	57,600	S.Y.	$2.09	$120,321

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Cap Construction				**$1,115,518**

Cap Construction

Tree Depth= 5

LEVEL	Item	QTY	Unit	UNIT COST	TOTAL
	B15 R.S.Means Crew	4,630	C.Y.	$27.34	$126,603
Memo: Topsoil Layer - Assume 2 feet of protective soil (62,500 * 2) / 27 = 4,630 CY.					
	B10G R.S.Means Crew	4,630	E.C.Y.	$1.25	$5,764
Memo: Compaction of the 2 feet of protective soil.					
	B34K R.S.Means Crew	4	Ea.	$423.07	$1,692
Memo: Mob/Demob for 2 dozers and 2 compactors.					
	1/2 TON 4WD TRUCKS, LARGE VANS	2,560	hrs	$5.45	$13,952
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	3,200	hrs	$2.70	$8,640
	Corner Monuments	4		$20,000.00	$80,000
	PPE 2 c/o per day 10 hr day cost per hr	3,200		$1.95	$6,240
LABOR	PRIME CONTRACTOR LABOR	313,495		$1.00	$313,495
Memo: 3,930 HOURS					

Subtotal	$930,704
1st Layer Markups assigned to Detail Items	$75,062

TOTAL Cap Construction **$1,005,766**

Memo: Assume 4 month duration. 3 months for dirt work and 1 month for mob/demob and HDPE liner installation.
Cap area is 44,000 SF. Assume perimeter increases by a linear 10 feet for every layer.
Layer 1: Leveling Layer - Assume 1 foot of soil to form a base. (44,000 *1) / 27 = 1,630 CY.
Layer 2: Clay Liner - Assume 2 feet of clay. (48,400 * 2) / 27 = 3,585 CY.
Layer 3: Geomembrane - Assume 52,900 SF
Layer 4: Drainage Layer - Assume 1 feet of sand. (57,600 * 1) / 27 = 2,133 CY.
Layer 5: Geotextile Fabric. 57,600 SF.
Layer 6: Topsoil Layer - Assume 2 feet of protective soil (62,500 * 2) / 27 = 4,630 CY.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6WDF		**$15,669,890**
Capital Costs		**$14,370,215**
Riprap Cover		**$781,776**

Bedding Layer

Tree Depth= 5

LEVEL	Item	QTY	Unit	UNIT COST	TOTAL
	Skilled Workers Average (35 trades)	68.75	M.S.F.	$1,156.55	$79,513
Memo: 62,500 SF + 10% for waste = 68,750.					
	B15 R.S.Means Crew	1,158	C.Y.	$23.34	$27,032
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	PPE 2 c/o per day 10 hr day cost per hr	480	hr	$1.95	$936

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Capital Costs				**$14,370,215**
	Riprap Cover				**$781,776**

Bedding Layer

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	74,808		$1.00	$74,808
Memo: 879 HOURS					
Subtotal					$185,329
1st Layer Markups assigned to Detail Items					$39,325

TOTAL Bedding Layer **$224,654**

Memo: Assume bedding layer 250' x 250' or 62,500 SF. Layer will be 6" sand overlaying geotextile.

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 6WDF	**$15,669,890**
	Capital Costs	**$14,370,215**
	Riprap Cover	**$781,776**

Riprap Layer

Tree Depth= 5

	B12G R.S.Means Crew	4,630	L.C.Y.	$55.68	$257,793
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	PPE 2 c/o per day 10 hr day cost per hr	480	hr	$1.95	$936
	B15 R.S.Means Crew	4,630	C.Y.	$17.69	$81,924
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	B81 R.S.Means Crew	62.50	M.S.F.	$56.24	$3,515
	B10G R.S.Means Crew	2,315	E.C.Y.	$1.25	$2,882
Memo: Compaction of 1 foot.					
LABOR	PRIME CONTRACTOR LABOR	136,991		$1.00	$136,991
Memo: 1,632 HOURS					
Subtotal					$490,120
1st Layer Markups assigned to Detail Items					$67,001

TOTAL Riprap Layer **$557,121**

Memo: Assume riprap layer is 250' x 250' or 62,500 SF at 2 feet thick or 4,630 CY. 2 foot of soil cover the same.

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 6WDF	**$15,669,890**
	Annual Costs	**$1,299,675**
	Operations & Maintenance	**$1,153,066**

Inspections

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Inspections

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	20,180		$1.00	$20,180
Memo: 240 HOURS					

TOTAL Inspections **$21,156**

Memo: Annual Cost. General inspections of the action. Quarterly.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Weed Removal and Cover Inspection

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	10,090		$1.00	$10,090
Memo: 120 HOURS					

TOTAL Weed Removal and Cover Inspection **$10,578**

Memo: Annual Cost. Semiannual following the initial 100 years.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Groundwater Storage Tank Collection/Disposal

Tree Depth= 5

	1/2 TON 4WD TRUCKS, LARGE VANS	20	hrs	$5.45	$109
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	40	hrs	$2.70	$108
LABOR	PRIME CONTRACTOR LABOR	3,815		$1.00	$3,815
Memo: 50 HOURS					

TOTAL Groundwater Storage Tank Collection/Disposal **$4,032**

Memo: Annual Cost. Occurs once every year.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Extraction Well Pump Replacement

Tree Depth= 5

	Extraction Well Pump Installation	4		$42,032.80	$168,131

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Extraction Well Pump Replacement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	7,745		$1.00	$7,745
Memo: 100 HOURS					

TOTAL Extraction Well Pump Replacement **$175,876**
Memo: Occurs every 5 years.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Sign Replacement

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	20	hrs	$2.70	$54
	1/2 TON 4WD TRUCKS, LARGE VANS	20	hrs	$5.45	$109
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	2,392		$1.00	$2,392
Memo: 30 HOURS					

TOTAL Sign Replacement **$2,555**
Memo: Occurs every 30 years.

	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Above Grade Groundwater Components Replacement

Tree Depth= 5

	1,000 Gallon Water Tank	1		$1,100.00	$1,100
	Q1 R.S.Means Crew	5,000	L.F.	$22.36	$111,775
	LAUNDRY 2 CHANGES COST PER HOUR	800	hrs	$2.70	$2,160
	Pump House Building Pre Fab	1		$24,999.00	$24,999
Memo: Tank structure.					
	Extraction Well Subcontractor Mob/Demob	1		$34,878.49	$34,878
	Extraction Well Installation & Development	2		$65,577.27	$131,155
Memo: Assume quantity of 2 to represent total of 4 well re-develop.					
	1/2 TON 4WD TRUCKS, LARGE VANS	640	hrs	$5.45	$3,488
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	59,803		$1.00	$59,803
Memo: 800 HOURS					

Subtotal $369,358
1st Layer Markups assigned to Detail Items $45,704

TOTAL Above Grade Groundwater Components Replacement **$415,062**
Memo: Occurs every 50 years.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Annual Costs				**$1,299,675**
	Operations & Maintenance				**$1,153,066**

Extraction Well Replacement

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Extraction Well Subcontractor Mob/Demob	1		$34,878.49	$34,878
	Extraction Well Installation & Development	4		$65,577.27	$262,309
	Extraction Well Pump Installation	4		$42,032.80	$168,131
	LAUNDRY 2 CHANGES COST PER HOUR	1,040	hrs	$2.70	$2,808
Memo: LATAKY personnel plus assume 5 drillers.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	53,598		$1.00	$53,598
Memo: 640 HOURS					

TOTAL Extraction Well Replacement **$523,807**
Memo: Occurs every 100 years.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6WDF		**$15,669,890**
Annual Costs		**$1,299,675**
Groundwater Monitoring		**$96,472**
Semiannual Monitoring		**$64,315**

Monitoring Well Sampling

Tree Depth= 6

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	8		$689.05	$5,512
LABOR	PRIME CONTRACTOR LABOR	25,165		$1.00	$25,165
Memo: 320 HOURS					

TOTAL Monitoring Well Sampling **$32,157**
Memo: 4 monitoring wells sampled semiannually. 5 hours per well.

Estimate Tree Structure Rollups		
SWMU 2 Alternative 6WDF		**$15,669,890**
Annual Costs		**$1,299,675**
Groundwater Monitoring		**$96,472**
Semiannual Monitoring		**$64,315**

Extraction Well Sampling

Tree Depth= 6

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	8		$689.05	$5,512

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 2 Alternative 6WDF				**$15,669,890**
	Annual Costs				**$1,299,675**
	Groundwater Monitoring				**$96,472**
	Semiannual Monitoring				**$64,315**

Extraction Well Sampling

Tree Depth= 6

LABOR	PRIME CONTRACTOR LABOR	25,165		$1.00	$25,165
Memo: 320 HOURS					

TOTAL Extraction Well Sampling **$32,157**
Memo: 4 extraction wells sampled semiannually. 5 hours per well.

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 6WDF	**$15,669,890**
	Annual Costs	**$1,299,675**
	Groundwater Monitoring	**$96,472**
	Annual Monitoring	**$32,157**

Monitoring Well Sampling

Tree Depth= 6

	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	4		$689.05	$2,756
LABOR	PRIME CONTRACTOR LABOR	12,582.50		$1.00	$12,583
Memo: 160 HOURS					

TOTAL Monitoring Well Sampling **$16,079**
Memo: 4 monitoring wells sampled annually. 5 hours per well.

	Estimate Tree Structure Rollups	
	SWMU 2 Alternative 6WDF	**$15,669,890**
	Annual Costs	**$1,299,675**
	Groundwater Monitoring	**$96,472**
	Annual Monitoring	**$32,157**

Extraction Well Sampling

Tree Depth= 6

	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	4		$689.05	$2,756
LABOR	PRIME CONTRACTOR LABOR	12,582.50		$1.00	$12,583
Memo: 160 HOURS					

TOTAL Extraction Well Sampling **$16,079**
Memo: 4 extraction wells sampled annually. 5 hours per well.

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study | **Reported From:** **SWMU 2 Alternative 6WDF**
Report Total: **$15,669,890**

Author
Manager

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 2 Alternative 6WDF			**$15,669,890**
	Annual Costs			**$1,299,675**
	Five Year Reviews			**$50,137**

Five Year Reviews

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,137	$1.00	$50,137
Memo: 500 HOURS				

TOTAL Five Year Reviews **$50,137**

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E.2. SWMU 3 COST ESTIMATES

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COST ESTIMATE
BGOU SWMU 3
Alternative 3—Containment, LUCs, Monitoring

Cost Estimate Summary									
Capital Cost	**Quantity**	**Units**	**Unit Price**	**Total**					
1.0 Remedial Design	1	LS	$896,000	$896,000					
2.0 Other Project Plans	1	LS	$690,000	$690,000					
3.0 RDSI	1	LS	$240,000	$240,000					
4.0 Riprap Cover	1	LS	$1,865,000	$1,865,000					
Subproject Management	1	LS	$369,100	$369,000					Subproject Management = 10%
Management Reserve	1	LS	$609,000	$609,000					Contractor MR = 15%
Fee	1	LS	$326,830	$327,000					Fee = 7%
Contingency	1	LS	$999,200	$999,000					Contingency = 20%
	SUBTOTAL CAPITAL COST			**$5,995,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Inspections	1000	EA	$21,000	$21,000,000			7.59E+17		Quarterly for 1,000 years
Weed Removal and Cover Inspection	1000	EA	$21,000	$21,000,000			7.59E+17		Semiannually for 1000 years.
Leachate Collection - First 50 years	50	EA	$50,000	$2,500,000			5.47E+06		1,000 gallons per year for the first 50 years
Leachate Collection - Years 51 through 1,000	950	EA	$24,000	$22,800,000			8.67E+17		300 gallons per year for years 51 through 1,000
Leachate Collection Vault Replacement	10	EA	$72,000	$720,000			7.56E+16		Every 100 years
Groundwater Monitoring - First 5 years	5	EA	$28,000	$140,000			1.52E+05		Semiannually for first 5 years
Groundwater Monitoring - Years 6 through 1000	995	EA	$14,000	$13,930,000			5.06E+17		Annually for years 6 through 1,000
Five-Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
	SUBTOTAL ANNUAL COST			**$92,090,000**			**3.35E+18**		
			TOTAL	**$98,085,000**					

COST ESTIMATE
BGOU SWMU 3
Alternative 3—Containment, LUCs, Monitoring

Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	ls	$5,995,000	$5,995,000				**$5,995,000**	
Inspections	1000	EA	$21,000	$21,000,000				**$1,909,057**	1.1% discount rate
Weed Removal and Cover Inspection	1000	EA	$21,000	$21,000,000				**$1,909,057**	1.1% discount rate
Leachate Collection - First 50 years	50	EA	$50,000	$2,500,000				**$1,915,068**	1.1% discount rate
Leachate Collection - Years 51 through 1,000	950	EA	$24,000	$22,800,000				**$1,262,547**	1.1% discount rate
Leachate Collection Vault Replacement	10	EA	$72,000	$720,000				**$36,250**	1.1% discount rate
Groundwater Monitoring - First 5 years	5	EA	$28,000	$140,000				**$135,496**	1.1% discount rate
Groundwater Monitoring - Years 6 through 1000	995	EA	$14,000	$13,930,000				**$1,204,957**	1.1% discount rate
Five-Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$5,995,000**	
						Present Worth Values	**Annual**	**$9,262,000**	
							Avg. Annual	**$9,262**	
							Total	**$15,257,000**	
This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.									
Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.									

CAPITAL COSTS									
	Material/Equipment/Subcontractors/ODCs				**Labor**				
Task Description	**Qty**	**Unit**	**Unit Price**	**Total**	**Hours**	**Rate**	**Total**	**Total Cost**	**Basis of Estimate**
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					2404		$212,842		
Remedial Design Report					4544		$421,612		
Civil Surveying					160		$16,902		
Procurement					300		$24,232		
Work Packages/Readiness					952		$83,743		
Training	1	LS	$33,600	$33,600	1320		$102,736		$33,600 includes subcontractor training
TASK TOTAL				**$33,600**	**9680**		**$862,067**	**$896,000**	

COST ESTIMATE
BGOU SWMU 3
Alternative 3—Containment, LUCs, Monitoring

2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					2864		$260,844		
O&M Plan					700		$66,863		
SAP/QAPP					840		$73,002		
Waste Management Plan					616		$58,809		
RACR					1900		$179,749		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**7504**		**$689,992**	**$690,000**	
3.0 RDSI									
Refer to the Success reports for detailed cost and resources.									
Prime Contractor Labor					2100		$167,560		
Subcontractors	1	LS	$53,221	$53,221					
Materials	1	LS	$8,447	$8,447					
Vehicles and Equipment	1	LS	$4,564	$4,564					
Sampling & Analytical	1	LS	$6,569	$6,569					
TASK TOTAL				**$72,801**	**2100**		**$167,560**	**$240,000**	
4.0 Riprap Cover									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Bedding Layer									
Prime Contractor Labor					880		$74,808		
Subcontractors	1	LS	$315,046	$315,046					
Materials	1	LS	$2,232	$2,232					
Vehicles and Equipment	1	LS	$1,744	$1,744					
Riprap Layer									Incudes 2 ft soil cover
Prime Contractor Labor					4895		$410,972		
Subcontractors	1	LS	$892,256	$892,256					
Materials	1	LS	$9,468	$9,468					
Vehicles and Equipment	1	LS	$10,464	$10,464					
Monitoring Well Installation									
Prime Contractor Labor					992		$79,246		
Subcontractors	1	LS	$64,720	$64,720					Local quote from existing drilling sub.
Materials	1	LS	$2,232	$2,232					
Vehicles and Equipment	1	LS	$1,744	$1,744					
TASK TOTAL				**$1,299,906**	**6767**		**$565,026**	**$1,865,000**	
							SUBTOTAL CAPITAL COST	**$3,691,000**	
ANNUAL COSTS									
Inspections									
Duration: Occurs quarterly for 1,000 years.									
Prime Contractor Labor					240		$20,180		
Materials	1	LS	$540	$540					
Vehicles and Equipment	1	LS	$436	$436					
TASK TOTAL				**$976**	**240**		**$20,180**	**$21,000**	ANNUAL COST

COST ESTIMATE
BGOU SWMU 3
Alternative 3—Containment, LUCs, Monitoring

Weed Removal and Cover Inspection									
Duration: Semiannually for 1,000 years.									
Prime Contractor Labor					240		$20,180		
Materials	1	LS	$540	$540					
Vehicles and Equipment	1	LS	$436	$436					
TASK TOTAL				**$976**			**$20,180**	**$21,000**	ANNUAL COST
Leachate Collection - First 50 years									
Duration: Assume 1,000 gallons per year									
Prime Contractor Labor					240		$18,824		
Materials	1	LS	$1,490	$1,490					
Treatment & Disposal	1	LS	$29,450	$29,450					
Vehicles and Equipment	1	LS	$436	$436					
TASK TOTAL				**$31,376**			**$18,824**	**$50,000**	ANNUAL COST
Leachate Collection - Years 51 through 1,000									
Duration: Assume 300 gallons per year									
Prime Contractor Labor					120		$9,412		
Materials	1	LS	$481	$481					
Treatment & Disposal	1	LS	$14,162	$14,162					
Vehicles and Equipment	1	LS	$218	$218					
TASK TOTAL				**$14,861**			**$9,412**	**$24,000**	ANNUAL COST
Leachate Collection Vault Replacement									
Duration: Every 100 years.									
Prime Contractor Labor					640		$47,521		
Subcontractors	1	LS	$21,704	$21,704					
Materials	1	LS	$1,512	$1,512					
Vehicles and Equipment	1	LS	$872	$872					
TASK TOTAL				**$24,088**			**$47,521**	**$72,000**	EVERY 100 YEARS
Groundwater Monitoring - First 5 years									
Duration: Semiannually for the first 5 years.									
Prime Contractor Labor					320		$25,165		
Laboratory	1	LS	$2,005	$2,005					
Materials	1	LS	$540	$540					
Vehicles and Equipment	1	LS	$436	$436					
TASK TOTAL				**$2,981**			**$25,165**	**$28,000**	ANNUAL COST
Groundwater Monitoring - Years 6 through 1000									
Duration: Annually for years 6 through 1000									
Prime Contractor Labor					160		$12,582		
Laboratory	1	LS	$1,002	$1,002					
Materials	1	LS	$270	$270					
Vehicles and Equipment	1	LS	$218	$218					
TASK TOTAL				**$1,490**			**$12,582**	**$14,000**	ANNUAL COST
Five-Year Review									
Duration: Every 5 years.									
Prime Contractor Labor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study **Reported From: SWMU 3 Alternative 3**
Report Total: $3,971,701

Author
Manager

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 3			**$3,971,701**
	Capital Costs			**$3,690,953**
	Remedial Desgin			**$895,667**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	212,842	$1.00	$212,842
Memo: 2,404 HOURS				

TOTAL RDWP/RDSI Work Plan **$212,842**

Estimate Tree Structure Rollups		
SWMU 3 Alternative 3		**$3,971,701**
Capital Costs		**$3,690,953**
Remedial Desgin		**$895,667**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	421,612	$1.00	$421,612
Memo: 4,544 HOURS				

TOTAL RDR **$421,612**

Estimate Tree Structure Rollups		
SWMU 3 Alternative 3		**$3,971,701**
Capital Costs		**$3,690,953**
Remedial Desgin		**$895,667**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	16,902	$1.00	$16,902
Memo: 160 HOURS				

TOTAL Civil Surveying **$16,902**

Estimate Tree Structure Rollups		
SWMU 3 Alternative 3		**$3,971,701**
Capital Costs		**$3,690,953**
Remedial Desgin		**$895,667**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	24,232	$1.00	$24,232
Memo: 300 HOURS				

TOTAL Procurement **$24,232**

Estimate Tree Structure Rollups		
SWMU 3 Alternative 3		**$3,971,701**
Capital Costs		**$3,690,953**
Remedial Desgin		**$895,667**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	83,743	$1.00	$83,743
Memo: 952 HOURS				

TOTAL Work Packages/Readiness Review **$83,743**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 3			**$3,971,701**
	Capital Costs			**$3,690,953**
	Remedial Desgin			**$895,667**

Training

Tree Depth= 5

		QTY	UNIT COST	TOTAL
Memo:	Training for Subcontractors per Person per Hour	480	$70.00	$33,600
	Assume 80 hours of training per person. Assume 6 people or 480 hours.			
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training **$136,336**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 3			**$3,971,701**
	Capital Costs			**$3,690,953**
	Other Project Plans			**$689,992**

RAWP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	260,844	$1.00	$260,844
Memo: 2,864 HOURS				

TOTAL RAWP **$260,844**

	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 3			**$3,971,701**
	Capital Costs			**$3,690,953**
	Other Project Plans			**$689,992**

O&M Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan **$66,863**

	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 3			**$3,971,701**
	Capital Costs			**$3,690,953**
	Other Project Plans			**$689,992**

SAP/QAPP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	73,002	$1.00	$73,002
Memo: 840 HOURS				

TOTAL SAP/QAPP **$73,002**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Capital Costs				**$3,690,953**
	Other Project Plans				**$689,992**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	58,809		$1.00	$58,809
Memo: 616 HOURS					

TOTAL Waste Management Plan **$58,809**

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Capital Costs				**$3,690,953**
	Other Project Plans				**$689,992**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	179,749		$1.00	$179,749
Memo: 1,900 HOURS					

TOTAL RACR **$179,749**

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Capital Costs				**$3,690,953**
	Other Project Plans				**$689,992**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Capital Costs				**$3,690,953**
	RDSI				**$240,362**

Rad Survey

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	66,766		$1.00	$66,766
Memo: 800 HOURS					

TOTAL Rad Survey **$66,766**

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Capital Costs				**$3,690,953**
	RDSI				**$240,362**

Surface Soil Sampling

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	240	hrs	$2.70	$648
	PPE 2 c/o per day 10 hr day cost per hr	240		$1.95	$468
LABOR	PRIME CONTRACTOR LABOR	17,530		$1.00	$17,530
Memo: 240 HOURS					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Capital Costs				**$3,690,953**
	RDSI				**$240,362**

Surface Soil Sampling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RDSI Soil Sampling Analytical	0.03		$218,979.33	$6,569
Memo: MANAL114 is for 240 samples. 6 / 240 = .025					
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 2 shipments per day for 15 days plus 1 shipment later for the waste water.					
LABOR	PRIME CONTRACTOR LABOR	5,482		$1.00	$5,482
Memo: 64 HOURS					

TOTAL Surface Soil Sampling **$31,201**
Memo: Assume 20% more samples than SWMU 30 based on area.

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Capital Costs				**$3,690,953**
	RDSI				**$240,362**

Well Installation and Inspection

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
MMONWELL13	Shallow Monitoring Well	7		$5,253.00	$36,771
Memo: 7 shallow monitoring wells. Includes abandonment.					
MMONMOB13	Monitoring Well Mod/Demob	1		$16,450.00	$16,450
MWTRLVTR	Water Level Transducer	8		$500.00	$4,000
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	1/2 TON 4WD TRUCKS, LARGE VANS	640	hrs	$5.45	$3,488
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	240		$1.95	$468
LABOR	PRIME CONTRACTOR LABOR	60,000		$1.00	$60,000
Memo: 776 HOURS					

TOTAL Well Installation and Inspection **$122,473**

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Capital Costs				**$3,690,953**
	RDSI				**$240,362**

Exploratory Excavation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	JOHN DEERE 624E 4WD ARTICULATED WHEEL LOADER	20	hr	$18.23	$365
	KOMATSU WB142-5 BACKHOE cost per hour	20	hr	$35.58	$712
	PPE 2 c/o per day 10 hr day cost per hr	80	hr	$1.95	$156
	LAUNDRY 2 CHANGES COST PER HOUR	80	hrs	$2.70	$216
	MSA OptiFilter HEPA per hour	80		$3.45	$276
	Resp cleaning 10 hr day 2 C/O per day cost per hr	80		$5.19	$415

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Capital Costs				**$3,690,953**
	RDSI				**$240,362**

Exploratory Excavation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	7,610		$1.00	$7,610
Memo: 100 HOURS					

TOTAL Exploratory Excavation **$9,749**
Memo: Assume 2 days of excavation.

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Capital Costs				**$3,690,953**
	RDSI				**$240,362**

Perform Engineering Evaluation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	10,172		$1.00	$10,172
Memo: 120 HOURS					

TOTAL Perform Engineering Evaluation **$10,172**

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Capital Costs				**$3,690,953**
	Riprap Cover				**$1,864,932**

Bedding Layer

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Skilled Workers Average (35 trades)	148.50	M.S.F.	$1,156.55	$171,747
Memo: Geotextile will be the riprap area + 10% waste = 148,500					
	B15 R.S.Means Crew	2,500	C.Y.	$23.34	$58,360
Memo: Assumed riprap area is 135,000 SF. 135,000 * .5 = 67,500 / 27 = 2,500 CY.					
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	PPE 2 c/o per day 10 hr day cost per hr	480	hr	$1.95	$936
LABOR	PRIME CONTRACTOR LABOR	74,808		$1.00	$74,808
Memo: 880 HOURS					
Subtotal					$308,891
1st Layer Markups assigned to Detail Items					$84,938

TOTAL Bedding Layer **$393,830**
Memo: Assumed riprap area is 135,000 SF. 135,000 * .5 = 67,500 / 27 = 2,500 CY. Assume 1 month duration.

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Capital Costs				**$3,690,953**
	Riprap Cover				**$1,864,932**

Riprap Layer

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B12G R.S.Means Crew	10,000	L.C.Y.	$55.68	$556,788
	1/2 TON 4WD TRUCKS, LARGE VANS	960	hrs	$5.45	$5,232
Memo: 2 LATAKY vehicles.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Capital Costs				**$3,690,953**
	Riprap Cover				**$1,864,932**

Riprap Layer

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	1,200	hrs	$2.70	$3,240
	PPE 2 c/o per day 10 hr day cost per hr	1,200	hr	$1.95	$2,340
	B15 R.S.Means Crew	10,000	C.Y.	$17.69	$176,941
	1/2 TON 4WD TRUCKS, LARGE VANS	960	hrs	$5.45	$5,232
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,440	hrs	$2.70	$3,888
	B81 R.S.Means Crew	135	M.S.F.	$56.24	$7,593
	B10G R.S.Means Crew	5,000	E.C.Y.	$1.25	$6,224
Memo: Compaction of 1 foot.					
LABOR	PRIME CONTRACTOR LABOR	410,972		$1.00	$410,972
Memo: 4,895 HOURS					

Subtotal	$1,178,450
1st Layer Markups assigned to Detail Items	$144,711

TOTAL Riprap Layer **$1,323,160**

Memo: Assumed riprap layer is 135,000 SF. 135,000 * 2' / 27 = 10,000 CY. Assume 6 months. 2 foot of soil cover the same.

Estimate Tree Structure Rollups		
SWMU 3 Alternative 3		**$3,971,701**
Capital Costs		**$3,690,953**
Riprap Cover		**$1,864,932**

Monitoring Well Installation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Monitoring Well	4		$16,180.00	$64,720
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	480		$1.95	$936
LABOR	PRIME CONTRACTOR LABOR	79,246		$1.00	$79,246
Memo: 992 HOURS					

TOTAL Monitoring Well Installation **$147,942**

Memo: 4 monitoring wells installed.

Estimate Tree Structure Rollups		
SWMU 3 Alternative 3		**$3,971,701**
Annual Costs		**$280,748**
Operations & Maintenance		**$188,394**

Inspections

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Annual Costs				**$280,748**
	Operations & Maintenance				**$188,394**

Inspections

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	20,180		$1.00	$20,180
Memo: 240 HOURS					

TOTAL Inspections **$21,156**
Memo: Annual Cost. General inspections of the action. Quarterly.

	Estimate Tree Structure Rollups	
	SWMU 3 Alternative 3	**$3,971,701**
	Annual Costs	**$280,748**
	Operations & Maintenance	**$188,394**

Weed Removal and Cover Inspection

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	20,180		$1.00	$20,180
Memo: 240 HOURS					

TOTAL Weed Removal and Cover Inspection **$21,156**
Memo: Annual Cost. Semiannual for 1,000 years.

	Estimate Tree Structure Rollups	
	SWMU 3 Alternative 3	**$3,971,701**
	Annual Costs	**$280,748**
	Operations & Maintenance	**$188,394**

Leachate Collection 50 years

Tree Depth= 5

	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
	C-404 Leachate Disposal per gallon	1,000		$21.84	$21,840
	330 Gallon IBC Tote	4		$264.50	$1,058
	Transportation to ES by Truck	1		$7,610.00	$7,610
LABOR	PRIME CONTRACTOR LABOR	18,824		$1.00	$18,824
Memo: 240 HOURS					

TOTAL Leachate Collection 50 years **$50,200**
Memo: Annual Cost. Assume 1,000 gallons per year.

	Estimate Tree Structure Rollups	
	SWMU 3 Alternative 3	**$3,971,701**
	Annual Costs	**$280,748**
	Operations & Maintenance	**$188,394**

Leachate Collection 950 years

Tree Depth= 5

	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	80	hrs	$2.70	$216

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Annual Costs				**$280,748**
	Operations & Maintenance				**$188,394**

Leachate Collection 950 years

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	C-404 Leachate Disposal per gallon	300		$21.84	$6,552
	330 Gallon IBC Tote	1		$264.50	$265
	Transportation to ES by Truck	1		$7,610.00	$7,610
LABOR	PRIME CONTRACTOR LABOR	9,412		$1.00	$9,412
Memo: 120 HOURS					

TOTAL Leachate Collection 950 years **$24,273**
Memo: Annual Cost. Assume 300 gallons per year.

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Annual Costs				**$280,748**
	Operations & Maintenance				**$188,394**

Leachate Collection Vault Replacement

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B21 R.S.Means Crew	1	Ea.	$2,233.57	$2,234
	RSMeans Crew B-10W cost per day	5		$1,470.00	$7,350
	RSMeans Crew B-12C cost per day	5		$2,354.00	$11,770
	LAUNDRY 2 CHANGES COST PER HOUR	560	hrs	$2.70	$1,512
	1/2 TON 4WD TRUCKS, LARGE VANS	160	hrs	$5.45	$872
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	47,521		$1.00	$47,521
Memo: 640 HOURS					
Subtotal					$71,259
1st Layer Markups assigned to Detail Items					$350

TOTAL Leachate Collection Vault Replacement **$71,609**
Memo: Occurs every 100 years. 2 week duration.

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Annual Costs				**$280,748**
	Groundwater Monitoring				**$42,218**

Semiannual Monitoring 5 years

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	12		$125.05	$1,501
LABOR	PRIME CONTRACTOR LABOR	25,165		$1.00	$25,165
Memo: 320 HOURS					

TOTAL Semiannual Monitoring 5 years **$28,146**

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study

Reported From: SWMU 3 Alternative 3
Report Total: $3,971,701

Author
Manager

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 3				**$3,971,701**
	Annual Costs				**$280,748**
	Groundwater Monitoring				**$42,218**

Annual Monitoring 995 years

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	6		$125.05	$750
LABOR	PRIME CONTRACTOR LABOR	12,582		$1.00	$12,582
Memo: 160 HOURS					

TOTAL Annual Monitoring 995 years **$14,072**

Estimate Tree Structure Rollups		
SWMU 3 Alternative 3		**$3,971,701**
Annual Costs		**$280,748**
Five Year Reviews		**$50,137**

Five Year Reviews

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	50,137		$1.00	$50,137
Memo: 500 HOURS					

TOTAL Five Year Reviews **$50,137**

COST ESTIMATE
BGOU SWMU 3
Alternative 5—Excavation, Disposal, and LUCs

Cost Estimate Summary									
Capital Cost	**Quantity**	**Units**	**Unit Price**	**Total**					
1.0 Remedial Design	1	LS	$1,561,000	$1,561,000					
2.0 Other Project Plans	1	LS	$1,038,000	$1,038,000					
3.0 Excavation	1	LS	$3,197,000	$3,197,000					
4.0 Treat and Dispose of Water	1	LS	$706,000	$706,000					
5.0 Post Remediation Sampling	1	LS	$198,000	$198,000					
6.0 Waste Handling, Treatment, Disposal, and Transportation	1	LS	$69,516,000	$69,516,000					
7.0 Excavation Backfill	1	LS	$3,069,000	$3,069,000					
Subproject Management	1	LS	$7,928,500	$7,929,000					Subproject Management = 10%
Management Reserve	1	LS	$13,082,100	$13,082,000					Contractor MR = 15%
Fee	1	LS	$7,020,720	$7,021,000					Fee = 7%
Contingency	1	LS	$21,463,400	$21,463,000					Contingency = 20%
			SUBTOTAL CAPITAL COST	**$128,780,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Five-Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
			SUBTOTAL ANNUAL COST	**$10,000,000**			**3.82E+17**		
			TOTAL	**$138,780,000**					
Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	LS	$128,780,000	$128,780,000				**$128,780,000**	
Five-Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$128,780,000**	
						Present Worth Values	**Annual**	**$889,000**	
							Avg. Annual	**$889**	
							Total	**$129,669,000**	
This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.									
Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.									

COST ESTIMATE
BGOU SWMU 3
Alternative 5—Excavation, Disposal, and LUCs

CAPITAL COSTS									
	Material/Equipment/Subcontractors/ODCs				Labor				
Task Description	**Qty**	**Unit**	**Unit Price**	**Total**	**Hours**	**Rate**	**Total**	**Total Cost**	**Basis of Estimate**
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					4224		$376,224		
Remedial Design Report					8744		$803,933		
Civil Surveying					216		$22,818		
Procurement					634		$52,676		
Work Packages/Readiness					1688		$146,788		
Training	1	LS	$56,000	$56,000	1320		$102,736		$56,000 includes subcontractor training
TASK TOTAL				**$56,000**	**16826**		**$1,505,175**	**$1,561,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					5724		$517,587		
O&M Plan					700		$66,863		
SAP/QAPP					1100		$96,201		
Waste Management Plan					1020		$94,190		
RACR					2274		$212,751		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**11402**		**$1,038,317**	**$1,038,000**	
3.0 Excavation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Subtitle C Cap									
Prime Contractor Labor					9072		$780,882		
Subcontractors	1	LS	$478,288	$478,288					
Materials	1	LS	$20,832	$20,832					
Vehicles and Equipment	1	LS	$12,208	$12,208					
Original Impoundment									
Prime Contractor Labor					1782		$153,388		
Subcontractors	1	LS	$85,844	$85,844					
Materials	1	LS	$9,979	$9,979					
Vehicles and Equipment	1	LS	$2,398	$2,398					
Original Diked Area									
Prime Contractor Labor					8748		$752,993		
Subcontractors	1	LS	$412,992	$412,992					
Materials	1	LS	$20,088	$20,088					
Vehicles and Equipment	1	LS	$11,772	$11,772					
Source									
Prime Contractor Labor					81		$6,972		
Subcontractors	1	LS	$3,902	$3,902					
Materials	1	LS	$454	$454					
Vehicles and Equipment	1	LS	$109	$109					
Below Grade									
Prime Contractor Labor					3240		$278,886		
Subcontractors	1	LS	$152,960	$152,960					
Materials	1	LS	$7,440	$7,440					
Vehicles and Equipment	1	LS	$4,360	$4,360					
TASK TOTALS				**$1,223,626**	**22,923**		**$1,973,121**	**$3,197,000**	

COST ESTIMATE
BGOU SWMU 3
Alternative 5—Excavation, Disposal, and LUCs

4.0 Treat and Dispose of Water									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Water Treatment									
Prime Contractor Labor					3384		$240,840		
Subcontractors	1	LS	$360,043	$360,043					Rainforrent.com and RSMeans
Materials	1	LS	$15,735	$15,735					
Vehicles and Equipment	1	LS	$12,295	$12,295					
Water Disposal									
Prime Contractor Labor					80		$4,550		
Characterization Sampling	1	LS	$55,909	$55,909					
Vehicles and Equipment	1	LS	$16,667	$16,667					
TASK TOTALS				**$460,649**	**3,464**		**$245,390**	**$706,000**	
5.0 Post Remediation Sampling									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Sampling									
Prime Contractor Labor					400		$29,217		
Materials	1	LS	$8,830	$8,830					
Analytical									
Prime Contractor Labor					112		$10,206		
Materials	1	LS	$149,818	$149,818					
TASK TOTAL				**$ 158,648**	**512**		**$39,423**	**$198,000**	
6.0 Waste Handling, Treatment, Disposal, and Transportation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Subtitle C Cap									
Prime Contractor Labor					14462		$946,334		
Materials	1	LS	$63,224	$63,224					
Characterization Sampling	1	LS	$445,815	$445,815					
Vehicles and Equipment	1	LS	$592,074	$592,074					
Original Impoundment									
Prime Contractor Labor					3466		$247,794		
Materials	1	LS	$100,690	$100,690					
Characterization Sampling	1	LS	$63,504	$63,504					
Vehicles and Equipment	1	LS	$40,164	$40,164					
Treatment	1	LS	$4,449,816	$4,449,816					
Disposal	1	LS	$4,946,784	$4,946,784					
Transportation	1	LS	$807,990	$807,990					
Original Diked Area									
Prime Contractor Labor					34672		$2,479,366		
Materials	1	LS	$1,105,500	$1,105,500					
Characterization Sampling	1	LS	$711,058	$711,058					
Vehicles and Equipment	1	LS	$401,640	$401,640					
Disposal	1	LS	$28,077,122	$28,077,122					
Transportation	1	LS	$9,076,421	$9,076,421					
Source									
Prime Contractor Labor					198		$14,940		
Materials	1	LS	$2,097	$2,097					
Characterization Sampling	1	LS	$1,400	$1,400					
Vehicles and Equipment	1	LS	$761	$761					
Transportation	1	LS	$9,585	$9,585					

COST ESTIMATE
BGOU SWMU 3
Alternative 5—Excavation, Disposal, and LUCs

Below Grade									
Prime Contractor Labor					12540		$896,964		
Materials	1	LS	$404,572	$404,572					
Characterization Sampling	1	LS	$253,511	$253,511					
Vehicles and Equipment	1	LS	$140,666	$140,666					
Disposal	1	LS	$10,003,840	$10,003,840					
Transportation	1	LS	$3,231,960	$3,231,960					
TASK TOTALS				**$64,930,194**	**65,338**		**$4,585,398**	**$69,516,000**	
7.0 Excavation Backfill									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Backfill									
Prime Contractor Labor					6511		$558,306		
Subcontractors	1	LS	$2,479,094	$2,479,094					RSMeans and local engineering firm
Materials	1	LS	$21,623	$21,623					
Vehicles and Equipment	1	LS	$10,137	$10,137					
TASK TOTAL				**$2,510,854**	**6511**		**$558,306**	**$3,069,000**	
							SUBTOTAL CAPITAL COST	**$79,285,000**	
ANNUAL COSTS									
Five-Year Review									
Duration: Every 5 years.									
Prime Contractor Labor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

SWMUs 2,3,7&30 Feasibility Study

Reported From: SWMU 3 Alternative 5
Report Total: $79,335,237

Author
Manager

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 5			**$79,335,237**
	Capital Costs			**$79,285,100**
	Remedial Desgin			**$1,561,175**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	376,224	$1.00	$376,224

Memo: 4,224 HOURS

TOTAL RDWP/RDSI Work Plan **$376,224**

	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 5			**$79,335,237**
	Capital Costs			**$79,285,100**
	Remedial Desgin			**$1,561,175**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	803,933	$1.00	$803,933

Memo: 8,744 HOURS

TOTAL RDR **$803,933**

	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 5			**$79,335,237**
	Capital Costs			**$79,285,100**
	Remedial Desgin			**$1,561,175**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	22,818	$1.00	$22,818

Memo: 216 HOURS

TOTAL Civil Surveying **$22,818**

	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 5			**$79,335,237**
	Capital Costs			**$79,285,100**
	Remedial Desgin			**$1,561,175**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	52,676	$1.00	$52,676

Memo: 634 HOURS

TOTAL Procurement **$52,676**

	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 5			**$79,335,237**
	Capital Costs			**$79,285,100**
	Remedial Desgin			**$1,561,175**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	146,788	$1.00	$146,788

Memo: 1,688 HOURS

TOTAL Work Packages/Readiness Review **$146,788**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 5			**$79,335,237**
	Capital Costs			**$79,285,100**
	Remedial Desgin			**$1,561,175**

Training

Tree Depth= 5

Memo:	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
	Assume 80 hours of training per person. Assume 10 people or 800 hours.			
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training **$158,736**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

Estimate Tree Structure Rollups		
SWMU 3 Alternative 5		**$79,335,237**
Capital Costs		**$79,285,100**
Other Project Plans		**$1,038,317**

RAWP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	517,587	$1.00	$517,587
Memo: 5,724 HOURS				

TOTAL RAWP **$517,587**

Estimate Tree Structure Rollups		
SWMU 3 Alternative 5		**$79,335,237**
Capital Costs		**$79,285,100**
Other Project Plans		**$1,038,317**

O&M Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan **$66,863**

Estimate Tree Structure Rollups		
SWMU 3 Alternative 5		**$79,335,237**
Capital Costs		**$79,285,100**
Other Project Plans		**$1,038,317**

SAP/QAPP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	96,201	$1.00	$96,201
Memo: 1,100 HOURS				

TOTAL SAP/QAPP **$96,201**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5				**$79,335,237**
	Capital Costs				**$79,285,100**
	Other Project Plans				**$1,038,317**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	94,190		$1.00	$94,190
Memo: 1,020 HOURS					

TOTAL Waste Management Plan **$94,190**

Estimate Tree Structure Rollups		
SWMU 3 Alternative 5		**$79,335,237**
Capital Costs		**$79,285,100**
Other Project Plans		**$1,038,317**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	212,751		$1.00	$212,751
Memo: 2,274 HOURS					

TOTAL RACR **$212,751**

Estimate Tree Structure Rollups		
SWMU 3 Alternative 5		**$79,335,237**
Capital Costs		**$79,285,100**
Other Project Plans		**$1,038,317**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

Estimate Tree Structure Rollups		
SWMU 3 Alternative 5		**$79,335,237**
Capital Costs		**$79,285,100**
Excavation		**$3,196,747**

Subtitle C Cap

Tree Depth= 5

	RSMeans Crew B-10W cost per day	112		$1,470.00	$164,640
	RSMeans Crew B-12C cost per day	112		$2,354.00	$263,648
	Mob/Demob of Subcontractor and Equipment	1	LS	$50,000.00	$50,000
	LAUNDRY 2 CHANGES COST PER HOUR	4,480	hrs	$2.70	$12,096
	1/2 TON 4WD TRUCKS, LARGE VANS	2,240	hrs	$5.45	$12,208
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	4,480		$1.95	$8,736
LABOR	PRIME CONTRACTOR LABOR	780,882		$1.00	$780,882
Memo: 9,072 HOURS					

TOTAL Subtitle C Cap **$1,292,210**
Memo: 23,734 BCY. Assume 225 CY per day so 106 days + weather/delays. Assume 112 day duration.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5				**$79,335,237**
	Capital Costs				**$79,285,100**
	Excavation				**$3,196,747**

Original Impoundment

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	22		$1,470.00	$32,340
	RSMeans Crew B-12C cost per day	22		$2,354.00	$51,788
	LAUNDRY 2 CHANGES COST PER HOUR	880	hrs	$2.70	$2,376
	1/2 TON 4WD TRUCKS, LARGE VANS	440	hrs	$5.45	$2,398
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	880		$5.19	$4,567
	PPE 2 c/o per day 10 hr day cost per hr	880		$1.95	$1,716
	MSA OptiFilter HEPA per hour	880		$3.45	$3,036
LABOR	PRIME CONTRACTOR LABOR	153,388		$1.00	$153,388
Memo: 1,782 HOURS					

TOTAL Original Impoundment **$251,609**
Memo: 2,000 BCY. Excavating and moving a 100 CY per day, so 20 days plus weather/delays is 22 days.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5				**$79,335,237**
	Capital Costs				**$79,285,100**
	Excavation				**$3,196,747**

Original Diked Area

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	108		$1,470.00	$158,760
	RSMeans Crew B-12C cost per day	108		$2,354.00	$254,232
	LAUNDRY 2 CHANGES COST PER HOUR	4,320	hrs	$2.70	$11,664
	1/2 TON 4WD TRUCKS, LARGE VANS	2,160	hrs	$5.45	$11,772
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	4,320		$1.95	$8,424
LABOR	PRIME CONTRACTOR LABOR	752,993		$1.00	$752,993
Memo: 8,748 HOURS					

TOTAL Original Diked Area **$1,197,845**
Memo: 22,703 BCY. Excavating and moving a 225 CY per day, so 101 days plus weather/delays is 108 days.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5				**$79,335,237**
	Capital Costs				**$79,285,100**
	Excavation				**$3,196,747**

Source

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	1		$1,470.00	$1,470
	RSMeans Crew B-12C cost per day	1		$2,354.00	$2,354
	LAUNDRY 2 CHANGES COST PER HOUR	40	hrs	$2.70	$108
	1/2 TON 4WD TRUCKS, LARGE VANS	20	hrs	$5.45	$109
Memo: 2 LATAKY vehicles.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5				**$79,335,237**
	Capital Costs				**$79,285,100**
	Excavation				**$3,196,747**

Source

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Resp cleaning 10 hr day 2 C/O per day cost per hr	40		$5.19	$208
	PPE 2 c/o per day 10 hr day cost per hr	40		$1.95	$78
	MSA OptiFilter HEPA per hour	40		$3.45	$138
LABOR Memo: 81 HOURS	PRIME CONTRACTOR LABOR	6,972		$1.00	$6,972

TOTAL Source **$11,437**
Memo: 1 day.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5				**$79,335,237**
	Capital Costs				**$79,285,100**
	Excavation				**$3,196,747**

Below Grade

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	40		$1,470.00	$58,800
	RSMeans Crew B-12C cost per day	40		$2,354.00	$94,160
	LAUNDRY 2 CHANGES COST PER HOUR	1,600	hrs	$2.70	$4,320
Memo: 2 LATAKY vehicles.	1/2 TON 4WD TRUCKS, LARGE VANS	800	hrs	$5.45	$4,360
	PPE 2 c/o per day 10 hr day cost per hr	1,600		$1.95	$3,120
LABOR Memo: 3,240 HOURS	PRIME CONTRACTOR LABOR	278,886		$1.00	$278,886

TOTAL Below Grade **$443,646**
Memo: 8,089 BCY. Excavating and moving a 225 CY per day, so 36 days plus weather/delays is 40 days.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5				**$79,335,237**
	Capital Costs				**$79,285,100**
	Treat and Dispose of Water				**$706,041**

Water Treatment

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B10H R.S.Means Crew	282	Day	$581.53	$163,993
Memo: Packaged system with 2 frac tanks.	Water Treatment System w/ Tanks per month	13		$7,785.00	$101,205
	LAUNDRY 2 CHANGES COST PER HOUR	3,384	hrs	$2.70	$9,137
Memo: 2 LATAKY vehicles.	1/2 TON 4WD TRUCKS, LARGE VANS	2,256	hrs	$5.45	$12,295
	PPE 2 c/o per day 10 hr day cost per hr	3,384		$1.95	$6,599

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5				**$79,335,237**
	Capital Costs				**$79,285,100**
	Treat and Dispose of Water				**$706,041**

Water Treatment

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	240,840		$1.00	$240,840
Memo: 3,384 HOURS					
Subtotal					$534,069
1st Layer Markups assigned to Detail Items					$94,846
TOTAL Water Treatment					**$628,915**
Memo: 13 months					

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5				**$79,335,237**
	Capital Costs				**$79,285,100**
	Treat and Dispose of Water				**$706,041**

Water Disposal

Tree Depth= 5

	Water Truck 10k Gallon cost per hr	80	hr	$208.34	$16,667
	Overnight Shipment per Cooler	7		$251.97	$1,764
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Water Cost per Sample	65		$833.00	$54,145
Memo: Assume Frac tanks will be emptied every 2 months. 6.5 * 5 tanks * 20,000 gallons = 650,000 gallons. Assume a water sample will be taken from each water truck (10,000 gallons). 650,000 gallons / 10,000 = 65 samples.					
LABOR	PRIME CONTRACTOR LABOR	4,550		$1.00	$4,550
Memo: 80 HOURS					
TOTAL Water Disposal					**$77,126**

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5				**$79,335,237**
	Capital Costs				**$79,285,100**
	Post Remediation Sampling				**$198,071**

Sampling

Tree Depth= 5

	5 gram EN CORE SAMPLER	200		$6.94	$1,388
	Niton XRF Rental One Month	1		$4,500.00	$4,500
	PCB Test Kits	2		$541.00	$1,082
	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780
LABOR	PRIME CONTRACTOR LABOR	29,217		$1.00	$29,217
Memo: 400 HOURS					
TOTAL Sampling					**$38,047**
Memo: 44 sidewall samples and 88 floor samples. Total is 132 samples. 2 weeks.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5				**$79,335,237**
	Capital Costs				**$79,285,100**
	Post Remediation Sampling				**$198,071**

Analytical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Overnight Shipment per Cooler	21		$251.97	$5,291
Memo: Assume 2 shipments per day for 10 days plus 1 shipment later for the waste water.					
	RDSI Soil Sampling Analytical	0.55		$262,775.00	$144,526
Memo: MANAL114 is for 240 samples. 132 / 240 = .55					
LABOR	PRIME CONTRACTOR LABOR	10,206		$1.00	$10,206
Memo: 112 HOURS					

TOTAL Analytical **$160,024**

Estimate Tree Structure Rollups		
SWMU 3 Alternative 5		**$79,335,237**
Capital Costs		**$79,285,100**
Waste Handling/Treatment/Disposal/Transportation		**$69,515,591**

Subtitle C Cap

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	13,335	hrs	$2.70	$36,005
	1/2 TON 4WD TRUCKS, LARGE VANS	2,540	hrs	$5.45	$13,843
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	6,350	hr	$91.06	$578,231
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	633		$43.00	$27,219
	Overnight Shipment per Cooler	38		$251.97	$9,575
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	380		$1,148.00	$436,240
Memo: 28,481 LCY / 15 CY = 1,899. Assume 20% sampling rate. 1,899 / 5 = 380 samples.					
LABOR	PRIME CONTRACTOR LABOR	946,334		$1.00	$946,334
Memo: 14,462 HOURS					

TOTAL Subtitle C Cap **$2,047,446**

Memo: U Landfill WAC Compliant. 23,734 BCY x 1.2 = 28,481 LCY. Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 127 days.

Estimate Tree Structure Rollups		
SWMU 3 Alternative 5		**$79,335,237**
Capital Costs		**$79,285,100**
Waste Handling/Treatment/Disposal/Transportation		**$69,515,591**

Original Impoundment

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	2,600	hrs	$2.70	$7,020
	1/2 TON 4WD TRUCKS, LARGE VANS	600	hrs	$5.45	$3,270
Memo: 3 LATAKY vehicles.					
	MLLW Treatment at ES ST90 per CY	2,400		$1,854.09	$4,449,816
	Disposal ES MLLW by rail	4,800		$1,030.58	$4,946,784
Memo: Double the disposal volume for MLLW.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5				**$79,335,237**
	Capital Costs				**$79,285,100**
	Waste Handling/Treatment/Disposal/Transportation				**$69,515,591**

Original Impoundment

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	Transportation to ES by Gondola	30		$26,933.00	$807,990
Memo: Assume 9 bags per car. 267 / 9 = 30 gons.					
	Lift Liner Bags 9 CY	267		$300.00	$80,100
	Loading or Lifting Frames per month	17		$500.00	$8,500
Memo: Rent for 1 months. 11 loading frames and 6 lifting frames. 17 x 1 months = 17.					
	Skid Steer per hour	200	hr	$32.54	$6,508
	18,000 lb Fork Lift per hour	400	hr	$32.66	$13,064
	Flat Bed Truck per hour	200	hr	$45.74	$9,148
	30' IC Scissor Lift Rent per hour	200	hr	$14.88	$2,976
	65 Ton Link-Belt Crane GFE cost per hr	200	hr	$25.99	$5,198
	PPE 2 c/o per day 10 hr day cost per hr	2,600		$1.95	$5,070
	Overnight Shipment per Cooler	6		$251.97	$1,512
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	54		$1,148.00	$61,992
Assume 20% sampling rate. 267 / 5 = 54 samples.					
LABOR	PRIME CONTRACTOR LABOR	247,794		$1.00	$247,794
Memo: 3,466 HOURS					

TOTAL Original Impoundment **$10,656,742**

Memo: 2,000 BCY x 1.2 = 2,400 LCY. Load in soft sided bags and ship to ES by rail for treatment and disposal. 2,400 LCY / 9 CY per bag = 267 bags. Load 16 bags per day so 17 days plus weather/delays = 20 days.

	Estimate Tree Structure Rollups		
	SWMU 3 Alternative 5		**$79,335,237**
	Capital Costs		**$79,285,100**
	Waste Handling/Treatment/Disposal/Transportation		**$69,515,591**

Original Diked Area

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	26,000	hrs	$2.70	$70,200
	1/2 TON 4WD TRUCKS, LARGE VANS	6,000	hrs	$5.45	$32,700
Memo: 3 LATAKY vehicles.					
	Disposal ES MLLW by rail	27,244		$1,030.58	$28,077,122
	Transportation to ES by Gondola	337		$26,933.00	$9,076,421
Memo: Assume 9 bags per car. 3027 / 9 = 337 gons.					
	Lift Liner Bags 9 CY	3,027		$300.00	$908,100
	Loading or Lifting Frames per month	153		$500.00	$76,500
Memo: Rent for 9 months. 11 loading frames and 6 lifting frames. 17 x 9 months = 153.					
	Skid Steer per hour	2,000	hr	$32.54	$65,080
	18,000 lb Fork Lift per hour	4,000	hr	$32.66	$130,640
	Flat Bed Truck per hour	2,000	hr	$45.74	$91,480
	30' IC Scissor Lift Rent per hour	2,000	hr	$14.88	$29,760

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5				**$79,335,237**
	Capital Costs				**$79,285,100**
	Waste Handling/Treatment/Disposal/Transportation				**$69,515,591**

Original Diked Area

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	65 Ton Link-Belt Crane GFE cost per hr	2,000	hr	$25.99	$51,980
	PPE 2 c/o per day 10 hr day cost per hr	26,000		$1.95	$50,700
	Overnight Shipment per Cooler	61		$251.97	$15,370
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	606		$1,148.00	$695,688
Assume 20% sampling rate. 3,027 / 5 = 606 samples.					
LABOR	PRIME CONTRACTOR LABOR	2,479,366		$1.00	$2,479,366
Memo: 34,672 HOURS					

TOTAL Original Diked Area **$41,851,107**

Memo: 22,703 BCY x 1.2 = 27,244 LCY. Load into soft sided bags and ship to ES by rail for disposal. Assume can load 16 bags per day. 27,244 / 9 = 3,027 bags. 3,027 / 16 = 189 days + weather/delays = 200 days.

	Estimate Tree Structure Rollups		
	SWMU 3 Alternative 5		**$79,335,237**
	Capital Costs		**$79,285,100**
	Waste Handling/Treatment/Disposal/Transportation		**$69,515,591**

Source

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	70	hrs	$2.70	$189
	1/2 TON 4WD TRUCKS, LARGE VANS	20	hrs	$5.45	$109
Memo: 2 LATAKY vehicles.					
	Skid Steer per hour	10	hr	$32.54	$325
	18,000 lb Fork Lift per hour	10	hr	$32.66	$327
	ST-90 CONTAINER DELIVERED	1		$1,770.63	$1,771
	Transportation to NNSS by Truck	1		$9,585.00	$9,585
	PPE 2 c/o per day 10 hr day cost per hr	70		$1.95	$137
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	1		$1,148.00	$1,148
Assume 20% sampling rate. 267 / 5 = 54 samples.					
LABOR	PRIME CONTRACTOR LABOR	14,940		$1.00	$14,940
Memo: 198 HOURS					

TOTAL Source **$28,782**

Memo: 1/3 BCY - 1 ST-90 box to NNSS. 5 day duration to prepare NNSS shipment. 1 day of field work.

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study **Reported From: SWMU 3 Alternative 5**
Report Total: $79,335,237

Author
Manager

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5				**$79,335,237**
	Capital Costs				**$79,285,100**
	Waste Handling/Treatment/Disposal/Transportation				**$69,515,591**

Below Grade

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	10,080	hrs	$2.70	$27,216
	1/2 TON 4WD TRUCKS, LARGE VANS	1,440	hrs	$5.45	$7,848
Memo: 3 LATAKY vehicles.					
	Disposal ES MLLW by rail	9,707		$1,030.58	$10,003,840
	Transportation to ES by Gondola	120		$26,933.00	$3,231,960
Memo: Assume 9 bags per car. 1,079 / 9 = 120 gons.					
	Lift Liner Bags 9 CY	1,079		$300.00	$323,700
	Loading or Lifting Frames per month	68		$500.00	$34,000
Memo: Rent for 4 months. 11 loading frames and 6 lifting frames. 17 x 4 months = 68.					
	Skid Steer per hour	720	hr	$32.54	$23,429
	18,000 lb Fork Lift per hour	1,440	hr	$32.66	$47,030
	Flat Bed Truck per hour	720	hr	$45.74	$32,933
	30' IC Scissor Lift Rent per hour	720	hr	$14.88	$10,714
	65 Ton Link-Belt Crane GFE cost per hr	720	hr	$25.99	$18,713
	PPE 2 c/o per day 10 hr day cost per hr	10,080		$1.95	$19,656
	Overnight Shipment per Cooler	22		$251.97	$5,543
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	216		$1,148.00	$247,968
Memo: Assume 20% sampling rate. 1,079 / 5 = 216 samples.					
LABOR	PRIME CONTRACTOR LABOR	896,964		$1.00	$896,964
Memo: 12,540 HOURS					

TOTAL Below Grade **$14,931,514**

Memo: 8,089 BCY x 1.2 = 9,707 LCY. Load into soft sided bags and ship to ES by rail for disposal. Assume can load 16 bags per day. 9,707 / 9 = 1,079 bags. 1,079 / 16 = 68 days + weather/delays = 72 days.

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5				**$79,335,237**
	Capital Costs				**$79,285,100**
	Excavation Backfill				**$3,069,159**

Backfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B10D R.S.Means Crew	69,773	E.C.Y.	$2.67	$186,116
	B34C R.S.Means Crew	69,773	L.C.Y.	$7.98	$556,736
	Backfill Delivered per CY	69,773		$16.00	$1,116,368
	LAUNDRY 2 CHANGES COST PER HOUR	4,650	hrs	$2.70	$12,555
Memo: .					
	1/2 TON 4WD TRUCKS, LARGE VANS	1,860	hrs	$5.45	$10,137
Memo: 2 LATAKY vehicles.					
	Geotechnical Testing Technician per hour	930		$52.19	$48,537
	Geotechnical Testing Density Testing per hour	930		$50.00	$46,500

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 5			**$79,335,237**
	Capital Costs			**$79,285,100**
	Excavation Backfill			**$3,069,159**

Backfill

Tree Depth= 5

	RSMeans Crew B-10W cost per day	93	$1,470.00	$136,710
	RSMeans Crew B-10P cost per day	93	$2,129.00	$197,997
	PPE 2 c/o per day 10 hr day cost per hr	4,650	$1.95	$9,068
LABOR	PRIME CONTRACTOR LABOR	558,306	$1.00	$558,306

Memo: 6,511 HOURS

Subtotal	$2,879,029
1st Layer Markups assigned to Detail Items	$190,130

TOTAL Backfill **$3,069,159**

Memo: 58,144 BCY total removed. 58,144 x 1.2 = 69,773 CY of fill needed. Assume 750 CY filled per day. 69,773 / 750 = 93 days. Fill is stockpiled during other activities and transfered to site as needed.

Estimate Tree Structure Rollups		
SWMU 3 Alternative 5		**$79,335,237**
Annual Costs		**$50,137**
Five Year Reviews		**$50,137**

Five Year Reviews

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,137	$1.00	$50,137

Memo: 500 HOURS

TOTAL Five Year Reviews **$50,137**

COST ESTIMATE
BGOU SWMU 3
Alternative 5WDF—Excavation, Disposal, and LUCs

Cost Estimate Summary									
Capital Cost	**Quantity**	**Units**	**Unit Price**	**Total**					
1.0 Remedial Design	1	LS	$1,561,000	$1,561,000					
2.0 Other Project Plans	1	LS	$1,038,000	$1,038,000					
3.0 Excavation	1	LS	$3,197,000	$3,197,000					
4.0 Treat and Dispose of Water	1	LS	$706,000	$706,000					
5.0 Post Remediation Sampling	1	LS	$198,000	$198,000					
6.0 Waste Handling, Treatment, Disposal, and Transportation	1	LS	$15,593,000	$15,593,000					
7.0 Excavation Backfill	1	LS	$3,069,000	$3,069,000					
Subproject Management	1	LS	$2,536,200	$2,536,000					Subproject Management = 10%
Management Reserve	1	LS	$4,184,700	$4,185,000					Contractor MR = 15%
Fee	1	LS	$2,245,810	$2,246,000					Fee = 7%
Contingency	1	LS	$6,865,800	$6,866,000					Contingency = 20%
			SUBTOTAL CAPITAL COST	**$41,195,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Five-Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
			SUBTOTAL ANNUAL COST	**$10,000,000**			**3.82E+17**		
			TOTAL	**$51,195,000**					

Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	LS	$41,195,000	$41,195,000				**$41,195,000**	
Five-Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$41,195,000**	
						Present	**Annual**	**$889,000**	
						Worth	**Avg. Annual**	**$889**	
						Values	**Total**	**$42,084,000**	
This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.									
Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.									

COST ESTIMATE
BGOU SWMU 3
Alternative 5WDF—Excavation, Disposal, and LUCs

CAPITAL COSTS									
	Material/Equipment/Subcontractors/ODCs				Labor				
Task Description	**Qty**	**Unit**	**Unit Price**	**Total**	**Hours**	**Rate**	**Total**	**Total Cost**	**Basis of Estimate**
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					4224		$376,224		
Remedial Design Report					8744		$803,933		
Civil Surveying					216		$22,818		
Procurement					634		$52,676		
Work Packages/Readiness					1688		$146,788		
Training	1	LS	$56,000	$56,000	1320		$102,736		$56,000 includes subcontractor training
TASK TOTAL				**$56,000**	**16826**		**$1,505,175**	**$1,561,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					5724		$517,587		
O&M Plan					700		$66,863		
SAP/QAPP					1100		$96,201		
Waste Management Plan					1020		$94,190		
RACR					2274		$212,751		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**11402**		**$1,038,317**	**$1,038,000**	
3.0 Excavation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Subtitle C Cap									
Prime Contractor Labor					9072		$780,882		
Subcontractors	1	LS	$478,288	$478,288					
Materials	1	LS	$20,832	$20,832					
Vehicles and Equipment	1	LS	$12,208	$12,208					
Original Impoundment									
Prime Contractor Labor					1782		$153,388		
Subcontractors	1	LS	$85,844	$85,844					
Materials	1	LS	$9,979	$9,979					
Vehicles and Equipment	1	LS	$2,398	$2,398					
Original Diked Area									
Prime Contractor Labor					8748		$752,993		
Subcontractors	1	LS	$412,992	$412,992					
Materials	1	LS	$20,088	$20,088					
Vehicles and Equipment	1	LS	$11,772	$11,772					

COST ESTIMATE
BGOU SWMU 3
Alternative 5WDF—Excavation, Disposal, and LUCs

Source									
Prime Contractor Labor					81		$6,972		
Subcontractors	1	LS	$3,902	$3,902					
Materials	1	LS	$454	$454					
Vehicles and Equipment	1	LS	$109	$109					
Below Grade									
Prime Contractor Labor					3240		$278,886		
Subcontractors	1	LS	$152,960	$152,960					
Materials	1	LS	$7,440	$7,440					
Vehicles and Equipment	1	LS	$4,360	$4,360					
TASK TOTALS				**$1,223,626**	**22,923**		**$1,973,121**	**$3,197,000**	
4.0 Treat and Dispose of Water									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Water Treatment									
Prime Contractor Labor					3384		$240,840		
Subcontractors	1	LS	$360,043	$360,043					Rainforrent.com and RSMeans
Materials	1	LS	$15,735	$15,735					
Vehicles and Equipment	1	LS	$12,295	$12,295					
Water Disposal									
Prime Contractor Labor					80		$4,550		
Characterization Sampling	1	LS	$55,909	$55,909					
Vehicles and Equipment	1	LS	$16,667	$16,667					
TASK TOTALS				**$460,649**	**3,464**		**$245,390**	**$706,000**	
5.0 Post Remediation Sampling									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Sampling									
Prime Contractor Labor					400		$29,217		
Materials	1	LS	$8,830	$8,830					
Analytical									
Prime Contractor Labor					112		$10,206		
Materials	1	LS	$149,818	$149,818					
TASK TOTAL				**$ 158,648**	**512**		**$39,423**	**$198,000**	
6.0 Waste Handling, Treatment, Disposal, and Transportation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Subtitle C Cap									
Prime Contractor Labor					14462		$946,334		
Materials	1	LS	$63,224	$63,224					
Characterization Sampling	1	LS	$445,815	$445,815					
Vehicles and Equipment	1	LS	$592,074	$592,074					
Original Impoundment									
Prime Contractor Labor					3466		$247,794		
Materials	1	LS	$100,690	$100,690					
Characterization Sampling	1	LS	$63,504	$63,504					
Vehicles and Equipment	1	LS	$40,164	$40,164					
Treatment	1	LS	$4,449,816	$4,449,816					
Disposal	1	LS	$4,946,784	$4,946,784					
Transportation	1	LS	$807,990	$807,990					

COST ESTIMATE
BGOU SWMU 3
Alternative 5WDF—Excavation, Disposal, and LUCs

Original Diked Area									
Prime Contractor Labor					17192		$1,154,150		
Materials	1	LS	$119,028	$119,028					
Characterization Sampling	1	LS	$320,459	$320,459					
Vehicles and Equipment	1	LS	$526,051	$526,051					
Transportation	1	LS	$0	$0					Costs contained in LATA Kentucky equipment and labor
Source									
Prime Contractor Labor					198		$14,940		
Materials	1	LS	$2,097	$2,097					
Characterization Sampling	1	LS	$1,400	$1,400					
Vehicles and Equipment	1	LS	$761	$761					
Transportation	1	LS	$9,585	$9,585					
Below Grade									
Prime Contractor Labor					5300		$350,577		
Materials	1	LS	$31,794	$31,794					
Characterization Sampling	1	LS	$152,516	$152,516					
Vehicles and Equipment	1	LS	$205,128	$205,128					
Transportation	1	LS	$0	$0					Costs contained in LATA Kentucky equipment and labor
TASK TOTALS				**$12,878,880**	**40,618**		**$2,713,795**	**$15,593,000**	
7.0 Excavation Backfill									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Backfill									
Prime Contractor Labor					6511		$558,306		
Subcontractors	1	LS	$2,479,094	$2,479,094					RSMeans and local engineering firm
Materials	1	LS	$21,623	$21,623					
Vehicles and Equipment	1	LS	$10,137	$10,137					
TASK TOTAL				**$2,510,854**	**6511**		**$558,306**	**$3,069,000**	
							SUBTOTAL CAPITAL COST	**$25,362,000**	
ANNUAL COSTS									
Five-Year Review									
Duration: Every 5 years.									
Prime Contractor Labor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study **Reported From: SWMU 3 Alternative 5WDF**
Report Total: $25,412,320

Author
Manager

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 5WDF			**$25,412,320**
	Capital Costs			**$25,362,183**
	Remedial Desgin			**$1,561,175**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	376,224	$1.00	$376,224

Memo: 4,224 HOURS

TOTAL RDWP/RDSI Work Plan **$376,224**

Estimate Tree Structure Rollups			
SWMU 3 Alternative 5WDF			**$25,412,320**
Capital Costs			**$25,362,183**
Remedial Desgin			**$1,561,175**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	803,933	$1.00	$803,933

Memo: 8,744 HOURS

TOTAL RDR **$803,933**

Estimate Tree Structure Rollups			
SWMU 3 Alternative 5WDF			**$25,412,320**
Capital Costs			**$25,362,183**
Remedial Desgin			**$1,561,175**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	22,818	$1.00	$22,818

Memo: 216 HOURS

TOTAL Civil Surveying **$22,818**

Estimate Tree Structure Rollups			
SWMU 3 Alternative 5WDF			**$25,412,320**
Capital Costs			**$25,362,183**
Remedial Desgin			**$1,561,175**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	52,676	$1.00	$52,676

Memo: 634 HOURS

TOTAL Procurement **$52,676**

Estimate Tree Structure Rollups			
SWMU 3 Alternative 5WDF			**$25,412,320**
Capital Costs			**$25,362,183**
Remedial Desgin			**$1,561,175**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	146,788	$1.00	$146,788

Memo: 1,688 HOURS

TOTAL Work Packages/Readiness Review **$146,788**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 5WDF			**$25,412,320**
	Capital Costs			**$25,362,183**
	Remedial Desgin			**$1,561,175**

Training

Tree Depth= 5

		QTY	UNIT COST	TOTAL
Memo:	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
	Assume 80 hours of training per person. Assume 10 people or 800 hours.			
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training **$158,736**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 5WDF			**$25,412,320**
	Capital Costs			**$25,362,183**
	Other Project Plans			**$1,038,317**

RAWP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	517,587	$1.00	$517,587
Memo: 5,724 HOURS				

TOTAL RAWP **$517,587**

	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 5WDF			**$25,412,320**
	Capital Costs			**$25,362,183**
	Other Project Plans			**$1,038,317**

O&M Plan

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan **$66,863**

	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 5WDF			**$25,412,320**
	Capital Costs			**$25,362,183**
	Other Project Plans			**$1,038,317**

SAP/QAPP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	96,201	$1.00	$96,201
Memo: 1,100 HOURS				

TOTAL SAP/QAPP **$96,201**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5WDF				**$25,412,320**
	Capital Costs				**$25,362,183**
	Other Project Plans				**$1,038,317**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	94,190		$1.00	$94,190
Memo: 1,020 HOURS					

TOTAL Waste Management Plan **$94,190**

	Estimate Tree Structure Rollups	
	SWMU 3 Alternative 5WDF	**$25,412,320**
	Capital Costs	**$25,362,183**
	Other Project Plans	**$1,038,317**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	212,751		$1.00	$212,751
Memo: 2,274 HOURS					

TOTAL RACR **$212,751**

	Estimate Tree Structure Rollups	
	SWMU 3 Alternative 5WDF	**$25,412,320**
	Capital Costs	**$25,362,183**
	Other Project Plans	**$1,038,317**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

	Estimate Tree Structure Rollups	
	SWMU 3 Alternative 5WDF	**$25,412,320**
	Capital Costs	**$25,362,183**
	Excavation	**$3,196,747**

Subtitle C Cap

Tree Depth= 5

	RSMeans Crew B-10W cost per day	112		$1,470.00	$164,640
	RSMeans Crew B-12C cost per day	112		$2,354.00	$263,648
	Mob/Demob of Subcontractor and Equipment	1	LS	$50,000.00	$50,000
	LAUNDRY 2 CHANGES COST PER HOUR	4,480	hrs	$2.70	$12,096
	1/2 TON 4WD TRUCKS, LARGE VANS	2,240	hrs	$5.45	$12,208
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	4,480		$1.95	$8,736
LABOR	PRIME CONTRACTOR LABOR	780,882		$1.00	$780,882
Memo: 9,072 HOURS					

TOTAL Subtitle C Cap **$1,292,210**

Memo: 23,734 BCY. Assume 225 CY per day so 106 days + weather/delays. Assume 112 day duration.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5WDF				**$25,412,320**
	Capital Costs				**$25,362,183**
	Excavation				**$3,196,747**

Original Impoundment

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	22		$1,470.00	$32,340
	RSMeans Crew B-12C cost per day	22		$2,354.00	$51,788
	LAUNDRY 2 CHANGES COST PER HOUR	880	hrs	$2.70	$2,376
	1/2 TON 4WD TRUCKS, LARGE VANS	440	hrs	$5.45	$2,398
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	880		$5.19	$4,567
	PPE 2 c/o per day 10 hr day cost per hr	880		$1.95	$1,716
	MSA OptiFilter HEPA per hour	880		$3.45	$3,036
LABOR	PRIME CONTRACTOR LABOR	153,388		$1.00	$153,388
Memo: 1,782 HOURS					

TOTAL Original Impoundment **$251,609**
Memo: 2,000 BCY. Excavating and moving a 100 CY per day, so 20 days plus weather/delays is 22 days.

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5WDF				**$25,412,320**
	Capital Costs				**$25,362,183**
	Excavation				**$3,196,747**

Original Diked Area

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	108		$1,470.00	$158,760
	RSMeans Crew B-12C cost per day	108		$2,354.00	$254,232
	LAUNDRY 2 CHANGES COST PER HOUR	4,320	hrs	$2.70	$11,664
	1/2 TON 4WD TRUCKS, LARGE VANS	2,160	hrs	$5.45	$11,772
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	4,320		$1.95	$8,424
LABOR	PRIME CONTRACTOR LABOR	752,993		$1.00	$752,993
Memo: 8,748 HOURS					

TOTAL Original Diked Area **$1,197,845**
Memo: 22,703 BCY. Excavating and moving a 225 CY per day, so 101 days plus weather/delays is 108 days.

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5WDF				**$25,412,320**
	Capital Costs				**$25,362,183**
	Excavation				**$3,196,747**

Source

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	1		$1,470.00	$1,470
	RSMeans Crew B-12C cost per day	1		$2,354.00	$2,354
	LAUNDRY 2 CHANGES COST PER HOUR	40	hrs	$2.70	$108
	1/2 TON 4WD TRUCKS, LARGE VANS	20	hrs	$5.45	$109
Memo: 2 LATAKY vehicles.					

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study — **Reported From: SWMU 3 Alternative 5WDF**
Report Total: $25,412,320

Author
Manager

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5WDF				**$25,412,320**
	Capital Costs				**$25,362,183**
	Excavation				**$3,196,747**

Source

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Resp cleaning 10 hr day 2 C/O per day cost per hr	40		$5.19	$208
	PPE 2 c/o per day 10 hr day cost per hr	40		$1.95	$78
	MSA OptiFilter HEPA per hour	40		$3.45	$138
LABOR Memo: 81 HOURS	PRIME CONTRACTOR LABOR	6,972		$1.00	$6,972

TOTAL Source **$11,437**
Memo: 1 day.

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5WDF				**$25,412,320**
	Capital Costs				**$25,362,183**
	Excavation				**$3,196,747**

Below Grade

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	40		$1,470.00	$58,800
	RSMeans Crew B-12C cost per day	40		$2,354.00	$94,160
	LAUNDRY 2 CHANGES COST PER HOUR	1,600	hrs	$2.70	$4,320
Memo: 2 LATAKY vehicles.	1/2 TON 4WD TRUCKS, LARGE VANS	800	hrs	$5.45	$4,360
	PPE 2 c/o per day 10 hr day cost per hr	1,600		$1.95	$3,120
LABOR Memo: 3,240 HOURS	PRIME CONTRACTOR LABOR	278,886		$1.00	$278,886

TOTAL Below Grade **$443,646**
Memo: 8,089 BCY. Excavating and moving a 225 CY per day, so 36 days plus weather/delays is 40 days.

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5WDF				**$25,412,320**
	Capital Costs				**$25,362,183**
	Treat and Dispose of Water				**$706,041**

Water Treatment

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B10H R.S.Means Crew	282	Day	$581.53	$163,993
Memo: Packaged system with 2 frac tanks.	Water Treatment System w/ Tanks per month	13		$7,785.00	$101,205
	LAUNDRY 2 CHANGES COST PER HOUR	3,384	hrs	$2.70	$9,137
Memo: 2 LATAKY vehicles.	1/2 TON 4WD TRUCKS, LARGE VANS	2,256	hrs	$5.45	$12,295
	PPE 2 c/o per day 10 hr day cost per hr	3,384		$1.95	$6,599

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5WDF				**$25,412,320**
	Capital Costs				**$25,362,183**
	Treat and Dispose of Water				**$706,041**

Water Treatment

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	240,840		$1.00	$240,840
Memo: 3,384 HOURS					
Subtotal					$534,069
1st Layer Markups assigned to Detail Items					$94,846

TOTAL Water Treatment **$628,915**
Memo: 13 months

Estimate Tree Structure Rollups		
SWMU 3 Alternative 5WDF		**$25,412,320**
Capital Costs		**$25,362,183**
Treat and Dispose of Water		**$706,041**

Water Disposal

Tree Depth= 5

	Water Truck 10k Gallon cost per hr	80	hr	$208.34	$16,667
	Overnight Shipment per Cooler	7		$251.97	$1,764
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Water Cost per Sample	65		$833.00	$54,145
Memo: Assume Frac tanks will be emptied every 2 months. 6.5 * 5 tanks * 20,000 gallons = 650,000 gallons. Assume a water sample will be taken from each water truck (10,000 gallons). 650,000 gallons / 10,000 = 65 samples.					
LABOR	PRIME CONTRACTOR LABOR	4,550		$1.00	$4,550
Memo: 80 HOURS					

TOTAL Water Disposal **$77,126**

Estimate Tree Structure Rollups		
SWMU 3 Alternative 5WDF		**$25,412,320**
Capital Costs		**$25,362,183**
Post Remediation Sampling		**$198,071**

Sampling

Tree Depth= 5

	5 gram EN CORE SAMPLER	200		$6.94	$1,388
	Niton XRF Rental One Month	1		$4,500.00	$4,500
	PCB Test Kits	2		$541.00	$1,082
	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780
LABOR	PRIME CONTRACTOR LABOR	29,217		$1.00	$29,217
Memo: 400 HOURS					

TOTAL Sampling **$38,047**
Memo: 44 sidewall samples and 88 floor samples. Total is 132 samples. 2 weeks.

LEVEL		QTY		UNIT COST	TOTAL

Estimate Tree Structure Rollups
SWMU 3 Alternative 5WDF **$25,412,320**
Capital Costs **$25,362,183**
Post Remediation Sampling **$198,071**

Analytical

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	Overnight Shipment per Cooler	21		$251.97	$5,291
Memo: Assume 2 shipments per day for 10 days plus 1 shipment later for the waste water.					
	RDSI Soil Sampling Analytical	0.55		$262,775.00	$144,526
Memo: MANAL114 is for 240 samples. 132 / 240 = .55					
LABOR	PRIME CONTRACTOR LABOR	10,206		$1.00	$10,206
Memo: 112 HOURS					

TOTAL Analytical **$160,024**

Estimate Tree Structure Rollups
SWMU 3 Alternative 5WDF **$25,412,320**
Capital Costs **$25,362,183**
Waste Handling/Treatment/Disposal/Transportation **$15,592,673**

Subtitle C Cap

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	13,335	hrs	$2.70	$36,005
	1/2 TON 4WD TRUCKS, LARGE VANS	2,540	hrs	$5.45	$13,843
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	6,350	hr	$91.06	$578,231
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	633		$43.00	$27,219
	Overnight Shipment per Cooler	38		$251.97	$9,575
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	380		$1,148.00	$436,240
Memo: 28,481 LCY / 15 CY = 1,899. Assume 20% sampling rate. 1,899 / 5 = 380 samples.					
LABOR	PRIME CONTRACTOR LABOR	946,334		$1.00	$946,334
Memo: 14,462 HOURS					

TOTAL Subtitle C Cap **$2,047,446**

Memo: U Landfill WAC Compliant. 23,734 BCY x 1.2 = 28,481 LCY. Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 127 days.

Estimate Tree Structure Rollups
SWMU 3 Alternative 5WDF **$25,412,320**
Capital Costs **$25,362,183**
Waste Handling/Treatment/Disposal/Transportation **$15,592,673**

Original Impoundment

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	2,600	hrs	$2.70	$7,020
	1/2 TON 4WD TRUCKS, LARGE VANS	600	hrs	$5.45	$3,270
Memo: 3 LATAKY vehicles.					
	MLLW Treatment at ES ST90 per CY	2,400		$1,854.09	$4,449,816
	Disposal ES MLLW by rail	4,800		$1,030.58	$4,946,784
Memo: Double the disposal volume for MLLW.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5WDF				**$25,412,320**
	Capital Costs				**$25,362,183**
	Waste Handling/Treatment/Disposal/Transportation				**$15,592,673**

Original Impoundment

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	Transportation to ES by Gondola	30		$26,933.00	$807,990
Memo: Assume 9 bags per car. 267 / 9 = 30 gons.					
	Lift Liner Bags 9 CY	267		$300.00	$80,100
	Loading or Lifting Frames per month	17		$500.00	$8,500
Memo: Rent for 1 months. 11 loading frames and 6 lifting frames. 17 x 1 months = 17.					
	Skid Steer per hour	200	hr	$32.54	$6,508
	18,000 lb Fork Lift per hour	400	hr	$32.66	$13,064
	Flat Bed Truck per hour	200	hr	$45.74	$9,148
	30' IC Scissor Lift Rent per hour	200	hr	$14.88	$2,976
	65 Ton Link-Belt Crane GFE cost per hr	200	hr	$25.99	$5,198
	PPE 2 c/o per day 10 hr day cost per hr	2,600		$1.95	$5,070
	Overnight Shipment per Cooler	6		$251.97	$1,512
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	54		$1,148.00	$61,992
Assume 20% sampling rate. 267 / 5 = 54 samples.					
LABOR	PRIME CONTRACTOR LABOR	247,794		$1.00	$247,794
Memo: 3,466 HOURS					

TOTAL Original Impoundment **$10,656,742**

Memo: 2,000 BCY x 1.2 = 2,400 LCY. Load in soft sided bags and ship to ES by rail for treatment and disposal. 2,400 LCY / 9 CY per bag = 267 bags. Load 16 bags per day so 17 days plus weather/delays = 20 days.

Estimate Tree Structure Rollups		
SWMU 3 Alternative 5WDF		**$25,412,320**
Capital Costs		**$25,362,183**
Waste Handling/Treatment/Disposal/Transportation		**$15,592,673**

Original Diked Area

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	14,400	hrs	$2.70	$38,880
	1/2 TON 4WD TRUCKS, LARGE VANS	1,920	hrs	$5.45	$10,464
Memo: 3 LATAKY vehicles.					
	Skid Steer per hour	960	hr	$32.54	$31,238
	30' IC Scissor Lift Rent per hour	960	hr	$14.88	$14,285
	Roll Off Bin monthly rental	50		$60.00	$3,000
Memo: 10 bins for 5 months.					
	Roll Off Bin Truck per hour	4,800	hr	$97.93	$470,064
	Roll Off Bin Liner	1,363		$36.00	$49,068
	PPE 2 c/o per day 10 hr day cost per hr	14,400		$1.95	$28,080
	Overnight Shipment per Cooler	28		$251.97	$7,055
Memo: Assume 10 samples per cooler.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5WDF				**$25,412,320**
	Capital Costs				**$25,362,183**
	Waste Handling/Treatment/Disposal/Transportation				**$15,592,673**

Original Diked Area

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
Memo:	Characterization Sampling Soil Cost per Sample	273		$1,148.00	$313,404
Assume 20% sampling rate. 1,363 / 5 = 273 samples.					
LABOR	PRIME CONTRACTOR LABOR	1,154,150		$1.00	$1,154,150
Memo: 17,192 HOURS					

TOTAL Original Diked Area **$2,119,688**

Memo: 22,703 BCY x 1.2 = 27,244 LCY. Load into roll off bins and transfer to the WDF by truck. Assume each roll off can hold 20 CY and we can load 15 trucks per day. 27,244 / 300 = 91 days plus weather/delays = 96 days.

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5WDF				**$25,412,320**
	Capital Costs				**$25,362,183**
	Waste Handling/Treatment/Disposal/Transportation				**$15,592,673**

Source

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	70	hrs	$2.70	$189
	1/2 TON 4WD TRUCKS, LARGE VANS	20	hrs	$5.45	$109
Memo: 2 LATAKY vehicles.					
	Skid Steer per hour	10	hr	$32.54	$325
	18,000 lb Fork Lift per hour	10	hr	$32.66	$327
	ST-90 CONTAINER DELIVERED	1		$1,770.63	$1,771
	Transportation to NNSS by Truck	1		$9,585.00	$9,585
	PPE 2 c/o per day 10 hr day cost per hr	70		$1.95	$137
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	1		$1,148.00	$1,148
Assume 20% sampling rate. 267 / 5 = 54 samples.					
LABOR	PRIME CONTRACTOR LABOR	14,940		$1.00	$14,940
Memo: 198 HOURS					

TOTAL Source **$28,782**

Memo: 1/3 BCY - 1 ST-90 box to NNSS. 5 day duration to prepare NNSS shipment. 1 day of field work.

	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5WDF				**$25,412,320**
	Capital Costs				**$25,362,183**
	Waste Handling/Treatment/Disposal/Transportation				**$15,592,673**

Below Grade

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	4,840	hrs	$2.70	$13,068
	1/2 TON 4WD TRUCKS, LARGE VANS	880	hrs	$5.45	$4,796
Memo: 2 LATAKY vehicles.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 3 Alternative 5WDF				**$25,412,320**
	Capital Costs				**$25,362,183**
	Waste Handling/Treatment/Disposal/Transportation				**$15,592,673**

Below Grade

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	15 CY Dump Truck per hour	2,200	hr	$91.06	$200,332
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	216		$43.00	$9,288
	PPE 2 c/o per day 10 hr day cost per hr	4,840		$1.95	$9,438
	Overnight Shipment per Cooler	13		$251.97	$3,276
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	130		$1,148.00	$149,240
Memo: Assume 20% sampling rate. 1,079 / 5 = 216 samples.					
LABOR	PRIME CONTRACTOR LABOR	350,577		$1.00	$350,577
Memo: 5,300 HOURS					

TOTAL Below Grade **$740,015**

Memo: 8,089 BCY x 1.2 = 9,707 LCY. Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 44 days.

Estimate Tree Structure Rollups		
SWMU 3 Alternative 5WDF		**$25,412,320**
Capital Costs		**$25,362,183**
Excavation Backfill		**$3,069,159**

Backfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B10D R.S.Means Crew	69,773	E.C.Y.	$2.67	$186,116
	B34C R.S.Means Crew	69,773	L.C.Y.	$7.98	$556,736
	Backfill Delivered per CY	69,773		$16.00	$1,116,368
	LAUNDRY 2 CHANGES COST PER HOUR	4,650	hrs	$2.70	$12,555
Memo: .					
	1/2 TON 4WD TRUCKS, LARGE VANS	1,860	hrs	$5.45	$10,137
Memo: 2 LATAKY vehicles.					
	Geotechnical Testing Technician per hour	930		$52.19	$48,537
	Geotechnical Testing Density Testing per hour	930		$50.00	$46,500
	RSMeans Crew B-10W cost per day	93		$1,470.00	$136,710
	RSMeans Crew B-10P cost per day	93		$2,129.00	$197,997
	PPE 2 c/o per day 10 hr day cost per hr	4,650		$1.95	$9,068
LABOR	PRIME CONTRACTOR LABOR	558,306		$1.00	$558,306
Memo: 6,511 HOURS					
Subtotal					$2,879,029
1st Layer Markups assigned to Detail Items					$190,130

TOTAL Backfill **$3,069,159**

Memo: 58,144 BCY total removed. 58,144 x 1.2 = 69,773 CY of fill needed. Assume 750 CY filled per day. 69,773 / 750 = 93 days. Fill is stockpiled during other activities and transfered to site as needed.

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 3 Alternative 5WDF			**$25,412,320**
	Annual Costs			**$50,137**
	Five Year Reviews			**$50,137**

Five Year Reviews

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,137	$1.00	$50,137

Memo: 500 HOURS

TOTAL Five Year Reviews **$50,137**

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E.3. SWMU 7 COST ESTIMATES

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COST ESTIMATE
BGOU SWMU 7
Alternative 4 (ERH)—Containment, ERH, LUCs, and Monitoring

Cost Estimate Summary									
Capital Cost	**Quantity**	**Units**	**Unit Price**	**Total**					
1.0 Remedial Design	1	ls	$1,283,000	$1,283,000					
2.0 Other Project Plans	1	ls	$863,000	$863,000					
3.0 Remedial Design Site Investigation (RDSI)	1	ls	$475,000	$475,000					
4.0 In Situ Source Treatment (ERH)	1	ls	$34,275,000	$34,275,000					
5.0 Subtitle D Cap Construction	1	ls	$3,839,000	$3,839,000					
Subproject Management	1	ls	$4,073,500	$4,074,000					Subproject Management = 10%
Management Reserve	1	ls	$6,721,350	$6,721,000					Contractor MR = 15%
Fee	1	ls	$3,607,100	$3,607,000					Fee = 7%
Contingency	1	ls	$11,027,400	$11,027,000					Contingency = 20%
		SUBTOTAL CAPITAL COST		**$66,164,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Inspections	1000	EA	$85,000	$85,000,000			3.07E+18		Quarterly for 1,000 years
Mowing Cap	1000	EA	$32,000	$32,000,000			1.16E+18		Semiannually for 1,000 years.
Sign Replacement	33	EA	$10,000	$333,000			1.33E+15		Every 30 years for 1,000 years
Groundwater Monitoring	1000	EA	$29,000	$29,000,000			1.05E+18		Annually for 1,000 years
Five-Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
		SUBTOTAL ANNUAL COST		**$156,333,000**			**5.66E+18**		
			TOTAL	**$222,497,000**					
Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	ls	$66,164,000	$66,164,000				**$66,164,000**	
Inspections	1000	EA	$85,000	$85,000,000				**$7,727,136**	1.1% discount rate
Mowing Cap	1000	EA	$32,000	$32,000,000				**$2,909,039**	1.1% discount rate
Sign Replacement	33	EA	$10,000	$333,333				**$25,742**	1.1% discount rate
Groundwater Monitoring	1000	EA	$29,000	$29,000,000				**$2,636,317**	1.1% discount rate
Five-Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$66,164,000**	
						Present Worth Values	**Annual**	**$14,188,000**	
							Avg. Annual	**$14,188**	
							Total	**$80,352,000**	

This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.

COST ESTIMATE
BGOU SWMU 7
Alternative 4 (ERH)—Containment, ERH, LUCs, and Monitoring

CAPITAL COSTS

	Material/Equipment/Subcontractors/ODCs				Labor				
Task Description	**Qty**	**Unit**	**Unit Price**	**Total**	**Hours**	**Rate**	**Total**	**Total Cost**	**Basis of Estimate**
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					3444		$306,203		
Remedial Design Report					7184		$663,892		
Civil Surveying					192		$20,283		
Procurement					440		$36,198		
Work Packages/Readiness					1128		$98,096		
Training	1	LS	$56,000	$56,000	1320		$102,736		$56,000 includes subcontractor training
TASK TOTAL				**$56,000**	**13708**		**$1,227,408**	**$1,283,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					4489		$406,721		
O&M Plan					700		$66,863		
SAP/QAPP					970		$84,602		
Waste Management Plan					616		$58,809		
RACR					2065		$195,210		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**9424**		**$862,930**	**$863,000**	
3.0 Remedial Design Site Investigation (RDSI)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated and therefore includes labor, material, and equipment where applicable.									
Drilling									
Prime Contractor Labor					2340		$190,626		
Subcontractors	1	LS	$39,376	$39,376					Local quote from existing drilling sub.
Materials	1	LS	$28,256	$28,256					
Vehicles and Equipment	1	LS	$4,360	$4,360					
Sampling									
Prime Contractor Labor					600		$43,825		
Materials	1	LS	$9,913	$9,913					
Analytical									
Prime Contractor Labor					200		$18,393		
Materials	1	LS	$121,347	$121,347					
Excavation									
Prime Contractor Labor	1				200		$15,220		
Materials	1	LS	$744	$744					
Equipment	1	LS	$3,214	$3,214					
TASK TOTAL				**$ 207,210**	**3340**		**$ 268,064**	**$475,000**	
4.0 In Situ Source Treatment (ERH)									
Refer to the Success reports for detailed cost and resources. Costs in this section are derived from the C-400 Project's actual costs.									
Installation									
Scaled Actual Costs	1	LS	$20,714,070	$20,714,070					Costs escalated to FY14 and scaled down by a factor .66
Operations				$0					
Scaled Actual Costs	1	LS	$13,048,540	$13,048,540					Costs escalated to FY14 and scaled down by a factor .66
D&D				$0					
Scaled Actual Costs	1	LS	$512,635	$512,635					Costs escalated to FY14 and scaled down by a factor .66
TASK TOTALS				**$34,275,245**	**0**		**$0**	**$34,275,000**	

COST ESTIMATE
BGOU SWMU 7
Alternative 4 (ERH)—Containment, ERH, LUCs, and Monitoring

5.0 Subtitle D Cap Construction									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Surveying, Marking, Testing									
Prime Contractor Labor					1920		$225,090		
Subcontractors	1	LS	$280,410	$280,410					Local engineering firm
Materials	1	LS	$1,488	$1,488					
Road and Ditch Relocation									
Prime Contractor Labor					1153		$98,925		
Subcontractors	1	LS	$118,809	$118,809					
Materials	1	LS	$1,296	$1,296					
Vehicles and Equipment	1	LS	$3,488	$3,488					
Cap Construction									
Prime Contractor Labor					11904		$950,950		
Subcontractors	1	LS	$1,821,836	$1,821,836					
Materials	1	LS	$35,712	$35,712					
Vehicles and Equipment	1	LS	$41,856	$41,856					
Monitoring Well Installation									
Prime Contractor Labor					1736		$138,680		
Subcontractors	1	LS	$113,260	$113,260					Local quote from existing drilling sub.
Materials	1	LS	$3,906	$3,906					
Vehicles and Equipment	1	LS	$3,052	$3,052					
TASK TOTAL				**$ 2,425,113**	**16713**		**$1,413,645**	**$3,839,000**	
							SUBTOTAL CAPITAL COST	**$40,735,000**	
ANNUAL COSTS									
Inspections									
Duration: Occurs quarterly for 1,000 years.									
Prime Contractor Labor					960		$80,722		
Materials	1	LS	$2,160	$2,160					
Vehicles and Equipment	1	LS	$1,744	$1,744					
TASK TOTAL				**$3,904**	**960**		**$80,722**	**$85,000**	ANNUAL COST
Mowing Cap									
Duration: Semiannually for 1,000 years.									
Prime Contractor Labor					30		$2,582		
Subcontractors	1	LS	$29,048	$29,048					
TASK TOTAL				**$29,048**			**$2,582**	**$32,000**	ANNUAL COST
Sign Replacement									
Duration: Every 30 years.									
Prime Contractor Labor					120		$9,567		
Materials	1	LS	$216	$216					
Vehicles and Equipment	1	LS	$436	$436					
TASK TOTAL				**$652**			**$9,567**	**$10,000**	EVERY 30 YEARS
Groundwater Monitoring									
Duration: Annually for years 6 through 1000									
Prime Contractor Labor					285		$22,391		
Laboratory	1	LS	$5,327	$5,327					
Materials	1	LS	$473	$473					
Vehicles and Equipment	1	LS	$409	$409					
TASK TOTAL				**$6,209**			**$22,391**	**$29,000**	ANNUAL COST
Five-Year Review									
Duration: Every 5 years.									
Prime Contractor Labor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study **Reported From: SWMU 7 Alternative 4(ERH)**
Report Total: $40,940,827

Author
Manager

LEVEL		QTY	UNIT COST	TOTAL
		Estimate Tree Structure Rollups		
		SWMU 7 Alternative 4(ERH)		**$40,940,827**
		Capital Costs		**$40,735,615**
		Remedial Desgin		**$1,283,408**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	306,203	$1.00	$306,203
Memo: 3,444 HOURS				

TOTAL RDWP/RDSI Work Plan **$306,203**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(ERH)		**$40,940,827**
Capital Costs		**$40,735,615**
Remedial Desgin		**$1,283,408**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	663,892	$1.00	$663,892
Memo: 7,184 HOURS				

TOTAL RDR **$663,892**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(ERH)		**$40,940,827**
Capital Costs		**$40,735,615**
Remedial Desgin		**$1,283,408**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	20,283	$1.00	$20,283
Memo: 192 HOURS				

TOTAL Civil Surveying **$20,283**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(ERH)		**$40,940,827**
Capital Costs		**$40,735,615**
Remedial Desgin		**$1,283,408**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	36,198	$1.00	$36,198
Memo: 440 HOURS				

TOTAL Procurement **$36,198**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(ERH)		**$40,940,827**
Capital Costs		**$40,735,615**
Remedial Desgin		**$1,283,408**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	98,096	$1.00	$98,096
Memo: 1,128 HOURS				

TOTAL Work Packages/Readiness Review **$98,096**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 4(ERH)			**$40,940,827**
	Capital Costs			**$40,735,615**
	Remedial Desgin			**$1,283,408**

Training

Tree Depth= 5

Memo:	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
	Assume 80 hours of training per person. Assume 10 people or 800 hours.			
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training — **$158,736**
Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(ERH)		**$40,940,827**
Capital Costs		**$40,735,615**
Other Project Plans		**$862,930**

RAWP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	406,721	$1.00	$406,721
Memo: 4,489 HOURS				

TOTAL RAWP — **$406,721**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(ERH)		**$40,940,827**
Capital Costs		**$40,735,615**
Other Project Plans		**$862,930**

O&M Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan — **$66,863**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(ERH)		**$40,940,827**
Capital Costs		**$40,735,615**
Other Project Plans		**$862,930**

SAP/QAPP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	84,602	$1.00	$84,602
Memo: 970 HOURS				

TOTAL SAP/QAPP — **$84,602**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(ERH)				**$40,940,827**
	Capital Costs				**$40,735,615**
	Other Project Plans				**$862,930**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	58,809		$1.00	$58,809
Memo: 616 HOURS					

TOTAL Waste Management Plan **$58,809**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(ERH)		**$40,940,827**
Capital Costs		**$40,735,615**
Other Project Plans		**$862,930**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	195,210		$1.00	$195,210
Memo: 2,065 HOURS					

TOTAL RACR **$195,210**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(ERH)		**$40,940,827**
Capital Costs		**$40,735,615**
Other Project Plans		**$862,930**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(ERH)		**$40,940,827**
Capital Costs		**$40,735,615**
RDSI		**$475,275**

Drilling

Tree Depth= 5

	Mob/Demob for DPT subcontractor	1		$8,500.00	$8,500
	DPT Borings to 65 feet	12		$2,573.00	$30,876
	1/2 TON 4WD TRUCKS, LARGE VANS	800	hrs	$5.45	$4,360
Memo: 4 LATAKY vehicles.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	ST-90 CONTAINER DELIVERED	2		$1,770.63	$3,541
Memo: 2 ST-90 box for PPE/Trash.					
	PORTABLE TOILET & HAND WASH PER MONTH	2		$227.21	$454
Memo: Rent for 2 months.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,800	hrs	$2.70	$4,860
Memo: LATAKY personnel plus assume 5 drillers.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,800		$5.19	$9,342
	PPE 2 c/o per day 10 hr day cost per hr	1,800		$1.95	$3,510

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(ERH)				**$40,940,827**
	Capital Costs				**$40,735,615**
	RDSI				**$475,275**

Drilling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	MSA OptiFilter HEPA per hour	1,800		$3.45	$6,210
LABOR Memo: 2,340 HOURS	PRIME CONTRACTOR LABOR	190,626		$1.00	$190,626

TOTAL Drilling **$262,618**

Memo: 12 DPT locations. 12 day duration plus one week for mod and one week for demob. 5 week total duration.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(ERH)				**$40,940,827**
	Capital Costs				**$40,735,615**
	RDSI				**$475,275**

Sampling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	5 gram EN CORE SAMPLER	300		$6.94	$2,082
	Niton XRF Rental One Month	1		$4,500.00	$4,500
	PCB Test Kits	1		$541.00	$541
	LAUNDRY 2 CHANGES COST PER HOUR	600	hrs	$2.70	$1,620
	PPE 2 c/o per day 10 hr day cost per hr	600		$1.95	$1,170
LABOR Memo: 600 HOURS	PRIME CONTRACTOR LABOR	43,825		$1.00	$43,825

TOTAL Sampling **$53,738**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(ERH)				**$40,940,827**
	Capital Costs				**$40,735,615**
	RDSI				**$475,275**

Analytical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
Memo: Assume 2 shipments per day for 25 days plus 1 shipment later for the waste water.	Overnight Shipment per Cooler	51		$251.97	$12,850
Memo: 3 Geophysical samples taken for particle size and atterberg limits.	RDSI Geophysical Sampling Analytical	1		$1,275.00	$1,275
Memo: MANAL114 is for 240 samples. 8 samples per hole x 12 holes = 96 samples. 96/240 = .4.	RDSI Soil Sampling Analytical	0.40		$262,775.00	$105,110
Memo: 2 per hole.	VOCs in Water	24		$88.00	$2,112
LABOR Memo: 200 HOURS	PRIME CONTRACTOR LABOR	18,393		$1.00	$18,393

TOTAL Analytical **$139,740**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(ERH)				**$40,940,827**
	Capital Costs				**$40,735,615**
	RDSI				**$475,275**

Excavation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	CATERPILLAR 345B CRAWLER MOUNTED SHEAR HEAD EXCAVATOR	40	hr	$62.12	$2,485
	JOHN DEERE 624E 4WD ARTICULATED WHEEL LOADER	40	hr	$18.23	$729
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
LABOR	PRIME CONTRACTOR LABOR	15,220		$1.00	$15,220

Memo: 200 HOURS

TOTAL Excavation **$19,178**

Memo: 2 excavations. Performed methodically to verify lack of metal debris.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(ERH)		**$40,940,827**
Capital Costs		**$40,735,615**

In Situ Source Treatment (ERH)

Tree Depth= 4

	QTY	UNIT COST	TOTAL
	1	$0.01	$0

Memo: SWMU 7 treated area is 75' x 75' x 60' or 12,500 CY.
C-400 treated area was 19,000 CY.
12,500 / 19,000 = .66.
Assume a .66 scaling factor.

Subtotal	$0
Rollup from Child Levels	$34,275,245

TOTAL In Situ Source Treatment (ERH) **$34,275,245**

Estimate Tree Structure Rollups	
SWMU 7 Alternative 4(ERH)	**$40,940,827**
Capital Costs	**$40,735,615**
In Situ Source Treatment (ERH)	**$34,275,245**

Installation

Tree Depth= 5

	QTY	UNIT COST	TOTAL
ERH Costs from C-400	20,714,070	$1.00	$20,714,070

TOTAL Installation **$20,714,070**

Memo: FY14 Construction costs from C-400: $31,384,955.
$31,384,955 x .66 = $20,714,070.

Estimate Tree Structure Rollups	
SWMU 7 Alternative 4(ERH)	**$40,940,827**
Capital Costs	**$40,735,615**
In Situ Source Treatment (ERH)	**$34,275,245**

Operations

Tree Depth= 5

	QTY	UNIT COST	TOTAL
ERH Costs from C-400	13,048,540	$1.00	$13,048,540

LEVEL		QTY		UNIT COST	TOTAL
TOTAL Operations					**$13,048,540**

Memo: FY14 Operations costs from C-400: $19,770,515.
$19,770,515 x .66 = $13,048,540.

Estimate Tree Structure Rollups
SWMU 7 Alternative 4(ERH) **$40,940,827**
Capital Costs **$40,735,615**
In Situ Source Treatment (ERH) **$34,275,245**

D&D

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	ERH Costs from C-400	512,635		$1.00	$512,635
TOTAL D&D					**$512,635**

Memo: FY14 D&D costs from C-400: $776,720.
$776,720 x .66 = $512,635.

Estimate Tree Structure Rollups
SWMU 7 Alternative 4(ERH) **$40,940,827**
Capital Costs **$40,735,615**
Cap Construction **$3,838,757**

Surveying, Marking, Testing

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	320	hrs	$2.70	$864
	Geotechnical Testing Technician per hour	3,840		$52.19	$200,410
Memo: Construction 2 FTE. Geotechnical testing, data recording, surveying, and reporting.					
	Geotechnical Testing Density Testing per hour	1,600		$50.00	$80,000
Memo: Construction Nuclear Density testing per hour. Estimated 10 months.					
	PPE 2 c/o per day 10 hr day cost per hr	320		$1.95	$624
LABOR	PRIME CONTRACTOR LABOR	225,090		$1.00	$225,090
Memo: 1,920 HOURS					
TOTAL Surveying, Marking, Testing					**$506,988**

Estimate Tree Structure Rollups
SWMU 7 Alternative 4(ERH) **$40,940,827**
Capital Costs **$40,735,615**
Cap Construction **$3,838,757**

Road and Ditch Relocation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B34K R.S.Means Crew	4	Ea.	$423.07	$1,692
	B38 R.S.Means Crew	940	S.Y.	$6.76	$6,353
Memo: 700 lf x 12' wide = 8,400 SF or 940 SY. Remove existing pavement.					
	B13H R.S.Means Crew	1,554	B.C.Y.	$8.68	$13,494
Memo: 700' x 4' x 15' / 27 = 1,554 CY. Excavate new ditch.					
	B13H R.S.Means Crew	390	B.C.Y.	$8.68	$3,387
Memo: 700' x 1' x 15' / 27 = 390 CY. Muck existing ditch.					
	B10D R.S.Means Crew	1,554	E.C.Y.	$2.67	$4,145
	B34C R.S.Means Crew	1,554	L.C.Y.	$7.98	$12,400
	Backfill Delivered per CY	1,554		$16.00	$24,864

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(ERH)				**$40,940,827**
	Capital Costs				**$40,735,615**
	Cap Construction				**$3,838,757**

Road and Ditch Relocation

Tree Depth= 5

LEVEL	Item	QTY	Unit	UNIT COST	TOTAL
	B13 R.S.Means Crew	60	L.F.	$95.05	$5,703
Memo: (2) 30 foot culverts.					
	B25C R.S.Means Crew	8,400	S.F.	$3.42	$28,772
Memo: Repave road.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	1/2 TON 4WD TRUCKS, LARGE VANS	640	hrs	$5.45	$3,488
Memo: 4 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	98,925		$1.00	$98,925
Memo: 1,153 HOURS					
Subtotal					$204,519
1st Layer Markups assigned to Detail Items					$17,998
TOTAL Road and Ditch Relocation					**$222,517**

Memo: 1 month duration.

	Estimate Tree Structure Rollups		
	SWMU 7 Alternative 4(ERH)		**$40,940,827**
	Capital Costs		**$40,735,615**
	Cap Construction		**$3,838,757**

Cap Construction

Tree Depth= 5

LEVEL	Item	QTY	Unit	UNIT COST	TOTAL
	Common Building Laborers	25,556	S.Y.	$2.09	$53,384
	B15 R.S.Means Crew	13,334	C.Y.	$29.84	$397,941
Memo: CLAY LINER LAYER: 18" clay layer.					
	B10G R.S.Means Crew	13,334	E.C.Y.	$1.25	$16,599
Memo: Compaction of Clay Liner Layer.					
	B15 R.S.Means Crew	9,259	C.Y.	$23.34	$216,143
Memo: DRAINAGE LAYER: 12" sand layer.					
	B10G R.S.Means Crew	9,259	E.C.Y.	$1.25	$11,526
Memo: Compaction of Sand Layer.					
	B15 R.S.Means Crew	28,889	C.Y.	$27.34	$789,943
Memo: Topsoil Layer - Assume 3 feet of vegetative soil (72,900 * 3) / 27 = 8,100 CY.					
	B10G R.S.Means Crew	19,259	E.C.Y.	$1.25	$23,974
Memo: Compaction of the 2 feet of protective soil.					
	B81 R.S.Means Crew	260	M.S.F.	$44.24	$11,503
	B34K R.S.Means Crew	4	Ea.	$423.07	$1,692
Memo: Mob/Demob for 2 dozers and 2 compactors.					
	1/2 TON 4WD TRUCKS, LARGE VANS	7,680	hrs	$5.45	$41,856
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	7,680	hrs	$2.70	$20,736
	Corner Monuments	4		$20,000.00	$80,000
	PPE 2 c/o per day 10 hr day cost per hr	7,680		$1.95	$14,976

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(ERH)				**$40,940,827**
	Capital Costs				**$40,735,615**
	Cap Construction				**$3,838,757**

Cap Construction

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	950,950		$1.00	$950,950
Memo: 11,904 HOURS					
Subtotal					$2,631,222
1st Layer Markups assigned to Detail Items					$219,132

TOTAL Cap Construction **$2,850,355**

Memo: Assume 12 month duration.
Cap area is 230,000 SF. Assume perimeter increases by a linear 10 feet for every layer.
Layer 1: Geotextile Fabric. 230,000 SF.
Layer 2: Clay Liner - Assume 18 inches of clay. (240,000 * 1.5) / 27 = 13,334 CY.
Layer 3: Drainage Layer - Assume 1 feet of sand. (250,000 * 1) / 27 = 9,259 CY.
Layer 4: Vegetative Soil Layer - Assume 3 feet of protective soil (260,000 * 3) / 27 = 28,889 CY.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(ERH)		**$40,940,827**
Capital Costs		**$40,735,615**
Cap Construction		**$3,838,757**

Monitoring Well Installation

Tree Depth= 5

	Monitoring Well	7		$16,180.00	$113,260
	LAUNDRY 2 CHANGES COST PER HOUR	840	hrs	$2.70	$2,268
	1/2 TON 4WD TRUCKS, LARGE VANS	560	hrs	$5.45	$3,052
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	840		$1.95	$1,638
LABOR	PRIME CONTRACTOR LABOR	138,680		$1.00	$138,680
Memo: 1,736 HOURS					

TOTAL Monitoring Well Installation **$258,898**

Memo: 7 monitoring wells installed.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(ERH)		**$40,940,827**
Annual Costs		**$205,211**
Operations & Maintenance		**$126,475**

Inspections

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	800	hrs	$2.70	$2,160
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	80,722		$1.00	$80,722
Memo: 960 HOURS					

TOTAL Inspections **$84,626**

Memo: Annual Cost. General inspections of the action. Quarterly.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(ERH)				**$40,940,827**
	Annual Costs				**$205,211**
	Operations & Maintenance				**$126,475**

Mowing Cap

Tree Depth= 5

	B84 R.S.Means Crew	260	M.S.F.	$81.20	$21,112
LABOR Memo: 30 HOURS	PRIME CONTRACTOR LABOR	2,582		$1.00	$2,582
Subtotal					$23,694
1st Layer Markups assigned to Detail Items					$7,936

TOTAL Mowing Cap **$31,630**
Memo: Annual Cost. Semiannually mow cap. 1 day each time.

	Estimate Tree Structure Rollups		
	SWMU 7 Alternative 4(ERH)		**$40,940,827**
	Annual Costs		**$205,211**
	Operations & Maintenance		**$126,475**

Sign Replacement

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	80	hrs	$2.70	$216
Memo: 2 LATAKY vehicles.	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
LABOR Memo: 120 HOURS	PRIME CONTRACTOR LABOR	9,567		$1.00	$9,567

TOTAL Sign Replacement **$10,219**
Memo: Occurs every 30 years.

	Estimate Tree Structure Rollups		
	SWMU 7 Alternative 4(ERH)		**$40,940,827**
	Annual Costs		**$205,211**
	Groundwater Monitoring		**$28,600**

Monitoring Well Sampling

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	175	hrs	$2.70	$473
Memo: 2 LATAKY vehicles.	1/2 TON 4WD TRUCKS, LARGE VANS	75	hrs	$5.45	$409
Memo: Assume 1 cooler per sampling event for the 4 wells.	Overnight Shipment per Cooler	2		$251.97	$504
	Well Sampling	7		$689.05	$4,823
LABOR Memo: 285 HOURS	PRIME CONTRACTOR LABOR	22,391		$1.00	$22,391

TOTAL Monitoring Well Sampling **$28,600**

	Estimate Tree Structure Rollups		
	SWMU 7 Alternative 4(ERH)		**$40,940,827**
	Annual Costs		**$205,211**
	Five Year Reviews		**$50,137**

Five Year Reviews

Tree Depth= 5

LABOR Memo: 500 HOURS	PRIME CONTRACTOR LABOR	50,137	$1.00	$50,137

LEVEL	QTY	UNIT COST	TOTAL
TOTAL Five Year Reviews			**$50,137**

COST ESTIMATE
BGOU SWMU 7
Alternative 4 (P&T)—Containment, Pump-and-Treat, LUCs, and Monitoring

Cost Estimate Summary									
Capital Cost	**Quantity**	**Units**	**Unit Price**	**Total**					
1.0 Remedial Design	1	LS	$1,283,000	$1,283,000					
2.0 Other Project Plans	1	LS	$863,000	$863,000					
3.0 Remedial Design Site Investigation (RDSI)	1	LS	$475,000	$475,000					
4.0 In Situ Source Treatment (P&T)	1	LS	$2,515,000	$2,515,000					
5.0 Subtitle D Cap Construction	1	LS	$3,839,000	$3,839,000					
Subproject Management	1	LS	$897,500	$898,000					Subproject Management = 10%
Management Reserve	1	LS	$1,480,950	$1,481,000					Contractor MR = 15%
Fee	1	LS	$794,780	$795,000					Fee = 7%
Contingency	1	LS	$2,429,800	$2,430,000					Contingency = 20%
		SUBTOTAL CAPITAL COST		**$14,579,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Inspections	1000	EA	$85,000	$85,000,000			3.07E+18		Quarterly for 1,000 years
Mowing Cap	1000	EA	$32,000	$32,000,000			1.16E+18		Semiannually for 1,000 years.
Sign Replacement	33	EA	$10,000	$333,000			1.33E+15		Every 30 years for 1,000 years
Pump & Treat O&M	50	EA	$218,000	$10,900,000			2.38E+07		Annually for 50 years
Groundwater Monitoring	1000	EA	$29,000	$29,000,000			1.05E+18		Annually for 1,000 years
Five-Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
		SUBTOTAL ANNUAL COST		**$167,233,000**			**5.66E+18**		
			TOTAL	**$181,812,000**					
Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	LS	$14,579,000	$14,579,000				**$14,579,000**	
Inspections	1000	EA	$85,000	$85,000,000				**$7,727,136**	1.1% discount rate
Mowing Cap	1000	EA	$32,000	$32,000,000				**$2,909,039**	1.1% discount rate
Sign Replacement	33	EA	$10,000	$333,333				**$25,742**	1.1% discount rate
Pump & Treat O&M	50	EA	$218,000	$10,900,000				**$8,349,697**	1.1% discount rate
Groundwater Monitoring	1000	EA	$29,000	$29,000,000				**$2,636,317**	1.1% discount rate
Five-Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$14,579,000**	
						Present Worth Values	**Annual**	**$22,537,000**	
							Avg. Annual	**$22,537**	
							Total	**$37,116,000**	
This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.									
Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.									

COST ESTIMATE
BGOU SWMU 7
Alternative 4 (P&T)—Containment, Pump-and-Treat, LUCs, and Monitoring

CAPITAL COSTS									
	Material/Equipment/Subcontractors/ODCs				Labor				
Task Description	**Qty**	**Unit**	**Unit Price**	**Total**	**Hours**	**Rate**	**Total**	**Total Cost**	**Basis of Estimate**
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					3444		$306,203		
Remedial Design Report					7184		$663,892		
Civil Surveying					192		$20,283		
Procurement					440		$36,198		
Work Packages/Readiness					1128		$98,096		
Training	1	LS	$56,000	$56,000	1320		$102,736		$56,000 includes subcontractor training
TASK TOTAL				**$56,000**	**13708**		**$1,227,408**	**$1,283,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					4489		$406,721		
O&M Plan					700		$66,863		
SAP/QAPP					970		$84,602		
Waste Management Plan					616		$58,809		
RACR					2065		$195,210		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**9424**		**$862,930**	**$863,000**	
3.0 Remedial Design Site Investigation (RDSI)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Drilling									
Prime Contractor Labor					2340		$190,626		
Subcontractors	1	LS	$39,376	$39,376					Local quote from existing drilling sub.
Materials	1	LS	$28,256	$28,256					
Vehicles and Equipment	1	LS	$4,360	$4,360					
Sampling									
Prime Contractor Labor					600		$43,825		
Materials	1	LS	$9,913	$9,913					
Analytical									
Prime Contractor Labor					200		$18,393		
Materials	1	LS	$121,347	$121,347					
Excavation									
Prime Contractor Labor	1				200		$15,220		
Materials	1	LS	$744	$744					
Equipment	1	LS	$3,214	$3,214					
TASK TOTAL				**$ 207,210**	**3340**		**$ 268,064**	**$475,000**	
4.0 In Situ Source Treatment (P&T)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Extraction Well									
Prime Contractor Labor					480		$38,170		
Subcontractors	1	LS	$168,497	$168,497					Local quote from existing drilling sub.
Materials	1	LS	$1,455	$1,455					
Vehicles and Equipment	1	LS	$872	$872					
Treatment System									
Prime Contractor Labor					9216		$706,716		
Subcontractors	1	LS	$1,560,193	$1,560,193					RSMeans and historical costs from the groundwater OU.
Materials	1	LS	$33,480	$33,480					
Vehicles and Equipment	1	LS	$5,232	$5,232					
TASK TOTALS				**$1,769,729**	**9,696**		**$744,886**	**$2,515,000**	

COST ESTIMATE
BGOU SWMU 7
Alternative 4 (P&T)—Containment, Pump-and-Treat, LUCs, and Monitoring

5.0 Subtitle D Cap Construction									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Surveying, Marking, Testing									
Prime Contractor Labor					1920		$225,090		
Subcontractors	1	LS	$280,410	$280,410					Local engineering firm
Materials	1	LS	$1,488	$1,488					
Road and Ditch Relocation									
Prime Contractor Labor					1153		$98,925		
Subcontractors	1	LS	$118,809	$118,809					
Materials	1	LS	$1,296	$1,296					
Vehicles and Equipment	1	LS	$3,488	$3,488					
Cap Construction									
Prime Contractor Labor					11904		$950,950		
Subcontractors	1	LS	$1,821,836	$1,821,836					
Materials	1	LS	$35,712	$35,712					
Vehicles and Equipment	1	LS	$41,856	$41,856					
Monitoring Well Installation									
Prime Contractor Labor					1736		$138,680		
Subcontractors	1	LS	$113,260	$113,260					Local quote from existing drilling sub.
Materials	1	LS	$3,906	$3,906					
Vehicles and Equipment	1	LS	$3,052	$3,052					
TASK TOTAL				**$ 2,425,113**	**16713**		**$1,413,645**	**$3,839,000**	
						SUBTOTAL CAPITAL COST		**$8,975,000**	
ANNUAL COSTS									
Inspections									
Duration: Occurs quarterly for 1,000 years.									
Prime Contractor Labor					960		$80,722		
Materials	1	LS	$2,160	$2,160					
Vehicles and Equipment	1	LS	$1,744	$1,744					
TASK TOTAL				**$3,904**	**960**		**$80,722**	**$85,000**	ANNUAL COST
Mowing Cap									
Duration: Semiannually for 1,000 years.									
Prime Contractor Labor					30		$2,582		
Subcontractors	1	LS	$29,048	$29,048					
TASK TOTAL				**$29,048**			**$2,582**	**$32,000**	ANNUAL COST
Sign Replacement									
Duration: Every 30 years.									
Prime Contractor Labor					120		$9,567		
Materials	1	LS	$216	$216					
Vehicles and Equipment	1	LS	$436	$436					
TASK TOTAL				**$652**			**$9,567**	**$10,000**	EVERY 30 YEARS
Pump & Treat O&M									
Duration: Annually for 50 years.									
Prime Contractor Labor					2480		$191,694		
Materials	1	LS	$24,992	$24,992					
Vehicles and Equipment	1	LS	$1,744	$1,744					
TASK TOTAL				**$26,736**			**$191,694**	**$218,000**	ANNUAL COST
Groundwater Monitoring									
Duration: Annually for years 6 through 1000									
Prime Contractor Labor					285		$22,391		
Laboratory	1	LS	$5,327	$5,327					
Materials	1	LS	$473	$473					
Vehicles and Equipment	1	LS	$409	$409					
TASK TOTAL				**$6,209**			**$22,391**	**$29,000**	ANNUAL COST

COST ESTIMATE
BGOU SWMU 7
Alternative 4 (P&T)—Containment, Pump-and-Treat, LUCs, and Monitoring

Five-Year Review										
Duration: Every 5 years.										
	Prime Contractor Labor					500		$50,137		
	TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study — **Reported From: SWMU 7 Alternative 4(P&T)**
Report Total: $9,398,627

Author
Manager

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 4(P&T)			**$9,398,627**
	Capital Costs			**$8,974,985**
	Remedial Desgin			**$1,283,408**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	306,203	$1.00	$306,203
Memo: 3,444 HOURS				
TOTAL RDWP/RDSI Work Plan				**$306,203**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(P&T)		**$9,398,627**
Capital Costs		**$8,974,985**
Remedial Desgin		**$1,283,408**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	663,892	$1.00	$663,892
Memo: 7,184 HOURS				
TOTAL RDR				**$663,892**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(P&T)		**$9,398,627**
Capital Costs		**$8,974,985**
Remedial Desgin		**$1,283,408**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	20,283	$1.00	$20,283
Memo: 192 HOURS				
TOTAL Civil Surveying				**$20,283**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(P&T)		**$9,398,627**
Capital Costs		**$8,974,985**
Remedial Desgin		**$1,283,408**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	36,198	$1.00	$36,198
Memo: 440 HOURS				
TOTAL Procurement				**$36,198**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(P&T)		**$9,398,627**
Capital Costs		**$8,974,985**
Remedial Desgin		**$1,283,408**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	98,096	$1.00	$98,096
Memo: 1,128 HOURS				
TOTAL Work Packages/Readiness Review				**$98,096**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 4(P&T)			**$9,398,627**
	Capital Costs			**$8,974,985**
	Remedial Desgin			**$1,283,408**

Training

Tree Depth= 5

		QTY	UNIT COST	TOTAL
Memo:	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
	Assume 80 hours of training per person. Assume 10 people or 800 hours.			
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training **$158,736**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 4(P&T)			**$9,398,627**
	Capital Costs			**$8,974,985**
	Other Project Plans			**$862,930**

RAWP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	406,721	$1.00	$406,721
Memo: 4,489 HOURS				

TOTAL RAWP **$406,721**

	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 4(P&T)			**$9,398,627**
	Capital Costs			**$8,974,985**
	Other Project Plans			**$862,930**

O&M Plan

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan **$66,863**

	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 4(P&T)			**$9,398,627**
	Capital Costs			**$8,974,985**
	Other Project Plans			**$862,930**

SAP/QAPP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	84,602	$1.00	$84,602
Memo: 970 HOURS				

TOTAL SAP/QAPP **$84,602**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Capital Costs				**$8,974,985**
	Other Project Plans				**$862,930**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	58,809		$1.00	$58,809
Memo: 616 HOURS					

TOTAL Waste Management Plan **$58,809**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Capital Costs				**$8,974,985**
	Other Project Plans				**$862,930**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	195,210		$1.00	$195,210
Memo: 2,065 HOURS					

TOTAL RACR **$195,210**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Capital Costs				**$8,974,985**
	Other Project Plans				**$862,930**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Capital Costs				**$8,974,985**
	RDSI				**$475,275**

Drilling

Tree Depth= 5

	Mob/Demob for DPT subcontractor	1		$8,500.00	$8,500
	DPT Borings to 65 feet	12		$2,573.00	$30,876
	1/2 TON 4WD TRUCKS, LARGE VANS	800	hrs	$5.45	$4,360
Memo: 4 LATAKY vehicles.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	ST-90 CONTAINER DELIVERED	2		$1,770.63	$3,541
Memo: 2 ST-90 box for PPE/Trash.					
	PORTABLE TOILET & HAND WASH PER MONTH	2		$227.21	$454
Memo: Rent for 2 months.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,800	hrs	$2.70	$4,860
Memo: LATAKY personnel plus assume 5 drillers.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,800		$5.19	$9,342
	PPE 2 c/o per day 10 hr day cost per hr	1,800		$1.95	$3,510

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Capital Costs				**$8,974,985**
	RDSI				**$475,275**

Drilling

Tree Depth= 5

	MSA OptiFilter HEPA per hour	1,800		$3.45	$6,210
LABOR	PRIME CONTRACTOR LABOR	190,626		$1.00	$190,626
Memo: 2,340 HOURS					

TOTAL Drilling **$262,618**

Memo: 12 DPT locations. 12 day duration plus one week for mod and one week for demob. 5 week total duration.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Capital Costs				**$8,974,985**
	RDSI				**$475,275**

Sampling

Tree Depth= 5

	5 gram EN CORE SAMPLER	300		$6.94	$2,082
	Niton XRF Rental One Month	1		$4,500.00	$4,500
	PCB Test Kits	1		$541.00	$541
	LAUNDRY 2 CHANGES COST PER HOUR	600	hrs	$2.70	$1,620
	PPE 2 c/o per day 10 hr day cost per hr	600		$1.95	$1,170
LABOR	PRIME CONTRACTOR LABOR	43,825		$1.00	$43,825
Memo: 600 HOURS					

TOTAL Sampling **$53,738**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Capital Costs				**$8,974,985**
	RDSI				**$475,275**

Analytical

Tree Depth= 5

	Overnight Shipment per Cooler	51		$251.97	$12,850
Memo: Assume 2 shipments per day for 25 days plus 1 shipment later for the waste water.					
	RDSI Geophysical Sampling Analytical	1		$1,275.00	$1,275
Memo: 3 Geophysical samples taken for particle size and atterberg limits.					
	RDSI Soil Sampling Analytical	0.40		$262,775.00	$105,110
Memo: MANAL114 is for 240 samples. 8 samples per hole x 12 holes = 96 samples. 96/240 = .4.					
	VOCs in Water	24		$88.00	$2,112
Memo: 2 per hole.					
LABOR	PRIME CONTRACTOR LABOR	18,393		$1.00	$18,393
Memo: 200 HOURS					

TOTAL Analytical **$139,740**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Capital Costs				**$8,974,985**
	RDSI				**$475,275**

Excavation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	CATERPILLAR 345B CRAWLER MOUNTED SHEAR HEAD EXCAVATOR	40	hr	$62.12	$2,485
	JOHN DEERE 624E 4WD ARTICULATED WHEEL LOADER	40	hr	$18.23	$729
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
LABOR	PRIME CONTRACTOR LABOR	15,220		$1.00	$15,220
Memo: 200 HOURS					

TOTAL Excavation **$19,178**

Memo: 2 excavations. Performed methodically to verify lack of metal debris.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(P&T)		**$9,398,627**
Capital Costs		**$8,974,985**

In Situ Source Treatment (Pump & Treat)

Tree Depth= 4

	QTY	UNIT COST	TOTAL
	1	$0.01	$0

Memo: SWMU 7 treated area is 75' x 75' x 60' or 12,500 CY.
C-400 treated area was 19,000 CY.
12,500 / 19,000 = .66.
Assume a .66 scaling factor.

Subtotal	$0
Rollup from Child Levels	$2,506,220
1st Layer Markups assigned to Detail Items	$8,395

TOTAL In Situ Source Treatment (Pump & Treat) **$2,514,615**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(P&T)		**$9,398,627**
Capital Costs		**$8,974,985**
In Situ Source Treatment (Pump & Treat)		**$2,514,615**

Extraction Well

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Pump & Treat System Extraction Well Mob/Demob	1		$30,362.49	$30,362
	Pump & Treat System Extraction Well Install	1		$138,135.27	$138,135
	LAUNDRY 2 CHANGES COST PER HOUR	240	hrs	$2.70	$648
Memo: LATAKY personnel plus assume 5 drillers.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	1/2 TON 4WD TRUCKS, LARGE VANS	160	hrs	$5.45	$872
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	240		$1.95	$468

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Capital Costs				**$8,974,985**
	In Situ Source Treatment (Pump & Treat)				**$2,514,615**

Extraction Well

Tree Depth= 5

		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	38,170		$1.00	$38,170
Memo: 480 HOURS					

TOTAL Extraction Well **$208,994**
Memo: 1 extraction well. 2 week duration.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Capital Costs				**$8,974,985**
	In Situ Source Treatment (Pump & Treat)				**$2,514,615**

Treatment System

Tree Depth= 5

		QTY		UNIT COST	TOTAL
	ATU Air Stripper costs from NE Plume	1		$1,210,984.00	$1,210,984
Memo: Costs include LATAKY labor and testing.					
	Ion Exchange System w/ Media	1		$146,645.00	$146,645
	Granulated Active Carbon Treatment System	1		$130,900.00	$130,900
	1/2 TON 4WD TRUCKS, LARGE VANS	960	hrs	$5.45	$5,232
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	7,200	hrs	$2.70	$19,440
	RSMeans Assembly A1030-120-4560 per SF	2,400		$13.84	$33,216
Memo: 40' x 60' concrete slab for treatment system.					
	E2 R.S.Means Crew	2,400	SF Flr.	$12.52	$30,053
	PPE 2 c/o per day 10 hr day cost per hr	7,200		$1.95	$14,040
LABOR	PRIME CONTRACTOR LABOR	706,716		$1.00	$706,716
Memo: 9,216 HOURS					
Subtotal					$2,297,226
1st Layer Markups assigned to Detail Items					$8,395

TOTAL Treatment System **$2,305,620**
Memo: 6 month total duration. LATAKY labor costs only for 3 months. LATAKY labor costs for the air stripper already covered in item ATUCOSTS.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Capital Costs				**$8,974,985**
	Cap Construction				**$3,838,757**

Surveying, Marking, Testing

Tree Depth= 5

		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	320	hrs	$2.70	$864
	Geotechnical Testing Technician per hour	3,840		$52.19	$200,410
Memo: Construction 2 FTE. Geotechnical testing, data recording, surveying, and reporting.					
	Geotechnical Testing Density Testing per hour	1,600		$50.00	$80,000
Memo: Construction Nuclear Density testing per hour. Estimated 10 months.					
	PPE 2 c/o per day 10 hr day cost per hr	320		$1.95	$624

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Capital Costs				**$8,974,985**
	Cap Construction				**$3,838,757**

Surveying, Marking, Testing

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	225,090		$1.00	$225,090
Memo: 1,920 HOURS					

TOTAL Surveying, Marking, Testing **$506,988**

Estimate Tree Structure Rollups			
SWMU 7 Alternative 4(P&T)			**$9,398,627**
Capital Costs			**$8,974,985**
Cap Construction			**$3,838,757**

Road and Ditch Relocation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B34K R.S.Means Crew	4	Ea.	$423.07	$1,692
	B38 R.S.Means Crew	940	S.Y.	$6.76	$6,353
Memo: 700 lf x 12' wide = 8,400 SF or 940 SY. Remove existing pavement.					
	B13H R.S.Means Crew	1,554	B.C.Y.	$8.68	$13,494
Memo: 700' x 4' x 15' / 27 = 1,554 CY. Excavate new ditch.					
	B13H R.S.Means Crew	390	B.C.Y.	$8.68	$3,387
Memo: 700' x 1' x 15' / 27 = 390 CY. Muck existing ditch.					
	B10D R.S.Means Crew	1,554	E.C.Y.	$2.67	$4,145
	B34C R.S.Means Crew	1,554	L.C.Y.	$7.98	$12,400
	Backfill Delivered per CY	1,554		$16.00	$24,864
	B13 R.S.Means Crew	60	L.F.	$95.05	$5,703
Memo: (2) 30 foot culverts.					
	B25C R.S.Means Crew	8,400	S.F.	$3.42	$28,772
Memo: Repave road.					
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	1/2 TON 4WD TRUCKS, LARGE VANS	640	hrs	$5.45	$3,488
Memo: 4 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	98,925		$1.00	$98,925
Memo: 1,153 HOURS					
Subtotal					$204,519
1st Layer Markups assigned to Detail Items					$17,998

TOTAL Road and Ditch Relocation **$222,517**

Memo: 1 month duration.

Estimate Tree Structure Rollups			
SWMU 7 Alternative 4(P&T)			**$9,398,627**
Capital Costs			**$8,974,985**
Cap Construction			**$3,838,757**

Cap Construction

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Common Building Laborers	25,556	S.Y.	$2.09	$53,384
	B15 R.S.Means Crew	13,334	C.Y.	$29.84	$397,941
Memo: CLAY LINER LAYER: 18" clay layer.					
	B10G R.S.Means Crew	13,334	E.C.Y.	$1.25	$16,599
Memo: Compaction of Clay Liner Layer.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Capital Costs				**$8,974,985**
	Cap Construction				**$3,838,757**

Cap Construction

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B15 R.S.Means Crew	9,259	C.Y.	$23.34	$216,143
Memo: DRAINAGE LAYER: 12" sand layer.					
	B10G R.S.Means Crew	9,259	E.C.Y.	$1.25	$11,526
Memo: Compaction of Sand Layer.					
	B15 R.S.Means Crew	28,889	C.Y.	$27.34	$789,943
Memo: Topsoil Layer - Assume 3 feet of vegetative soil (72,900 * 3) / 27 = 8,100 CY.					
	B10G R.S.Means Crew	19,259	E.C.Y.	$1.25	$23,974
Memo: Compaction of the 2 feet of protective soil.					
	B81 R.S.Means Crew	260	M.S.F.	$44.24	$11,503
	B34K R.S.Means Crew	4	Ea.	$423.07	$1,692
Memo: Mob/Demob for 2 dozers and 2 compactors.					
	1/2 TON 4WD TRUCKS, LARGE VANS	7,680	hrs	$5.45	$41,856
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	7,680	hrs	$2.70	$20,736
	Corner Monuments	4		$20,000.00	$80,000
	PPE 2 c/o per day 10 hr day cost per hr	7,680		$1.95	$14,976
LABOR	PRIME CONTRACTOR LABOR	950,950		$1.00	$950,950
Memo: 11,904 HOURS					
Subtotal					$2,631,222
1st Layer Markups assigned to Detail Items					$219,132
TOTAL Cap Construction					**$2,850,355**

Memo: Assume 12 month duration.
Cap area is 230,000 SF. Assume perimeter increases by a linear 10 feet for every layer.
Layer 1: Geotextile Fabric. 230,000 SF.
Layer 2: Clay Liner - Assume 18 inches of clay. (240,000 * 1.5) / 27 = 13,334 CY.
Layer 3: Drainage Layer - Assume 1 feet of sand. (250,000 * 1) / 27 = 9,259 CY.
Layer 4: Vegetative Soil Layer - Assume 3 feet of protective soil (260,000 * 3) / 27 = 28,889 CY.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Capital Costs				**$8,974,985**
	Cap Construction				**$3,838,757**

Monitoring Well Installation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Monitoring Well	7		$16,180.00	$113,260
	LAUNDRY 2 CHANGES COST PER HOUR	840	hrs	$2.70	$2,268
	1/2 TON 4WD TRUCKS, LARGE VANS	560	hrs	$5.45	$3,052
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	840		$1.95	$1,638

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Capital Costs				**$8,974,985**
	Cap Construction				**$3,838,757**

Monitoring Well Installation

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	138,680		$1.00	$138,680
Memo: 1,736 HOURS					

TOTAL Monitoring Well Installation **$258,898**

Memo: 7 monitoring wells installed.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(P&T)		**$9,398,627**
Annual Costs		**$423,642**
Operations & Maintenance		**$344,905**

Inspections

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	800	hrs	$2.70	$2,160
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	80,722		$1.00	$80,722
Memo: 960 HOURS					

TOTAL Inspections **$84,626**

Memo: Annual Cost. General inspections of the action. Quarterly.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(P&T)		**$9,398,627**
Annual Costs		**$423,642**
Operations & Maintenance		**$344,905**

Mowing Cap

Tree Depth= 5

	B84 R.S.Means Crew	260	M.S.F.	$81.20	$21,112
LABOR	PRIME CONTRACTOR LABOR	2,582		$1.00	$2,582
Memo: 30 HOURS					

Subtotal	$23,694
1st Layer Markups assigned to Detail Items	$7,936

TOTAL Mowing Cap **$31,630**

Memo: Annual Cost. Semiannually mow cap. 1 day each time.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 4(P&T)		**$9,398,627**
Annual Costs		**$423,642**
Operations & Maintenance		**$344,905**

Sign Replacement

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	80	hrs	$2.70	$216
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Annual Costs				**$423,642**
	Operations & Maintenance				**$344,905**

Sign Replacement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	9,567		$1.00	$9,567
Memo: 120 HOURS					

TOTAL Sign Replacement **$10,219**
Memo: Occurs every 30 years.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Annual Costs				**$423,642**
	Operations & Maintenance				**$344,905**

Pump & Treat O&M

Tree Depth= 5

	RESIN FOR USEC COST PER CF	10	CF	$296.00	$2,960
Memo: ASSUME PURCHASE OF 10 CF PER YEAR					
	PUMP & TREAT RESIN DISPOAL RATES PER CF	15	C	$164.69	$2,470
Memo: RESIN DISPOSAL ASSUME 2 DRUMS OR 15 CF PER YEAR					
	CARBON (INITIAL FILTER CHARGE) COST PER LB	4,000	lb	$2.05	$8,200
Memo: 2,000 lbs, twice per year.					
	REPLACE RESIN COST PER CF	40	CF	$154.45	$6,178
Memo: Assume 80 CF every 2 years.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,920	hrs	$2.70	$5,184
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	191,694		$1.00	$191,694
Memo: 2,480 HOURS					

TOTAL Pump & Treat O&M **$218,430**
Memo: ANNUAL COST. O&M for 50 years.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 4(P&T)				**$9,398,627**
	Annual Costs				**$423,642**
	Groundwater Monitoring				**$28,600**

Monitoring Well Sampling

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	175	hrs	$2.70	$473
	1/2 TON 4WD TRUCKS, LARGE VANS	75	hrs	$5.45	$409
Memo: 2 LATAKY vehicles.					
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 1 cooler per sampling event for the 4 wells.					
	Well Sampling	7		$689.05	$4,823
LABOR	PRIME CONTRACTOR LABOR	22,391		$1.00	$22,391
Memo: 285 HOURS					

TOTAL Monitoring Well Sampling **$28,600**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 4(P&T)			**$9,398,627**
	Annual Costs			**$423,642**
	Five Year Reviews			**$50,137**

Five Year Reviews

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,137	$1.00	$50,137
Memo: 500 HOURS				

TOTAL Five Year Reviews **$50,137**

COST ESTIMATE
BGOU SWMU 7
Alternative 5(ERH)—Excavation and Disposal, ERH, LUCs, and Monitoring

Cost Estimate Summary									
Capital Cost	**Quantity**	**Units**	**Unit Price**	**Total**					
1.0 Remedial Design	1	LS	$1,561,000	$1,561,000					
2.0 Other Project Plans	1	LS	$1,038,000	$1,038,000					
3.0 Remedial Design Site Investigation (RDSI)	1	LS	$475,000	$475,000					
4.0 Excavation	1	LS	$3,710,000	$3,710,000					
5.0 Treat and Dispose of Water	1	LS	$876,000	$876,000					
6.0 Post Remediation Sampling	1	LS	$351,000	$351,000					
7.0 Waste Handling, Treatment, Disposal, and Transportation	1	LS	$86,965,000	$86,965,000					
8.0 Excavation Backfill	1	LS	$2,954,000	$2,954,000					
9.0 In Situ Source Treatment (ERH)	1	LS	$34,275,000	$34,275,000					
Subproject Management	1	LS	$13,220,500	$13,221,000					Subproject Management = 10%
Management Reserve	1	LS	$21,813,900	$21,814,000					Contractor MR = 15%
Fee	1	LS	$11,706,800	$11,707,000					Fee = 7%
Contingency	1	LS	$35,789,400	$35,789,000					Contingency = 20%
			SUBTOTAL CAPITAL COST	**$214,736,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Five-Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
			SUBTOTAL ANNUAL COST	**$10,000,000**			**3.82E+17**		
			TOTAL	**$224,736,000**					
Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	ls	$214,736,000	$214,736,000				**$214,736,000**	
Five-Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$214,736,000**	
						Present Worth Values	**Annual**	**$889,000**	
							Avg. Annual	**$889**	
							Total	**$215,625,000**	

This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.

Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.

COST ESTIMATE
BGOU SWMU 7
Alternative 5(ERH)—Excavation and Disposal, ERH, LUCs, and Monitoring

CAPITAL COSTS									
	Material/Equipment/Subcontractors/ODCs				Labor				
Task Description	**Qty**	**Unit**	**Unit Price**	**Total**	**Hours**	**Rate**	**Total**	**Total Cost**	**Basis of Estimate**
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					4224		$376,224		
Remedial Design Report					8744		$803,933		
Civil Surveying					216		$22,818		
Procurement					634		$52,676		
Work Packages/Readiness					1688		$146,788		
Training	1	LS	$56,000	$56,000	1320		$102,736		$68,800 includes subcontractor training
TASK TOTAL				**$56,000**	**16826**		**$1,505,175**	**$1,561,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					5724		$517,587		
O&M Plan					700		$66,863		
SAP/QAPP					1100		$96,201		
Waste Management Plan					1020		$94,190		
RACR					2274		$212,751		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**11402**		**$1,038,317**	**$1,038,000**	
3.0 Remedial Design Site Investigation (RDSI)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Drilling									
Prime Contractor Labor					2340		$190,626		
Subcontractors	1	LS	$39,376	$39,376					Local quote from existing drilling sub.
Materials	1	LS	$28,256	$28,256					
Vehicles and Equipment	1	LS	$4,360	$4,360					
Sampling									
Prime Contractor Labor					600		$43,825		
Materials	1	LS	$9,913	$9,913					
Analytical									
Prime Contractor Labor					200		$18,393		
Materials	1	LS	$121,347	$121,347					
Excavation									
Prime Contractor Labor	0				200		$15,220		
Materials	1	LS	$744	$744					
Equipment	1	LS	$3,214	$3,214					
TASK TOTAL				**$ 207,210**	**3340**		**$ 268,064**	**$475,000**	

COST ESTIMATE
BGOU SWMU 7
Alternative 5(ERH)—Excavation and Disposal, ERH, LUCs, and Monitoring

4.0 Excavation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Pit & Slopeback - U Landfill									
Prime Contractor Labor					7128		$613,550		
Subcontractors	1	LS	$386,512	$386,512					
Materials	1	LS	$16,368	$16,368					
Vehicles and Equipment	1	LS	$9,592	$9,592					
Pit & Slopeback - Offsite									
Prime Contractor Labor					13365		$1,150,406		
Subcontractors	1	LS	$630,960	$630,960					
Materials	1	LS	$30,690	$30,690					
Vehicles and Equipment	1	LS	$17,985	$17,985					
Pit & Slopeback - Treated Offsite									
Prime Contractor Labor					2592		$223,109		
Subcontractors	1	LS	$124,864	$124,864					
Materials	1	LS	$14,515	$14,515					
Vehicles and Equipment	1	LS	$3,488	$3,488					
Surface Soils - U Landfill									
Prime Contractor Labor					2673		$230,081		
Subcontractors	1	LS	$126,192	$126,192					
Materials	1	LS	$6,138	$6,138					
Vehicles and Equipment	1	LS	$3,597	$3,597					
Surface Soils - Offsite									
Prime Contractor Labor					891		$76,694		
Subcontractors	1	LS	$42,064	$42,064					
Materials	1	LS	$2,046	$2,046					
Vehicles and Equipment	1	LS	$1,199	$1,199					
TASK TOTALS				**$1,416,210**	**26,649**		**$2,293,840**	**$3,710,000**	
5.0 Treat and Dispose of Water									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Water Treatment									
Prime Contractor Labor					3948		$280,980		
Subcontractors	1	LS	$494,353	$494,353					Rainforrent.com and RSMeans
Materials	1	LS	$18,359	$18,359					
Vehicles and Equipment	1	LS	$7,172	$7,172					
Water Disposal									
Prime Contractor Labor					40		$2,275		
Characterization Sampling	1	LS	$64,491	$64,491					
Vehicles and Equipment	1	LS	$14,244	$8,334					
TASK TOTALS				**$592,709**	**3,988**		**$283,255**	**$876,000**	
6.0 Post Remediation Sampling									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Sampling									
Prime Contractor Labor					400		$29,217		
Materials	1	LS	$10,371	$10,371					
Analytical									
Prime Contractor Labor					112		$10,206		
Materials	1	LS	$301,579	$301,579					
TASK TOTAL				**$ 311,950**	**512**		**$39,423**	**$351,000**	

COST ESTIMATE
BGOU SWMU 7
Alternative 5(ERH)—Excavation and Disposal, ERH, LUCs, and Monitoring

7.0 Waste Handling, Treatment, Disposal, and Transportation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Pit & Slopeback - U Landfill									
Prime Contractor Labor					12035		$793,914		
Materials	1	LS	$48,942	$48,942					
Characterization Sampling	1	LS	$354,507	$354,507					
Vehicles and Equipment	1	LS	$470,862	$470,862					
Pit & Slopeback - Offsite									
Prime Contractor Labor					54144		$3,877,690		
Materials	1	LS	$1,725,704	$1,725,704					
Characterization Sampling	1	LS	$1,109,945	$1,109,945					
Vehicles and Equipment	1	LS	$609,554	$609,554					
Disposal	1	LS	$43,840,873	$43,840,873					
Transportation	1	LS	$14,139,825	$14,139,825					
Pit & Slopeback - Treated Offsite									
Prime Contractor Labor					4500		$321,643		
Materials	1	LS	$138,517	$138,517					
Characterization Sampling	1	LS	$90,412	$90,412					
Vehicles and Equipment	1	LS	$50,796	$50,796					
Treatment	1	LS	$6,359,529	$6,359,529					
Disposal	1	LS	$7,068,748	$7,068,748					
Transportation	1	LS	$1,158,119	$1,158,119					
Surface Soils - U Landfill									
Prime Contractor Labor					4423		$291,785		
Materials	1	LS	$11,779	$11,779					
Characterization Sampling	1	LS	$127,904	$127,904					
Vehicles and Equipment	1	LS	$172,494	$172,494					
Surface Soils - Offsite									
Prime Contractor Labor					3659		$261,816		
Materials	1	LS	$111,795	$111,795					
Characterization Sampling	1	LS	$71,792	$71,792					
Vehicles and Equipment	1	LS	$41,028	$41,028					
Disposal	1	LS	$2,799,055	$2,799,055					
Transportation	1	LS	$915,722	$915,722					
TASK TOTALS				**$81,417,902**	**78,761**		**$5,546,848**	**$86,965,000**	
8.0 Excavation Backfill									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Backfill									
Prime Contractor Labor					5519		$486,828		
Subcontractors	1	LS	$2,440,459	$2,440,459					RSMeans and local engineering firm
Materials	1	LS	$17,112	$17,112					
Vehicles and Equipment	1	LS	$10,028	$10,028					
TASK TOTAL				**$2,467,599**	**5519**		**$486,828**	**$2,954,000**	

COST ESTIMATE
BGOU SWMU 7
Alternative 5(ERH)—Excavation and Disposal, ERH, LUCs, and Monitoring

9.0 In Situ Source Treatment (ERH)									
Refer to the Success reports for detailed cost and resources. Costs in this section are derived from the C-400 Project's actual costs.									
Installation									
Scaled Actual Costs	1	LS	$20,714,070	$20,714,070					Costs escalated to FY14 and scaled down by a factor .66
Operations				$0					
Scaled Actual Costs	1	LS	$13,048,540	$13,048,540					Costs escalated to FY14 and scaled down by a factor .66
D&D				$0					
Scaled Actual Costs	1	LS	$512,635	$512,635					Costs escalated to FY14 and scaled down by a factor .66
TASK TOTALS				**$34,275,245**	**0**		**$0**	**$34,275,000**	
							SUBTOTAL CAPITAL COST	**$132,205,000**	
ANNUAL COSTS									
Five-Year Review									
Duration: Every 5 years.									
Prime Contractor Labor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study

Reported From: SWMU 7 Alternative 5(ERH)
Report Total: $132,256,714

Author
Manager

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5(ERH)			**$132,256,714**
	Capital Costs			**$132,206,577**
	Remedial Desgin			**$1,561,175**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	376,224	$1.00	$376,224

Memo: 4,224 HOURS

TOTAL RDWP/RDSI Work Plan **$376,224**

	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5(ERH)			**$132,256,714**
	Capital Costs			**$132,206,577**
	Remedial Desgin			**$1,561,175**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	803,933	$1.00	$803,933

Memo: 8,744 HOURS

TOTAL RDR **$803,933**

	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5(ERH)			**$132,256,714**
	Capital Costs			**$132,206,577**
	Remedial Desgin			**$1,561,175**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	22,818	$1.00	$22,818

Memo: 216 HOURS

TOTAL Civil Surveying **$22,818**

	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5(ERH)			**$132,256,714**
	Capital Costs			**$132,206,577**
	Remedial Desgin			**$1,561,175**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	52,676	$1.00	$52,676

Memo: 634 HOURS

TOTAL Procurement **$52,676**

	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5(ERH)			**$132,256,714**
	Capital Costs			**$132,206,577**
	Remedial Desgin			**$1,561,175**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	146,788	$1.00	$146,788

Memo: 1,688 HOURS

TOTAL Work Packages/Readiness Review **$146,788**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5(ERH)			**$132,256,714**
	Capital Costs			**$132,206,577**
	Remedial Desgin			**$1,561,175**

Training

Tree Depth= 5

		QTY	UNIT COST	TOTAL
Memo:	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
	Assume 80 hours of training per person. Assume 10 people or 800 hours.			
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training **$158,736**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

Estimate Tree Structure Rollups			
SWMU 7 Alternative 5(ERH)			**$132,256,714**
Capital Costs			**$132,206,577**
Other Project Plans			**$1,038,317**

RAWP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	517,587	$1.00	$517,587
Memo: 5,724 HOURS				

TOTAL RAWP **$517,587**

Estimate Tree Structure Rollups			
SWMU 7 Alternative 5(ERH)			**$132,256,714**
Capital Costs			**$132,206,577**
Other Project Plans			**$1,038,317**

O&M Plan

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan **$66,863**

Estimate Tree Structure Rollups			
SWMU 7 Alternative 5(ERH)			**$132,256,714**
Capital Costs			**$132,206,577**
Other Project Plans			**$1,038,317**

SAP/QAPP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	96,201	$1.00	$96,201
Memo: 1,100 HOURS				

TOTAL SAP/QAPP **$96,201**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Other Project Plans				**$1,038,317**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	94,190		$1.00	$94,190
Memo: 1,020 HOURS					

TOTAL Waste Management Plan **$94,190**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(ERH)		**$132,256,714**
Capital Costs		**$132,206,577**
Other Project Plans		**$1,038,317**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	212,751		$1.00	$212,751
Memo: 2,274 HOURS					

TOTAL RACR **$212,751**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(ERH)		**$132,256,714**
Capital Costs		**$132,206,577**
Other Project Plans		**$1,038,317**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(ERH)		**$132,256,714**
Capital Costs		**$132,206,577**
RDSI		**$475,275**

Drilling

Tree Depth= 5

	Mob/Demob for DPT subcontractor	1		$8,500.00	$8,500
	DPT Borings to 65 feet	12		$2,573.00	$30,876
	1/2 TON 4WD TRUCKS, LARGE VANS	800	hrs	$5.45	$4,360
Memo: 4 LATAKY vehicles.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	ST-90 CONTAINER DELIVERED	2		$1,770.63	$3,541
Memo: 2 ST-90 box for PPE/Trash.					
	PORTABLE TOILET & HAND WASH PER MONTH	2		$227.21	$454
Memo: Rent for 2 months.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,800	hrs	$2.70	$4,860
Memo: LATAKY personnel plus assume 5 drillers.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,800		$5.19	$9,342
	PPE 2 c/o per day 10 hr day cost per hr	1,800		$1.95	$3,510

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	RDSI				**$475,275**

Drilling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	MSA OptiFilter HEPA per hour	1,800		$3.45	$6,210
LABOR Memo: 2,340 HOURS	PRIME CONTRACTOR LABOR	190,626		$1.00	$190,626

TOTAL Drilling **$262,618**

Memo: 12 DPT locations. 12 day duration plus one week for mod and one week for demob. 5 week total duration.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(ERH)		**$132,256,714**
Capital Costs		**$132,206,577**
RDSI		**$475,275**

Sampling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	5 gram EN CORE SAMPLER	300		$6.94	$2,082
	Niton XRF Rental One Month	1		$4,500.00	$4,500
	PCB Test Kits	1		$541.00	$541
	LAUNDRY 2 CHANGES COST PER HOUR	600	hrs	$2.70	$1,620
	PPE 2 c/o per day 10 hr day cost per hr	600		$1.95	$1,170
LABOR Memo: 600 HOURS	PRIME CONTRACTOR LABOR	43,825		$1.00	$43,825

TOTAL Sampling **$53,738**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(ERH)		**$132,256,714**
Capital Costs		**$132,206,577**
RDSI		**$475,275**

Analytical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Overnight Shipment per Cooler Memo: Assume 2 shipments per day for 25 days plus 1 shipment later for the waste water.	51		$251.97	$12,850
	RDSI Geophysical Sampling Analytical Memo: 3 Geophysical samples taken for particle size and atterberg limits.	1		$1,275.00	$1,275
	RDSI Soil Sampling Analytical Memo: MANAL114 is for 240 samples. 8 samples per hole x 12 holes = 96 samples. 96/240 = .4.	0.40		$262,775.00	$105,110
	VOCs in Water Memo: 2 per hole.	24		$88.00	$2,112
LABOR Memo: 200 HOURS	PRIME CONTRACTOR LABOR	18,393		$1.00	$18,393

TOTAL Analytical **$139,740**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	RDSI				**$475,275**

Excavation

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
	CATERPILLAR 345B CRAWLER MOUNTED SHEAR HEAD EXCAVATOR	40	hr	$62.12	$2,485
	JOHN DEERE 624E 4WD ARTICULATED WHEEL LOADER	40	hr	$18.23	$729
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
LABOR Memo: 200 HOURS	PRIME CONTRACTOR LABOR	15,220		$1.00	$15,220

TOTAL Excavation **$19,178**
Memo: 2 excavations. Performed methodically to verify lack of metal debris.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(ERH)		**$132,256,714**
Capital Costs		**$132,206,577**
Excavation		**$3,710,050**

Pit & Slopeback U Landfill

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	88		$1,470.00	$129,360
	RSMeans Crew B-12C cost per day	88		$2,354.00	$207,152
	Mob/Demob of Subcontractor and Equipment	1	LS	$50,000.00	$50,000
	LAUNDRY 2 CHANGES COST PER HOUR	3,520	hrs	$2.70	$9,504
Memo: 2 LATAKY vehicles.	1/2 TON 4WD TRUCKS, LARGE VANS	1,760	hrs	$5.45	$9,592
	PPE 2 c/o per day 10 hr day cost per hr	3,520		$1.95	$6,864
LABOR Memo: 7,128 HOURS	PRIME CONTRACTOR LABOR	613,550		$1.00	$613,550

TOTAL Pit & Slopeback U Landfill **$1,026,022**
Memo: 18,869 BCY. Assume 225 CY per day so 84 days + weather/delays. Assume 88 day duration.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(ERH)		**$132,256,714**
Capital Costs		**$132,206,577**
Excavation		**$3,710,050**

Pit & Slopeback Offsite

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	165		$1,470.00	$242,550
	RSMeans Crew B-12C cost per day	165		$2,354.00	$388,410
	LAUNDRY 2 CHANGES COST PER HOUR	6,600	hrs	$2.70	$17,820
Memo: 2 LATAKY vehicles.	1/2 TON 4WD TRUCKS, LARGE VANS	3,300	hrs	$5.45	$17,985
	PPE 2 c/o per day 10 hr day cost per hr	6,600		$1.95	$12,870

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Excavation				**$3,710,050**

Pit & Slopeback Offsite

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	1,150,406		$1.00	$1,150,406
Memo: 13,365 HOURS					

TOTAL Pit & Slopeback Offsite **$1,830,041**
Memo: 35,450 BCY. Excavating and moving a 225 CY per day, so 158 days plus weather/delays is 165 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Excavation				**$3,710,050**

Pit & Slopeback Treated Offsite

Tree Depth= 5

	RSMeans Crew B-10W cost per day	32		$1,470.00	$47,040
	RSMeans Crew B-12C cost per day	32		$2,354.00	$75,328
	LAUNDRY 2 CHANGES COST PER HOUR	1,280	hrs	$2.70	$3,456
	1/2 TON 4WD TRUCKS, LARGE VANS	640	hrs	$5.45	$3,488
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,280		$5.19	$6,643
	PPE 2 c/o per day 10 hr day cost per hr	1,280		$1.95	$2,496
	MSA OptiFilter HEPA per hour	1,280		$3.45	$4,416
LABOR	PRIME CONTRACTOR LABOR	223,109		$1.00	$223,109
Memo: 2,592 HOURS					

TOTAL Pit & Slopeback Treated Offsite **$365,976**
Memo: 2,858 BCY. Excavating and moving a 100 CY per day, so 29 days plus weather/delays is 32 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Excavation				**$3,710,050**

Surface Soils U Landfill

Tree Depth= 5

	RSMeans Crew B-10W cost per day	33		$1,470.00	$48,510
	RSMeans Crew B-12C cost per day	33		$2,354.00	$77,682
	LAUNDRY 2 CHANGES COST PER HOUR	1,320	hrs	$2.70	$3,564
	1/2 TON 4WD TRUCKS, LARGE VANS	660	hrs	$5.45	$3,597
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	1,320		$1.95	$2,574

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Excavation				**$3,710,050**

Surface Soils U Landfill

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	230,081		$1.00	$230,081
Memo: 2,673 HOURS					

TOTAL Surface Soils U Landfill **$366,008**

Memo: 6,739 BCY. Excavating and moving a 225 CY per day, so 30 days plus weather/delays is 33 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Excavation				**$3,710,050**

Surface Soils Offsite

Tree Depth= 5

	RSMeans Crew B-10W cost per day	11		$1,470.00	$16,170
	RSMeans Crew B-12C cost per day	11		$2,354.00	$25,894
	LAUNDRY 2 CHANGES COST PER HOUR	440	hrs	$2.70	$1,188
	1/2 TON 4WD TRUCKS, LARGE VANS	220	hrs	$5.45	$1,199
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	440		$1.95	$858
LABOR	PRIME CONTRACTOR LABOR	76,694		$1.00	$76,694
Memo: 891 HOURS					

TOTAL Surface Soils Offsite **$122,003**

Memo: 2,264 BCY. Excavating and moving a 225 CY per day, so 10 days plus weather/delays is 11 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Treat and Dispose of Water				**$875,964**

Water Treatment

Tree Depth= 5

	B10H R.S.Means Crew	329	Day	$581.53	$191,325
	Water Treatment System w/ Tanks per month	15		$12,825.00	$192,375
Memo: Packaged system with 5 frac tanks.					
	LAUNDRY 2 CHANGES COST PER HOUR	3,948	hrs	$2.70	$10,660
	1/2 TON 4WD TRUCKS, LARGE VANS	1,316	hrs	$5.45	$7,172
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	3,948		$1.95	$7,699
LABOR	PRIME CONTRACTOR LABOR	280,980		$1.00	$280,980
Memo: 3,948 HOURS					

Subtotal	$690,210
1st Layer Markups assigned to Detail Items	$110,654

TOTAL Water Treatment **$800,864**

Memo: 15 months

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Treat and Dispose of Water				**$875,964**

Water Disposal

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	Water Truck 10k Gallon cost per hr	40	hr	$208.34	$8,334
	Overnight Shipment per Cooler	8		$251.97	$2,016
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Water Cost per Sample	75		$833.00	$62,475
Assume Frac tanks will be emptied every 2 months. 7.5 * 5 tanks * 20,000 gallons = 750,000 gallons. Assume a water sample will be taken from each water truck (10,000 gallons). 750,000 gallons / 10,000 = 75 samples.					
LABOR	PRIME CONTRACTOR LABOR	2,275		$1.00	$2,275
Memo: 40 HOURS					

TOTAL Water Disposal **$75,099**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Post Remediation Sampling				**$351,373**

Sampling

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	5 gram EN CORE SAMPLER	500		$6.94	$3,470
	Niton XRF Rental One Month	1		$4,500.00	$4,500
	PCB Test Kits	1		$541.00	$541
	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780
LABOR	PRIME CONTRACTOR LABOR	29,217		$1.00	$29,217
Memo: 400 HOURS					

TOTAL Sampling **$39,588**

Memo: 109 Floor Samples.
108 Sidewall Samples.
57 Surface Soils.
Total of 274 samples.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Post Remediation Sampling				**$351,373**

Analytical

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	Overnight Shipment per Cooler	8		$251.97	$2,016
	RDSI Soil Sampling Analytical	1.14		$262,775.00	$299,564
Memo: MANAL114 is for 240 samples. 274/240 = 1.14.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Post Remediation Sampling				**$351,373**

Analytical

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	10,206		$1.00	$10,206
Memo: 112 HOURS					

TOTAL Analytical **$311,785**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(ERH)		**$132,256,714**
Capital Costs		**$132,206,577**
Waste Handling/Treatment/Disposal/Transportation		**$86,964,750**

Pit & Slopeback U Landfill

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	10,100	hrs	$2.70	$27,270
	1/2 TON 4WD TRUCKS, LARGE VANS	2,020	hrs	$5.45	$11,009
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	5,050	hr	$91.06	$459,853
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	504		$43.00	$21,672
	Overnight Shipment per Cooler	31		$251.97	$7,811
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	302		$1,148.00	$346,696
Memo: 22,643 LCY / 15 CY = 1,510. Assume 20% sampling rate. 1,510 / 5 = 302 samples.					
LABOR	PRIME CONTRACTOR LABOR	793,914		$1.00	$793,914
Memo: 12,035 HOURS					

TOTAL Pit & Slopeback U Landfill **$1,668,225**

Memo: U Landfill WAC Compliant. 18,869 BCY x 1.2 = 22,643 LCY. Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 101 days.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(ERH)		**$132,256,714**
Capital Costs		**$132,206,577**
Waste Handling/Treatment/Disposal/Transportation		**$86,964,750**

Pit & Slopeback Offsite

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	40,560	hrs	$2.70	$109,512
	1/2 TON 4WD TRUCKS, LARGE VANS	6,240	hrs	$5.45	$34,008
Memo: 3 LATAKY vehicles.					
	Disposal ES MLLW by rail	42,540		$1,030.58	$43,840,873
	Transportation to ES by Gondola	525		$26,933.00	$14,139,825
Memo: Assume 9 bags per car. 4727 / 9 = 525 gons.					
	Lift Liner Bags 9 CY	4,727		$300.00	$1,418,100
	Loading or Lifting Frames per month	238		$500.00	$119,000
Memo: Rent for 14 months. 11 loading frames and 6 lifting frames. 17 x 14 months = 238.					
	Skid Steer per hour	3,120	hr	$32.54	$101,525

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Waste Handling/Treatment/Disposal/Transportation				**$86,964,750**

Pit & Slopeback Offsite

Tree Depth= 5

LEVEL	Description	QTY		UNIT COST	TOTAL
	18,000 lb Fork Lift per hour	6,240	hr	$32.66	$203,798
	Flat Bed Truck per hour	3,120	hr	$45.74	$142,709
	30' IC Scissor Lift Rent per hour	3,120	hr	$14.88	$46,426
	65 Ton Link-Belt Crane GFE cost per hr	3,120	hr	$25.99	$81,089
	PPE 2 c/o per day 10 hr day cost per hr	40,560		$1.95	$79,092
	Overnight Shipment per Cooler	95		$251.97	$23,937
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	946		$1,148.00	$1,086,008
Assume 20% sampling rate. 4,727 / 5 = 946 samples.					
LABOR	PRIME CONTRACTOR LABOR	3,877,690		$1.00	$3,877,690
Memo: 54,144 HOURS					

TOTAL Pit & Slopeback Offsite **$65,303,592**

Memo: 35,450 BCY x 1.2 = 42,540 LCY. Load in soft sided bags and ship to ES by rail for disposal. 42,540 LCY / 9 CY per bag = 4,727 bags. Load 16 bags per day so 296 days plus weather/delays = 312 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Waste Handling/Treatment/Disposal/Transportation				**$86,964,750**

Pit & Slopeback Treated Offsite

Tree Depth= 5

LEVEL	Description	QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	3,380	hrs	$2.70	$9,126
	1/2 TON 4WD TRUCKS, LARGE VANS	520	hrs	$5.45	$2,834
Memo: 3 LATAKY vehicles.					
	Disposal ES MLLW by rail	6,859		$1,030.58	$7,068,748
Memo: Double the disposal volume for MLLW.					
	MLLW Treatment at ES ST90 per CY	3,430		$1,854.09	$6,359,529
	Transportation to ES by Gondola	43		$26,933.00	$1,158,119
Memo: Assume 9 bags per car. 381 / 9 = 43 gons.					
	Lift Liner Bags 9 CY	381		$300.00	$114,300
	Loading or Lifting Frames per month	17		$500.00	$8,500
Memo: Rent for 1 month. 11 loading frames and 6 lifting frames. 17 x 1 months = 17.					
	Skid Steer per hour	260	hr	$32.54	$8,460
	18,000 lb Fork Lift per hour	520	hr	$32.66	$16,983
	Flat Bed Truck per hour	260	hr	$45.74	$11,892
	30' IC Scissor Lift Rent per hour	260	hr	$14.88	$3,869
	65 Ton Link-Belt Crane GFE cost per hr	260	hr	$25.99	$6,757
	PPE 2 c/o per day 10 hr day cost per hr	3,380		$1.95	$6,591
	Overnight Shipment per Cooler	8		$251.97	$2,016
Memo: Assume 10 samples per cooler.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Waste Handling/Treatment/Disposal/Transportation				**$86,964,750**

Pit & Slopeback Treated Offsite

Tree Depth= 5

Memo:	Characterization Sampling Soil Cost per Sample	77		$1,148.00	$88,396
	Assume 20% sampling rate. 381 / 5 = 77 samples.				
LABOR	PRIME CONTRACTOR LABOR	321,643		$1.00	$321,643
Memo: 4,500 HOURS					

TOTAL Pit & Slopeback Treated Offsite **$15,187,764**

Memo: 2,858 BCY x 1.2 = 3,430 LCY. Load into soft sided bags and ship to ES by rail for treatment and disposal. Assume can load 16 bags per day. 3,430 / 9 = 381 bags. 381 / 16 = 24 days + weather/delays = 26 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Waste Handling/Treatment/Disposal/Transportation				**$86,964,750**

Surface Soils U Landfill

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	1,480	hrs	$2.70	$3,996
	1/2 TON 4WD TRUCKS, LARGE VANS	740	hrs	$5.45	$4,033
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	1,850	hr	$91.06	$168,461
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	181		$43.00	$7,783
	Overnight Shipment per Cooler	11		$251.97	$2,772
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	109		$1,148.00	$125,132
	8,147 LCY / 15 CY = 543. Assume 20% sampling rate. 543 / 5 = 109 samples.				
LABOR	PRIME CONTRACTOR LABOR	291,785		$1.00	$291,785
Memo: 4,423 HOURS					

TOTAL Surface Soils U Landfill **$603,962**

Memo: U Landfill WAC Compliant. 6,789 BCY x 1.2 = 8,147 LCY. Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 37 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Waste Handling/Treatment/Disposal/Transportation				**$86,964,750**

Surface Soils Offsite

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	2,730	hrs	$2.70	$7,371
	1/2 TON 4WD TRUCKS, LARGE VANS	420	hrs	$5.45	$2,289
Memo: 3 LATAKY vehicles.					
	Disposal ES MLLW by rail	2,716		$1,030.58	$2,799,055

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(ERH)				**$132,256,714**
	Capital Costs				**$132,206,577**
	Waste Handling/Treatment/Disposal/Transportation				**$86,964,750**

Surface Soils Offsite

Tree Depth= 5

		QTY		UNIT COST	TOTAL
	Transportation to ES by Gondola	34		$26,933.00	$915,722
Memo: Assume 9 bags per car. 302 / 9 = 34 gons.					
	Lift Liner Bags 9 CY	302		$300.00	$90,600
	Loading or Lifting Frames per month	17		$500.00	$8,500
Memo: Rent for 1 months. 11 loading frames and 6 lifting frames. 17 x 1 months = 17.					
	Skid Steer per hour	210	hr	$32.54	$6,833
	18,000 lb Fork Lift per hour	420	hr	$32.66	$13,717
	Flat Bed Truck per hour	210	hr	$45.74	$9,605
	30' IC Scissor Lift Rent per hour	210	hr	$14.88	$3,125
	65 Ton Link-Belt Crane GFE cost per hr	210	hr	$25.99	$5,458
	PPE 2 c/o per day 10 hr day cost per hr	2,730		$1.95	$5,324
	Overnight Shipment per Cooler	7		$251.97	$1,764
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	61		$1,148.00	$70,028
22,643 LCY / 15 CY = 1,510. Assume 20% sampling rate. 1,510 / 5 = 302 samples.					
LABOR	PRIME CONTRACTOR LABOR	261,816		$1.00	$261,816
Memo: 3,659 HOURS					

TOTAL Surface Soils Offsite **$4,201,207**

Memo: 2,264 BCY x 1.2 = 2,716 LCY. Load into soft sided bags and ship to ES by rail for disposal. Assume can load 16 bags per day. 2,716 / 9 = 302 bags. 302 / 16 = 19 days + weather/delays = 21 days.

	Estimate Tree Structure Rollups	
	SWMU 7 Alternative 5(ERH)	**$132,256,714**
	Capital Costs	**$132,206,577**
	Excavation Backfill	**$2,954,428**

Backfill

Tree Depth= 5

		QTY		UNIT COST	TOTAL
	B10D R.S.Means Crew	68,615	E.C.Y.	$2.67	$183,027
	B34C R.S.Means Crew	68,615	L.C.Y.	$7.98	$547,496
	Backfill Delivered per CY	68,615		$16.00	$1,097,840
	LAUNDRY 2 CHANGES COST PER HOUR	3,680	hrs	$2.70	$9,936
Memo: .					
	1/2 TON 4WD TRUCKS, LARGE VANS	1,840	hrs	$5.45	$10,028
Memo: 2 LATAKY vehicles.					
	Geotechnical Testing Technician per hour	920		$52.19	$48,015
	Geotechnical Testing Density Testing per hour	920		$50.00	$46,000
	RSMeans Crew B-10W cost per day	92		$1,470.00	$135,240
	RSMeans Crew B-10P cost per day	92		$2,129.00	$195,868
	PPE 2 c/o per day 10 hr day cost per hr	3,680		$1.95	$7,176

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5(ERH)			**$132,256,714**
	Capital Costs			**$132,206,577**
	Excavation Backfill			**$2,954,428**

Backfill

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	486,828	$1.00	$486,828

Memo: 5,519 HOURS

Subtotal	$2,767,454
1st Layer Markups assigned to Detail Items	$186,975

TOTAL Backfill **$2,954,428**

Memo: 57,179 BCY total removed. 57,179 x 1.2 = 68,615 CY of fill needed. Assume 750 CY filled per day. 68,615 / 750 = 92 days. Fill is stockpiled during other activities and transfered to site as needed.

Estimate Tree Structure Rollups	
SWMU 7 Alternative 5(ERH)	**$132,256,714**
Capital Costs	**$132,206,577**

In Situ Source Treatment (ERH)

Tree Depth= 4

QTY	UNIT COST	TOTAL
1	$0.01	$0

Memo: SWMU 7 treated area is 75' x 75' x 60' or 12,500 CY.
C-400 treated area was 19,000 CY.
12,500 / 19,000 = .66.
Assume a .66 scaling factor.

Subtotal	$0
Rollup from Child Levels	$34,275,245

TOTAL In Situ Source Treatment (ERH) **$34,275,245**

Estimate Tree Structure Rollups	
SWMU 7 Alternative 5(ERH)	**$132,256,714**
Capital Costs	**$132,206,577**
In Situ Source Treatment (ERH)	**$34,275,245**

Installation

Tree Depth= 5

	QTY	UNIT COST	TOTAL
ERH Costs from C-400	20,714,070	$1.00	$20,714,070

TOTAL Installation **$20,714,070**

Memo: FY14 Construction costs from C-400: $31,384,955.
$31,384,955 x .66 = $20,714,070.

Estimate Tree Structure Rollups	
SWMU 7 Alternative 5(ERH)	**$132,256,714**
Capital Costs	**$132,206,577**
In Situ Source Treatment (ERH)	**$34,275,245**

Operations

Tree Depth= 5

	QTY	UNIT COST	TOTAL
ERH Costs from C-400	13,048,540	$1.00	$13,048,540

TOTAL Operations **$13,048,540**

Memo: FY14 Operations costs from C-400: $19,770,515.
$19,770,515 x .66 = $13,048,540.

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study **Reported From: SWMU 7 Alternative 5(ERH)**
Report Total: $132,256,714

Author
Manager

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5(ERH)			**$132,256,714**
	Capital Costs			**$132,206,577**
	In Situ Source Treatment (ERH)			**$34,275,245**

D&D

Tree Depth= 5

		QTY	UNIT COST	TOTAL
	ERH Costs from C-400	512,635	$1.00	$512,635

TOTAL D&D **$512,635**

Memo: FY14 D&D costs from C-400: $776,720.
$776,720 x .66 = $512,635.

Estimate Tree Structure Rollups			
SWMU 7 Alternative 5(ERH)			**$132,256,714**
Annual Costs			**$50,137**
Five Year Reviews			**$50,137**

Five Year Reviews

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	50,137	$1.00	$50,137

Memo: 500 HOURS

TOTAL Five Year Reviews **$50,137**

COST ESTIMATE
BGOU SWMU 7
Alternative 5(P&T)—Excavation and Disposal, Pump-and-Treat, LUCs and Monitoring

Cost Estimate Summary									
Capital Cost	**Quantity**	**Units**	**Unit Price**	**Total**					
1.0 Remedial Design	1	LS	$1,561,000	$1,561,000					
2.0 Other Project Plans	1	LS	$1,038,000	$1,038,000					
3.0 Remedial Design Site Investigation (RDSI)	1	LS	$475,000	$475,000					
4.0 Excavation	1	LS	$3,710,000	$3,710,000					
5.0 Treat and Dispose of Water	1	LS	$876,000	$876,000					
6.0 Post Remediation Sampling	1	LS	$351,000	$351,000					
7.0 Waste Handling, Treatment, Disposal, and Transportation	1	LS	$86,965,000	$86,965,000					
8.0 Excavation Backfill	1	LS	$2,954,000	$2,954,000					
9.0 In Situ Source Treatment (P&T)	1	LS	$2,515,000	$2,515,000					
Subproject Management	1	LS	$10,044,500	$10,045,000					Subproject Management = 10%
Management Reserve	1	LS	$16,573,500	$16,574,000					Contractor MR = 15%
Fee	1	LS	$8,894,480	$8,894,000					Fee = 7%
Contingency	1	LS	$27,191,600	$27,192,000					Contingency = 20%
	SUBTOTAL CAPITAL COST			**$163,150,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Pump & Treat O&M	50	EA	$218,000	$10,900,000			2.38E+07		Annually for 50 years
Five Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
	SUBTOTAL ANNUAL COST			**$20,900,000**			**3.82E+17**		
			TOTAL	**$184,050,000**					

COST ESTIMATE
BGOU SWMU 7
Alternative 5(P&T)—Excavation and Disposal, Pump-and-Treat, LUCs and Monitoring

Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	LS	$163,150,000	$163,150,000				**$163,150,000**	
Pump & Treat O&M	50	EA	$218,000	$10,900,000				**$8,349,697**	
Five Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$163,150,000**	
						Present Worth Values	**Annual**	**$9,239,000**	
							Avg. Annual	**$9,239**	
							Total	**$172,389,000**	
This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.									
Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.									

CAPITAL COSTS									
	Material/Equipment/Subcontractors/ODCs				**Labor**				
Task Description	**Qty**	**Unit**	**Unit Price**	**Total**	**Hours**	**Rate**	**Total**	**Total Cost**	**Basis of Estimate**
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					4224		$376,224		
Remedial Design Report					8744		$803,933		
Civil Surveying					216		$22,818		
Procurement					634		$52,676		
Work Packages/Readiness					1688		$146,788		
Training	1	LS	$56,000	$56,000	1320		$102,736		$68,800 includes subcontractor training
TASK TOTAL				**$56,000**	**16826**		**$1,505,175**	**$1,561,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					5724		$517,587		
O&M Plan					700		$66,863		
SAP/QAPP					1100		$96,201		
Waste Management Plan					1020		$94,190		
RACR					2274		$212,751		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**11402**		**$1,038,317**	**$1,038,000**	

COST ESTIMATE
BGOU SWMU 7
Alternative 5(P&T)—Excavation and Disposal, Pump-and-Treat, LUCs and Monitoring

3.0 Remedial Design Site Investigation (RDSI)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Drilling									
Prime Contractor Labor					2340		$190,626		
Subcontractors	1	LS	$39,376	$39,376					Local quote from existing drilling sub.
Materials	1	LS	$28,256	$28,256					
Vehicles and Equipment	1	LS	$4,360	$4,360					
Sampling									
Prime Contractor Labor					600		$43,825		
Materials	1	LS	$9,913	$9,913					
Analytical									
Prime Contractor Labor					200		$18,393		
Materials	1	LS	$121,347	$121,347					
Excavation									
Prime Contractor Labor	0				200		$15,220		
Materials	1	LS	$744	$744					
Equipment	1	LS	$3,214	$3,214					
TASK TOTAL				**$ 207,210**	**3340**		**$ 268,064**	**$475,000**	
4.0 Excavation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Pit & Slopeback - U Landfill									
Prime Contractor Labor					7128		$613,550		
Subcontractors	1	LS	$386,512	$386,512					
Materials	1	LS	$16,368	$16,368					
Vehicles and Equipment	1	LS	$9,592	$9,592					
Pit & Slopeback - Off-Site									
Prime Contractor Labor					13365		$1,150,406		
Subcontractors	1	LS	$630,960	$630,960					
Materials	1	LS	$30,690	$30,690					
Vehicles and Equipment	1	LS	$17,985	$17,985					
Pit & Slopeback - Treated Off-Site									
Prime Contractor Labor					2592		$223,109		
Subcontractors	1	LS	$124,864	$124,864					
Materials	1	LS	$14,515	$14,515					
Vehicles and Equipment	1	LS	$3,488	$3,488					
Surface Soils - U Landfill									
Prime Contractor Labor					2673		$230,081		
Subcontractors	1	LS	$126,192	$126,192					
Materials	1	LS	$6,138	$6,138					
Vehicles and Equipment	1	LS	$3,597	$3,597					
Surface Soils - Off-Site									
Prime Contractor Labor					891		$76,694		
Subcontractors	1	LS	$42,064	$42,064					
Materials	1	LS	$2,046	$2,046					
Vehicles and Equipment	1	LS	$1,199	$1,199					
TASK TOTALS				**$1,416,210**	**26,649**		**$2,293,840**	**$3,710,000**	

COST ESTIMATE
BGOU SWMU 7
Alternative 5(P&T)—Excavation and Disposal, Pump-and-Treat, LUCs and Monitoring

5.0 Treat and Dispose of Water									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Water Treatment									
Prime Contractor Labor					3948		$280,980		
Subcontractors	1	LS	$494,353	$494,353					Rainforrent.com and RSMeans
Materials	1	LS	$18,359	$18,359					
Vehicles and Equipment	1	LS	$7,172	$7,172					
Water Disposal									
Prime Contractor Labor					40		$2,275		
Characterization Sampling	1	LS	$64,491	$64,491					
Vehicles and Equipment	1	LS	$14,244	$8,334					
TASK TOTALS				**$592,709**	**3,988**		**$283,255**	**$876,000**	
6.0 Post Remediation Sampling									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Sampling									
Prime Contractor Labor					400		$29,217		
Materials	1	LS	$10,371	$10,371					
Analytical									
Prime Contractor Labor					112		$10,206		
Materials	1	LS	$301,579	$301,579					
TASK TOTAL				**$ 311,950**	**512**		**$39,423**	**$351,000**	
7.0 Waste Handling, Treatment, Disposal, and Transportation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Pit & Slopeback - U Landfill									
Prime Contractor Labor					12035		$793,914		
Materials	1	LS	$48,942	$48,942					
Characterization Sampling	1	LS	$354,507	$354,507					
Vehicles and Equipment	1	LS	$470,862	$470,862					

COST ESTIMATE

BGOU SWMU 7

Alternative 5(P&T)—Excavation and Disposal, Pump-and-Treat, LUCs and Monitoring

Pit & Slopeback - Off-Site									
Prime Contractor Labor					54144		$3,877,690		
Materials	1	LS	$1,725,704	$1,725,704					
Characterization Sampling	1	LS	$1,109,945	$1,109,945					
Vehicles and Equipment	1	LS	$609,554	$609,554					
Disposal	1	LS	$43,840,873	$43,840,873					
Transportation	1	LS	$14,139,825	$14,139,825					
Pit & Slopeback - Treated Off-Site									
Prime Contractor Labor					4500		$321,643		
Materials	1	LS	$138,517	$138,517					
Characterization Sampling	1	LS	$90,412	$90,412					
Vehicles and Equipment	1	LS	$50,796	$50,796					
Treatment	1	LS	$6,359,529	$6,359,529					
Disposal	1	LS	$7,068,748	$7,068,748					
Transportation	1	LS	$1,158,119	$1,158,119					
Surface Soils - U Landfill									
Prime Contractor Labor					4423		$291,785		
Materials	1	LS	$11,779	$11,779					
Characterization Sampling	1	LS	$127,904	$127,904					
Vehicles and Equipment	1	LS	$172,494	$172,494					
Surface Soils - Off-Site									
Prime Contractor Labor					3659		$261,816		
Materials	1	LS	$111,795	$111,795					
Characterization Sampling	1	LS	$71,792	$71,792					
Vehicles and Equipment	1	LS	$41,028	$41,028					
Disposal	1	LS	$2,799,055	$2,799,055					
Transportation	1	LS	$915,722	$915,722					
TASK TOTALS				**$81,417,902**	**78,761**		**$5,546,848**	**$86,965,000**	
8.0 Excavation Backfill									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Backfill									
Prime Contractor Labor					5519		$486,828		
Subcontractors	1	LS	$2,440,459	$2,440,459					RSMeans and local Engineering firm
Materials	1	LS	$17,112	$17,112					
Vehicles and Equipment	1	LS	$10,028	$10,028					
TASK TOTAL				**$2,467,599**	**5519**		**$486,828**	**$2,954,000**	

COST ESTIMATE
BGOU SWMU 7
Alternative 5(P&T)—Excavation and Disposal, Pump-and-Treat, LUCs and Monitoring

9.0 In Situ Source Treatment (P&T)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Extraction Well									
Prime Contractor Labor					480		$38,170		
Subcontractors	1	LS	$168,497	$168,497					Local quote from existing drilling sub.
Materials	1	LS	$1,455	$1,455					
Vehicles and Equipment	1	LS	$872	$872					
Treatment System									
Prime Contractor Labor					9216		$706,716		
Subcontractors	1	LS	$1,560,193	$1,560,193					RSMeans and historical costs from the groundwater OU.
Materials	1	LS	$33,480	$33,480					
Vehicles and Equipment	1	LS	$5,232	$5,232					
TASK TOTALS				**$1,769,729**	**9,696**		**$744,886**	**$2,515,000**	
							SUBTOTAL CAPITAL COST	**$100,445,000**	
ANNUAL COSTS									
Pump & Treat O&M									
Duration: Annually for 50 years.									
Prime Contractor Labor					2480		$191,694		
Materials	1	LS	$24,992	$24,992					
Vehicles and Equipment	1	LS	$1,744	$1,744					
TASK TOTAL				**$26,736**			**$191,694**	**$218,000**	ANNUAL COST
Five Year Review									
Duration: Every 5 years.									
Prime Contractor Labor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study — **Reported From: SWMU 7 Alternative 5(P&T)**
Report Total: $100,714,514

Author
Manager

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5(P&T)			**$100,714,514**
	Capital Costs			**$100,445,947**
	Remedial Desgin			**$1,561,175**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	376,224	$1.00	$376,224
Memo: 4,224 HOURS				

TOTAL RDWP/RDSI Work Plan — **$376,224**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(P&T)		**$100,714,514**
Capital Costs		**$100,445,947**
Remedial Desgin		**$1,561,175**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	803,933	$1.00	$803,933
Memo: 8,744 HOURS				

TOTAL RDR — **$803,933**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(P&T)		**$100,714,514**
Capital Costs		**$100,445,947**
Remedial Desgin		**$1,561,175**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	22,818	$1.00	$22,818
Memo: 216 HOURS				

TOTAL Civil Surveying — **$22,818**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(P&T)		**$100,714,514**
Capital Costs		**$100,445,947**
Remedial Desgin		**$1,561,175**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	52,676	$1.00	$52,676
Memo: 634 HOURS				

TOTAL Procurement — **$52,676**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(P&T)		**$100,714,514**
Capital Costs		**$100,445,947**
Remedial Desgin		**$1,561,175**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	146,788	$1.00	$146,788
Memo: 1,688 HOURS				

TOTAL Work Packages/Readiness Review — **$146,788**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5(P&T)			**$100,714,514**
	Capital Costs			**$100,445,947**
	Remedial Desgin			**$1,561,175**

Training

Tree Depth= 5

		QTY	UNIT COST	TOTAL
Memo:	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
	Assume 80 hours of training per person. Assume 10 people or 800 hours.			
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training **$158,736**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5(P&T)			**$100,714,514**
	Capital Costs			**$100,445,947**
	Other Project Plans			**$1,038,317**

RAWP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	517,587	$1.00	$517,587
Memo: 5,724 HOURS				

TOTAL RAWP **$517,587**

	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5(P&T)			**$100,714,514**
	Capital Costs			**$100,445,947**
	Other Project Plans			**$1,038,317**

O&M Plan

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan **$66,863**

	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5(P&T)			**$100,714,514**
	Capital Costs			**$100,445,947**
	Other Project Plans			**$1,038,317**

SAP/QAPP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	96,201	$1.00	$96,201
Memo: 1,100 HOURS				

TOTAL SAP/QAPP **$96,201**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Other Project Plans				**$1,038,317**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	94,190		$1.00	$94,190
Memo: 1,020 HOURS					

TOTAL Waste Management Plan **$94,190**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Other Project Plans				**$1,038,317**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	212,751		$1.00	$212,751
Memo: 2,274 HOURS					

TOTAL RACR **$212,751**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Other Project Plans				**$1,038,317**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	RDSI				**$475,275**

Drilling

Tree Depth= 5

	Mob/Demob for DPT subcontractor	1		$8,500.00	$8,500
	DPT Borings to 65 feet	12		$2,573.00	$30,876
	1/2 TON 4WD TRUCKS, LARGE VANS	800	hrs	$5.45	$4,360
Memo: 4 LATAKY vehicles.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	ST-90 CONTAINER DELIVERED	2		$1,770.63	$3,541
Memo: 2 ST-90 box for PPE/Trash.					
	PORTABLE TOILET & HAND WASH PER MONTH	2		$227.21	$454
Memo: Rent for 2 months.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,800	hrs	$2.70	$4,860
Memo: LATAKY personnel plus assume 5 drillers.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,800		$5.19	$9,342
	PPE 2 c/o per day 10 hr day cost per hr	1,800		$1.95	$3,510

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	RDSI				**$475,275**

Drilling

Tree Depth= 5

	MSA OptiFilter HEPA per hour	1,800		$3.45	$6,210
LABOR	PRIME CONTRACTOR LABOR	190,626		$1.00	$190,626
Memo: 2,340 HOURS					

TOTAL Drilling **$262,618**

Memo: 12 DPT locations. 12 day duration plus one week for mod and one week for demob. 5 week total duration.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	RDSI				**$475,275**

Sampling

Tree Depth= 5

	5 gram EN CORE SAMPLER	300		$6.94	$2,082
	Niton XRF Rental One Month	1		$4,500.00	$4,500
	PCB Test Kits	1		$541.00	$541
	LAUNDRY 2 CHANGES COST PER HOUR	600	hrs	$2.70	$1,620
	PPE 2 c/o per day 10 hr day cost per hr	600		$1.95	$1,170
LABOR	PRIME CONTRACTOR LABOR	43,825		$1.00	$43,825
Memo: 600 HOURS					

TOTAL Sampling **$53,738**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	RDSI				**$475,275**

Analytical

Tree Depth= 5

	Overnight Shipment per Cooler	51		$251.97	$12,850
Memo: Assume 2 shipments per day for 25 days plus 1 shipment later for the waste water.					
	RDSI Geophysical Sampling Analytical	1		$1,275.00	$1,275
Memo: 3 Geophysical samples taken for particle size and atterberg limits.					
	RDSI Soil Sampling Analytical	0.40		$262,775.00	$105,110
Memo: MANAL114 is for 240 samples. 8 samples per hole x 12 holes = 96 samples. 96/240 = .4.					
	VOCs in Water	24		$88.00	$2,112
Memo: 2 per hole.					
LABOR	PRIME CONTRACTOR LABOR	18,393		$1.00	$18,393
Memo: 200 HOURS					

TOTAL Analytical **$139,740**

SWMUs 2,3,7&30 Feasibility Study

Reported From: SWMU 7 Alternative 5(P&T)
Report Total: $100,714,514

Author
Manager

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	RDSI				**$475,275**

Excavation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	CATERPILLAR 345B CRAWLER MOUNTED SHEAR HEAD EXCAVATOR	40	hr	$62.12	$2,485
	JOHN DEERE 624E 4WD ARTICULATED WHEEL LOADER	40	hr	$18.23	$729
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
LABOR	PRIME CONTRACTOR LABOR	15,220		$1.00	$15,220

Memo: 200 HOURS

TOTAL Excavation **$19,178**

Memo: 2 excavations. Performed methodically to verify lack of metal debris.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(P&T)		**$100,714,514**
Capital Costs		**$100,445,947**
Excavation		**$3,710,050**

Pit & Slopeback U Landfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	88		$1,470.00	$129,360
	RSMeans Crew B-12C cost per day	88		$2,354.00	$207,152
	Mob/Demob of Subcontractor and Equipment	1	LS	$50,000.00	$50,000
	LAUNDRY 2 CHANGES COST PER HOUR	3,520	hrs	$2.70	$9,504
	1/2 TON 4WD TRUCKS, LARGE VANS	1,760	hrs	$5.45	$9,592
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	3,520		$1.95	$6,864
LABOR	PRIME CONTRACTOR LABOR	613,550		$1.00	$613,550

Memo: 7,128 HOURS

TOTAL Pit & Slopeback U Landfill **$1,026,022**

Memo: 18,869 BCY. Assume 225 CY per day so 84 days + weather/delays. Assume 88 day duration.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(P&T)		**$100,714,514**
Capital Costs		**$100,445,947**
Excavation		**$3,710,050**

Pit & Slopeback Offsite

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	165		$1,470.00	$242,550
	RSMeans Crew B-12C cost per day	165		$2,354.00	$388,410
	LAUNDRY 2 CHANGES COST PER HOUR	6,600	hrs	$2.70	$17,820
	1/2 TON 4WD TRUCKS, LARGE VANS	3,300	hrs	$5.45	$17,985
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	6,600		$1.95	$12,870

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Excavation				**$3,710,050**

Pit & Slopeback Offsite

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	1,150,406		$1.00	$1,150,406
Memo: 13,365 HOURS					

TOTAL Pit & Slopeback Offsite **$1,830,041**

Memo: 35,450 BCY. Excavating and moving a 225 CY per day, so 158 days plus weather/delays is 165 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Excavation				**$3,710,050**

Pit & Slopeback Treated Offsite

Tree Depth= 5

	RSMeans Crew B-10W cost per day	32		$1,470.00	$47,040
	RSMeans Crew B-12C cost per day	32		$2,354.00	$75,328
	LAUNDRY 2 CHANGES COST PER HOUR	1,280	hrs	$2.70	$3,456
	1/2 TON 4WD TRUCKS, LARGE VANS	640	hrs	$5.45	$3,488
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,280		$5.19	$6,643
	PPE 2 c/o per day 10 hr day cost per hr	1,280		$1.95	$2,496
	MSA OptiFilter HEPA per hour	1,280		$3.45	$4,416
LABOR	PRIME CONTRACTOR LABOR	223,109		$1.00	$223,109
Memo: 2,592 HOURS					

TOTAL Pit & Slopeback Treated Offsite **$365,976**

Memo: 2,858 BCY. Excavating and moving a 100 CY per day, so 29 days plus weather/delays is 32 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Excavation				**$3,710,050**

Surface Soils U Landfill

Tree Depth= 5

	RSMeans Crew B-10W cost per day	33		$1,470.00	$48,510
	RSMeans Crew B-12C cost per day	33		$2,354.00	$77,682
	LAUNDRY 2 CHANGES COST PER HOUR	1,320	hrs	$2.70	$3,564
	1/2 TON 4WD TRUCKS, LARGE VANS	660	hrs	$5.45	$3,597
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	1,320		$1.95	$2,574

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Excavation				**$3,710,050**

Surface Soils U Landfill

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	230,081		$1.00	$230,081
Memo: 2,673 HOURS					

TOTAL Surface Soils U Landfill **$366,008**

Memo: 6,739 BCY. Excavating and moving a 225 CY per day, so 30 days plus weather/delays is 33 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Excavation				**$3,710,050**

Surface Soils Offsite

Tree Depth= 5

	RSMeans Crew B-10W cost per day	11		$1,470.00	$16,170
	RSMeans Crew B-12C cost per day	11		$2,354.00	$25,894
	LAUNDRY 2 CHANGES COST PER HOUR	440	hrs	$2.70	$1,188
	1/2 TON 4WD TRUCKS, LARGE VANS	220	hrs	$5.45	$1,199
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	440		$1.95	$858
LABOR	PRIME CONTRACTOR LABOR	76,694		$1.00	$76,694
Memo: 891 HOURS					

TOTAL Surface Soils Offsite **$122,003**

Memo: 2,264 BCY. Excavating and moving a 225 CY per day, so 10 days plus weather/delays is 11 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Treat and Dispose of Water				**$875,964**

Water Treatment

Tree Depth= 5

	B10H R.S.Means Crew	329	Day	$581.53	$191,325
	Water Treatment System w/ Tanks per month	15		$12,825.00	$192,375
Memo: Packaged system with 5 frac tanks.					
	LAUNDRY 2 CHANGES COST PER HOUR	3,948	hrs	$2.70	$10,660
	1/2 TON 4WD TRUCKS, LARGE VANS	1,316	hrs	$5.45	$7,172
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	3,948		$1.95	$7,699
LABOR	PRIME CONTRACTOR LABOR	280,980		$1.00	$280,980
Memo: 3,948 HOURS					
Subtotal					$690,210
1st Layer Markups assigned to Detail Items					$110,654

TOTAL Water Treatment **$800,864**

Memo: 15 months

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Treat and Dispose of Water				**$875,964**

Water Disposal

Tree Depth= 5

	Water Truck 10k Gallon cost per hr	40	hr	$208.34	$8,334
	Overnight Shipment per Cooler	8		$251.97	$2,016
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Water Cost per Sample	75		$833.00	$62,475
Memo: Assume Frac tanks will be emptied every 2 months. 7.5 * 5 tanks * 20,000 gallons = 750,000 gallons. Assume a water sample will be taken from each water truck (10,000 gallons). 750,000 gallons / 10,000 = 75 samples.					
LABOR	PRIME CONTRACTOR LABOR	2,275		$1.00	$2,275
Memo: 40 HOURS					

TOTAL Water Disposal **$75,099**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Post Remediation Sampling				**$351,373**

Sampling

Tree Depth= 5

	5 gram EN CORE SAMPLER	500		$6.94	$3,470
	Niton XRF Rental One Month	1		$4,500.00	$4,500
	PCB Test Kits	1		$541.00	$541
	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780
LABOR	PRIME CONTRACTOR LABOR	29,217		$1.00	$29,217
Memo: 400 HOURS					

TOTAL Sampling **$39,588**

Memo: 109 Floor Samples.
108 Sidewall Samples.
57 Surface Soils.
Total of 274 samples.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Post Remediation Sampling				**$351,373**

Analytical

Tree Depth= 5

	Overnight Shipment per Cooler	8		$251.97	$2,016
	RDSI Soil Sampling Analytical	1.14		$262,775.00	$299,564
Memo: MANAL114 is for 240 samples. 274/240 = 1.14.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Post Remediation Sampling				**$351,373**

Analytical

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	10,206		$1.00	$10,206
Memo: 112 HOURS					

TOTAL Analytical **$311,785**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(P&T)		**$100,714,514**
Capital Costs		**$100,445,947**
Waste Handling/Treatment/Disposal/Transportation		**$86,964,750**

Pit & Slopeback U Landfill

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	10,100	hrs	$2.70	$27,270
	1/2 TON 4WD TRUCKS, LARGE VANS	2,020	hrs	$5.45	$11,009
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	5,050	hr	$91.06	$459,853
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	504		$43.00	$21,672
	Overnight Shipment per Cooler	31		$251.97	$7,811
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	302		$1,148.00	$346,696
Memo: 22,643 LCY / 15 CY = 1,510. Assume 20% sampling rate. 1,510 / 5 = 302 samples.					
LABOR	PRIME CONTRACTOR LABOR	793,914		$1.00	$793,914
Memo: 12,035 HOURS					

TOTAL Pit & Slopeback U Landfill **$1,668,225**

Memo: U Landfill WAC Compliant. 18,869 BCY x 1.2 = 22,643 LCY. Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 101 days.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(P&T)		**$100,714,514**
Capital Costs		**$100,445,947**
Waste Handling/Treatment/Disposal/Transportation		**$86,964,750**

Pit & Slopeback Offsite

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	40,560	hrs	$2.70	$109,512
	1/2 TON 4WD TRUCKS, LARGE VANS	6,240	hrs	$5.45	$34,008
Memo: 3 LATAKY vehicles.					
	Disposal ES MLLW by rail	42,540		$1,030.58	$43,840,873
	Transportation to ES by Gondola	525		$26,933.00	$14,139,825
Memo: Assume 9 bags per car. 4727 / 9 = 525 gons.					
	Lift Liner Bags 9 CY	4,727		$300.00	$1,418,100
	Loading or Lifting Frames per month	238		$500.00	$119,000
Memo: Rent for 14 months. 11 loading frames and 6 lifting frames. 17 x 14 months = 238.					
	Skid Steer per hour	3,120	hr	$32.54	$101,525

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Waste Handling/Treatment/Disposal/Transportation				**$86,964,750**

Pit & Slopeback Offsite

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	18,000 lb Fork Lift per hour	6,240	hr	$32.66	$203,798
	Flat Bed Truck per hour	3,120	hr	$45.74	$142,709
	30' IC Scissor Lift Rent per hour	3,120	hr	$14.88	$46,426
	65 Ton Link-Belt Crane GFE cost per hr	3,120	hr	$25.99	$81,089
	PPE 2 c/o per day 10 hr day cost per hr	40,560		$1.95	$79,092
	Overnight Shipment per Cooler	95		$251.97	$23,937
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	946		$1,148.00	$1,086,008
Memo: Assume 20% sampling rate. 4,727 / 5 = 946 samples.					
LABOR	PRIME CONTRACTOR LABOR	3,877,690		$1.00	$3,877,690
Memo: 54,144 HOURS					

TOTAL Pit & Slopeback Offsite **$65,303,592**

Memo: 35,450 BCY x 1.2 = 42,540 LCY. Load in soft sided bags and ship to ES by rail for disposal. 42,540 LCY / 9 CY per bag = 4,727 bags. Load 16 bags per day so 296 days plus weather/delays = 312 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Waste Handling/Treatment/Disposal/Transportation				**$86,964,750**

Pit & Slopeback Treated Offsite

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	3,380	hrs	$2.70	$9,126
	1/2 TON 4WD TRUCKS, LARGE VANS	520	hrs	$5.45	$2,834
Memo: 3 LATAKY vehicles.					
	Disposal ES MLLW by rail	6,859		$1,030.58	$7,068,748
Memo: Double the disposal volume for MLLW.					
	MLLW Treatment at ES ST90 per CY	3,430		$1,854.09	$6,359,529
	Transportation to ES by Gondola	43		$26,933.00	$1,158,119
Memo: Assume 9 bags per car. 381 / 9 = 43 gons.					
	Lift Liner Bags 9 CY	381		$300.00	$114,300
	Loading or Lifting Frames per month	17		$500.00	$8,500
Memo: Rent for 1 month. 11 loading frames and 6 lifting frames. 17 x 1 months = 17.					
	Skid Steer per hour	260	hr	$32.54	$8,460
	18,000 lb Fork Lift per hour	520	hr	$32.66	$16,983
	Flat Bed Truck per hour	260	hr	$45.74	$11,892
	30' IC Scissor Lift Rent per hour	260	hr	$14.88	$3,869
	65 Ton Link-Belt Crane GFE cost per hr	260	hr	$25.99	$6,757
	PPE 2 c/o per day 10 hr day cost per hr	3,380		$1.95	$6,591
	Overnight Shipment per Cooler	8		$251.97	$2,016
Memo: Assume 10 samples per cooler.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Waste Handling/Treatment/Disposal/Transportation				**$86,964,750**

Pit & Slopeback Treated Offsite

Tree Depth= 5

		QTY		UNIT COST	TOTAL
Memo:	Characterization Sampling Soil Cost per Sample	77		$1,148.00	$88,396

Memo: Assume 20% sampling rate.
381 / 5 = 77 samples.

LABOR	PRIME CONTRACTOR LABOR	321,643		$1.00	$321,643

Memo: 4,500 HOURS

TOTAL Pit & Slopeback Treated Offsite **$15,187,764**

Memo: 2,858 BCY x 1.2 = 3,430 LCY. Load into soft sided bags and ship to ES by rail for treatment and disposal. Assume can load 16 bags per day. 3,430 / 9 = 381 bags. 381 / 16 = 24 days + weather/delays = 26 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Waste Handling/Treatment/Disposal/Transportation				**$86,964,750**

Surface Soils U Landfill

Tree Depth= 5

		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	1,480	hrs	$2.70	$3,996
	1/2 TON 4WD TRUCKS, LARGE VANS	740	hrs	$5.45	$4,033
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	1,850	hr	$91.06	$168,461
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	181		$43.00	$7,783
	Overnight Shipment per Cooler	11		$251.97	$2,772
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	109		$1,148.00	$125,132

Memo: 8,147 LCY / 15 CY = 543.
Assume 20% sampling rate.
543 / 5 = 109 samples.

LABOR	PRIME CONTRACTOR LABOR	291,785		$1.00	$291,785

Memo: 4,423 HOURS

TOTAL Surface Soils U Landfill **$603,962**

Memo: U Landfill WAC Compliant. 6,789 BCY x 1.2 = 8,147 LCY. Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 37 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Waste Handling/Treatment/Disposal/Transportation				**$86,964,750**

Surface Soils Offsite

Tree Depth= 5

		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	2,730	hrs	$2.70	$7,371
	1/2 TON 4WD TRUCKS, LARGE VANS	420	hrs	$5.45	$2,289
Memo: 3 LATAKY vehicles.					
	Disposal ES MLLW by rail	2,716		$1,030.58	$2,799,055

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Waste Handling/Treatment/Disposal/Transportation				**$86,964,750**

Surface Soils Offsite

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	Transportation to ES by Gondola	34		$26,933.00	$915,722
Memo: Assume 9 bags per car. 302 / 9 = 34 gons.					
	Lift Liner Bags 9 CY	302		$300.00	$90,600
	Loading or Lifting Frames per month	17		$500.00	$8,500
Memo: Rent for 1 months. 11 loading frames and 6 lifting frames. 17 x 1 months = 17.					
	Skid Steer per hour	210	hr	$32.54	$6,833
	18,000 lb Fork Lift per hour	420	hr	$32.66	$13,717
	Flat Bed Truck per hour	210	hr	$45.74	$9,605
	30' IC Scissor Lift Rent per hour	210	hr	$14.88	$3,125
	65 Ton Link-Belt Crane GFE cost per hr	210	hr	$25.99	$5,458
	PPE 2 c/o per day 10 hr day cost per hr	2,730		$1.95	$5,324
	Overnight Shipment per Cooler	7		$251.97	$1,764
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	61		$1,148.00	$70,028
22,643 LCY / 15 CY = 1,510. Assume 20% sampling rate. 1,510 / 5 = 302 samples.					
LABOR	PRIME CONTRACTOR LABOR	261,816		$1.00	$261,816
Memo: 3,659 HOURS					

TOTAL Surface Soils Offsite **$4,201,207**

Memo: 2,264 BCY x 1.2 = 2,716 LCY. Load into soft sided bags and ship to ES by rail for disposal. Assume can load 16 bags per day. 2,716 / 9 = 302 bags. 302 / 16 = 19 days + weather/delays = 21 days.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(P&T)	**$100,714,514**	
Capital Costs	**$100,445,947**	
Excavation Backfill	**$2,954,428**	

Backfill

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	B10D R.S.Means Crew	68,615	E.C.Y.	$2.67	$183,027
	B34C R.S.Means Crew	68,615	L.C.Y.	$7.98	$547,496
	Backfill Delivered per CY	68,615		$16.00	$1,097,840
	LAUNDRY 2 CHANGES COST PER HOUR	3,680	hrs	$2.70	$9,936
Memo: .					
	1/2 TON 4WD TRUCKS, LARGE VANS	1,840	hrs	$5.45	$10,028
Memo: 2 LATAKY vehicles.					
	Geotechnical Testing Technician per hour	920		$52.19	$48,015
	Geotechnical Testing Density Testing per hour	920		$50.00	$46,000
	RSMeans Crew B-10W cost per day	92		$1,470.00	$135,240
	RSMeans Crew B-10P cost per day	92		$2,129.00	$195,868
	PPE 2 c/o per day 10 hr day cost per hr	3,680		$1.95	$7,176

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	Excavation Backfill				**$2,954,428**

Backfill

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	486,828		$1.00	$486,828
Memo: 5,519 HOURS					
Subtotal					$2,767,454
1st Layer Markups assigned to Detail Items					$186,975
TOTAL Backfill					**$2,954,428**

Memo: 57,179 BCY total removed. 57,179 x 1.2 = 68,615 CY of fill needed. Assume 750 CY filled per day. 68,615 / 750 = 92 days. Fill is stockpiled during other activities and transfered to site as needed.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5(P&T)		**$100,714,514**
Capital Costs		**$100,445,947**

In Situ Source Treatment (Pump & Treat)

Tree Depth= 4

	QTY	UNIT COST	TOTAL
	1	$0.01	$0

Memo: SWMU 7 treated area is 75' x 75' x 60' or 12,500 CY.
C-400 treated area was 19,000 CY.
12,500 / 19,000 = .66.
Assume a .66 scaling factor.

Subtotal	$0
Rollup from Child Levels	$2,506,220
1st Layer Markups assigned to Detail Items	$8,395
TOTAL In Situ Source Treatment (Pump & Treat)	**$2,514,615**

Estimate Tree Structure Rollups	
SWMU 7 Alternative 5(P&T)	**$100,714,514**
Capital Costs	**$100,445,947**
In Situ Source Treatment (Pump & Treat)	**$2,514,615**

Extraction Well

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Pump & Treat System Extraction Well Mob/Demob	1		$30,362.49	$30,362
	Pump & Treat System Extraction Well Install	1		$138,135.27	$138,135
	LAUNDRY 2 CHANGES COST PER HOUR	240	hrs	$2.70	$648
Memo: LATAKY personnel plus assume 5 drillers.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	1/2 TON 4WD TRUCKS, LARGE VANS	160	hrs	$5.45	$872
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	240		$1.95	$468
LABOR	PRIME CONTRACTOR LABOR	38,170		$1.00	$38,170
Memo: 480 HOURS					
TOTAL Extraction Well					**$208,994**

Memo: 1 extraction well. 2 week duration.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5(P&T)				**$100,714,514**
	Capital Costs				**$100,445,947**
	In Situ Source Treatment (Pump & Treat)				**$2,514,615**

Treatment System

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	ATU Air Stripper costs from NE Plume	1		$1,210,984.00	$1,210,984
Memo: Costs include LATAKY labor and testing.					
	Ion Exchange System w/ Media	1		$146,645.00	$146,645
	Granulated Active Carbon Treatment System	1		$130,900.00	$130,900
	1/2 TON 4WD TRUCKS, LARGE VANS	960	hrs	$5.45	$5,232
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	7,200	hrs	$2.70	$19,440
	RSMeans Assembly A1030-120-4560 per SF	2,400		$13.84	$33,216
Memo: 40' x 60' concrete slab for treatment system.					
	E2 R.S.Means Crew	2,400	SF Flr.	$12.52	$30,053
	PPE 2 c/o per day 10 hr day cost per hr	7,200		$1.95	$14,040
LABOR	PRIME CONTRACTOR LABOR	706,716		$1.00	$706,716
Memo: 9,216 HOURS					

Subtotal	$2,297,226
1st Layer Markups assigned to Detail Items	$8,395

TOTAL Treatment System **$2,305,620**

Memo: 6 month total duration. LATAKY labor costs only for 3 months. LATAKY labor costs for the air stripper already covered in item ATUCOSTS.

	Estimate Tree Structure Rollups	
	SWMU 7 Alternative 5(P&T)	**$100,714,514**
	Annual Costs	**$268,567**
	Operations & Maintenance	**$218,430**

Pump & Treat O&M

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RESIN FOR USEC COST PER CF	10	CF	$296.00	$2,960
Memo: ASSUME PURCHASE OF 10 CF PER YEAR					
	PUMP & TREAT RESIN DISPOAL RATES PER CF	15	C	$164.69	$2,470
Memo: RESIN DISPOSAL ASSUME 2 DRUMS OR 15 CF PER YEAR					
	CARBON (INITIAL FILTER CHARGE) COST PER LB	4,000	lb	$2.05	$8,200
Memo: 2,000 lbs, twice per year.					
	REPLACE RESIN COST PER CF	40	CF	$154.45	$6,178
Memo: Assume 80 CF every 2 years.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,920	hrs	$2.70	$5,184
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	191,694		$1.00	$191,694
Memo: 2,480 HOURS					

TOTAL Pump & Treat O&M **$218,430**

Memo: ANNUAL COST. O&M for 50 years.

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5(P&T)			**$100,714,514**
	Annual Costs			**$268,567**
	Five Year Reviews			**$50,137**

Five Year Reviews

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,137	$1.00	$50,137
Memo: 500 HOURS				

TOTAL Five Year Reviews **$50,137**

COST ESTIMATE
BGOU SWMU 7
Alternative 5WDF (ERH)—Excavation and Disposal, ERH, LUCs, and Monitoring

Cost Estimate Summary									
Capital Cost	**Quantity**	**Units**	**Unit Price**	**Total**					
1.0 Remedial Design	1	LS	$1,561,000	$1,561,000					
2.0 Other Project Plans	1	LS	$1,038,000	$1,038,000					
3.0 Remedial Design Site Investigation (RDSI)	1	LS	$475,000	$475,000					
4.0 Excavation	1	LS	$3,710,000	$3,710,000					
5.0 Treat and Dispose of Water	1	LS	$876,000	$876,000					
6.0 Post Remediation Sampling	1	LS	$351,000	$351,000					
7.0 Waste Handling, Treatment, Disposal, and Transportation	1	LS	$20,950,000	$20,950,000					
8.0 Excavation Backfill	1	LS	$2,954,000	$2,954,000					
9.0 In Situ Source Treatment (ERH)	1	LS	$34,275,000	$34,275,000					
Subproject Management	1	LS	$6,619,000	$6,619,000					Subproject Management = 10%
Management Reserve	1	LS	$10,921,350	$10,921,000					Contractor MR = 15%
Fee	1	LS	$5,861,100	$5,861,000					Fee = 7%
Contingency	1	LS	$17,918,200	$17,918,000					Contingency = 20%
		SUBTOTAL CAPITAL COST		**$107,509,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Five-Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
		SUBTOTAL ANNUAL COST		**$10,000,000**			**3.82E+17**		
			TOTAL	**$117,509,000**					
Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	LS	$107,509,000	$107,509,000				**$107,509,000**	
Five-Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$107,509,000**	
						Present Worth Values	**Annual**	**$889,000**	
							Avg. Annual	**$889**	
							Total	**$108,398,000**	
This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.									
Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.									

COST ESTIMATE
BGOU SWMU 7
Alternative 5WDF (ERH)—Excavation and Disposal, ERH, LUCs, and Monitoring

CAPITAL COSTS									
	Material/Equipment/Subcontractors/ODCs				Labor				
Task Description	**Qty**	**Unit**	**Unit Price**	**Total**	**Hours**	**Rate**	**Total**	**Total Cost**	**Basis of Estimate**
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					4224		$376,224		
Remedial Design Report					8744		$803,933		
Civil Surveying					216		$22,818		
Procurement					634		$52,676		
Work Packages/Readiness					1688		$146,788		
Training	1	LS	$56,000	$56,000	1320		$102,736		$68,800 includes subcontractor training
TASK TOTAL				**$56,000**	**16826**		**$1,505,175**	**$1,561,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					5724		$517,587		
O&M Plan					700		$66,863		
SAP/QAPP					1100		$96,201		
Waste Management Plan					1020		$94,190		
RACR					2274		$212,751		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**11402**		**$1,038,317**	**$1,038,000**	
3.0 Remedial Design Site Investigation (RDSI)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Drilling									
Prime Contractor Labor					2340		$190,626		
Subcontractors	1	LS	$39,376	$39,376					Local quote from existing drilling sub.
Materials	1	LS	$28,256	$28,256					
Vehicles and Equipment	1	LS	$4,360	$4,360					
Sampling									
Prime Contractor Labor					600		$43,825		
Materials	1	LS	$9,913	$9,913					
Analytical									
Prime Contractor Labor					200		$18,393		
Materials	1	LS	$121,347	$121,347					
Excavation									
Prime Contractor Labor	0				200		$15,220		
Materials	1	LS	$744	$744					
Equipment	1	LS	$3,214	$3,214					
TASK TOTAL				**$ 207,210**	**3340**		**$ 268,064**	**$475,000**	

COST ESTIMATE
BGOU SWMU 7
Alternative 5WDF (ERH)—Excavation and Disposal, ERH, LUCs, and Monitoring

4.0 Excavation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Pit & Slopeback - U Landfill									
Prime Contractor Labor					7128		$613,550		
Subcontractors	1	LS	$386,512	$386,512					
Materials	1	LS	$16,368	$16,368					
Vehicles and Equipment	1	LS	$9,592	$9,592					
Pit & Slopeback - Offsite									
Prime Contractor Labor					13365		$1,150,406		
Subcontractors	1	LS	$630,960	$630,960					
Materials	1	LS	$30,690	$30,690					
Vehicles and Equipment	1	LS	$17,985	$17,985					
Pit & Slopeback - Treated Offsite									
Prime Contractor Labor					2592		$223,109		
Subcontractors	1	LS	$124,864	$124,864					
Materials	1	LS	$14,515	$14,515					
Vehicles and Equipment	1	LS	$3,488	$3,488					
Surface Soils - U Landfill									
Prime Contractor Labor					2673		$230,081		
Subcontractors	1	LS	$126,192	$126,192					
Materials	1	LS	$6,138	$6,138					
Vehicles and Equipment	1	LS	$3,597	$3,597					
Surface Soils - Offsite									
Prime Contractor Labor					891		$76,694		
Subcontractors	1	LS	$42,064	$42,064					
Materials	1	LS	$2,046	$2,046					
Vehicles and Equipment	1	LS	$1,199	$1,199					
TASK TOTALS				**$1,416,210**	**26,649**		**$2,293,840**	**$3,710,000**	
5.0 Treat and Dispose of Water									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Water Treatment									
Prime Contractor Labor					3948		$280,980		
Subcontractors	1	LS	$494,353	$494,353					Rainforrent.com and RSMeans
Materials	1	LS	$18,359	$18,359					
Vehicles and Equipment	1	LS	$7,172	$7,172					
Water Disposal									
Prime Contractor Labor					40		$2,275		
Characterization Sampling	1	LS	$64,491	$64,491					
Vehicles and Equipment	1	LS	$14,244	$8,334					
TASK TOTALS				**$592,709**	**3,988**		**$283,255**	**$876,000**	
6.0 Post Remediation Sampling									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Sampling									
Prime Contractor Labor					400		$29,217		
Materials	1	LS	$10,371	$10,371					
Analytical									
Prime Contractor Labor					112		$10,206		
Materials	1	LS	$301,579	$301,579					
TASK TOTAL				**$ 311,950**	**512**		**$39,423**	**$351,000**	

COST ESTIMATE
BGOU SWMU 7
Alternative 5WDF (ERH)—Excavation and Disposal, ERH, LUCs, and Monitoring

7.0 Waste Handling, Treatment, Disposal, and Transportation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Pit & Slopeback - U Landfill									
Prime Contractor Labor					12035		$793,914		
Materials	1	LS	$48,942	$48,942					
Characterization Sampling	1	LS	$354,507	$354,507					
Vehicles and Equipment	1	LS	$470,862	$470,862					
Pit & Slopeback - OSWDF									
Prime Contractor Labor					26802		$1,799,291		
Materials	1	LS	$141,522	$141,522					
Characterization Sampling	1	LS	$499,883	$499,883					
Vehicles and Equipment	1	LS	$830,130	$830,130					
Transportation	1	LS	$0	$0					Costs contained in LATA Kentucky equipment and labor
Pit & Slopeback - Treated Offsite									
Prime Contractor Labor					4500		$321,643		
Materials	1	LS	$138,517	$138,517					
Characterization Sampling	1	LS	$90,412	$90,412					
Vehicles and Equipment	1	LS	$50,796	$50,796					
Treatment	1	LS	$6,359,529	$6,359,529					
Disposal	1	LS	$7,068,748	$7,068,748					
Transportation	1	LS	$1,158,119	$1,158,119					
Surface Soils - U Landfill									
Prime Contractor Labor					4423		$291,785		
Materials	1	LS	$11,779	$11,779					
Characterization Sampling	1	LS	$127,904	$127,904					
Vehicles and Equipment	1	LS	$172,494	$172,494					
Surface Soils - OSWDF									
Prime Contractor Labor					1808		$121,413		
Materials	1	LS	$9,546	$9,546					
Characterization Sampling	1	LS	$32,900	$32,900					
Vehicles and Equipment	1	LS	$55,342	$55,342					
Transportation	1	LS	$0	$0					Costs contained in LATA Kentucky equipment and labor
TASK TOTALS				**$17,621,932**	**49,568**		**$3,328,046**	**$20,950,000**	
8.0 Excavation Backfill									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Backfill									
Prime Contractor Labor					5519		$486,828		
Subcontractors	1	LS	$2,440,459	$2,440,459					RSMeans and local engineering firm
Materials	1	LS	$17,112	$17,112					
Vehicles and Equipment	1	LS	$10,028	$10,028					
TASK TOTAL				**$2,467,599**	**5519**		**$486,828**	**$2,954,000**	

COST ESTIMATE
BGOU SWMU 7
Alternative 5WDF (ERH)—Excavation and Disposal, ERH, LUCs, and Monitoring

9.0 In Situ Source Treatment (ERH)									
Refer to the Success reports for detailed cost and resources. Costs in this section are derived from the C-400 Project's actual costs.									
Installation									
Scaled Actual Costs	1	LS	$20,714,070	$20,714,070					Costs escalated to FY14 and scaled down by a factor .66
Operations				$0					
Scaled Actual Costs	1	LS	$13,048,540	$13,048,540					Costs escalated to FY14 and scaled down by a factor .66
D&D				$0					
Scaled Actual Costs	1	LS	$512,635	$512,635					Costs escalated to FY14 and scaled down by a factor .66
TASK TOTALS				**$34,275,245**	**0**		**$0**	**$34,275,000**	
							SUBTOTAL CAPITAL COST	**$66,190,000**	
ANNUAL COSTS									
Five-Year Review									
Duration: Every 5 years.									
Prime Contractor Labor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study

Reported From: SWMU 7 Alternative 5WDF(ERH)
Report Total: $66,241,941

Author
Manager

LEVEL	QTY	UNIT COST	TOTAL

Estimate Tree Structure Rollups
SWMU 7 Alternative 5WDF(ERH) **$66,241,941**
Capital Costs **$66,191,804**
Remedial Desgin **$1,561,175**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	376,224	$1.00	$376,224

Memo: 4,224 HOURS

TOTAL RDWP/RDSI Work Plan **$376,224**

Estimate Tree Structure Rollups
SWMU 7 Alternative 5WDF(ERH) **$66,241,941**
Capital Costs **$66,191,804**
Remedial Desgin **$1,561,175**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	803,933	$1.00	$803,933

Memo: 8,744 HOURS

TOTAL RDR **$803,933**

Estimate Tree Structure Rollups
SWMU 7 Alternative 5WDF(ERH) **$66,241,941**
Capital Costs **$66,191,804**
Remedial Desgin **$1,561,175**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	22,818	$1.00	$22,818

Memo: 216 HOURS

TOTAL Civil Surveying **$22,818**

Estimate Tree Structure Rollups
SWMU 7 Alternative 5WDF(ERH) **$66,241,941**
Capital Costs **$66,191,804**
Remedial Desgin **$1,561,175**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	52,676	$1.00	$52,676

Memo: 634 HOURS

TOTAL Procurement **$52,676**

Estimate Tree Structure Rollups
SWMU 7 Alternative 5WDF(ERH) **$66,241,941**
Capital Costs **$66,191,804**
Remedial Desgin **$1,561,175**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	146,788	$1.00	$146,788

Memo: 1,688 HOURS

TOTAL Work Packages/Readiness Review **$146,788**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5WDF(ERH)			**$66,241,941**
	Capital Costs			**$66,191,804**
	Remedial Desgin			**$1,561,175**

Training

Tree Depth= 5

		QTY	UNIT COST	TOTAL
Memo:	Training for Subcontractors per Person per Hour	800	$70.00	$56,000

Assume 80 hours of training per person. Assume 10 people or 800 hours.

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736

Memo: 1,320 HOURS

TOTAL Training **$158,736**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5WDF(ERH)			**$66,241,941**
	Capital Costs			**$66,191,804**
	Other Project Plans			**$1,038,317**

RAWP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	517,587	$1.00	$517,587

Memo: 5,724 HOURS

TOTAL RAWP **$517,587**

	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5WDF(ERH)			**$66,241,941**
	Capital Costs			**$66,191,804**
	Other Project Plans			**$1,038,317**

O&M Plan

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863

Memo: 700 HOURS

TOTAL O&M Plan **$66,863**

	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5WDF(ERH)			**$66,241,941**
	Capital Costs			**$66,191,804**
	Other Project Plans			**$1,038,317**

SAP/QAPP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	96,201	$1.00	$96,201

Memo: 1,100 HOURS

TOTAL SAP/QAPP **$96,201**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Other Project Plans				**$1,038,317**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	94,190		$1.00	$94,190
Memo: 1,020 HOURS					

TOTAL Waste Management Plan **$94,190**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5WDF(ERH)		**$66,241,941**
Capital Costs		**$66,191,804**
Other Project Plans		**$1,038,317**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	212,751		$1.00	$212,751
Memo: 2,274 HOURS					

TOTAL RACR **$212,751**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5WDF(ERH)		**$66,241,941**
Capital Costs		**$66,191,804**
Other Project Plans		**$1,038,317**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5WDF(ERH)		**$66,241,941**
Capital Costs		**$66,191,804**
RDSI		**$475,275**

Drilling

Tree Depth= 5

	Mob/Demob for DPT subcontractor	1		$8,500.00	$8,500
	DPT Borings to 65 feet	12		$2,573.00	$30,876
	1/2 TON 4WD TRUCKS, LARGE VANS	800	hrs	$5.45	$4,360
Memo: 4 LATAKY vehicles.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	ST-90 CONTAINER DELIVERED	2		$1,770.63	$3,541
Memo: 2 ST-90 box for PPE/Trash.					
	PORTABLE TOILET & HAND WASH PER MONTH	2		$227.21	$454
Memo: Rent for 2 months.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,800	hrs	$2.70	$4,860
Memo: LATAKY personnel plus assume 5 drillers.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,800		$5.19	$9,342
	PPE 2 c/o per day 10 hr day cost per hr	1,800		$1.95	$3,510

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study

Reported From: SWMU 7 Alternative 5WDF(ERH)
Report Total: $66,241,941

Author
Manager

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	RDSI				**$475,275**

Drilling

Tree Depth= 5

	MSA OptiFilter HEPA per hour	1,800		$3.45	$6,210
LABOR Memo: 500 HOURS	PRIME CONTRACTOR LABOR	190,626		$1.00	$190,626

TOTAL Drilling **$262,618**

Memo: 12 DPT locations. 12 day duration plus one week for mod and one week for demob. 5 week total duration.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	RDSI				**$475,275**

Sampling

Tree Depth= 5

	5 gram EN CORE SAMPLER	300		$6.94	$2,082
	Niton XRF Rental One Month	1		$4,500.00	$4,500
	PCB Test Kits	1		$541.00	$541
	LAUNDRY 2 CHANGES COST PER HOUR	600	hrs	$2.70	$1,620
	PPE 2 c/o per day 10 hr day cost per hr	600		$1.95	$1,170
LABOR Memo: 600 HOURS	PRIME CONTRACTOR LABOR	43,825		$1.00	$43,825

TOTAL Sampling **$53,738**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	RDSI				**$475,275**

Analytical

Tree Depth= 5

	Overnight Shipment per Cooler	51		$251.97	$12,850
Memo: Assume 2 shipments per day for 25 days plus 1 shipment later for the waste water.					
	RDSI Geophysical Sampling Analytical	1		$1,275.00	$1,275
Memo: 3 Geophysical samples taken for particle size and atterberg limits.					
	RDSI Soil Sampling Analytical	0.40		$262,775.00	$105,110
Memo: MANAL114 is for 240 samples. 8 samples per hole x 12 holes = 96 samples. 96/240 = .4.					
	VOCs in Water	24		$88.00	$2,112
Memo: 2 per hole.					
LABOR Memo: 200 HOURS	PRIME CONTRACTOR LABOR	18,393		$1.00	$18,393

TOTAL Analytical **$139,740**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	RDSI				**$475,275**

Excavation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	CATERPILLAR 345B CRAWLER MOUNTED SHEAR HEAD EXCAVATOR	40	hr	$62.12	$2,485
	JOHN DEERE 624E 4WD ARTICULATED WHEEL LOADER	40	hr	$18.23	$729
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
LABOR	PRIME CONTRACTOR LABOR	15,220		$1.00	$15,220
Memo: 200 HOURS					

TOTAL Excavation **$19,178**

Memo: 2 excavations. Performed methodically to verify lack of metal debris.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Excavation				**$3,710,050**

Pit & Slopeback U Landfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	88		$1,470.00	$129,360
	RSMeans Crew B-12C cost per day	88		$2,354.00	$207,152
	Mob/Demob of Subcontractor and Equipment	1	LS	$50,000.00	$50,000
	LAUNDRY 2 CHANGES COST PER HOUR	3,520	hrs	$2.70	$9,504
	1/2 TON 4WD TRUCKS, LARGE VANS	1,760	hrs	$5.45	$9,592
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	3,520		$1.95	$6,864
LABOR	PRIME CONTRACTOR LABOR	613,550		$1.00	$613,550
Memo: 7,128 HOURS					

TOTAL Pit & Slopeback U Landfill **$1,026,022**

Memo: 18,869 BCY. Assume 225 CY per day so 84 days + weather/delays. Assume 88 day duration.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Excavation				**$3,710,050**

Pit & Slopeback Offsite

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	165		$1,470.00	$242,550
	RSMeans Crew B-12C cost per day	165		$2,354.00	$388,410
	LAUNDRY 2 CHANGES COST PER HOUR	6,600	hrs	$2.70	$17,820
	1/2 TON 4WD TRUCKS, LARGE VANS	3,300	hrs	$5.45	$17,985
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	6,600		$1.95	$12,870

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Excavation				**$3,710,050**

Pit & Slopeback Offsite

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	1,150,406		$1.00	$1,150,406
Memo: 13,365 HOURS					

TOTAL Pit & Slopeback Offsite **$1,830,041**
Memo: 35,450 BCY. Excavating and moving a 225 CY per day, so 158 days plus weather/delays is 165 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Excavation				**$3,710,050**

Pit & Slopeback Treated Offsite

Tree Depth= 5

	RSMeans Crew B-10W cost per day	32		$1,470.00	$47,040
	RSMeans Crew B-12C cost per day	32		$2,354.00	$75,328
	LAUNDRY 2 CHANGES COST PER HOUR	1,280	hrs	$2.70	$3,456
	1/2 TON 4WD TRUCKS, LARGE VANS	640	hrs	$5.45	$3,488
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,280		$5.19	$6,643
	PPE 2 c/o per day 10 hr day cost per hr	1,280		$1.95	$2,496
	MSA OptiFilter HEPA per hour	1,280		$3.45	$4,416
LABOR	PRIME CONTRACTOR LABOR	223,109		$1.00	$223,109
Memo: 2,592 HOURS					

TOTAL Pit & Slopeback Treated Offsite **$365,976**
Memo: 2,858 BCY. Excavating and moving a 100 CY per day, so 29 days plus weather/delays is 32 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Excavation				**$3,710,050**

Surface Soils U Landfill

Tree Depth= 5

	RSMeans Crew B-10W cost per day	33		$1,470.00	$48,510
	RSMeans Crew B-12C cost per day	33		$2,354.00	$77,682
	LAUNDRY 2 CHANGES COST PER HOUR	1,320	hrs	$2.70	$3,564
	1/2 TON 4WD TRUCKS, LARGE VANS	660	hrs	$5.45	$3,597
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	1,320		$1.95	$2,574

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Excavation				**$3,710,050**

Surface Soils U Landfill

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	230,081		$1.00	$230,081
Memo: 2,673 HOURS					

TOTAL Surface Soils U Landfill **$366,008**

Memo: 6,739 BCY. Excavating and moving a 225 CY per day, so 30 days plus weather/delays is 33 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Excavation				**$3,710,050**

Surface Soils Offsite

Tree Depth= 5

	RSMeans Crew B-10W cost per day	11		$1,470.00	$16,170
	RSMeans Crew B-12C cost per day	11		$2,354.00	$25,894
	LAUNDRY 2 CHANGES COST PER HOUR	440	hrs	$2.70	$1,188
	1/2 TON 4WD TRUCKS, LARGE VANS	220	hrs	$5.45	$1,199
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	440		$1.95	$858
LABOR	PRIME CONTRACTOR LABOR	76,694		$1.00	$76,694
Memo: 891 HOURS					

TOTAL Surface Soils Offsite **$122,003**

Memo: 2,264 BCY. Excavating and moving a 225 CY per day, so 10 days plus weather/delays is 11 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Treat and Dispose of Water				**$875,964**

Water Treatment

Tree Depth= 5

	B10H R.S.Means Crew	329	Day	$581.53	$191,325
	Water Treatment System w/ Tanks per month	15		$12,825.00	$192,375
Memo: Packaged system with 5 frac tanks.					
	LAUNDRY 2 CHANGES COST PER HOUR	3,948	hrs	$2.70	$10,660
	1/2 TON 4WD TRUCKS, LARGE VANS	1,316	hrs	$5.45	$7,172
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	3,948		$1.95	$7,699
LABOR	PRIME CONTRACTOR LABOR	280,980		$1.00	$280,980
Memo: 3,948 HOURS					
Subtotal					$690,210
1st Layer Markups assigned to Detail Items					$110,654

TOTAL Water Treatment **$800,864**

Memo: 15 months

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Treat and Dispose of Water				**$875,964**

Water Disposal

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Water Truck 10k Gallon cost per hr	40	hr	$208.34	$8,334
	Overnight Shipment per Cooler	8		$251.97	$2,016
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Water Cost per Sample	75		$833.00	$62,475
Memo: Assume Frac tanks will be emptied every 2 months. 7.5 * 5 tanks * 20,000 gallons = 750,000 gallons. Assume a water sample will be taken from each water truck (10,000 gallons). 750,000 gallons / 10,000 = 75 samples.					
LABOR	PRIME CONTRACTOR LABOR	2,275		$1.00	$2,275
Memo: 40 HOURS					

TOTAL Water Disposal **$75,099**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Post Remediation Sampling				**$351,373**

Sampling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	5 gram EN CORE SAMPLER	500		$6.94	$3,470
	Niton XRF Rental One Month	1		$4,500.00	$4,500
	PCB Test Kits	1		$541.00	$541
	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780
LABOR	PRIME CONTRACTOR LABOR	29,217		$1.00	$29,217
Memo: 400 HOURS					

TOTAL Sampling **$39,588**

Memo: 109 Floor Samples.
108 Sidewall Samples.
57 Surface Soils.
Total of 274 samples.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Post Remediation Sampling				**$351,373**

Analytical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Overnight Shipment per Cooler	8		$251.97	$2,016
	RDSI Soil Sampling Analytical	1.14		$262,775.00	$299,564
Memo: MANAL114 is for 240 samples. 274/240 = 1.14.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Post Remediation Sampling				**$351,373**

Analytical

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	10,206		$1.00	$10,206
Memo: 112 HOURS					

TOTAL Analytical **$311,785**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Waste Handling/Treatment/Disposal/Transportation				**$20,949,977**

Pit & Slopeback U Landfill

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	10,100	hrs	$2.70	$27,270
	1/2 TON 4WD TRUCKS, LARGE VANS	2,020	hrs	$5.45	$11,009
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	5,050	hr	$91.06	$459,853
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	504		$43.00	$21,672
	Overnight Shipment per Cooler	31		$251.97	$7,811
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	302		$1,148.00	$346,696
Memo: 22,643 LCY / 15 CY = 1,510. Assume 20% sampling rate. 1,510 / 5 = 302 samples.					
LABOR	PRIME CONTRACTOR LABOR	793,914		$1.00	$793,914
Memo: 12,035 HOURS					

TOTAL Pit & Slopeback U Landfill **$1,668,225**

Memo: U Landfill WAC Compliant. 18,869 BCY x 1.2 = 22,643 LCY.
Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 101 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Waste Handling/Treatment/Disposal/Transportation				**$20,949,977**

Pit & Slopeback OSWDF

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	22,500	hrs	$2.70	$60,750
	1/2 TON 4WD TRUCKS, LARGE VANS	4,500	hrs	$5.45	$24,525
Memo: 3 LATAKY vehicles.					
	Skid Steer per hour	1,500	hr	$32.54	$48,810
	30' IC Scissor Lift Rent per hour	1,500	hr	$14.88	$22,320
	Roll Off Bin monthly rental	70		$60.00	$4,200
Memo: 10 bins for 7 months.					
	Roll Off Bin Truck per hour	7,500	hr	$97.93	$734,475
Memo: 5 trucks for 30 days.					
	Roll Off Bin Liner	2,127		$36.00	$76,572

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Waste Handling/Treatment/Disposal/Transportation				**$20,949,977**

Pit & Slopeback OSWDF

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Overnight Shipment per Cooler	43		$251.97	$10,835
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	426		$1,148.00	$489,048
Memo: Assume 20% sampling rate. 2,127 / 5 = 426 samples.					
LABOR	PRIME CONTRACTOR LABOR	1,799,291		$1.00	$1,799,291
Memo: 26,802 HOURS					

TOTAL Pit & Slopeback OSWDF **$3,270,826**

Memo: 35,450 BCY x 1.2 = 42,540 LCY. Load into roll off bins and transfer to the WDF by truck. Assume each roll off can hold 20 CY and we can load 15 trucks per day. 42,540 / 300 = 142 days plus weather/delays = 150 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Waste Handling/Treatment/Disposal/Transportation				**$20,949,977**

Pit & Slopeback Treated Offsite

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	3,380	hrs	$2.70	$9,126
	1/2 TON 4WD TRUCKS, LARGE VANS	520	hrs	$5.45	$2,834
Memo: 3 LATAKY vehicles.					
	Disposal ES MLLW by rail	6,859		$1,030.58	$7,068,748
Memo: Double the disposal volume for MLLW.					
	MLLW Treatment at ES ST90 per CY	3,430		$1,854.09	$6,359,529
	Transportation to ES by Gondola	43		$26,933.00	$1,158,119
Memo: Assume 9 bags per car. 381 / 9 = 43 gons.					
	Lift Liner Bags 9 CY	381		$300.00	$114,300
	Loading or Lifting Frames per month	17		$500.00	$8,500
Memo: Rent for 1 month. 11 loading frames and 6 lifting frames. 17 x 1 months = 17.					
	Skid Steer per hour	260	hr	$32.54	$8,460
	18,000 lb Fork Lift per hour	520	hr	$32.66	$16,983
	Flat Bed Truck per hour	260	hr	$45.74	$11,892
	30' IC Scissor Lift Rent per hour	260	hr	$14.88	$3,869
	65 Ton Link-Belt Crane GFE cost per hr	260	hr	$25.99	$6,757
	PPE 2 c/o per day 10 hr day cost per hr	3,380		$1.95	$6,591
	Overnight Shipment per Cooler	8		$251.97	$2,016
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	77		$1,148.00	$88,396
Memo: Assume 20% sampling rate. 381 / 5 = 77 samples.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Waste Handling/Treatment/Disposal/Transportation				**$20,949,977**

Pit & Slopeback Treated Offsite

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	321,643		$1.00	$321,643
Memo: 4,500 HOURS					

TOTAL Pit & Slopeback Treated Offsite **$15,187,764**

Memo: 2,858 BCY x 1.2 = 3,430 LCY. Load into soft sided bags and ship to ES by rail for treatment and disposal. Assume can load 16 bags per day. 3,430 / 9 = 381 bags. 381 / 16 = 24 days + weather/delays = 26 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Waste Handling/Treatment/Disposal/Transportation				**$20,949,977**

Surface Soils U Landfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	1,480	hrs	$2.70	$3,996
	1/2 TON 4WD TRUCKS, LARGE VANS	740	hrs	$5.45	$4,033
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	1,850	hr	$91.06	$168,461
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	181		$43.00	$7,783
	Overnight Shipment per Cooler	11		$251.97	$2,772
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	109		$1,148.00	$125,132
8,147 LCY / 15 CY = 543. Assume 20% sampling rate. 543 / 5 = 109 samples.					
LABOR	PRIME CONTRACTOR LABOR	291,785		$1.00	$291,785
Memo: 4,423 HOURS					

TOTAL Surface Soils U Landfill **$603,962**

Memo: U Landfill WAC Compliant. 6,789 BCY x 1.2 = 8,147 LCY. Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 37 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Waste Handling/Treatment/Disposal/Transportation				**$20,949,977**

Surface Soils OSWDF

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	1,500	hrs	$2.70	$4,050
	1/2 TON 4WD TRUCKS, LARGE VANS	300	hrs	$5.45	$1,635
Memo: 3 LATAKY vehicles.					
	Skid Steer per hour	100	hr	$32.54	$3,254
	30' IC Scissor Lift Rent per hour	100	hr	$14.88	$1,488
	Roll Off Bin monthly rental	10		$60.00	$600
Memo: 10 bins for 1 months.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(ERH)				**$66,241,941**
	Capital Costs				**$66,191,804**
	Waste Handling/Treatment/Disposal/Transportation				**$20,949,977**

Surface Soils OSWDF

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	Roll Off Bin Truck per hour	500	hr	$97.93	$48,965
Memo: 5 trucks for 30 days.					
	Roll Off Bin Liner	136		$36.00	$4,896
	Overnight Shipment per Cooler	3		$251.97	$756
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	28		$1,148.00	$32,144
Memo: 2,716 LCY / 15 CY = 136. Assume 20% sampling rate. 136 / 5 = 28 samples.					
LABOR	PRIME CONTRACTOR LABOR	121,413		$1.00	$121,413
Memo: 1,808 HOURS					

TOTAL Surface Soils OSWDF **$219,201**

Memo: 2,264 BCY x 1.2 = 2,716 LCY. Load into roll off bins and transfer to the WDF by truck. Assume each roll off can hold 20 CY and we can load 15 trucks per day. 2,716 / 300 = 9 days plus weather/delays = 10 days.

	Estimate Tree Structure Rollups	
	SWMU 7 Alternative 5WDF(ERH)	**$66,241,941**
	Capital Costs	**$66,191,804**
	Excavation Backfill	**$2,954,428**

Backfill

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	B10D R.S.Means Crew	68,615	E.C.Y.	$2.67	$183,027
	B34C R.S.Means Crew	68,615	L.C.Y.	$7.98	$547,496
	Backfill Delivered per CY	68,615		$16.00	$1,097,840
	LAUNDRY 2 CHANGES COST PER HOUR	3,680	hrs	$2.70	$9,936
Memo: .					
	1/2 TON 4WD TRUCKS, LARGE VANS	1,840	hrs	$5.45	$10,028
Memo: 2 LATAKY vehicles.					
	Geotechnical Testing Technician per hour	920		$52.19	$48,015
	Geotechnical Testing Density Testing per hour	920		$50.00	$46,000
	RSMeans Crew B-10W cost per day	92		$1,470.00	$135,240
	RSMeans Crew B-10P cost per day	92		$2,129.00	$195,868
	PPE 2 c/o per day 10 hr day cost per hr	3,680		$1.95	$7,176
LABOR	PRIME CONTRACTOR LABOR	486,828		$1.00	$486,828
Memo: 5,519 HOURS					
Subtotal					$2,767,454
1st Layer Markups assigned to Detail Items					$186,975

TOTAL Backfill **$2,954,428**

Memo: 57,179 BCY total removed. 57,179 x 1.2 = 68,615 CY of fill needed. Assume 750 CY filled per day. 68,615 / 750 = 92 days. Fill is stockpiled during other activities and transfered to site as needed.

LEVEL	QTY	UNIT COST	TOTAL

Estimate Tree Structure Rollups

SWMU 7 Alternative 5WDF(ERH)	**$66,241,941**
Capital Costs	**$66,191,804**

In Situ Source Treatment (ERH)

Tree Depth= 4

	QTY	UNIT COST	TOTAL
	1	$0.01	$0

Memo: SWMU 7 treated area is 75' x 75' x 60' or 12,500 CY.
C-400 treated area was 19,000 CY.
12,500 / 19,000 = .66.
Assume a .66 scaling factor.

Subtotal	$0
Rollup from Child Levels	$34,275,245

TOTAL In Situ Source Treatment (ERH) **$34,275,245**

Estimate Tree Structure Rollups

SWMU 7 Alternative 5WDF(ERH)	**$66,241,941**
Capital Costs	**$66,191,804**
In Situ Source Treatment (ERH)	**$34,275,245**

Installation

Tree Depth= 5

	QTY	UNIT COST	TOTAL
ERH Costs from C-400	20,714,070	$1.00	$20,714,070

TOTAL Installation **$20,714,070**

Memo: FY14 Construction costs from C-400: $31,384,955.
$31,384,955 x .66 = $20,714,070.

Estimate Tree Structure Rollups

SWMU 7 Alternative 5WDF(ERH)	**$66,241,941**
Capital Costs	**$66,191,804**
In Situ Source Treatment (ERH)	**$34,275,245**

Operations

Tree Depth= 5

	QTY	UNIT COST	TOTAL
ERH Costs from C-400	13,048,540	$1.00	$13,048,540

TOTAL Operations **$13,048,540**

Memo: FY14 Operations costs from C-400: $19,770,515.
$19,770,515 x .66 = $13,048,540.

Estimate Tree Structure Rollups

SWMU 7 Alternative 5WDF(ERH)	**$66,241,941**
Capital Costs	**$66,191,804**
In Situ Source Treatment (ERH)	**$34,275,245**

D&D

Tree Depth= 5

	QTY	UNIT COST	TOTAL
ERH Costs from C-400	512,635	$1.00	$512,635

TOTAL D&D **$512,635**

Memo: FY14 D&D costs from C-400: $776,720.
$776,720 x .66 = $512,635.

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5WDF(ERH)			**$66,241,941**
	Annual Costs			**$50,137**
	Five Year Reviews			**$50,137**

Five Year Reviews

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,137	$1.00	$50,137
Memo: 500 HOURS				

TOTAL Five Year Reviews **$50,137**

COST ESTIMATE
BGOU SWMU 7
Alternative 5WDF(P&T)—Excavation and Disposal, Pump-and-Treat, LUCs and Monitoring

Cost Estimate Summary									
Capital Cost	**Quantity**	**Units**	**Unit Price**	**Total**					
1.0 Remedial Design	1	LS	$1,561,000	$1,561,000					
2.0 Other Project Plans	1	LS	$1,038,000	$1,038,000					
3.0 Remedial Design Site Investigation (RDSI)	1	LS	$475,000	$475,000					
4.0 Excavation	1	LS	$3,710,000	$3,710,000					
5.0 Treat and Dispose of Water	1	LS	$876,000	$876,000					
6.0 Post Remediation Sampling	1	LS	$351,000	$351,000					
7.0 Waste Handling, Treatment, Disposal, and Transportation	1	LS	$20,950,000	$20,950,000					
8.0 Excavation Backfill	1	LS	$2,954,000	$2,954,000					
9.0 In Situ Source Treatment (P&T)	1	LS	$2,515,000	$2,515,000					
Subproject Management	1	LS	$3,443,000	$3,443,000					Subproject Management = 10%
Management Reserve	1	LS	$5,680,950	$5,681,000					Contractor MR = 15%
Fee	1	LS	$3,048,780	$3,049,000					Fee = 7%
Contingency	1	LS	$9,320,600	$9,321,000					Contingency = 20%
		SUBTOTAL CAPITAL COST		**$55,924,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Pump & Treat O&M	50	EA	$218,000	$10,900,000			2.38E+07		Annually for 50 years
Five-Year Review	200	EA	$50,000	$10,000,000			3.81597E+17		Every 5 years for 1,000 years
		SUBTOTAL ANNUAL COST		**$20,900,000**			**3.81597E+17**		
			TOTAL	**$76,824,000**					
Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	ls	$55,924,000	$55,924,000				**$55,924,000**	
Pump & Treat O&M	50	EA	$218,000	$10,900,000				**$8,349,697**	
Five-Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$55,924,000**	
						Present Worth Values	**Annual**	**$9,239,000**	
							Avg. Annual	**$9,239**	
							Total	**$65,163,000**	
This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.									
Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.									

COST ESTIMATE
BGOU SWMU 7
Alternative 5WDF(P&T)—Excavation and Disposal, Pump-and-Treat, LUCs and Monitoring

CAPITAL COSTS									
	Material/Equipment/Subcontractors/ODCs				Labor				
Task Description	**Qty**	**Unit**	**Unit Price**	**Total**	**Hours**	**Rate**	**Total**	**Total Cost**	**Basis of Estimate**
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					4224		$376,224		
Remedial Design Report					8744		$803,933		
Civil Surveying					216		$22,818		
Procurement					634		$52,676		
Work Packages/Readiness					1688		$146,788		
Training	1	LS	$56,000	$56,000	1320		$102,736		$68,800 includes subcontractor training
TASK TOTAL				**$56,000**	**16826**		**$1,505,175**	**$1,561,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					5724		$517,587		
O&M Plan					700		$66,863		
SAP/QAPP					1100		$96,201		
Waste Management Plan					1020		$94,190		
RACR					2274		$212,751		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**11402**		**$1,038,317**	**$1,038,000**	
3.0 Remedial Design Site Investigation (RDSI)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Drilling									
Prime Contractor Labor					2340		$190,626		
Subcontractors	1	LS	$39,376	$39,376					Local quote from existing drilling sub.
Materials	1	LS	$28,256	$28,256					
Vehicles and Equipment	1	LS	$4,360	$4,360					
Sampling									
Prime Contractor Labor					600		$43,825		
Materials	1	LS	$9,913	$9,913					
Analytical									
Prime Contractor Labor					200		$18,393		
Materials	1	LS	$121,347	$121,347					
Excavation									
Prime Contractor Labor	0				200		$15,220		
Materials	1	LS	$744	$744					
Equipment	1	LS	$3,214	$3,214					
TASK TOTAL				**$ 207,210**	**3340**		**$ 268,064**	**$475,000**	

COST ESTIMATE
BGOU SWMU 7
Alternative 5WDF(P&T)—Excavation and Disposal, Pump-and-Treat, LUCs and Monitoring

4.0 Excavation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Pit & Slopeback - U Landfill									
Prime Contractor Labor					7128		$613,550		
Subcontractors	1	LS	$386,512	$386,512					
Materials	1	LS	$16,368	$16,368					
Vehicles and Equipment	1	LS	$9,592	$9,592					
Pit & Slopeback - Off-Site									
Prime Contractor Labor					13365		$1,150,406		
Subcontractors	1	LS	$630,960	$630,960					
Materials	1	LS	$30,690	$30,690					
Vehicles and Equipment	1	LS	$17,985	$17,985					
Pit & Slopeback - Treated Off-Site									
Prime Contractor Labor					2592		$223,109		
Subcontractors	1	LS	$124,864	$124,864					
Materials	1	LS	$14,515	$14,515					
Vehicles and Equipment	1	LS	$3,488	$3,488					
Surface Soils - U Landfill									
Prime Contractor Labor					2673		$230,081		
Subcontractors	1	LS	$126,192	$126,192					
Materials	1	LS	$6,138	$6,138					
Vehicles and Equipment	1	LS	$3,597	$3,597					
Surface Soils - Off-Site									
Prime Contractor Labor					891		$76,694		
Subcontractors	1	LS	$42,064	$42,064					
Materials	1	LS	$2,046	$2,046					
Vehicles and Equipment	1	LS	$1,199	$1,199					
TASK TOTALS				**$1,416,210**	**26,649**		**$2,293,840**	**$3,710,000**	
5.0 Treat and Dispose of Water									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Water Treatment									
Prime Contractor Labor					3948		$280,980		
Subcontractors	1	LS	$494,353	$494,353					Rainforrent.com and RSMeans
Materials	1	LS	$18,359	$18,359					
Vehicles and Equipment	1	LS	$7,172	$7,172					
Water Disposal									
Prime Contractor Labor					40		$2,275		
Characterization Sampling	1	LS	$64,491	$64,491					
Vehicles and Equipment	1	LS	$14,244	$8,334					
TASK TOTALS				**$592,709**	**3,988**		**$283,255**	**$876,000**	
6.0 Post Remediation Sampling									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Sampling									
Prime Contractor Labor					400		$29,217		
Materials	1	LS	$10,371	$10,371					
Analytical									
Prime Contractor Labor					112		$10,206		
Materials	1	LS	$301,579	$301,579					
TASK TOTAL				**$ 311,950**	**512**		**$39,423**	**$351,000**	

COST ESTIMATE
BGOU SWMU 7
Alternative 5WDF(P&T)—Excavation and Disposal, Pump-and-Treat, LUCs and Monitoring

7.0 Waste Handling, Treatment, Disposal, and Transportation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Pit & Slopeback - U Landfill									
Prime Contractor Labor					12035		$793,914		
Materials	1	LS	$48,942	$48,942					
Characterization Sampling	1	LS	$354,507	$354,507					
Vehicles and Equipment	1	LS	$470,862	$470,862					
Pit & Slopeback - OSWDF									
Prime Contractor Labor					26802		$1,799,291		
Materials	1	LS	$141,522	$141,522					
Characterization Sampling	1	LS	$499,883	$499,883					
Vehicles and Equipment	1	LS	$830,130	$830,130					
Transportation	1	LS	$0	$0					Costs contained in LATA Kentucky equipment and labor
Pit & Slopeback - Treated Off-Site									
Prime Contractor Labor					4500		$321,643		
Materials	1	LS	$138,517	$138,517					
Characterization Sampling	1	LS	$90,412	$90,412					
Vehicles and Equipment	1	LS	$50,796	$50,796					
Treatment	1	LS	$6,359,529	$6,359,529					
Disposal	1	LS	$7,068,748	$7,068,748					
Transportation	1	LS	$1,158,119	$1,158,119					
Surface Soils - U Landfill									
Prime Contractor Labor					4423		$291,785		
Materials	1	LS	$11,779	$11,779					
Characterization Sampling	1	LS	$127,904	$127,904					
Vehicles and Equipment	1	LS	$172,494	$172,494					
Surface Soils - OSWDF									
Prime Contractor Labor					1808		$121,413		
Materials	1	LS	$9,546	$9,546					
Characterization Sampling	1	LS	$32,900	$32,900					
Vehicles and Equipment	1	LS	$55,342	$55,342					
Transportation	1	LS	$0	$0					Costs contained in LATAKY equipment and labor
TASK TOTALS				**$17,621,932**	**49,568**		**$3,328,046**	**$20,950,000**	
8.0 Excavation Backfill									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Backfill									
Prime Contractor Labor					5519		$486,828		
Subcontractors	1	LS	$2,440,459	$2,440,459					RSMeans and local Engineering firm
Materials	1	LS	$17,112	$17,112					
Vehicles and Equipment	1	LS	$10,028	$10,028					
TASK TOTAL				**$2,467,599**	**5519**		**$486,828**	**$2,954,000**	
9.0 In Situ Source Treatment (P&T)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Extraction Well									
Prime Contractor Labor					480		$38,170		
Subcontractors	1	LS	$168,497	$168,497					Local quote from existing drilling sub.
Materials	1	LS	$1,455	$1,455					
Vehicles and Equipment	1	LS	$872	$872					

COST ESTIMATE
BGOU SWMU 7
Alternative 5WDF(P&T)—Excavation and Disposal, Pump-and-Treat, LUCs and Monitoring

Treatment System									
Prime Contractor Labor					9216		$706,716		
Subcontractors	1	LS	$1,560,193	$1,560,193					RSMeans and historical costs from the groundwater OU.
Materials	1	LS	$33,480	$33,480					
Vehicles and Equipment	1	LS	$5,232	$5,232					
TASK TOTALS				**$1,769,729**	**9,696**		**$744,886**	**$2,515,000**	
							SUBTOTAL CAPITAL COST	**$34,430,000**	
ANNUAL COSTS									
Pump & Treat O&M									
Duration: Annually for 50 years.									
Prime Contractor Labor					2480		$191,694		
Materials	1	LS	$24,992	$24,992					
Vehicles and Equipment	1	LS	$1,744	$1,744					
TASK TOTAL				**$26,736**			**$191,694**	**$218,000**	ANNUAL COST
Five-Year Review									
Duration: Every 5 years.									
Prime Contractor Labor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5WDF(P&T)			**$34,699,742**
	Capital Costs			**$34,431,174**
	Remedial Desgin			**$1,561,175**

RDWP/RDSI Work Plan

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	376,224	$1.00	$376,224
Memo: 4,224 HOURS				

TOTAL RDWP/RDSI Work Plan **$376,224**

Estimate Tree Structure Rollups			
SWMU 7 Alternative 5WDF(P&T)			**$34,699,742**
Capital Costs			**$34,431,174**
Remedial Desgin			**$1,561,175**

RDR

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	803,933	$1.00	$803,933
Memo: 8,744 HOURS				

TOTAL RDR **$803,933**

Estimate Tree Structure Rollups			
SWMU 7 Alternative 5WDF(P&T)			**$34,699,742**
Capital Costs			**$34,431,174**
Remedial Desgin			**$1,561,175**

Civil Surveying

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	22,818	$1.00	$22,818
Memo: 216 HOURS				

TOTAL Civil Surveying **$22,818**

Estimate Tree Structure Rollups			
SWMU 7 Alternative 5WDF(P&T)			**$34,699,742**
Capital Costs			**$34,431,174**
Remedial Desgin			**$1,561,175**

Procurement

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	52,676	$1.00	$52,676
Memo: 634 HOURS				

TOTAL Procurement **$52,676**

Estimate Tree Structure Rollups			
SWMU 7 Alternative 5WDF(P&T)			**$34,699,742**
Capital Costs			**$34,431,174**
Remedial Desgin			**$1,561,175**

Work Packages/Readiness Review

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	146,788	$1.00	$146,788
Memo: 1,688 HOURS				

TOTAL Work Packages/Readiness Review **$146,788**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5WDF(P&T)			**$34,699,742**
	Capital Costs			**$34,431,174**
	Remedial Desgin			**$1,561,175**

Training

Tree Depth= 5

		QTY	UNIT COST	TOTAL
Memo:	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
	Assume 80 hours of training per person. Assume 10 people or 800 hours.			
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training **$158,736**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5WDF(P&T)			**$34,699,742**
	Capital Costs			**$34,431,174**
	Other Project Plans			**$1,038,317**

RAWP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	517,587	$1.00	$517,587
Memo: 5,724 HOURS				

TOTAL RAWP **$517,587**

	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5WDF(P&T)			**$34,699,742**
	Capital Costs			**$34,431,174**
	Other Project Plans			**$1,038,317**

O&M Plan

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan **$66,863**

	Estimate Tree Structure Rollups			
	SWMU 7 Alternative 5WDF(P&T)			**$34,699,742**
	Capital Costs			**$34,431,174**
	Other Project Plans			**$1,038,317**

SAP/QAPP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	96,201	$1.00	$96,201
Memo: 1,100 HOURS				

TOTAL SAP/QAPP **$96,201**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	Other Project Plans				**$1,038,317**

Waste Management Plan

Tree Depth= 5

		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	94,190		$1.00	$94,190
Memo: 1,020 HOURS					
TOTAL Waste Management Plan					**$94,190**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	Other Project Plans				**$1,038,317**

RACR

Tree Depth= 5

		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	212,751		$1.00	$212,751
Memo: 2,274 HOURS					
TOTAL RACR					**$212,751**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	Other Project Plans				**$1,038,317**

LUCIP

Tree Depth= 5

		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					
TOTAL LUCIP					**$50,725**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	RDSI				**$475,275**

Drilling

Tree Depth= 5

		QTY		UNIT COST	TOTAL
	Mob/Demob for DPT subcontractor	1		$8,500.00	$8,500
	DPT Borings to 65 feet	12		$2,573.00	$30,876
	1/2 TON 4WD TRUCKS, LARGE VANS	800	hrs	$5.45	$4,360
Memo: 4 LATAKY vehicles.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	ST-90 CONTAINER DELIVERED	2		$1,770.63	$3,541
Memo: 2 ST-90 box for PPE/Trash.					
	PORTABLE TOILET & HAND WASH PER MONTH	2		$227.21	$454
Memo: Rent for 2 months.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,800	hrs	$2.70	$4,860
Memo: LATAKY personnel plus assume 5 drillers.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,800		$5.19	$9,342
	PPE 2 c/o per day 10 hr day cost per hr	1,800		$1.95	$3,510

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	RDSI				**$475,275**

Drilling

Tree Depth= 5

	MSA OptiFilter HEPA per hour	1,800		$3.45	$6,210
LABOR	PRIME CONTRACTOR LABOR	190,626		$1.00	$190,626
Memo: 2,340 HOURS					

TOTAL Drilling **$262,618**

Memo: 12 DPT locations. 12 day duration plus one week for mod and one week for demob. 5 week total duration.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	RDSI				**$475,275**

Sampling

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	43,825		$1.00	$43,825
Memo: 600 HOURS					
	5 gram EN CORE SAMPLER	300		$6.94	$2,082
	Niton XRF Rental One Month	1		$4,500.00	$4,500
	PCB Test Kits	1		$541.00	$541
	LAUNDRY 2 CHANGES COST PER HOUR	600	hrs	$2.70	$1,620
	PPE 2 c/o per day 10 hr day cost per hr	600		$1.95	$1,170

TOTAL Sampling **$53,738**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	RDSI				**$475,275**

Analytical

Tree Depth= 5

	Overnight Shipment per Cooler	51		$251.97	$12,850
Memo: Assume 2 shipments per day for 25 days plus 1 shipment later for the waste water.					
	RDSI Geophysical Sampling Analytical	1		$1,275.00	$1,275
Memo: 3 Geophysical samples taken for particle size and atterberg limits.					
	RDSI Soil Sampling Analytical	0.40		$262,775.00	$105,110
Memo: MANAL114 is for 240 samples. 8 samples per hole x 12 holes = 96 samples. 96/240 = .4.					
	VOCs in Water	24		$88.00	$2,112
Memo: 2 per hole.					
LABOR	PRIME CONTRACTOR LABOR	18,393		$1.00	$18,393
Memo: 200 HOURS					

TOTAL Analytical **$139,740**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	RDSI				**$475,275**

Excavation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	CATERPILLAR 345B CRAWLER MOUNTED SHEAR HEAD EXCAVATOR	40	hr	$62.12	$2,485
	JOHN DEERE 624E 4WD ARTICULATED WHEEL LOADER	40	hr	$18.23	$729
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
LABOR	PRIME CONTRACTOR LABOR	15,220		$1.00	$15,220
Memo: 200 HOURS					

TOTAL Excavation **$19,178**

Memo: 2 excavations. Performed methodically to verify lack of metal debris.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5WDF(P&T)		**$34,699,742**
Capital Costs		**$34,431,174**
Excavation		**$3,710,050**

Pit & Slopeback U Landfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	88		$1,470.00	$129,360
	RSMeans Crew B-12C cost per day	88		$2,354.00	$207,152
	Mob/Demob of Subcontractor and Equipment	1	LS	$50,000.00	$50,000
	LAUNDRY 2 CHANGES COST PER HOUR	3,520	hrs	$2.70	$9,504
	1/2 TON 4WD TRUCKS, LARGE VANS	1,760	hrs	$5.45	$9,592
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	3,520		$1.95	$6,864
LABOR	PRIME CONTRACTOR LABOR	613,550		$1.00	$613,550
Memo: 7,128 HOURS					

TOTAL Pit & Slopeback U Landfill **$1,026,022**

Memo: 18,869 BCY. Assume 225 CY per day so 84 days + weather/delays. Assume 88 day duration.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5WDF(P&T)		**$34,699,742**
Capital Costs		**$34,431,174**
Excavation		**$3,710,050**

Pit & Slopeback Offsite

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	165		$1,470.00	$242,550
	RSMeans Crew B-12C cost per day	165		$2,354.00	$388,410
	LAUNDRY 2 CHANGES COST PER HOUR	6,600	hrs	$2.70	$17,820
	1/2 TON 4WD TRUCKS, LARGE VANS	3,300	hrs	$5.45	$17,985
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	6,600		$1.95	$12,870

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	Excavation				**$3,710,050**

Pit & Slopeback Offsite

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	1,150,406		$1.00	$1,150,406
Memo: 13,365 HOURS					

TOTAL Pit & Slopeback Offsite **$1,830,041**
Memo: 35,450 BCY. Excavating and moving a 225 CY per day, so 158 days plus weather/delays is 165 days.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5WDF(P&T)		**$34,699,742**
Capital Costs		**$34,431,174**
Excavation		**$3,710,050**

Pit & Slopeback Treated Offsite

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	32		$1,470.00	$47,040
	RSMeans Crew B-12C cost per day	32		$2,354.00	$75,328
	LAUNDRY 2 CHANGES COST PER HOUR	1,280	hrs	$2.70	$3,456
	1/2 TON 4WD TRUCKS, LARGE VANS	640	hrs	$5.45	$3,488
Memo: 2 LATAKY vehicles.					
	Resp cleaning 10 hr day 2 C/O per day cost per hr	1,280		$5.19	$6,643
	PPE 2 c/o per day 10 hr day cost per hr	1,280		$1.95	$2,496
	MSA OptiFilter HEPA per hour	1,280		$3.45	$4,416
LABOR	PRIME CONTRACTOR LABOR	223,109		$1.00	$223,109
Memo: 2,592 HOURS					

TOTAL Pit & Slopeback Treated Offsite **$365,976**
Memo: 2,858 BCY. Excavating and moving a 100 CY per day, so 29 days plus weather/delays is 32 days.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5WDF(P&T)		**$34,699,742**
Capital Costs		**$34,431,174**
Excavation		**$3,710,050**

Surface Soils U Landfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	33		$1,470.00	$48,510
	RSMeans Crew B-12C cost per day	33		$2,354.00	$77,682
	LAUNDRY 2 CHANGES COST PER HOUR	1,320	hrs	$2.70	$3,564
	1/2 TON 4WD TRUCKS, LARGE VANS	660	hrs	$5.45	$3,597
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	1,320		$1.95	$2,574

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	Excavation				**$3,710,050**

Surface Soils U Landfill

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	230,081		$1.00	$230,081
Memo: 2,673 HOURS					

TOTAL Surface Soils U Landfill **$366,008**

Memo: 6,739 BCY. Excavating and moving a 225 CY per day, so 30 days plus weather/delays is 33 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	Excavation				**$3,710,050**

Surface Soils Offsite

Tree Depth= 5

	RSMeans Crew B-10W cost per day	11		$1,470.00	$16,170
	RSMeans Crew B-12C cost per day	11		$2,354.00	$25,894
	LAUNDRY 2 CHANGES COST PER HOUR	440	hrs	$2.70	$1,188
	1/2 TON 4WD TRUCKS, LARGE VANS	220	hrs	$5.45	$1,199
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	440		$1.95	$858
LABOR	PRIME CONTRACTOR LABOR	76,694		$1.00	$76,694
Memo: 891 HOURS					

TOTAL Surface Soils Offsite **$122,003**

Memo: 2,264 BCY. Excavating and moving a 225 CY per day, so 10 days plus weather/delays is 11 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	Treat and Dispose of Water				**$875,964**

Water Treatment

Tree Depth= 5

	B10H R.S.Means Crew	329	Day	$581.53	$191,325
	Water Treatment System w/ Tanks per month	15		$12,825.00	$192,375
Memo: Packaged system with 5 frac tanks.					
	LAUNDRY 2 CHANGES COST PER HOUR	3,948	hrs	$2.70	$10,660
	1/2 TON 4WD TRUCKS, LARGE VANS	1,316	hrs	$5.45	$7,172
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	3,948		$1.95	$7,699
LABOR	PRIME CONTRACTOR LABOR	280,980		$1.00	$280,980
Memo: 3,948 HOURS					
Subtotal					$690,210
1st Layer Markups assigned to Detail Items					$110,654

TOTAL Water Treatment **$800,864**

Memo: 15 months

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	Treat and Dispose of Water				**$875,964**

Water Disposal

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	Water Truck 10k Gallon cost per hr	40	hr	$208.34	$8,334
	Overnight Shipment per Cooler	8		$251.97	$2,016
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Water Cost per Sample	75		$833.00	$62,475
Memo: Assume Frac tanks will be emptied every 2 months. 7.5 * 5 tanks * 20,000 gallons = 750,000 gallons. Assume a water sample will be taken from each water truck (10,000 gallons). 750,000 gallons / 10,000 = 75 samples.					
LABOR	PRIME CONTRACTOR LABOR	2,275		$1.00	$2,275
Memo: 40 HOURS					

TOTAL Water Disposal **$75,099**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	Post Remediation Sampling				**$351,373**

Sampling

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	5 gram EN CORE SAMPLER	500		$6.94	$3,470
	Niton XRF Rental One Month	1		$4,500.00	$4,500
	PCB Test Kits	1		$541.00	$541
	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780
LABOR	PRIME CONTRACTOR LABOR	29,217		$1.00	$29,217
Memo: 400 HOURS					

TOTAL Sampling **$39,588**

Memo: 109 Floor Samples.
108 Sidewall Samples.
57 Surface Soils.
Total of 274 samples.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	Post Remediation Sampling				**$351,373**

Analytical

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	Overnight Shipment per Cooler	8		$251.97	$2,016
	RDSI Soil Sampling Analytical	1.14		$262,775.00	$299,564
Memo: MANAL114 is for 240 samples. 274/240 = 1.14.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	Post Remediation Sampling				**$351,373**

Analytical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	10,206		$1.00	$10,206
Memo: 112 HOURS					

TOTAL Analytical **$311,785**

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	Waste Handling/Treatment/Disposal/Transportation				**$20,949,977**

Pit & Slopeback U Landfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	10,100	hrs	$2.70	$27,270
	1/2 TON 4WD TRUCKS, LARGE VANS	2,020	hrs	$5.45	$11,009
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	5,050	hr	$91.06	$459,853
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	504		$43.00	$21,672
	Overnight Shipment per Cooler	31		$251.97	$7,811
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	302		$1,148.00	$346,696
Memo: 22,643 LCY / 15 CY = 1,510. Assume 20% sampling rate. 1,510 / 5 = 302 samples.					
LABOR	PRIME CONTRACTOR LABOR	793,914		$1.00	$793,914
Memo: 12,035 HOURS					

TOTAL Pit & Slopeback U Landfill **$1,668,225**

Memo: U Landfill WAC Compliant. 18,869 BCY x 1.2 = 22,643 LCY.
Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 101 days.

	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	Waste Handling/Treatment/Disposal/Transportation				**$20,949,977**

Pit & Slopeback OSWDF

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	22,500	hrs	$2.70	$60,750
	1/2 TON 4WD TRUCKS, LARGE VANS	4,500	hrs	$5.45	$24,525
Memo: 3 LATAKY vehicles.					
	Skid Steer per hour	1,500	hr	$32.54	$48,810
	30' IC Scissor Lift Rent per hour	1,500	hr	$14.88	$22,320
	Roll Off Bin monthly rental	70		$60.00	$4,200
Memo: 10 bins for 7 months.					
	Roll Off Bin Truck per hour	7,500	hr	$97.93	$734,475
Memo: 5 trucks for 30 days.					
	Roll Off Bin Liner	2,127		$36.00	$76,572

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	Waste Handling/Treatment/Disposal/Transportation				**$20,949,977**

Pit & Slopeback OSWDF

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Overnight Shipment per Cooler	43		$251.97	$10,835
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	426		$1,148.00	$489,048
Assume 20% sampling rate. 2,127 / 5 = 426 samples.					
LABOR	PRIME CONTRACTOR LABOR	1,799,291		$1.00	$1,799,291
Memo: 26,802 HOURS					

TOTAL Pit & Slopeback OSWDF **$3,270,826**

Memo: 35,450 BCY x 1.2 = 42,540 LCY. Load into roll off bins and transfer to the WDF by truck. Assume each roll off can hold 20 CY and we can load 15 trucks per day. 42,540 / 300 = 142 days plus weather/delays = 150 days.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5WDF(P&T)		**$34,699,742**
Capital Costs		**$34,431,174**
Waste Handling/Treatment/Disposal/Transportation		**$20,949,977**

Pit & Slopeback Treated Offsite

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	3,380	hrs	$2.70	$9,126
	1/2 TON 4WD TRUCKS, LARGE VANS	520	hrs	$5.45	$2,834
Memo: 3 LATAKY vehicles.					
	Disposal ES MLLW by rail	6,859		$1,030.58	$7,068,748
Memo: Double the disposal volume for MLLW.					
	MLLW Treatment at ES ST90 per CY	3,430		$1,854.09	$6,359,529
	Transportation to ES by Gondola	43		$26,933.00	$1,158,119
Memo: Assume 9 bags per car. 381 / 9 = 43 gons.					
	Lift Liner Bags 9 CY	381		$300.00	$114,300
	Loading or Lifting Frames per month	17		$500.00	$8,500
Memo: Rent for 1 month. 11 loading frames and 6 lifting frames. 17 x 1 months = 17.					
	Skid Steer per hour	260	hr	$32.54	$8,460
	18,000 lb Fork Lift per hour	520	hr	$32.66	$16,983
	Flat Bed Truck per hour	260	hr	$45.74	$11,892
	30' IC Scissor Lift Rent per hour	260	hr	$14.88	$3,869
	65 Ton Link-Belt Crane GFE cost per hr	260	hr	$25.99	$6,757
	PPE 2 c/o per day 10 hr day cost per hr	3,380		$1.95	$6,591
	Overnight Shipment per Cooler	8		$251.97	$2,016
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	77		$1,148.00	$88,396
Assume 20% sampling rate. 381 / 5 = 77 samples.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	Waste Handling/Treatment/Disposal/Transportation				**$20,949,977**

Pit & Slopeback Treated Offsite

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	321,643		$1.00	$321,643
Memo: 4,500 HOURS					

TOTAL Pit & Slopeback Treated Offsite **$15,187,764**

Memo: 2,858 BCY x 1.2 = 3,430 LCY. Load into soft sided bags and ship to ES by rail for treatment and disposal. Assume can load 16 bags per day. 3,430 / 9 = 381 bags. 381 / 16 = 24 days + weather/delays = 26 days.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5WDF(P&T)		**$34,699,742**
Capital Costs		**$34,431,174**
Waste Handling/Treatment/Disposal/Transportation		**$20,949,977**

Surface Soils U Landfill

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	1,480	hrs	$2.70	$3,996
	1/2 TON 4WD TRUCKS, LARGE VANS	740	hrs	$5.45	$4,033
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	1,850	hr	$91.06	$168,461
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	181		$43.00	$7,783
	Overnight Shipment per Cooler	11		$251.97	$2,772
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	109		$1,148.00	$125,132
Memo: 8,147 LCY / 15 CY = 543. Assume 20% sampling rate. 543 / 5 = 109 samples.					
LABOR	PRIME CONTRACTOR LABOR	291,785		$1.00	$291,785
Memo: 4,423 HOURS					

TOTAL Surface Soils U Landfill **$603,962**

Memo: U Landfill WAC Compliant. 6,789 BCY x 1.2 = 8,147 LCY. Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 37 days.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5WDF(P&T)		**$34,699,742**
Capital Costs		**$34,431,174**
Waste Handling/Treatment/Disposal/Transportation		**$20,949,977**

Surface Soils OSWDF

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	1,500	hrs	$2.70	$4,050
	1/2 TON 4WD TRUCKS, LARGE VANS	300	hrs	$5.45	$1,635
Memo: 3 LATAKY vehicles.					
	Skid Steer per hour	100	hr	$32.54	$3,254
	30' IC Scissor Lift Rent per hour	100	hr	$14.88	$1,488
	Roll Off Bin monthly rental	10		$60.00	$600
Memo: 10 bins for 1 months.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	Waste Handling/Treatment/Disposal/Transportation				**$20,949,977**

Surface Soils OSWDF

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	Roll Off Bin Truck per hour	500	hr	$97.93	$48,965
Memo: 5 trucks for 30 days.					
	Roll Off Bin Liner	136		$36.00	$4,896
	Overnight Shipment per Cooler	3		$251.97	$756
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	28		$1,148.00	$32,144
Memo: 2,716 LCY / 15 CY = 136. Assume 20% sampling rate. 136 / 5 = 28 samples.					
LABOR	PRIME CONTRACTOR LABOR	121,413		$1.00	$121,413
Memo: 1,808 HOURS					

TOTAL Surface Soils OSWDF **$219,201**

Memo: 2,264 BCY x 1.2 = 2,716 LCY. Load into roll off bins and transfer to the WDF by truck. Assume each roll off can hold 20 CY and we can load 15 trucks per day. 2,716 / 300 = 9 days plus weather/delays = 10 days.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5WDF(P&T)		**$34,699,742**
Capital Costs		**$34,431,174**
Excavation Backfill		**$2,954,428**

Backfill

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	B10D R.S.Means Crew	68,615	E.C.Y.	$2.67	$183,027
	B34C R.S.Means Crew	68,615	L.C.Y.	$7.98	$547,496
	Backfill Delivered per CY	68,615		$16.00	$1,097,840
	LAUNDRY 2 CHANGES COST PER HOUR	3,680	hrs	$2.70	$9,936
Memo: .					
	1/2 TON 4WD TRUCKS, LARGE VANS	1,840	hrs	$5.45	$10,028
Memo: 2 LATAKY vehicles.					
	Geotechnical Testing Technician per hour	920		$52.19	$48,015
	Geotechnical Testing Density Testing per hour	920		$50.00	$46,000
	RSMeans Crew B-10W cost per day	92		$1,470.00	$135,240
	RSMeans Crew B-10P cost per day	92		$2,129.00	$195,868
	PPE 2 c/o per day 10 hr day cost per hr	3,680		$1.95	$7,176
LABOR	PRIME CONTRACTOR LABOR	486,828		$1.00	$486,828
Memo: 5,519 HOURS					

Subtotal	$2,767,454
1st Layer Markups assigned to Detail Items	$186,975

TOTAL Backfill **$2,954,428**

Memo: 57,179 BCY total removed. 57,179 x 1.2 = 68,615 CY of fill needed. Assume 750 CY filled per day. 68,615 / 750 = 92 days. Fill is stockpiled during other activities and transfered to site as needed.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**

In Situ Source Treatment (Pump & Treat)

Tree Depth= 4

		QTY		UNIT COST	TOTAL
		1		$0.01	$0

Memo: SWMU 7 treated area is 75' x 75' x 60' or 12,500 CY.
C-400 treated area was 19,000 CY.
12,500 / 19,000 = .66.
Assume a .66 scaling factor.

Subtotal	$0
Rollup from Child Levels	$2,506,220
1st Layer Markups assigned to Detail Items	$8,395
TOTAL In Situ Source Treatment (Pump & Treat)	**$2,514,615**

Estimate Tree Structure Rollups	
SWMU 7 Alternative 5WDF(P&T)	**$34,699,742**
Capital Costs	**$34,431,174**
In Situ Source Treatment (Pump & Treat)	**$2,514,615**

Extraction Well

Tree Depth= 5

LEVEL	Item	QTY	Unit	UNIT COST	TOTAL
	Pump & Treat System Extraction Well Mob/Demob	1		$30,362.49	$30,362
	Pump & Treat System Extraction Well Install	1		$138,135.27	$138,135
	LAUNDRY 2 CHANGES COST PER HOUR	240	hrs	$2.70	$648
Memo: LATAKY personnel plus assume 5 drillers.					
	55 GALLON DRUM	4		$84.68	$339
Memo: 4 drums for drill cuttings.					
	1/2 TON 4WD TRUCKS, LARGE VANS	160	hrs	$5.45	$872
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	240		$1.95	$468
LABOR	PRIME CONTRACTOR LABOR	38,170		$1.00	$38,170
Memo: 480 HOURS					

TOTAL Extraction Well **$208,994**
Memo: 1 extraction well. 2 week duration.

Estimate Tree Structure Rollups	
SWMU 7 Alternative 5WDF(P&T)	**$34,699,742**
Capital Costs	**$34,431,174**
In Situ Source Treatment (Pump & Treat)	**$2,514,615**

Treatment System

Tree Depth= 5

LEVEL	Item	QTY	Unit	UNIT COST	TOTAL
	ATU Air Stripper costs from NE Plume	1		$1,210,984.00	$1,210,984
Memo: Costs include LATAKY labor and testing.					
	Ion Exchange System w/ Media	1		$146,645.00	$146,645
	Granulated Active Carbon Treatment System	1		$130,900.00	$130,900
	1/2 TON 4WD TRUCKS, LARGE VANS	960	hrs	$5.45	$5,232
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	7,200	hrs	$2.70	$19,440
	RSMeans Assembly A1030-120-4560 per SF	2,400		$13.84	$33,216
Memo: 40' x 60' concrete slab for treatment system.					
	E2 R.S.Means Crew	2,400	SF Flr.	$12.52	$30,053
	PPE 2 c/o per day 10 hr day cost per hr	7,200		$1.95	$14,040

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 7 Alternative 5WDF(P&T)				**$34,699,742**
	Capital Costs				**$34,431,174**
	In Situ Source Treatment (Pump & Treat)				**$2,514,615**

Treatment System

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	706,716		$1.00	$706,716
Memo: 9,216 HOURS					
Subtotal					$2,297,226
1st Layer Markups assigned to Detail Items					$8,395
TOTAL Treatment System					**$2,305,620**

Memo: 6 month total duration. LATAKY labor costs only for 3 months. LATAKY labor costs for the air stripper already covered in item ATUCOSTS.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5WDF(P&T)		**$34,699,742**
Annual Costs		**$268,567**
Operations & Maintenance		**$218,430**

Pump & Treat O&M

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RESIN FOR USEC COST PER CF	10	CF	$296.00	$2,960
Memo: ASSUME PURCHASE OF 10 CF PER YEAR					
	PUMP & TREAT RESIN DISPOAL RATES PER CF	15	C	$164.69	$2,470
Memo: RESIN DISPOSAL ASSUME 2 DRUMS OR 15 CF PER YEAR					
	CARBON (INITIAL FILTER CHARGE) COST PER LB	4,000	lb	$2.05	$8,200
Memo: 2,000 lbs, twice per year.					
	REPLACE RESIN COST PER CF	40	CF	$154.45	$6,178
Memo: Assume 80 CF every 2 years.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,920	hrs	$2.70	$5,184
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	191,694		$1.00	$191,694
Memo: 2,480 HOURS					
TOTAL Pump & Treat O&M					**$218,430**

Memo: ANNUAL COST. O&M for 50 years.

Estimate Tree Structure Rollups		
SWMU 7 Alternative 5WDF(P&T)		**$34,699,742**
Annual Costs		**$268,567**
Five Year Reviews		**$50,137**

Five Year Reviews

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	50,137		$1.00	$50,137
Memo: 500 HOURS					
TOTAL Five Year Reviews					**$50,137**

E.4. SWMU 30 COST ESTIMATES

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COST ESTIMATE
BGOU SWMU 30
Alternative 3—Containment, LUCs, Monitoring

Cost Estimate Summary									
Capital Cost	**Quantity**	**Units**	**Unit Price**	**Total**					
1.0 Remedial Design	1	LS	$1,198,000	$1,198,000					
2.0 Other Project Plans	1	LS	$807,000	$807,000					
3.0 Remedial Design Site Investigation (RDSI)	1	LS	$58,000	$58,000					
4.0 Surface Soils Consolidation	1	LS	$114,000	$114,000					
5.0 Cap Construction	1	LS	$1,272,000	$1,272,000					
Subproject Management	1	LS	$344,900	$345,000					Subproject Management = 10%
Management Reserve	1	LS	$569,100	$569,000					Contractor MR = 15%
Fee	1	LS	$305,410	$305,000					Fee = 7%
Contingency	1	LS	$933,600	$934,000					Contingency = 20%
		SUBTOTAL CAPITAL COST		**$5,602,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Inspections	1000	EA	$21,000	$21,000,000			7.59E+17		Quarterly for 1,000 years
Mowing Cap	1000	EA	$11,000	$11,000,000			3.98E+17		Semiannually for 1000 years
Sign Replacement	33	EA	$3,000	$99,000			3.98E+15		Every 30 years.
Groundwater Monitoring	1000	EA	$16,000	$16,000,000			5.78E+17		Annually for 1,000 years.
Five-Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
		SUBTOTAL ANNUAL COST		**$58,099,000**			**2.12E+18**		
			TOTAL	**$63,701,000**					
Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	LS	$5,602,000	$5,602,000				**$5,602,000**	
Inspections	1000	EA	$21,000	$21,000,000				**$1,909,057**	1.1% discount rate
Mowing Cap	1000	EA	$11,000	$11,000,000				**$999,982**	1.1% discount rate
Sign Replacement	33	EA	$3,000	$99,000				**$7,723**	1.1% discount rate
Groundwater Monitoring	1000	EA	$16,000	$16,000,000				**$1,454,520**	1.1% discount rate
Five-Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$5,602,000**	
						Present Worth Values	**Annual**	**$5,261,000**	
							Avg. Annual	**$5,261**	
							Total	**$10,863,000**	
This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.									
Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.									

COST ESTIMATE
BGOU SWMU 30
Alternative 3—Containment, LUCs, Monitoring

CAPITAL COSTS									
	Material/Equipment/Subcontractors/ODCs				Labor				
Task Description	**Qty**	**Unit**	**Unit Price**	**Total**	**Hours**	**Rate**	**Total**	**Total Cost**	**Basis of Estimate**
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					3184		$282,863		
Remedial Design Report					6664		$617,211		
Civil Surveying					160		$16,902		
Procurement					300		$24,232		
Work Packages/Readiness					1128		$98,096		
Training	1	LS	$56,000	$56,000	1320		$102,736		$56,000 includes subcontractor training
TASK TOTAL				**$56,000**	**12756**		**$1,142,040**	**$1,198,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					4164		$377,545		
O&M Plan					700		$66,863		
SAP/QAPP					840		$73,002		
Waste Management Plan					616		$58,809		
RACR					1900		$179,749		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**8804**		**$806,693**	**$807,000**	
3.0 Remedial Design Site Investigation (RDSI)									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated and therefore includes labor, material, and equipment where applicable.									
Land Survey									
Prime Contractor Labor					240		$24,649		
Materials	1	LS	$744	$744					
Vehicles and Equipment	1	LS	$436	$436					
Surface Soil Sampling									
Prime Contractor Labor					200		$14,608		
Materials	1	LS	$11,151	$11,151					
Analytical									
Prime Contractor Labor					32		$2,741		
Materials	1	LS	$3,537	$3,537					
TASK TOTAL				**$15,868**	**472**		**$41,998**	**$58,000**	
4.0 Surface Soils Consolidation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated and therefore includes labor, material, and equipment where applicable.									
Surveying and Marking									
Prime Contractor Labor					160		$14,145		
Materials	1	LS	$744	$744					
Soil Consolidation									
Prime Contractor Labor					480		$40,944		
Subcontractors	1	LS	$55,686	$55,686					
Materials	1	LS	$1,488	$1,488					
Vehicles and Equipment	1	LS	$872	$872					
TASK TOTAL				**$58,790**	**640**		**$55,089**	**$114,000**	

COST ESTIMATE
BGOU SWMU 30
Alternative 3—Containment, LUCs, Monitoring

5.0 Cap Construction									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Surveying, Marking, Testing									
Prime Contractor Labor					280		$28,905		
Subcontractors	1	LS	$80,102	$80,102					Local engineering firm
Materials	1	LS	$744	$744					
Road and Ditch Relocation									
Prime Contractor Labor					575		$49,463		
Subcontractors	1	LS	$64,074	$64,074					
Materials	1	LS	$648	$648					
Vehicles and Equipment	1	LS	$1,744	$1,744					
Cap Construction									
Prime Contractor Labor					3930		$313,495		
Subcontractors	1	LS	$555,923	$555,923					
Materials	1	LS	$14,880	$14,880					
Vehicles and Equipment	1	LS	$13,952	$13,952					
Monitoring Well Installation									
Prime Contractor Labor					992		$79,246		
Subcontractors	1	LS	$64,720	$64,720					
Materials	1	LS	$2,232	$2,232					
Vehicles and Equipment	1	LS	$1,744	$1,744					
TASK TOTAL				**$800,763**	**5777**		**$471,109**	**$1,272,000**	
							SUBTOTAL CAPITAL COST	**$3,449,000**	
ANNUAL COSTS									
Inspections									
Duration: Occurs quarterly for 1,000 years.									
Prime Contractor Labor					240		$20,180		
Materials	1	LS	$540	$540					
Vehicles and Equipment	1	LS	$436	$436					
TASK TOTAL				**$976**	**240**		**$20,180**	**$21,000**	ANNUAL COST
Mowing Cap									
Duration: Semiannually for 1,000 years.									
Prime Contractor Labor					95		$2,582		
Subcontractors	1	LS	$8,155	$8,155					
TASK TOTAL				**$8,155**			**$2,582**	**$11,000**	ANNUAL COST
Sign Replacement									
Duration: Every 30 years.									
Prime Contractor Labor					30		$2,392		
Materials	1	LS	$54	$54					
Vehicles and Equipment	1	LS	$109	$109					
TASK TOTAL				**$163**			**$2,392**	**$3,000**	ANNUAL COST
Groundwater Monitoring									
Duration: Annually for 1,000 years.									
Prime Contractor Labor					160		$12,582		
Laboratory	1	LS	$3,008	$3,008					
Materials	1	LS	$270	$270					
Vehicles and Equipment	1	LS	$218	$218					
TASK TOTAL				**$3,496**			**$12,582**	**$16,000**	ANNUAL COST
Five-Year Review									
Duration: Every 5 years.									
Prime Contractor Labor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study **Reported From: SWMU 30 Alternative 3**
Report Total: $3,549,014

Author
Manager

LEVEL	QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups		
	SWMU 30 Alternative 3		**$3,549,014**
	Capital Costs		**$3,448,350**
	Remedial Desgin		**$1,198,040**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	282,863	$1.00	$282,863

Memo: 3,184 HOURS

TOTAL RDWP/RDSI Work Plan **$282,863**

Estimate Tree Structure Rollups		
SWMU 30 Alternative 3		**$3,549,014**
Capital Costs		**$3,448,350**
Remedial Desgin		**$1,198,040**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	617,211	$1.00	$617,211

Memo: 6,664 HOURS

TOTAL RDR **$617,211**

Estimate Tree Structure Rollups		
SWMU 30 Alternative 3		**$3,549,014**
Capital Costs		**$3,448,350**
Remedial Desgin		**$1,198,040**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	16,902	$1.00	$16,902

Memo: 160 HOURS

TOTAL Civil Surveying **$16,902**

Estimate Tree Structure Rollups		
SWMU 30 Alternative 3		**$3,549,014**
Capital Costs		**$3,448,350**
Remedial Desgin		**$1,198,040**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	24,232	$1.00	$24,232

Memo: 300 HOURS

TOTAL Procurement **$24,232**

Estimate Tree Structure Rollups		
SWMU 30 Alternative 3		**$3,549,014**
Capital Costs		**$3,448,350**
Remedial Desgin		**$1,198,040**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	98,096	$1.00	$98,096

Memo: 1,128 HOURS

TOTAL Work Packages/Readiness Review **$98,096**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 30 Alternative 3			**$3,549,014**
	Capital Costs			**$3,448,350**
	Remedial Desgin			**$1,198,040**

Training

Tree Depth= 5

		QTY	UNIT COST	TOTAL
Memo:	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
	Assume 80 hours of training per person. Assume 10 people or 800 hours.			
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training **$158,736**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

	Estimate Tree Structure Rollups			
	SWMU 30 Alternative 3			**$3,549,014**
	Capital Costs			**$3,448,350**
	Other Project Plans			**$806,693**

RAWP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	377,545	$1.00	$377,545
Memo: 4,164 HOURS				

TOTAL RAWP **$377,545**

	Estimate Tree Structure Rollups			
	SWMU 30 Alternative 3			**$3,549,014**
	Capital Costs			**$3,448,350**
	Other Project Plans			**$806,693**

O&M Plan

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan **$66,863**

	Estimate Tree Structure Rollups			
	SWMU 30 Alternative 3			**$3,549,014**
	Capital Costs			**$3,448,350**
	Other Project Plans			**$806,693**

SAP/QAPP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	73,002	$1.00	$73,002
Memo: 840 HOURS				

TOTAL SAP/QAPP **$73,002**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 3				**$3,549,014**
	Capital Costs				**$3,448,350**
	Other Project Plans				**$806,693**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	58,809		$1.00	$58,809
Memo: 616 HOURS					

TOTAL Waste Management Plan **$58,809**

Estimate Tree Structure Rollups			
SWMU 30 Alternative 3			**$3,549,014**
Capital Costs			**$3,448,350**
Other Project Plans			**$806,693**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	179,749		$1.00	$179,749
Memo: 1,900 HOURS					

TOTAL RACR **$179,749**

Estimate Tree Structure Rollups			
SWMU 30 Alternative 3			**$3,549,014**
Capital Costs			**$3,448,350**
Other Project Plans			**$806,693**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

Estimate Tree Structure Rollups			
SWMU 30 Alternative 3			**$3,549,014**
Capital Costs			**$3,448,350**
RDSI			**$57,865**

Land Survey

Tree Depth= 5

	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
LABOR	PRIME CONTRACTOR LABOR	24,649		$1.00	$24,649
Memo: 240 HOURS					

TOTAL Land Survey **$25,829**

Estimate Tree Structure Rollups			
SWMU 30 Alternative 3			**$3,549,014**
Capital Costs			**$3,448,350**
RDSI			**$57,865**

Surface Soil Sampling

Tree Depth= 5

	5 gram EN CORE SAMPLER	20		$6.94	$139

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 3				**$3,549,014**
	Capital Costs				**$3,448,350**
	RDSI				**$57,865**

Surface Soil Sampling

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Niton XRF Rental One Month	2		$4,500.00	$9,000
	PCB Test Kits	2		$541.00	$1,082
	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	PPE 2 c/o per day 10 hr day cost per hr	200		$1.95	$390
LABOR	PRIME CONTRACTOR LABOR	14,608		$1.00	$14,608
Memo: 200 HOURS					

TOTAL Surface Soil Sampling **$25,759**

Estimate Tree Structure Rollups		
SWMU 30 Alternative 3	**$3,549,014**
Capital Costs	**$3,448,350**
RDSI	**$57,865**

Analytical

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RDSI Soil Sampling Analytical	0.01		$328,469.00	$3,285
Memo: MANAL114 is for 240 samples. 3 / 240 = .0125					
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 2 shipments per day for 15 days plus 1 shipment later for the waste water.					
LABOR	PRIME CONTRACTOR LABOR	2,741		$1.00	$2,741
Memo: 32 HOURS					

TOTAL Analytical **$6,278**

Estimate Tree Structure Rollups	
SWMU 30 Alternative 3	**$3,549,014**
Capital Costs	**$3,448,350**
Surface Soils Consolidation	**$113,879**

Surveying and Marking

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
LABOR	PRIME CONTRACTOR LABOR	14,145		$1.00	$14,145
Memo: 160 HOURS					

TOTAL Surveying and Marking **$14,889**

Estimate Tree Structure Rollups	
SWMU 30 Alternative 3	**$3,549,014**
Capital Costs	**$3,448,350**
Surface Soils Consolidation	**$113,879**

Soil Consolidation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B10L R.S.Means Crew	1,116	B.C.Y.	$15.21	$16,971
	B10G R.S.Means Crew	1,116	E.C.Y.	$0.69	$772
	Water Truck 10k Gallon cost per hr	80	hrs	$208.34	$16,667

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 3				**$3,549,014**
	Capital Costs				**$3,448,350**
	Surface Soils Consolidation				**$113,879**

Soil Consolidation

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	RSMeans Crew B-11L cost per day	8		$1,823.30	$14,586
	LAUNDRY 2 CHANGES COST PER HOUR	320	hrs	$2.70	$864
	1/2 TON 4WD TRUCKS, LARGE VANS	160	hrs	$5.45	$872
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	320		$1.95	$624
LABOR	PRIME CONTRACTOR LABOR	40,944		$1.00	$40,944
Memo: 480 HOURS					
Subtotal					$92,300
1st Layer Markups assigned to Detail Items					$6,690

TOTAL Soil Consolidation **$98,990**

Memo: Assume depth of 2 feet. 25% of area outside cap or 1,116 CY.

Estimate Tree Structure Rollups		
SWMU 30 Alternative 3		**$3,549,014**
Capital Costs		**$3,448,350**
Cap Construction		**$1,271,873**

Surveying, Marking, Testing

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	160	hrs	$2.70	$432
	Geotechnical Testing Technician per hour	960		$52.19	$50,102
Memo: Construction 2 FTE. Geotechnical testing, data recording, surveying, and reporting.					
	Geotechnical Testing Density Testing per hour	600		$50.00	$30,000
Memo: Construction Nuclear Density testing per hour. Estimated 60 days.					
	PPE 2 c/o per day 10 hr day cost per hr	160		$1.95	$312
LABOR	PRIME CONTRACTOR LABOR	28,905		$1.00	$28,905
Memo: 280 HOURS					

TOTAL Surveying, Marking, Testing **$109,751**

Estimate Tree Structure Rollups		
SWMU 30 Alternative 3		**$3,549,014**
Capital Costs		**$3,448,350**
Cap Construction		**$1,271,873**

Road and Ditch Relocation

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	B34K R.S.Means Crew	4	Ea.	$423.07	$1,692
	B38 R.S.Means Crew	470	S.Y.	$6.76	$3,176
Memo: 350 lf x 12' wide = 4,200 SF or 470 SY. Remove existing pavement.					
	B13H R.S.Means Crew	777	B.C.Y.	$8.68	$6,747
Memo: 350' x 4' x 15' / 27 = 777 CY. Excavate new ditch.					
	B13H R.S.Means Crew	195	B.C.Y.	$8.68	$1,693
Memo: 350' x 1' x 15' / 27 = 195 CY. Muck existing ditch.					
	B10D R.S.Means Crew	777	E.C.Y.	$2.67	$2,073

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 3				**$3,549,014**
	Capital Costs				**$3,448,350**
	Cap Construction				**$1,271,873**

Road and Ditch Relocation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	B34C R.S.Means Crew	777	L.C.Y.	$7.98	$6,200
	Backfill Delivered per CY	777		$16.00	$12,432
	B13 R.S.Means Crew	60	L.F.	$95.05	$5,703
Memo: (2) 30 foot culverts.					
	B25C R.S.Means Crew	4,200	S.F.	$3.42	$14,386
Memo: Repave road.					
	LAUNDRY 2 CHANGES COST PER HOUR	240	hrs	$2.70	$648
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 4 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	49,463		$1.00	$49,463
Memo: 575 HOURS					
Subtotal					$105,958
1st Layer Markups assigned to Detail Items					$9,972
TOTAL Road and Ditch Relocation					**$115,929**
Memo: 2 week duration.					

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 3				**$3,549,014**
	Capital Costs				**$3,448,350**
	Cap Construction				**$1,271,873**

Cap Construction

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Common Building Laborers	6,373	S.Y.	$2.09	$13,313
	B15 R.S.Means Crew	3,472	C.Y.	$29.84	$103,619
Memo: CLAY LINER LAYER: 18" clay layer.					
	B10G R.S.Means Crew	3,472	E.C.Y.	$1.25	$4,322
Memo: Compaction of Clay Liner Layer.					
	B15 R.S.Means Crew	2,504	C.Y.	$23.34	$58,454
Memo: DRAINAGE LAYER: 12" sand layer.					
	B10G R.S.Means Crew	2,504	E.C.Y.	$1.25	$3,117
Memo: Compaction of Sand Layer.					
	B15 R.S.Means Crew	8,100	C.Y.	$27.34	$221,487
Memo: Topsoil Layer - Assume 3 feet of vegetative soil (72,900 * 3) / 27 = 8,100 CY.					
	B10G R.S.Means Crew	5,400	E.C.Y.	$1.25	$6,722
Memo: Compaction of the 2 feet of protective soil.					
	B81 R.S.Means Crew	73	M.S.F.	$44.24	$3,230
	B34K R.S.Means Crew	4	Ea.	$423.07	$1,692
Memo: Mob/Demob for 2 dozers and 2 compactors.					
	1/2 TON 4WD TRUCKS, LARGE VANS	2,560	hrs	$5.45	$13,952
Memo: 4 LATAKY vehicles.					
	LAUNDRY 2 CHANGES COST PER HOUR	3,200	hrs	$2.70	$8,640
	Corner Monuments	4		$20,000.00	$80,000
	PPE 2 c/o per day 10 hr day cost per hr	3,200		$1.95	$6,240

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 3				**$3,549,014**
	Capital Costs				**$3,448,350**
	Cap Construction				**$1,271,873**

Cap Construction

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	313,495		$1.00	$313,495
Memo: 3,930 HOURS					
Subtotal					$838,282
1st Layer Markups assigned to Detail Items					$59,968
TOTAL Cap Construction					**$898,250**

Memo: Assume 4 month duration.
Cap area is 57,350 SF. Assume perimeter increases by a linear 10 feet for every layer.
Layer 1: Geotextile Fabric. 57,350 SF.
Layer 2: Clay Liner - Assume 18 inches of clay. (62,500 * 1.5) / 27 = 3,472 CY.
Layer 3: Drainage Layer - Assume 1 feet of sand. (67,600 * 1) / 27 = 2,504 CY.
Layer 4: Vegetative Soil Layer - Assume 3 feet of protective soil (72,900 * 3) / 27 = 8,100 CY.

Estimate Tree Structure Rollups		
SWMU 30 Alternative 3		**$3,549,014**
Capital Costs		**$3,448,350**
Cap Construction		**$1,271,873**

Monitoring Well Installation

Tree Depth= 5

	Monitoring Well	4		$16,180.00	$64,720
	LAUNDRY 2 CHANGES COST PER HOUR	480	hrs	$2.70	$1,296
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	480		$1.95	$936
LABOR	PRIME CONTRACTOR LABOR	79,246		$1.00	$79,246
Memo: 992 HOURS					
TOTAL Monitoring Well Installation					**$147,942**

Memo: 4 monitoring wells installed. One upgradient and three downgradient. One week per well.

Estimate Tree Structure Rollups		
SWMU 30 Alternative 3		**$3,549,014**
Annual Costs		**$100,664**
Operations & Maintenance		**$34,449**

Inspections

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	200	hrs	$2.70	$540
	1/2 TON 4WD TRUCKS, LARGE VANS	80	hrs	$5.45	$436
Memo: 2 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	20,180		$1.00	$20,180
Memo: 240 HOURS					
TOTAL Inspections					**$21,156**

Memo: Annual Cost. General inspections of the action. Quarterly.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 3				**$3,549,014**
	Annual Costs				**$100,664**
	Operations & Maintenance				**$34,449**

Mowing Cap

Tree Depth= 5

	B84 R.S.Means Crew	73	M.S.F.	$81.20	$5,928
LABOR Memo: 95 HOURS	PRIME CONTRACTOR LABOR	2,582		$1.00	$2,582
Subtotal					$8,510
1st Layer Markups assigned to Detail Items					$2,228

TOTAL Mowing Cap **$10,738**
Memo: Annual Cost. Semiannually mow cap. 1 day each time.

Estimate Tree Structure Rollups		
SWMU 30 Alternative 3		**$3,549,014**
Annual Costs		**$100,664**
Operations & Maintenance		**$34,449**

Sign Replacement

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	20	hrs	$2.70	$54
Memo: 2 LATAKY vehicles.	1/2 TON 4WD TRUCKS, LARGE VANS	20	hrs	$5.45	$109
LABOR Memo: 30 HOURS	PRIME CONTRACTOR LABOR	2,392		$1.00	$2,392

TOTAL Sign Replacement **$2,555**
Memo: Annual Cost. Occurs every 30 years.

Estimate Tree Structure Rollups		
SWMU 30 Alternative 3		**$3,549,014**
Annual Costs		**$100,664**
Groundwater Monitoring		**$16,078**

Monitoring Well Sampling

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	100	hrs	$2.70	$270
Memo: 2 LATAKY vehicles.	1/2 TON 4WD TRUCKS, LARGE VANS	40	hrs	$5.45	$218
Memo: Assume 1 cooler per sampling event for the 4 wells.	Overnight Shipment per Cooler	1		$251.97	$252
	Well Sampling	4		$689.05	$2,756
LABOR Memo: 160 HOURS	PRIME CONTRACTOR LABOR	12,582		$1.00	$12,582

TOTAL Monitoring Well Sampling **$16,078**

Estimate Tree Structure Rollups		
SWMU 30 Alternative 3		**$3,549,014**
Annual Costs		**$100,664**
Five Year Reviews		**$50,137**

Five Year Reviews

Tree Depth= 5

LABOR Memo: 500 HOURS	PRIME CONTRACTOR LABOR	50,137	$1.00	$50,137

LEVEL	QTY	UNIT COST	TOTAL
TOTAL Five Year Reviews			**$50,137**

COST ESTIMATE
BGOU SWMU 30
Alternative 5—Excavation, Disposal, and LUCs

Cost Estimate Summary									
Capital Cost	**Quantity**	**Units**	**Unit Price**	**Total**					
1.0 Remedial Design	1	LS	$1,555,000	$1,555,000					
2.0 Other Project Plans	1	LS	$1,038,000	$1,038,000					
3.0 Excavation	1	LS	$2,015,000	$2,015,000					
4.0 Treat and Dispose of Water	1	LS	$425,000	$425,000					
5.0 Post Remediation Sampling	1	LS	$182,000	$182,000					
6.0 Waste Handling, Treatment, Disposal, and Transportation	1	LS	$20,894,000	$20,894,000					
7.0 Excavation Backfill	1	LS	$1,089,000	$1,089,000					
Subproject Management	1	LS	$2,719,800	$2,720,000					Subproject Management = 10%
Management Reserve	1	LS	$4,487,700	$4,488,000					Contractor MR = 15%
Fee	1	LS	$2,408,420	$2,408,000					Fee = 7%
Contingency	1	LS	$7,362,800	$7,363,000					Contingency = 20%
			SUBTOTAL CAPITAL COST	**$44,177,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Five-Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
			SUBTOTAL ANNUAL COST	**$10,000,000**			**3.82E+17**		
			TOTAL	**$54,177,000**					
Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	LS	$44,177,000	$44,177,000				**$44,177,000**	
Five-Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$44,177,000**	
						Present Worth Values	**Annual**	**$889,000**	
							Avg. Annual	**$889**	
							Total	**$45,066,000**	
This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.									
Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.									

COST ESTIMATE
BGOU SWMU 30
Alternative 5—Excavation, Disposal, and LUCs

CAPITAL COSTS									
	Material/Equipment/Subcontractors/ODCs				Labor				
Task Description	**Qty**	**Unit**	**Unit Price**	**Total**	**Hours**	**Rate**	**Total**	**Total Cost**	**Basis of Estimate**
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					4224		$376,224		
Remedial Design Report					8744		$803,933		
Civil Surveying					160		$16,902		
Procurement					634		$52,676		
Work Packages/Readiness					1688		$146,788		
Training	1	LS	$56,000	$56,000	1320		$102,736		$56,000 includes subcontractor training
TASK TOTAL				**$56,000**	**16770**		**$1,499,259**	**$1,555,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					5724		$517,587		
O&M Plan					700		$66,863		
SAP/QAPP					1100		$96,201		
Waste Management Plan					1020		$94,190		
RACR					2274		$212,751		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**11402**		**$1,038,317**	**$1,038,000**	
3.0 Excavation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Road and Ditch Relocation									
Prime Contractor Labor					575		$49,463		
Subcontractors	1	LS	$64,074	$64,074					
Materials	1	LS	$648	$648					
Vehicles and Equipment	1	LS	$1,744	$1,744					
Pit A Overburden - U Landfill									
Prime Contractor Labor					1215		$104,582		
Subcontractors	1	LS	$57,360	$57,360					
Materials	1	LS	$3,488	$3,488					
Vehicles and Equipment	1	LS	$1,635	$1,635					
Pit A Overburden - Offsite									
Prime Contractor Labor					972		$83,666		
Subcontractors	1	LS	$95,888	$95,888					
Materials	1	LS	$2,790	$2,790					
Vehicles and Equipment	1	LS	$1,308	$1,308					

COST ESTIMATE
BGOU SWMU 30
Alternative 5—Excavation, Disposal, and LUCs

Pit A Slopeback - U Landfill									
Prime Contractor Labor					1620		$139,443		
Subcontractors	1	LS	$76,480	$76,480					
Materials	1	LS	$4,650	$4,650					
Vehicles and Equipment	1	LS	$2,180	$2,180					
Pit A Slopeback - Offsite									
Prime Contractor Labor					405		$34,861		
Subcontractors	1	LS	$19,120	$19,120					
Materials	1	LS	$1,163	$1,163					
Vehicles and Equipment	1	LS	$545	$545					
Pit A Waste Area - U Landfill									
Prime Contractor Labor					1053		$90,638		
Subcontractors	1	LS	$49,712	$49,712					
Materials	1	LS	$3,023	$3,023					
Vehicles and Equipment	1	LS	$1,417	$1,417					
Pit A Waste Area - Offsite									
Prime Contractor Labor					6075		$522,912		
Subcontractors	1	LS	$286,800	$286,800					
Materials	1	LS	$17,438	$17,438					
Vehicles and Equipment	1	LS	$8,175	$8,175					
Burn Area - U Landfill									
Prime Contractor Labor					648		$55,777		
Subcontractors	1	LS	$30,592	$30,592					
Materials	1	LS	$1,860	$1,860					
Vehicles and Equipment	1	LS	$872	$872					
Burn Area - Offsite									
Prime Contractor Labor					486		$41,833		
Subcontractors	1	LS	$22,944	$22,944					
Materials	1	LS	$1,395	$1,395					
Vehicles and Equipment	1	LS	$654	$654					
Surface Soils									
Prime Contractor Labor					972		$83,666		
Subcontractors	1	LS	$45,888	$45,888					
Materials	1	LS	$2,790	$2,790					
Vehicles and Equipment	1	LS	$1,308	$1,308					
TASK TOTALS				**$807,939**	**14,021**		**$1,206,841**	**$2,015,000**	

COST ESTIMATE
BGOU SWMU 30
Alternative 5—Excavation, Disposal, and LUCs

4.0 Treat and Dispose of Water									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Water Treatment									
Prime Contractor Labor					1992		$141,771		
Subcontractors	1	LS	$214,645	$214,645					Rainforrent.com and RSMeans
Materials	1	LS	$6,176	$6,176					
Vehicles and Equipment	1	LS	$7,238	$7,238					
Water Disposal									
Prime Contractor Labor					80		$4,550		
Characterization Sampling	1	LS	$34,328	$34,328					
Vehicles and Equipment	1	LS	$16,667	$16,667					
TASK TOTALS				**$279,054**	**2,072**		**$146,321**	**$425,000**	
5.0 Post Remediation Sampling									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Sampling									
Prime Contractor Labor					400		$29,217		
Materials	1	LS	$3,248	$3,248					
Analytical									
Prime Contractor Labor					112		$10,206		
Materials	1	LS	$139,307	$139,307					
TASK TOTAL				**$ 142,555**	**512**		**$39,423**	**$182,000**	
6.0 Waste Handling, Treatment, Disposal, and Transportation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Pit A Overburden - U Landfill									
Prime Contractor Labor					1795		$118,440		
Materials	1	LS	$7,637	$7,637					
Characterization Sampling	1	LS	$52,920	$52,920					
Vehicles and Equipment	1	LS	$69,930	$69,930					
Pit A Overburden - Offsite									
Prime Contractor Labor					1720		$122,998		
Materials	1	LS	$51,745	$51,745					
Characterization Sampling	1	LS	$29,456	$29,456					
Vehicles and Equipment	1	LS	$20,082	$20,082					
Disposal	1	LS	$1,143,944	$1,143,944					
Transportation	1	LS	$377,062	$377,062					

COST ESTIMATE
BGOU SWMU 30
Alternative 5—Excavation, Disposal, and LUCs

Pit A Slopeback - U Landfill									
Prime Contractor Labor					2624		$173,101		
Materials	1	LS	$11,178	$11,178					
Characterization Sampling	1	LS	$76,384	$76,384					
Vehicles and Equipment	1	LS	$102,564	$102,564					
Pit A Slopeback - Offsite									
Prime Contractor Labor					692		$49,622		
Materials	1	LS	$23,218	$23,218					
Characterization Sampling	1	LS	$10,584	$10,584					
Vehicles and Equipment	1	LS	$8,033	$8,033					
Disposal	1	LS	$377,192	$377,192					
Transportation	1	LS	$134,665	$134,665					
Pit A Waste Area - U Landfill									
Prime Contractor Labor					1559		$102,864		
Materials	1	LS	$6,527	$6,527					
Characterization Sampling	1	LS	$44,632	$44,632					
Vehicles and Equipment	1	LS	$60,606	$60,606					
Pit A Waste Area - Offsite									
Prime Contractor Labor					10840		$776,891		
Materials	1	LS	$340,779	$340,779					
Characterization Sampling	1	LS	$218,315	$218,315					
Vehicles and Equipment	1	LS	$124,508	$124,508					
Disposal	1	LS	$8,587,823	$8,587,823					
Transportation	1	LS	$2,774,099	$2,774,099					
Burn Area - U Landfill									
Prime Contractor Labor					835		$55,079		
Materials	1	LS	$3,455	$3,455					
Characterization Sampling	1	LS	$22,316	$22,316					
Vehicles and Equipment	1	LS	$32,634	$32,634					
Burn Area - Offsite									
Prime Contractor Labor					861		$61,546		
Materials	1	LS	$27,423	$27,423					
Characterization Sampling	1	LS	$13,132	$13,132					
Vehicles and Equipment	1	LS	$10,041	$10,041					
Disposal	1	LS	$484,373	$484,373					
Transportation	1	LS	$161,598	$161,598					

COST ESTIMATE
BGOU SWMU 30
Alternative 5—Excavation, Disposal, and LUCs

Surface Soils									
Prime Contractor Labor					3109		$223,088		
Materials	1	LS	$108,495	$108,495					
Characterization Sampling	1	LS	$69,244	$69,244					
Vehicles and Equipment	1	LS	$41,028	$41,028					
Disposal	1	LS	$2,693,936	$2,693,936					
Transportation	1	LS	$888,789	$888,789					
TASK TOTALS				**$19,210,346**	**24,035**		**$1,683,629**	**$20,894,000**	
7.0 Excavation Backfill									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Backfill									
Prime Contractor Labor					2039		$179,915		
Subcontractors	1	LS	$899,215	$899,215					RSMeans and local engineering firm
Materials	1	LS	$6,324	$6,324					
Vehicles and Equipment	1	LS	$3,706	$3,706					
TASK TOTAL				**$909,245**	**2039**		**$179,915**	**$1,089,000**	
							SUBTOTAL CAPITAL COST	**$27,198,000**	
ANNUAL COSTS									
Five-Year Review									
Duration: Every 5 years.									
Prime Contractor Labor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study **Reported From: SWMU 30 Alternative 5**
Report Total: $27,248,981

Author
Manager

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 30 Alternative 5			**$27,248,981**
	Capital Costs			**$27,198,844**
	Remedial Desgin			**$1,555,259**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	376,224	$1.00	$376,224

Memo: 4,224 HOURS

TOTAL RDWP/RDSI Work Plan **$376,224**

	Estimate Tree Structure Rollups			
	SWMU 30 Alternative 5			**$27,248,981**
	Capital Costs			**$27,198,844**
	Remedial Desgin			**$1,555,259**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	803,933	$1.00	$803,933

Memo: 8,744 HOURS

TOTAL RDR **$803,933**

	Estimate Tree Structure Rollups			
	SWMU 30 Alternative 5			**$27,248,981**
	Capital Costs			**$27,198,844**
	Remedial Desgin			**$1,555,259**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	16,902	$1.00	$16,902

Memo: 160 HOURS

TOTAL Civil Surveying **$16,902**

	Estimate Tree Structure Rollups			
	SWMU 30 Alternative 5			**$27,248,981**
	Capital Costs			**$27,198,844**
	Remedial Desgin			**$1,555,259**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	52,676	$1.00	$52,676

Memo: 634 HOURS

TOTAL Procurement **$52,676**

	Estimate Tree Structure Rollups			
	SWMU 30 Alternative 5			**$27,248,981**
	Capital Costs			**$27,198,844**
	Remedial Desgin			**$1,555,259**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	146,788	$1.00	$146,788

Memo: 1,688 HOURS

TOTAL Work Packages/Readiness Review **$146,788**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 30 Alternative 5			**$27,248,981**
	Capital Costs			**$27,198,844**
	Remedial Desgin			**$1,555,259**

Training

Tree Depth= 5

Memo:	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
	Assume 80 hours of training per person. Assume 10 people or 800 hours.			
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training **$158,736**

Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

	Estimate Tree Structure Rollups			
	SWMU 30 Alternative 5			**$27,248,981**
	Capital Costs			**$27,198,844**
	Other Project Plans			**$1,038,317**

RAWP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	517,587	$1.00	$517,587
Memo: 5,724 HOURS				

TOTAL RAWP **$517,587**

	Estimate Tree Structure Rollups			
	SWMU 30 Alternative 5			**$27,248,981**
	Capital Costs			**$27,198,844**
	Other Project Plans			**$1,038,317**

O&M Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan **$66,863**

	Estimate Tree Structure Rollups			
	SWMU 30 Alternative 5			**$27,248,981**
	Capital Costs			**$27,198,844**
	Other Project Plans			**$1,038,317**

SAP/QAPP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	96,201	$1.00	$96,201
Memo: 1,100 HOURS				

TOTAL SAP/QAPP **$96,201**

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Other Project Plans				**$1,038,317**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	94,190		$1.00	$94,190
Memo: 1,020 HOURS					

TOTAL Waste Management Plan **$94,190**

Estimate Tree Structure Rollups			
SWMU 30 Alternative 5			**$27,248,981**
Capital Costs			**$27,198,844**
Other Project Plans			**$1,038,317**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	212,751		$1.00	$212,751
Memo: 2,274 HOURS					

TOTAL RACR **$212,751**

Estimate Tree Structure Rollups			
SWMU 30 Alternative 5			**$27,248,981**
Capital Costs			**$27,198,844**
Other Project Plans			**$1,038,317**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

Estimate Tree Structure Rollups			
SWMU 30 Alternative 5			**$27,248,981**
Capital Costs			**$27,198,844**
Excavation			**$2,014,780**

Road and Ditch Relocation

Tree Depth= 5

	B34K R.S.Means Crew	4	Ea.	$423.07	$1,692
	B38 R.S.Means Crew	470	S.Y.	$6.76	$3,176
Memo: 350 lf x 12' wide = 4,200 SF or 470 SY. Remove existing pavement.					
	B13H R.S.Means Crew	777	B.C.Y.	$8.68	$6,747
Memo: 350' x 4' x 15' / 27 = 777 CY. Excavate new ditch.					
	B13H R.S.Means Crew	195	B.C.Y.	$8.68	$1,693
Memo: 350' x 1' x 15' / 27 = 195 CY. Muck existing ditch.					
	B10D R.S.Means Crew	777	E.C.Y.	$2.67	$2,073
	B34C R.S.Means Crew	777	L.C.Y.	$7.98	$6,200
	Backfill Delivered per CY	777		$16.00	$12,432
	B13 R.S.Means Crew	60	L.F.	$95.05	$5,703
Memo: (2) 30 foot culverts.					
	B25C R.S.Means Crew	4,200	S.F.	$3.42	$14,386
Memo: Repave road.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Excavation				**$2,014,780**

Road and Ditch Relocation

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	240	hrs	$2.70	$648
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 4 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	49,463		$1.00	$49,463
Memo: 575 HOURS					
Subtotal					$105,958
1st Layer Markups assigned to Detail Items					$9,972
TOTAL Road and Ditch Relocation					**$115,929**

Memo: 2 week duration.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Excavation				**$2,014,780**

Pit A Overburden U Landfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	15		$1,470.00	$22,050
	RSMeans Crew B-12C cost per day	15		$2,354.00	$35,310
	LAUNDRY 2 CHANGES COST PER HOUR	750	hrs	$2.70	$2,025
	1/2 TON 4WD TRUCKS, LARGE VANS	300	hrs	$5.45	$1,635
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	750		$1.95	$1,463
LABOR	PRIME CONTRACTOR LABOR	104,582		$1.00	$104,582
Memo: 1,215 HOURS					
TOTAL Pit A Overburden U Landfill					**$167,065**

Memo: 2,778 BCY. Assume 225 CY per day so 13 days + weather/delays. Assume 15 day duration.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Excavation				**$2,014,780**

Pit A Overburden Offsite

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	12		$1,470.00	$17,640
	RSMeans Crew B-12C cost per day	12		$2,354.00	$28,248
	Mob/Demob of Subcontractor and Equipment	1	LS	$50,000.00	$50,000
	LAUNDRY 2 CHANGES COST PER HOUR	600	hrs	$2.70	$1,620
	1/2 TON 4WD TRUCKS, LARGE VANS	240	hrs	$5.45	$1,308
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	600		$1.95	$1,170

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Excavation				**$2,014,780**

Pit A Overburden Offsite

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	83,666		$1.00	$83,666
Memo: 972 HOURS					

TOTAL Pit A Overburden Offsite **$183,652**

Memo: 925 BCY. Assume 100 CY per day so 10 days + weather/delays. Assume 12 day duration.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Excavation				**$2,014,780**

Pit A Slopeback U Landfill

Tree Depth= 5

	RSMeans Crew B-10W cost per day	20		$1,470.00	$29,400
	RSMeans Crew B-12C cost per day	20		$2,354.00	$47,080
	LAUNDRY 2 CHANGES COST PER HOUR	1,000	hrs	$2.70	$2,700
	1/2 TON 4WD TRUCKS, LARGE VANS	400	hrs	$5.45	$2,180
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	1,000		$1.95	$1,950
LABOR	PRIME CONTRACTOR LABOR	139,443		$1.00	$139,443
Memo: 1,620 HOURS					

TOTAL Pit A Slopeback U Landfill **$222,753**

Memo: 4,043 BCY. Excavating and moving a 225 CY per day, so 18 days plus weather/delays is 20 days.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Excavation				**$2,014,780**

Pit A Slopeback Offsite

Tree Depth= 5

	RSMeans Crew B-10W cost per day	5		$1,470.00	$7,350
	RSMeans Crew B-12C cost per day	5		$2,354.00	$11,770
	LAUNDRY 2 CHANGES COST PER HOUR	250	hrs	$2.70	$675
	1/2 TON 4WD TRUCKS, LARGE VANS	100	hrs	$5.45	$545
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	250		$1.95	$488
LABOR	PRIME CONTRACTOR LABOR	34,861		$1.00	$34,861
Memo: 405 HOURS					

TOTAL Pit A Slopeback Offsite **$55,689**

Memo: 305 BCY. Excavating and moving a 100 CY per day, so 3 days plus weather/delays is 5 days.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Excavation				**$2,014,780**

Pit A Waste Area U Landfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	13		$1,470.00	$19,110
	RSMeans Crew B-12C cost per day	13		$2,354.00	$30,602
	LAUNDRY 2 CHANGES COST PER HOUR	650	hrs	$2.70	$1,755
	1/2 TON 4WD TRUCKS, LARGE VANS	260	hrs	$5.45	$1,417
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	650		$1.95	$1,268
LABOR	PRIME CONTRACTOR LABOR	90,638		$1.00	$90,638
Memo: 1,053 HOURS					

TOTAL Pit A Waste Area U Landfill **$144,790**
Memo: 2,314 BCY. Excavating and moving a 225 CY per day, so 11 days plus weather/delays is 13 days.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Excavation				**$2,014,780**

Pit A Waste Area Offsite

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	75		$1,470.00	$110,250
	RSMeans Crew B-12C cost per day	75		$2,354.00	$176,550
	LAUNDRY 2 CHANGES COST PER HOUR	3,750	hrs	$2.70	$10,125
	1/2 TON 4WD TRUCKS, LARGE VANS	1,500	hrs	$5.45	$8,175
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	3,750		$1.95	$7,313
LABOR	PRIME CONTRACTOR LABOR	522,912		$1.00	$522,912
Memo: 6,075 HOURS					

TOTAL Pit A Waste Area Offsite **$835,325**
Memo: 6,944 BCY. Excavating and moving a 100 CY per day, so 70 days plus weather/delays is 75 days.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Excavation				**$2,014,780**

Burn Area U Landfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	RSMeans Crew B-10W cost per day	8		$1,470.00	$11,760
	RSMeans Crew B-12C cost per day	8		$2,354.00	$18,832
	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
	1/2 TON 4WD TRUCKS, LARGE VANS	160	hrs	$5.45	$872
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Excavation				**$2,014,780**

Burn Area U Landfill

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	55,777		$1.00	$55,777
Memo: 648 HOURS					

TOTAL Burn Area U Landfill **$89,101**

Memo: 1,176 BCY. Excavating and moving a 225 CY per day, so 6 days plus weather/delays is 8 days.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Excavation				**$2,014,780**

Burn Area Offsite

Tree Depth= 5

	RSMeans Crew B-10W cost per day	6		$1,470.00	$8,820
	RSMeans Crew B-12C cost per day	6		$2,354.00	$14,124
	LAUNDRY 2 CHANGES COST PER HOUR	300	hrs	$2.70	$810
	1/2 TON 4WD TRUCKS, LARGE VANS	120	hrs	$5.45	$654
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	300		$1.95	$585
LABOR	PRIME CONTRACTOR LABOR	41,833		$1.00	$41,833
Memo: 486 HOURS					

TOTAL Burn Area Offsite **$66,826**

Memo: 392 BCY. Excavating and moving a 100 CY per day, so 4 days plus weather/delays is 6 days.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Excavation				**$2,014,780**

Surface Soils

Tree Depth= 5

	RSMeans Crew B-10W cost per day	12		$1,470.00	$17,640
	RSMeans Crew B-12C cost per day	12		$2,354.00	$28,248
	LAUNDRY 2 CHANGES COST PER HOUR	600	hrs	$2.70	$1,620
	1/2 TON 4WD TRUCKS, LARGE VANS	240	hrs	$5.45	$1,308
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	600		$1.95	$1,170
LABOR	PRIME CONTRACTOR LABOR	83,666		$1.00	$83,666
Memo: 972 HOURS					

TOTAL Surface Soils **$133,652**

Memo: 2,178 BCY. Excavating and moving a 225 CY per day, so 10 days plus weather/delays is 12 days.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Treat and Dispose of Water				**$425,375**

Water Treatment

Tree Depth= 5

LEVEL	ITEM	QTY	UNIT	UNIT COST	TOTAL
	B10H R.S.Means Crew	166	Day	$581.53	$96,535
	Water Treatment System w/ Tanks per month	8		$7,785.00	$62,280
Memo: Packaged system with 2 frac tanks.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,328	hrs	$2.70	$3,586
	1/2 TON 4WD TRUCKS, LARGE VANS	1,328	hrs	$5.45	$7,238
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	1,328		$1.95	$2,590
LABOR	PRIME CONTRACTOR LABOR	141,771		$1.00	$141,771
Memo: 1,992 HOURS					
Subtotal					$313,999
1st Layer Markups assigned to Detail Items					$55,832
TOTAL Water Treatment					**$369,830**
Memo: 8 months					

Estimate Tree Structure Rollups		
SWMU 30 Alternative 5		**$27,248,981**
Capital Costs		**$27,198,844**
Treat and Dispose of Water		**$425,375**

Water Disposal

Tree Depth= 5

LEVEL	ITEM	QTY	UNIT	UNIT COST	TOTAL
	Water Truck 10k Gallon cost per hr	80	hr	$208.34	$16,667
	Overnight Shipment per Cooler	4		$251.97	$1,008
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Water Cost per Sample	40		$833.00	$33,320
Memo: Assume Frac tanks will be emptied every 2 months. 4 * 5 tanks * 20,000 gallons = 400,000 gallons. Assume a water sample will be taken from each water truck (10,000 gallons). 400,000 gallons / 10,000 = 40 samples.					
LABOR	PRIME CONTRACTOR LABOR	4,550		$1.00	$4,550
Memo: 80 HOURS					
TOTAL Water Disposal					**$55,545**

Estimate Tree Structure Rollups		
SWMU 30 Alternative 5		**$27,248,981**
Capital Costs		**$27,198,844**
Post Remediation Sampling		**$181,978**

Sampling

Tree Depth= 5

LEVEL	ITEM	QTY	UNIT	UNIT COST	TOTAL
	5 gram EN CORE SAMPLER	200		$6.94	$1,388
	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Post Remediation Sampling				**$181,978**

Sampling

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	29,217		$1.00	$29,217
Memo: 400 HOURS					
TOTAL Sampling					**$32,465**
Memo: Total is 122 samples. 2 weeks.					

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Post Remediation Sampling				**$181,978**

Analytical

Tree Depth= 5

	Overnight Shipment per Cooler	21		$251.97	$5,291
Memo: Assume 2 shipments per day for 10 days plus 1 shipment later for the waste water.					
	RDSI Soil Sampling Analytical	0.51		$262,775.00	$134,015
Memo: MANAL114 is for 240 samples. 122 / 240 = .51					
LABOR	PRIME CONTRACTOR LABOR	10,206		$1.00	$10,206
Memo: 112 HOURS					
TOTAL Analytical					**$149,513**

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Waste Handling/Treatment/Disposal/Transportation				**$20,893,974**

Pit A Overburden U Landfill

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	1,650	hrs	$2.70	$4,455
	1/2 TON 4WD TRUCKS, LARGE VANS	300	hrs	$5.45	$1,635
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	750	hr	$91.06	$68,295
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	74		$43.00	$3,182
	Overnight Shipment per Cooler	5		$251.97	$1,260
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	45		$1,148.00	$51,660
3,334 LCY / 15 CY = 222. Assume 20% sampling rate. 222 / 5 = 45 samples.					
LABOR	PRIME CONTRACTOR LABOR	118,440		$1.00	$118,440
Memo: 1,795 HOURS					
TOTAL Pit A Overburden U Landfill					**$248,927**
Memo: U Landfill WAC Compliant. 2,778 BCY x 1.2 = 3,334 LCY. Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 15 days.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Waste Handling/Treatment/Disposal/Transportation				**$20,893,974**

Pit A Overburden Offsite

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	1,300	hrs	$2.70	$3,510
	1/2 TON 4WD TRUCKS, LARGE VANS	300	hrs	$5.45	$1,635
Memo: 3 LATAKY vehicles.					
	Disposal ES MLLW by rail	1,110		$1,030.58	$1,143,944
	Transportation to ES by Gondola	14		$26,933.00	$377,062
Memo: Assume 9 bags per car. 124 / 9 = 14 gons.					
	Lift Liner Bags 9 CY	124		$300.00	$37,200
	Loading or Lifting Frames per month	17		$500.00	$8,500
Memo: Rent for 1 month. 11 loading frames and 6 lifting frames. 17 x 1 months = 17.					
	Skid Steer per hour	100	hr	$32.54	$3,254
	18,000 lb Fork Lift per hour	200	hr	$32.66	$6,532
	Flat Bed Truck per hour	100	hr	$45.74	$4,574
	30' IC Scissor Lift Rent per hour	100	hr	$14.88	$1,488
	65 Ton Link-Belt Crane GFE cost per hr	100	hr	$25.99	$2,599
	PPE 2 c/o per day 10 hr day cost per hr	1,300		$1.95	$2,535
	Overnight Shipment per Cooler	3		$251.97	$756
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	25		$1,148.00	$28,700
Assume 20% sampling rate. 124 / 5 = 25 samples.					
LABOR	PRIME CONTRACTOR LABOR	122,998		$1.00	$122,998
Memo: 1,720 HOURS					

TOTAL Pit A Overburden Offsite **$1,745,287**

Memo: 925 BCY x 1.2 = 1,110 LCY. Load into soft sided bags and ship to ES by rail for disposal. Assume can load 16 bags per day. 1,110 / 9 = 124 bags. 124 / 16 = 8 days + weather/delays = 10 days.

Estimate Tree Structure Rollups		
SWMU 30 Alternative 5	**$27,248,981**
Capital Costs	**$27,198,844**
Waste Handling/Treatment/Disposal/Transportation	**$20,893,974**

Pit A Slopeback U Landfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	2,420	hrs	$2.70	$6,534
	1/2 TON 4WD TRUCKS, LARGE VANS	440	hrs	$5.45	$2,398
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	1,100	hr	$91.06	$100,166
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	108		$43.00	$4,644
	Overnight Shipment per Cooler	7		$251.97	$1,764
Memo: Assume 10 samples per cooler.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Waste Handling/Treatment/Disposal/Transportation				**$20,893,974**

Pit A Slopeback U Landfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
Memo:	Characterization Sampling Soil Cost per Sample 4,852 LCY / 15 CY = 323. Assume 20% sampling rate. 323 / 5 = 65 samples.	65		$1,148.00	$74,620
LABOR Memo: 2,624 HOURS	PRIME CONTRACTOR LABOR	173,101		$1.00	$173,101

TOTAL Pit A Slopeback U Landfill **$363,227**

Memo: U Landfill WAC Compliant. 4,043 BCY x 1.2 = 4,852 LCY. Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 22 days.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Waste Handling/Treatment/Disposal/Transportation				**$20,893,974**

Pit A Slopeback Offsite

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	520	hrs	$2.70	$1,404
Memo: 3 LATAKY vehicles.	1/2 TON 4WD TRUCKS, LARGE VANS	120	hrs	$5.45	$654
	Disposal ES MLLW by rail	366		$1,030.58	$377,192
Memo: Assume 9 bags per car. 41 / 9 = 5 gons.	Transportation to ES by Gondola	5		$26,933.00	$134,665
	Lift Liner Bags 9 CY	41		$300.00	$12,300
Memo: Rent for 1 month. 11 loading frames and 6 lifting frames. 17 x 1 months = 17.	Loading or Lifting Frames per month	17		$500.00	$8,500
	Skid Steer per hour	40	hr	$32.54	$1,302
	18,000 lb Fork Lift per hour	80	hr	$32.66	$2,613
	Flat Bed Truck per hour	40	hr	$45.74	$1,830
	30' IC Scissor Lift Rent per hour	40	hr	$14.88	$595
	65 Ton Link-Belt Crane GFE cost per hr	40	hr	$25.99	$1,040
	PPE 2 c/o per day 10 hr day cost per hr	520		$1.95	$1,014
Memo: Assume 10 samples per cooler.	Overnight Shipment per Cooler	1		$251.97	$252
Memo:	Characterization Sampling Soil Cost per Sample Assume 20% sampling rate. 41 / 5 = 9 samples.	9		$1,148.00	$10,332
LABOR Memo: 692 HOURS	PRIME CONTRACTOR LABOR	49,622		$1.00	$49,622

TOTAL Pit A Slopeback Offsite **$603,314**

Memo: 305 BCY x 1.2 = 366 LCY. Load into soft sided bags and ship to ES by rail for disposal. Assume can load 16 bags per day. 366 / 9 = 41 bags. 41 / 16 = 3 days + weather/delays = 4 days.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Waste Handling/Treatment/Disposal/Transportation				**$20,893,974**

Pit A Waste Area U Landfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	1,430	hrs	$2.70	$3,861
	1/2 TON 4WD TRUCKS, LARGE VANS	260	hrs	$5.45	$1,417
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	650	hr	$91.06	$59,189
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	62		$43.00	$2,666
	Overnight Shipment per Cooler	4		$251.97	$1,008
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	38		$1,148.00	$43,624
2,777 LCY / 15 CY = 185. Assume 20% sampling rate. 185 / 5 = 38 samples.					
LABOR	PRIME CONTRACTOR LABOR	102,864		$1.00	$102,864
Memo: 1,559 HOURS					

TOTAL Pit A Waste Area U Landfill **$214,629**

Memo: U Landfill WAC Compliant. 2,314 BCY x 1.2 = 2,777 LCY.
Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 13 days.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Waste Handling/Treatment/Disposal/Transportation				**$20,893,974**

Pit A Waste Area Offsite

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	8,060	hrs	$2.70	$21,762
	1/2 TON 4WD TRUCKS, LARGE VANS	1,860	hrs	$5.45	$10,137
Memo: 3 LATAKY vehicles.					
	Disposal ES MLLW by rail	8,333		$1,030.58	$8,587,823
	Transportation to ES by Gondola	103		$26,933.00	$2,774,099
Memo: Assume 9 bags per car. 926 / 9 = 103 gons.					
	Lift Liner Bags 9 CY	926		$300.00	$277,800
	Loading or Lifting Frames per month	51		$500.00	$25,500
Memo: Rent for 3 months. 11 loading frames and 6 lifting frames. 17 x 3 months = 51.					
	Skid Steer per hour	620	hr	$32.54	$20,175
	18,000 lb Fork Lift per hour	1,240	hr	$32.66	$40,498
	Flat Bed Truck per hour	620	hr	$45.74	$28,359
	30' IC Scissor Lift Rent per hour	620	hr	$14.88	$9,226
	65 Ton Link-Belt Crane GFE cost per hr	620	hr	$25.99	$16,114
	PPE 2 c/o per day 10 hr day cost per hr	8,060		$1.95	$15,717
	Overnight Shipment per Cooler	19		$251.97	$4,787
Memo: Assume 10 samples per cooler.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Waste Handling/Treatment/Disposal/Transportation				**$20,893,974**

Pit A Waste Area Offsite

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
Memo:	Characterization Sampling Soil Cost per Sample	186		$1,148.00	$213,528
Assume 20% sampling rate. 926 / 5 = 186 samples.					
LABOR	PRIME CONTRACTOR LABOR	776,891		$1.00	$776,891
Memo: 10,840 HOURS					

TOTAL Pit A Waste Area Offsite **$12,822,416**

Memo: 6,944 BCY x 1.2 = 8,333 LCY. Load into soft sided bags and ship to ES by rail for disposal. Assume can load 16 bags per day. 8,333 / 9 = 926 bags. / 16 = 58 days + weather/delays = 62 days.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Waste Handling/Treatment/Disposal/Transportation				**$20,893,974**

Burn Area U Landfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	770	hrs	$2.70	$2,079
	1/2 TON 4WD TRUCKS, LARGE VANS	140	hrs	$5.45	$763
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	350	hr	$91.06	$31,871
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	32		$43.00	$1,376
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	19		$1,148.00	$21,812
1,411 LCY / 15 CY = 94. Assume 20% sampling rate. 94 / 5 = 19 samples.					
LABOR	PRIME CONTRACTOR LABOR	55,079		$1.00	$55,079
Memo: 835 HOURS					

TOTAL Burn Area U Landfill **$113,484**

Memo: U Landfill WAC Compliant. 1,176 BCY x 1.2 = 1,411 LCY. Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 7 days.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Waste Handling/Treatment/Disposal/Transportation				**$20,893,974**

Burn Area Offsite

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	650	hrs	$2.70	$1,755
	1/2 TON 4WD TRUCKS, LARGE VANS	150	hrs	$5.45	$818
Memo: 3 LATAKY vehicles.					
	Disposal ES MLLW by rail	470		$1,030.58	$484,373

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Waste Handling/Treatment/Disposal/Transportation				**$20,893,974**

Burn Area Offsite

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	Transportation to ES by Gondola	6		$26,933.00	$161,598
Memo: Assume 9 bags per car. 53 / 9 = 6 gons.					
	Lift Liner Bags 9 CY	53		$300.00	$15,900
	Loading or Lifting Frames per month	17		$500.00	$8,500
Memo: Rent for 1 month. 11 loading frames and 6 lifting frames. 17 x 1 months = 17.					
	Skid Steer per hour	50	hr	$32.54	$1,627
	18,000 lb Fork Lift per hour	100	hr	$32.66	$3,266
	Flat Bed Truck per hour	50	hr	$45.74	$2,287
	30' IC Scissor Lift Rent per hour	50	hr	$14.88	$744
	65 Ton Link-Belt Crane GFE cost per hr	50	hr	$25.99	$1,300
	PPE 2 c/o per day 10 hr day cost per hr	650		$1.95	$1,268
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	11		$1,148.00	$12,628
Memo: Assume 20% sampling rate. 53 / 5 = 11 samples.					
LABOR	PRIME CONTRACTOR LABOR	61,546		$1.00	$61,546
Memo: 861 HOURS					

TOTAL Burn Area Offsite **$758,112**

Memo: 392 BCY x 1.2 = 470 LCY. Load into soft sided bags and ship to ES by rail for disposal. Assume can load 16 bags per day. 470 / 9 = 53 bags. 53 / 16 = 4 days + weather/delays = 5 days.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Waste Handling/Treatment/Disposal/Transportation				**$20,893,974**

Surface Soils

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	2,730	hrs	$2.70	$7,371
	1/2 TON 4WD TRUCKS, LARGE VANS	420	hrs	$5.45	$2,289
Memo: 3 LATAKY vehicles.					
	Disposal ES MLLW by rail	2,614		$1,030.58	$2,693,936
	Transportation to ES by Gondola	33		$26,933.00	$888,789
Memo: Assume 9 bags per car. 291 / 9 = 33 gons.					
	Lift Liner Bags 9 CY	291		$300.00	$87,300
	Loading or Lifting Frames per month	17		$500.00	$8,500
Memo: Rent for 1 month. 11 loading frames and 6 lifting frames. 17 x 1 months = 17.					
	Skid Steer per hour	210	hr	$32.54	$6,833
	18,000 lb Fork Lift per hour	420	hr	$32.66	$13,717
	Flat Bed Truck per hour	210	hr	$45.74	$9,605
	30' IC Scissor Lift Rent per hour	210	hr	$14.88	$3,125

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5				**$27,248,981**
	Capital Costs				**$27,198,844**
	Waste Handling/Treatment/Disposal/Transportation				**$20,893,974**

Surface Soils

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	65 Ton Link-Belt Crane GFE cost per hr	210	hr	$25.99	$5,458
	PPE 2 c/o per day 10 hr day cost per hr	2,730		$1.95	$5,324
	Overnight Shipment per Cooler	6		$251.97	$1,512
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	59		$1,148.00	$67,732
Assume 20% sampling rate. 291 / 5 = 59 samples.					
LABOR	PRIME CONTRACTOR LABOR	223,088		$1.00	$223,088
Memo: 3,109 HOURS					

TOTAL Surface Soils **$4,024,579**

Memo: 2,178 BCY x 1.2 = 2,614 LCY. Load into soft sided bags and ship to ES by rail for disposal. Assume can load 16 bags per day. 2,614 / 9 = 291 bags. 291 / 16 = 19 days + weather/delays = 21 days.

Estimate Tree Structure Rollups		
SWMU 30 Alternative 5	**$27,248,981**
Capital Costs	**$27,198,844**
Excavation Backfill	**$1,089,160**

Backfill

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	B10D R.S.Means Crew	25,266	E.C.Y.	$2.67	$67,396
	B34C R.S.Means Crew	25,266	L.C.Y.	$7.98	$201,604
	Backfill Delivered per CY	25,266		$16.00	$404,256
	LAUNDRY 2 CHANGES COST PER HOUR	1,360	hrs	$2.70	$3,672
Memo: .					
	1/2 TON 4WD TRUCKS, LARGE VANS	680	hrs	$5.45	$3,706
Memo: 2 LATAKY vehicles.					
	Geotechnical Testing Technician per hour	340		$52.19	$17,745
	Geotechnical Testing Density Testing per hour	340		$50.00	$17,000
	RSMeans Crew B-10W cost per day	34		$1,470.00	$49,980
	RSMeans Crew B-10P cost per day	34		$2,129.00	$72,386
	PPE 2 c/o per day 10 hr day cost per hr	1,360		$1.95	$2,652
LABOR	PRIME CONTRACTOR LABOR	179,915		$1.00	$179,915
Memo: 2,039 HOURS					

Subtotal	$1,020,311
1st Layer Markups assigned to Detail Items	$68,849

TOTAL Backfill **$1,089,160**

Memo: 21,055 BCY total removed. 21,055 x 1.2 = 25,266 CY of fill needed. Assume 750 CY filled per day. 25,266 / 750 = 34 days. Fill is stockpiled during other activities and transfered to site as needed.

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 30 Alternative 5			**$27,248,981**
	Annual Costs			**$50,137**
	Five Year Reviews			**$50,137**

Five Year Reviews

Tree Depth= 5

LEVEL		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	50,137	$1.00	$50,137
Memo: 500 HOURS				

TOTAL Five Year Reviews **$50,137**

COST ESTIMATE
BGOU SWMU 30
Alternative 5WDF—Excavation, Disposal, and LUCs

Cost Estimate Summary									
Capital Cost	**Quantity**	**Units**	**Unit Price**	**Total**					
1.0 Remedial Design	1	LS	$1,555,000	$1,555,000					
2.0 Other Project Plans	1	LS	$1,038,000	$1,038,000					
3.0 Excavation	1	LS	$2,015,000	$2,015,000					
4.0 Treat and Dispose of Water	1	LS	$425,000	$425,000					
5.0 Post Remediation Sampling	1	LS	$182,000	$182,000					
6.0 Waste Handling, Treatment, Disposal, and Transportation	1	LS	$2,045,000	$2,045,000					
7.0 Excavation Backfill	1	LS	$1,089,000	$1,089,000					
Subproject Management	1	LS	$834,900	$835,000					Subproject Management = 10%
Management Reserve	1	LS	$1,377,600	$1,378,000					Contractor MR = 15%
Fee	1	LS	$739,340	$739,000					Fee = 7%
Contingency	1	LS	$2,260,200	$2,260,000					Contingency = 20%
			SUBTOTAL CAPITAL COST	**$13,561,000**					
Annual Cost				**Unescalated**			**Escalated (2.8%)**		
Five-Year Review	200	EA	$50,000	$10,000,000			3.82E+17		Every 5 years for 1,000 years
			SUBTOTAL ANNUAL COST	**$10,000,000**			**3.82E+17**		
			TOTAL	**$23,561,000**					
Present Worth Value									
	Quantity	**Unit**	**Unit Cost**	**Total**				**Present Worth**	
Total Capital Cost	1	LS	$13,561,000	$13,561,000				**$13,561,000**	
Five-Year Review	200	EA	$50,000	$10,000,000				**$889,294**	1.1% discount rate
							Capital Costs	**$13,561,000**	
						Present Worth Values	**Annual**	**$889,000**	
							Avg. Annual	**$889**	
							Total	**$14,450,000**	
This is an order-of-magnitude engineering cost estimate that is expected to be within +50 to -30 percent of the actual project cost.									
Not used for budgeting or planning purposes because value is based on investing funds for out year expenditures.									

COST ESTIMATE
BGOU SWMU 30
Alternative 5WDF—Excavation, Disposal, and LUCs

CAPITAL COSTS									
	Material/Equipment/Subcontractors/ODCs				Labor				
Task Description	**Qty**	**Unit**	**Unit Price**	**Total**	**Hours**	**Rate**	**Total**	**Total Cost**	**Basis of Estimate**
1.0 Remedial Design									
Refer to the Success reports for detailed cost and resources.									
RDWP/RDSI Work Plan					4224		$376,224		
Remedial Design Report					8744		$803,933		
Civil Surveying					160		$16,902		
Procurement					634		$52,676		
Work Packages/Readiness					1688		$146,788		
Training	1	LS	$56,000	$56,000	1320		$102,736		$56,000 includes subcontractor training
TASK TOTAL				**$56,000**	**16770**		**$1,499,259**	**$1,555,000**	
2.0 Other Project Plans									
Refer to the Success reports for detailed cost and resources.									
Remedial Action Work Plan					5724		$517,587		
O&M Plan					700		$66,863		
SAP/QAPP					1100		$96,201		
Waste Management Plan					1020		$94,190		
RACR					2274		$212,751		
LUCIP					584		$50,725		
TASK TOTAL				**$0**	**11402**		**$1,038,317**	**$1,038,000**	
3.0 Excavation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Road and Ditch Relocation									
Prime Contractor Labor					575		$49,463		
Subcontractors	1	LS	$64,074	$64,074					
Materials	1	LS	$648	$648					
Vehicles and Equipment	1	LS	$1,744	$1,744					
Pit A Overburden - U Landfill									
Prime Contractor Labor					1215		$104,582		
Subcontractors	1	LS	$57,360	$57,360					
Materials	1	LS	$3,488	$3,488					
Vehicles and Equipment	1	LS	$1,635	$1,635					
Pit A Overburden - Off-Site									
Prime Contractor Labor					972		$83,666		
Subcontractors	1	LS	$95,888	$95,888					
Materials	1	LS	$2,790	$2,790					
Vehicles and Equipment	1	LS	$1,308	$1,308					

COST ESTIMATE
BGOU SWMU 30
Alternative 5WDF—Excavation, Disposal, and LUCs

Pit A Slopeback - U Landfill									
Prime Contractor Labor					1620		$139,443		
Subcontractors	1	LS	$76,480	$76,480					
Materials	1	LS	$4,650	$4,650					
Vehicles and Equipment	1	LS	$2,180	$2,180					
Pit A Slopeback - Off-Site									
Prime Contractor Labor					405		$34,861		
Subcontractors	1	LS	$19,120	$19,120					
Materials	1	LS	$1,163	$1,163					
Vehicles and Equipment	1	LS	$545	$545					
Pit A Waste Area - U Landfill									
Prime Contractor Labor					1053		$90,638		
Subcontractors	1	LS	$49,712	$49,712					
Materials	1	LS	$3,023	$3,023					
Vehicles and Equipment	1	LS	$1,417	$1,417					
Pit A Waste Area - Off-Site									
Prime Contractor Labor					6075		$522,912		
Subcontractors	1	LS	$286,800	$286,800					
Materials	1	LS	$17,438	$17,438					
Vehicles and Equipment	1	LS	$8,175	$8,175					
Burn Area - U Landfill									
Prime Contractor Labor					648		$55,777		
Subcontractors	1	LS	$30,592	$30,592					
Materials	1	LS	$1,860	$1,860					
Vehicles and Equipment	1	LS	$872	$872					
Burn Area - Off-Site									
Prime Contractor Labor					486		$41,833		
Subcontractors	1	LS	$22,944	$22,944					
Materials	1	LS	$1,395	$1,395					
Vehicles and Equipment	1	LS	$654	$654					
Surface Soils									
Prime Contractor Labor					972		$83,666		
Subcontractors	1	LS	$45,888	$45,888					
Materials	1	LS	$2,790	$2,790					
Vehicles and Equipment	1	LS	$1,308	$1,308					
TASK TOTALS				**$807,939**	**14,021**		**$1,206,841**	**$2,015,000**	

COST ESTIMATE
BGOU SWMU 30
Alternative 5WDF—Excavation, Disposal, and LUCs

4.0 Treat and Dispose of Water									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Water Treatment									
Prime Contractor Labor					1992		$141,771		
Subcontractors	1	LS	$214,645	$214,645					Rainforrent.com and RSMeans
Materials	1	LS	$6,176	$6,176					
Vehicles and Equipment	1	LS	$7,238	$7,238					
Water Disposal									
Prime Contractor Labor					80		$4,550		
Characterization Sampling	1	LS	$34,328	$34,328					
Vehicles and Equipment	1	LS	$16,667	$16,667					
TASK TOTALS				**$279,054**	**2,072**		**$146,321**	**$425,000**	
5.0 Post Remediation Sampling									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Sampling									
Prime Contractor Labor					400		$29,217		
Materials	1	LS	$3,248	$3,248					
Analytical									
Prime Contractor Labor					112		$10,206		
Materials	1	LS	$139,307	$139,307					
TASK TOTAL				**$ 142,555**	**512**		**$39,423**	**$182,000**	
6.0 Waste Handling, Treatment, Disposal, and Transportation									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Pit A Overburden - U Landfill									
Prime Contractor Labor					1795		$118,440		
Materials	1	LS	$7,637	$7,637					
Characterization Sampling	1	LS	$52,920	$52,920					
Vehicles and Equipment	1	LS	$69,930	$69,930					
Pit A Overburden - OSWDF									
Prime Contractor Labor					889		$59,658		
Materials	1	LS	$5,654	$5,654					
Characterization Sampling	1	LS	$14,280	$14,280					
Vehicles and Equipment	1	LS	$27,671	$27,671					
Transportation	1	LS	$0	$0					Costs contained in LATA Kentucky equipment and labor
Pit A Slopeback - U Landfill									
Prime Contractor Labor					2624		$173,101		
Materials	1	LS	$11,178	$11,178					
Characterization Sampling	1	LS	$76,384	$76,384					
Vehicles and Equipment	1	LS	$102,564	$102,564					
Pit A Slopeback - OSWDF									
Prime Contractor Labor					527		$35,324		
Materials	1	LS	$2,867	$2,867					
Characterization Sampling	1	LS	$4,844	$4,844					
Vehicles and Equipment	1	LS	$16,603	$16,603					
Transportation	1	LS	$0	$0					Costs contained in LATA Kentucky equipment and labor

COST ESTIMATE
BGOU SWMU 30
Alternative 5WDF—Excavation, Disposal, and LUCs

Pit A Waste Area - U Landfill									
Prime Contractor Labor					1559		$102,864		
Materials	1	LS	$6,527	$6,527					
Characterization Sampling	1	LS	$44,632	$44,632					
Vehicles and Equipment	1	LS	$60,606	$60,606					
Pit A Waste Area - OSWDF									
Prime Contractor Labor					5374		$360,762		
Materials	1	LS	$36,837	$36,837					
Characterization Sampling	1	LS	$98,700	$98,700					
Vehicles and Equipment	1	LS	$166,026	$166,026					
Transportation	1	LS	$0	$0					Costs contained in LATA Kentucky equipment and labor
Burn Area - U Landfill									
Prime Contractor Labor					835		$55,079		
Materials	1	LS	$3,455	$3,455					
Characterization Sampling	1	LS	$22,316	$22,316					
Vehicles and Equipment	1	LS	$32,634	$32,634					
Burn Area - OSWDF									
Prime Contractor Labor					529		$35,473		
Materials	1	LS	$3,047	$3,047					
Characterization Sampling	1	LS	$5,992	$5,992					
Vehicles and Equipment	1	LS	$16,603	$16,603					
Transportation	1	LS	$0	$0					Costs contained in LATA Kentucky equipment and labor
Surface Soils									
Prime Contractor Labor					1792		$120,304		
Materials	1	LS	$7,275	$7,275					
Characterization Sampling	1	LS	$31,752	$31,752					
Vehicles and Equipment	1	LS	$55,342	$55,342					
Transportation	1	LS	$0	$0					Costs contained in LATA Kentucky equipment and labor
TASK TOTALS				**$984,275**	**15,924**		**$1,061,005**	**$2,045,000**	

COST ESTIMATE
BGOU SWMU 30
Alternative 5WDF—Excavation, Disposal, and LUCs

7.0 Excavation Backfill									
Refer to the Success reports for detailed cost and resources. 'Subcontractors' line item determined from RSMeans unless otherwise stated									
and therefore includes labor, material, and equipment where applicable.									
Backfill									
Prime Contractor Labor					2039		$179,915		
Subcontractors	1	LS	$899,215	$899,215					RSMeans and local engineering firm
Materials	1	LS	$6,324	$6,324					
Vehicles and Equipment	1	LS	$3,706	$3,706					
TASK TOTAL				**$909,245**	**2039**		**$179,915**	**$1,089,000**	
							SUBTOTAL CAPITAL COST	**$8,349,000**	
ANNUAL COSTS									
Five-Year Review									
Duration: Every 5 years.									
Prime Contractor Labor					500		$50,137		
TASK TOTAL							$50,137	**$50,000**	EVERY 5 YEARS

DETAIL REPORT NO.4A

SWMUs 2,3,7&30 Feasibility Study

Reported From: **SWMU 30 Alternative 5WDF**
Report Total: **$8,400,284**

Author
Manager

LEVEL	QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups		
	SWMU 30 Alternative 5WDF		**$8,400,284**
	Capital Costs		**$8,350,147**
	Remedial Desgin		**$1,555,259**

RDWP/RDSI Work Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	376,224	$1.00	$376,224

Memo: 4,224 HOURS

TOTAL RDWP/RDSI Work Plan **$376,224**

Estimate Tree Structure Rollups		
SWMU 30 Alternative 5WDF		**$8,400,284**
Capital Costs		**$8,350,147**
Remedial Desgin		**$1,555,259**

RDR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	803,933	$1.00	$803,933

Memo: 8,744 HOURS

TOTAL RDR **$803,933**

Estimate Tree Structure Rollups		
SWMU 30 Alternative 5WDF		**$8,400,284**
Capital Costs		**$8,350,147**
Remedial Desgin		**$1,555,259**

Civil Surveying

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	16,902	$1.00	$16,902

Memo: 160 HOURS

TOTAL Civil Surveying **$16,902**

Estimate Tree Structure Rollups		
SWMU 30 Alternative 5WDF		**$8,400,284**
Capital Costs		**$8,350,147**
Remedial Desgin		**$1,555,259**

Procurement

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	52,676	$1.00	$52,676

Memo: 634 HOURS

TOTAL Procurement **$52,676**

Estimate Tree Structure Rollups		
SWMU 30 Alternative 5WDF		**$8,400,284**
Capital Costs		**$8,350,147**
Remedial Desgin		**$1,555,259**

Work Packages/Readiness Review

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	146,788	$1.00	$146,788

Memo: 1,688 HOURS

TOTAL Work Packages/Readiness Review **$146,788**

LEVEL		QTY	UNIT COST	TOTAL
	Estimate Tree Structure Rollups			
	SWMU 30 Alternative 5WDF			**$8,400,284**
	Capital Costs			**$8,350,147**
	Remedial Desgin			**$1,555,259**

Training

Tree Depth= 5

		QTY	UNIT COST	TOTAL
Memo:	Training for Subcontractors per Person per Hour	800	$70.00	$56,000
	Assume 80 hours of training per person. Assume 10 people or 800 hours.			
LABOR	PRIME CONTRACTOR LABOR	102,736	$1.00	$102,736
Memo: 1,320 HOURS				

TOTAL Training **$158,736**
Memo: Assume 40 hours training required for LATAKY employees and 80 hours of training for subcontractors.

		TOTAL
	Estimate Tree Structure Rollups	
	SWMU 30 Alternative 5WDF	**$8,400,284**
	Capital Costs	**$8,350,147**
	Other Project Plans	**$1,038,317**

RAWP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	517,587	$1.00	$517,587
Memo: 5,724 HOURS				

TOTAL RAWP **$517,587**

		TOTAL
	Estimate Tree Structure Rollups	
	SWMU 30 Alternative 5WDF	**$8,400,284**
	Capital Costs	**$8,350,147**
	Other Project Plans	**$1,038,317**

O&M Plan

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	66,863	$1.00	$66,863
Memo: 700 HOURS				

TOTAL O&M Plan **$66,863**

		TOTAL
	Estimate Tree Structure Rollups	
	SWMU 30 Alternative 5WDF	**$8,400,284**
	Capital Costs	**$8,350,147**
	Other Project Plans	**$1,038,317**

SAP/QAPP

Tree Depth= 5

		QTY	UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	96,201	$1.00	$96,201
Memo: 1,100 HOURS				

TOTAL SAP/QAPP **$96,201**

SWMUs 2,3,7&30 Feasibility Study

Reported From: SWMU 30 Alternative 5WDF
Report Total: $8,400,284

Author
Manager

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Other Project Plans				**$1,038,317**

Waste Management Plan

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	94,190		$1.00	$94,190
Memo: 1,020 HOURS					

TOTAL Waste Management Plan **$94,190**

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Other Project Plans				**$1,038,317**

RACR

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	212,751		$1.00	$212,751
Memo: 2,274 HOURS					

TOTAL RACR **$212,751**

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Other Project Plans				**$1,038,317**

LUCIP

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	50,725		$1.00	$50,725
Memo: 584 HOURS					

TOTAL LUCIP **$50,725**

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Excavation				**$2,014,780**

Road and Ditch Relocation

Tree Depth= 5

	B34K R.S.Means Crew	4	Ea.	$423.07	$1,692
	B38 R.S.Means Crew	470	S.Y.	$6.76	$3,176
Memo: 350 lf x 12' wide = 4,200 SF or 470 SY. Remove existing pavement.					
	B13H R.S.Means Crew	777	B.C.Y.	$8.68	$6,747
Memo: 350' x 4' x 15' / 27 = 777 CY. Excavate new ditch.					
	B13H R.S.Means Crew	195	B.C.Y.	$8.68	$1,693
Memo: 350' x 1' x 15' / 27 = 195 CY. Muck existing ditch.					
	B10D R.S.Means Crew	777	E.C.Y.	$2.67	$2,073
	B34C R.S.Means Crew	777	L.C.Y.	$7.98	$6,200
	Backfill Delivered per CY	777		$16.00	$12,432
	B13 R.S.Means Crew	60	L.F.	$95.05	$5,703
Memo: (2) 30 foot culverts.					
	B25C R.S.Means Crew	4,200	S.F.	$3.42	$14,386
Memo: Repave road.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Excavation				**$2,014,780**

Road and Ditch Relocation

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	240	hrs	$2.70	$648
	1/2 TON 4WD TRUCKS, LARGE VANS	320	hrs	$5.45	$1,744
Memo: 4 LATAKY vehicles.					
LABOR	PRIME CONTRACTOR LABOR	49,463		$1.00	$49,463
Memo: 575 HOURS					
Subtotal					$105,958
1st Layer Markups assigned to Detail Items					$9,972
TOTAL Road and Ditch Relocation					**$115,929**

Memo: 2 week duration.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Excavation				**$2,014,780**

Pit A Overburden U Landfill

Tree Depth= 5

	RSMeans Crew B-10W cost per day	15		$1,470.00	$22,050
	RSMeans Crew B-12C cost per day	15		$2,354.00	$35,310
	LAUNDRY 2 CHANGES COST PER HOUR	750	hrs	$2.70	$2,025
	1/2 TON 4WD TRUCKS, LARGE VANS	300	hrs	$5.45	$1,635
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	750		$1.95	$1,463
LABOR	PRIME CONTRACTOR LABOR	104,582		$1.00	$104,582
Memo: 1,215 HOURS					
TOTAL Pit A Overburden U Landfill					**$167,065**

Memo: 2,778 BCY. Assume 225 CY per day so 13 days + weather/delays. Assume 15 day duration.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Excavation				**$2,014,780**

Pit A Overburden Offsite

Tree Depth= 5

	RSMeans Crew B-10W cost per day	12		$1,470.00	$17,640
	RSMeans Crew B-12C cost per day	12		$2,354.00	$28,248
	Mob/Demob of Subcontractor and Equipment	1	LS	$50,000.00	$50,000
	LAUNDRY 2 CHANGES COST PER HOUR	600	hrs	$2.70	$1,620
	1/2 TON 4WD TRUCKS, LARGE VANS	240	hrs	$5.45	$1,308
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	600		$1.95	$1,170

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Excavation				**$2,014,780**

Pit A Overburden Offsite

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	83,666		$1.00	$83,666
Memo: 972 HOURS					

TOTAL Pit A Overburden Offsite **$183,652**

Memo: 925 BCY. Assume 100 CY per day so 10 days + weather/delays. Assume 12 day duration.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Excavation				**$2,014,780**

Pit A Slopeback U Landfill

Tree Depth= 5

	RSMeans Crew B-10W cost per day	20		$1,470.00	$29,400
	RSMeans Crew B-12C cost per day	20		$2,354.00	$47,080
	LAUNDRY 2 CHANGES COST PER HOUR	1,000	hrs	$2.70	$2,700
	1/2 TON 4WD TRUCKS, LARGE VANS	400	hrs	$5.45	$2,180
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	1,000		$1.95	$1,950
LABOR	PRIME CONTRACTOR LABOR	139,443		$1.00	$139,443
Memo: 1,620 HOURS					

TOTAL Pit A Slopeback U Landfill **$222,753**

Memo: 4,043 BCY. Excavating and moving a 225 CY per day, so 18 days plus weather/delays is 20 days.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Excavation				**$2,014,780**

Pit A Slopeback Offsite

Tree Depth= 5

	RSMeans Crew B-10W cost per day	5		$1,470.00	$7,350
	RSMeans Crew B-12C cost per day	5		$2,354.00	$11,770
	LAUNDRY 2 CHANGES COST PER HOUR	250	hrs	$2.70	$675
	1/2 TON 4WD TRUCKS, LARGE VANS	100	hrs	$5.45	$545
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	250		$1.95	$488
LABOR	PRIME CONTRACTOR LABOR	34,861		$1.00	$34,861
Memo: 405 HOURS					

TOTAL Pit A Slopeback Offsite **$55,689**

Memo: 305 BCY. Excavating and moving a 100 CY per day, so 3 days plus weather/delays is 5 days.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Excavation				**$2,014,780**

Pit A Waste Area U Landfill

Tree Depth= 5

	RSMeans Crew B-10W cost per day	13		$1,470.00	$19,110
	RSMeans Crew B-12C cost per day	13		$2,354.00	$30,602
	LAUNDRY 2 CHANGES COST PER HOUR	650	hrs	$2.70	$1,755
	1/2 TON 4WD TRUCKS, LARGE VANS	260	hrs	$5.45	$1,417
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	650		$1.95	$1,268
LABOR	PRIME CONTRACTOR LABOR	90,638		$1.00	$90,638
Memo: 1,053 HOURS					

TOTAL Pit A Waste Area U Landfill **$144,790**
Memo: 2,314 BCY. Excavating and moving a 225 CY per day, so 11 days plus weather/delays is 13 days.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Excavation				**$2,014,780**

Pit A Waste Area Offsite

Tree Depth= 5

	RSMeans Crew B-10W cost per day	75		$1,470.00	$110,250
	RSMeans Crew B-12C cost per day	75		$2,354.00	$176,550
	LAUNDRY 2 CHANGES COST PER HOUR	3,750	hrs	$2.70	$10,125
	1/2 TON 4WD TRUCKS, LARGE VANS	1,500	hrs	$5.45	$8,175
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	3,750		$1.95	$7,313
LABOR	PRIME CONTRACTOR LABOR	522,912		$1.00	$522,912
Memo: 6,075 HOURS					

TOTAL Pit A Waste Area Offsite **$835,325**
Memo: 6,944 BCY. Excavating and moving a 100 CY per day, so 70 days plus weather/delays is 75 days.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Excavation				**$2,014,780**

Burn Area U Landfill

Tree Depth= 5

	RSMeans Crew B-10W cost per day	8		$1,470.00	$11,760
	RSMeans Crew B-12C cost per day	8		$2,354.00	$18,832
	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
	1/2 TON 4WD TRUCKS, LARGE VANS	160	hrs	$5.45	$872
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Excavation				**$2,014,780**

Burn Area U Landfill

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	55,777		$1.00	$55,777
Memo: 648 HOURS					

TOTAL Burn Area U Landfill **$89,101**

Memo: 1,176 BCY. Excavating and moving a 225 CY per day, so 6 days plus weather/delays is 8 days.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Excavation				**$2,014,780**

Burn Area Offsite

Tree Depth= 5

	RSMeans Crew B-10W cost per day	6		$1,470.00	$8,820
	RSMeans Crew B-12C cost per day	6		$2,354.00	$14,124
	LAUNDRY 2 CHANGES COST PER HOUR	300	hrs	$2.70	$810
	1/2 TON 4WD TRUCKS, LARGE VANS	120	hrs	$5.45	$654
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	300		$1.95	$585
LABOR	PRIME CONTRACTOR LABOR	41,833		$1.00	$41,833
Memo: 486 HOURS					

TOTAL Burn Area Offsite **$66,826**

Memo: 392 BCY. Excavating and moving a 100 CY per day, so 4 days plus weather/delays is 6 days.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Excavation				**$2,014,780**

Surface Soils

Tree Depth= 5

	RSMeans Crew B-10W cost per day	12		$1,470.00	$17,640
	RSMeans Crew B-12C cost per day	12		$2,354.00	$28,248
	LAUNDRY 2 CHANGES COST PER HOUR	600	hrs	$2.70	$1,620
	1/2 TON 4WD TRUCKS, LARGE VANS	240	hrs	$5.45	$1,308
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	600		$1.95	$1,170
LABOR	PRIME CONTRACTOR LABOR	83,666		$1.00	$83,666
Memo: 972 HOURS					

TOTAL Surface Soils **$133,652**

Memo: 2,178 BCY. Excavating and moving a 225 CY per day, so 10 days plus weather/delays is 12 days.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Treat and Dispose of Water				**$425,375**

Water Treatment

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	B10H R.S.Means Crew	166	Day	$581.53	$96,535
	Water Treatment System w/ Tanks per month	8		$7,785.00	$62,280
Memo: Packaged system with 2 frac tanks.					
	LAUNDRY 2 CHANGES COST PER HOUR	1,328	hrs	$2.70	$3,586
	1/2 TON 4WD TRUCKS, LARGE VANS	1,328	hrs	$5.45	$7,238
Memo: 2 LATAKY vehicles.					
	PPE 2 c/o per day 10 hr day cost per hr	1,328		$1.95	$2,590
LABOR	PRIME CONTRACTOR LABOR	141,771		$1.00	$141,771
Memo: 1,992 HOURS					
Subtotal					$313,999
1st Layer Markups assigned to Detail Items					$55,832
TOTAL Water Treatment					**$369,830**

Memo: 8 months

	Estimate Tree Structure Rollups		
	SWMU 30 Alternative 5WDF		**$8,400,284**
	Capital Costs		**$8,350,147**
	Treat and Dispose of Water		**$425,375**

Water Disposal

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	Water Truck 10k Gallon cost per hr	80	hr	$208.34	$16,667
	Overnight Shipment per Cooler	4		$251.97	$1,008
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Water Cost per Sample	40		$833.00	$33,320
LABOR	PRIME CONTRACTOR LABOR	4,550		$1.00	$4,550
Memo: 80 HOURS					
TOTAL Water Disposal					**$55,545**

Memo (Characterization Sampling):
Assume Frac tanks will be emptied every 2 months.
4 * 5 tanks * 20,000 gallons = 400,000 gallons.
Assume a water sample will be taken from each water truck (10,000 gallons).
400,000 gallons / 10,000 = 40 samples.

	Estimate Tree Structure Rollups		
	SWMU 30 Alternative 5WDF		**$8,400,284**
	Capital Costs		**$8,350,147**
	Post Remediation Sampling		**$181,978**

Sampling

Tree Depth= 5

LEVEL	Description	QTY	Unit	UNIT COST	TOTAL
	5 gram EN CORE SAMPLER	200		$6.94	$1,388
	LAUNDRY 2 CHANGES COST PER HOUR	400	hrs	$2.70	$1,080
LABOR	PRIME CONTRACTOR LABOR	29,217		$1.00	$29,217
Memo: 400 HOURS					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Post Remediation Sampling				**$181,978**

Sampling

Tree Depth= 5

		QTY		UNIT COST	TOTAL
	PPE 2 c/o per day 10 hr day cost per hr	400		$1.95	$780

TOTAL Sampling **$32,465**
Memo: Total is 122 samples. 2 weeks.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Post Remediation Sampling				**$181,978**

Analytical

Tree Depth= 5

		QTY		UNIT COST	TOTAL
	Overnight Shipment per Cooler	21		$251.97	$5,291
Memo: Assume 2 shipments per day for 10 days plus 1 shipment later for the waste water.					
	RDSI Soil Sampling Analytical	0.51		$262,775.00	$134,015
Memo: MANAL114 is for 240 samples. 122 / 240 = .51					
LABOR	PRIME CONTRACTOR LABOR	10,206		$1.00	$10,206
Memo: 112 HOURS					

TOTAL Analytical **$149,513**

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Waste Handling/Treatment/Disposal/Transportation				**$2,045,278**

Pit A Overburden U Landfill

Tree Depth= 5

		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	1,650	hrs	$2.70	$4,455
	1/2 TON 4WD TRUCKS, LARGE VANS	300	hrs	$5.45	$1,635
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	750	hr	$91.06	$68,295
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	74		$43.00	$3,182
	Overnight Shipment per Cooler	5		$251.97	$1,260
Memo: Assume 10 samples per cooler.					
Memo:	Characterization Sampling Soil Cost per Sample	45		$1,148.00	$51,660
3,334 LCY / 15 CY = 222. Assume 20% sampling rate. 222 / 5 = 45 samples.					
LABOR	PRIME CONTRACTOR LABOR	118,440		$1.00	$118,440
Memo: 1,795 HOURS					

TOTAL Pit A Overburden U Landfill **$248,927**
Memo: U Landfill WAC Compliant. 2,778 BCY x 1.2 = 3,334 LCY.
Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 15 days.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Waste Handling/Treatment/Disposal/Transportation				**$2,045,278**

Pit A Overburden OSWDF

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	750	hrs	$2.70	$2,025
	1/2 TON 4WD TRUCKS, LARGE VANS	150	hrs	$5.45	$818
Memo: 3 LATAKY vehicles.					
	Skid Steer per hour	50	hr	$32.54	$1,627
	30' IC Scissor Lift Rent per hour	50	hr	$14.88	$744
	Roll Off Bin monthly rental	2.50		$60.00	$150
Memo: 10 bins for .25 months.					
	Roll Off Bin Truck per hour	250	hr	$97.93	$24,483
Memo: 5 trucks for 5 days.					
	Roll Off Bin Liner	56		$36.00	$2,016
	PPE 2 c/o per day 10 hr day cost per hr	750		$1.95	$1,463
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 10 samples per cooler.					
Memo: 1,110 LCY / 20 CY = 56. Assume 20% sampling rate. 56 / 5 = 12 samples.	Characterization Sampling Soil Cost per Sample	12		$1,148.00	$13,776
LABOR	PRIME CONTRACTOR LABOR	59,658		$1.00	$59,658
Memo: 889 HOURS					

TOTAL Pit A Overburden OSWDF **$107,262**

Memo: 925 BCY x 1.2 = 1,110 LCY. Load into roll off bins and transfer to the WDF by truck. Assume each roll off can hold 20 CY and we can load 15 trucks per day. 1,110 / 300 = 4 days plus weather/delays = 5 days.

Estimate Tree Structure Rollups		
SWMU 30 Alternative 5WDF	**$8,400,284**
Capital Costs	**$8,350,147**
Waste Handling/Treatment/Disposal/Transportation	**$2,045,278**

Pit A Slopeback U Landfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	2,420	hrs	$2.70	$6,534
	1/2 TON 4WD TRUCKS, LARGE VANS	440	hrs	$5.45	$2,398
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	1,100	hr	$91.06	$100,166
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	108		$43.00	$4,644
	Overnight Shipment per Cooler	7		$251.97	$1,764
Memo: Assume 10 samples per cooler.					
Memo: 4,852 LCY / 15 CY = 323. Assume 20% sampling rate. 323 / 5 = 65 samples.	Characterization Sampling Soil Cost per Sample	65		$1,148.00	$74,620

LEVEL		QTY		UNIT COST	TOTAL

Estimate Tree Structure Rollups
SWMU 30 Alternative 5WDF **$8,400,284**
Capital Costs **$8,350,147**
Waste Handling/Treatment/Disposal/Transportation **$2,045,278**

Pit A Slopeback U Landfill

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	173,101		$1.00	$173,101
Memo: 2,624 HOURS					

TOTAL Pit A Slopeback U Landfill **$363,227**

Memo: U Landfill WAC Compliant. 4,043 BCY x 1.2 = 4,852 LCY. Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 22 days.

Estimate Tree Structure Rollups
SWMU 30 Alternative 5WDF **$8,400,284**
Capital Costs **$8,350,147**
Waste Handling/Treatment/Disposal/Transportation **$2,045,278**

Pit A Slopeback OSWDF

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	450	hrs	$2.70	$1,215
	1/2 TON 4WD TRUCKS, LARGE VANS	90	hrs	$5.45	$491
Memo: 3 LATAKY vehicles.					
	Skid Steer per hour	30	hr	$32.54	$976
	30' IC Scissor Lift Rent per hour	30	hr	$14.88	$446
	Roll Off Bin monthly rental	1.50		$60.00	$90
Memo: 10 bins for .15 months.					
	Roll Off Bin Truck per hour	150	hr	$97.93	$14,690
Memo: 5 trucks for 3 days.					
	Roll Off Bin Liner	19		$36.00	$684
	PPE 2 c/o per day 10 hr day cost per hr	450		$1.95	$878
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 10 samples per cooler.					
	Characterization Sampling Soil Cost per Sample	4		$1,148.00	$4,592
Memo: 366 LCY / 20 CY = 18. Assume 20% sampling rate. 18 / 5 = 4 samples.					
LABOR	PRIME CONTRACTOR LABOR	35,324		$1.00	$35,324
Memo: 527 HOURS					

TOTAL Pit A Slopeback OSWDF **$59,637**

Memo: 305 BCY x 1.2 = 366 LCY. Load into roll off bins and transfer to the WDF by truck. Assume each roll off can hold 20 CY and we can load 15 trucks per day. 366 / 300 = 2 days plus weather/delays = 3 days.

Estimate Tree Structure Rollups
SWMU 30 Alternative 5WDF **$8,400,284**
Capital Costs **$8,350,147**
Waste Handling/Treatment/Disposal/Transportation **$2,045,278**

Pit A Waste Area U Landfill

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	1,430	hrs	$2.70	$3,861
	1/2 TON 4WD TRUCKS, LARGE VANS	260	hrs	$5.45	$1,417
Memo: 2 LATAKY vehicles.					

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Waste Handling/Treatment/Disposal/Transportation				**$2,045,278**

Pit A Waste Area U Landfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	15 CY Dump Truck per hour	650	hr	$91.06	$59,189
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	62		$43.00	$2,666
	Overnight Shipment per Cooler	4		$251.97	$1,008
Memo: Assume 10 samples per cooler.					
Memo: 2,777 LCY / 15 CY = 185. Assume 20% sampling rate. 185 / 5 = 38 samples.	Characterization Sampling Soil Cost per Sample	38		$1,148.00	$43,624
LABOR	PRIME CONTRACTOR LABOR	102,864		$1.00	$102,864
Memo: 1,559 HOURS					

TOTAL Pit A Waste Area U Landfill **$214,629**

Memo: U Landfill WAC Compliant. 2,314 BCY x 1.2 = 2,777 LCY. Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 13 days.

	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Waste Handling/Treatment/Disposal/Transportation				**$2,045,278**

Pit A Waste Area OSWDF

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	4,500	hrs	$2.70	$12,150
	1/2 TON 4WD TRUCKS, LARGE VANS	900	hrs	$5.45	$4,905
Memo: 3 LATAKY vehicles.					
	Skid Steer per hour	300	hr	$32.54	$9,762
	30' IC Scissor Lift Rent per hour	300	hr	$14.88	$4,464
	Roll Off Bin monthly rental	15		$60.00	$900
Memo: 10 bins for 1.5 months.					
	Roll Off Bin Truck per hour	1,500	hr	$97.93	$146,895
Memo: 5 trucks for 30 days.					
	Roll Off Bin Liner	417		$36.00	$15,012
	PPE 2 c/o per day 10 hr day cost per hr	4,500		$1.95	$8,775
	Overnight Shipment per Cooler	9		$251.97	$2,268
Memo: Assume 10 samples per cooler.					
Memo: 8,333 LCY / 20 CY = 417. Assume 20% sampling rate. 417 / 5 = 84 samples.	Characterization Sampling Soil Cost per Sample	84		$1,148.00	$96,432
LABOR	PRIME CONTRACTOR LABOR	360,762		$1.00	$360,762
Memo: 5,374 HOURS					

TOTAL Pit A Waste Area OSWDF **$662,325**

Memo: 6.944 BCY x 1.2 = 8.333 LCY. Load into roll off bins and transfer to the WDF by truck. Assume each roll off can hold 20 CY and we can load 15 trucks per day. 8,333 / 300 = 28 days plus weather/delays = 30 days.

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Waste Handling/Treatment/Disposal/Transportation				**$2,045,278**

Burn Area U Landfill

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	770	hrs	$2.70	$2,079
	1/2 TON 4WD TRUCKS, LARGE VANS	140	hrs	$5.45	$763
Memo: 2 LATAKY vehicles.					
	15 CY Dump Truck per hour	350	hr	$91.06	$31,871
Memo: 5 trucks for 48 days.					
	Dump Truck Liner	32		$43.00	$1,376
	Overnight Shipment per Cooler	2		$251.97	$504
Memo: Assume 10 samples per cooler.					
Memo: 1,411 LCY / 15 CY = 94. Assume 20% sampling rate. 94 / 5 = 19 samples.	Characterization Sampling Soil Cost per Sample	19		$1,148.00	$21,812
LABOR	PRIME CONTRACTOR LABOR	55,079		$1.00	$55,079
Memo: 835 HOURS					

TOTAL Burn Area U Landfill **$113,484**

Memo: U Landfill WAC Compliant. 1,176 BCY x 1.2 = 1,411 LCY.
Haul using dump trucks. At 225 CY per day, need 5 trucks, 3 trips each per day. 7 days.

	Estimate Tree Structure Rollups	
	SWMU 30 Alternative 5WDF	**$8,400,284**
	Capital Costs	**$8,350,147**
	Waste Handling/Treatment/Disposal/Transportation	**$2,045,278**

Burn Area OSWDF

Tree Depth= 5

LEVEL	DESCRIPTION	QTY	UNIT	UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	450	hrs	$2.70	$1,215
	1/2 TON 4WD TRUCKS, LARGE VANS	90	hrs	$5.45	$491
Memo: 3 LATAKY vehicles.					
	Skid Steer per hour	30	hr	$32.54	$976
	30' IC Scissor Lift Rent per hour	30	hr	$14.88	$446
	Roll Off Bin monthly rental	1.50		$60.00	$90
Memo: 10 bins for .15 months.					
	Roll Off Bin Truck per hour	150	hr	$97.93	$14,690
Memo: 5 trucks for 3 days.					
	Roll Off Bin Liner	24		$36.00	$864
	PPE 2 c/o per day 10 hr day cost per hr	450		$1.95	$878
	Overnight Shipment per Cooler	1		$251.97	$252
Memo: Assume 10 samples per cooler.					
Memo: 470 LCY / 20 CY = 24. Assume 20% sampling rate. 24 / 5 = 5 samples.	Characterization Sampling Soil Cost per Sample	5		$1,148.00	$5,740

LEVEL		QTY		UNIT COST	TOTAL

Estimate Tree Structure Rollups
SWMU 30 Alternative 5WDF **$8,400,284**
Capital Costs **$8,350,147**
Waste Handling/Treatment/Disposal/Transportation **$2,045,278**

Burn Area OSWDF

Tree Depth= 5

LABOR	PRIME CONTRACTOR LABOR	35,473		$1.00	$35,473
Memo: 529 HOURS					

TOTAL Burn Area OSWDF **$61,114**

Memo: 392 BCY x 1.2 = 470 LCY. Load into roll off bins and transfer to the WDF by truck. Assume each roll off can hold 20 CY and we can load 15 trucks per day. 470 / 300 = 2 days plus weather/delays = 3 days.

Estimate Tree Structure Rollups
SWMU 30 Alternative 5WDF **$8,400,284**
Capital Costs **$8,350,147**
Waste Handling/Treatment/Disposal/Transportation **$2,045,278**

Surface Soils

Tree Depth= 5

	LAUNDRY 2 CHANGES COST PER HOUR	1,500	hrs	$2.70	$4,050
	1/2 TON 4WD TRUCKS, LARGE VANS	300	hrs	$5.45	$1,635
Memo: 3 LATAKY vehicles.					
	Skid Steer per hour	100	hr	$32.54	$3,254
	30' IC Scissor Lift Rent per hour	100	hr	$14.88	$1,488
	Roll Off Bin monthly rental	5		$60.00	$300
Memo: 10 bins for .5 months.					
	Roll Off Bin Truck per hour	500	hr	$97.93	$48,965
Memo: 5 trucks for 10 days.					
	PPE 2 c/o per day 10 hr day cost per hr	1,500		$1.95	$2,925
	Overnight Shipment per Cooler	3		$251.97	$756
Memo: Assume 10 samples per cooler.					
Memo: 2,614 LCY / 20 CY = 131. Assume 20% sampling rate. 131 / 5 = 27 samples.	Characterization Sampling Soil Cost per Sample	27		$1,148.00	$30,996
LABOR	PRIME CONTRACTOR LABOR	120,304		$1.00	$120,304
Memo: 1,792 HOURS					

TOTAL Surface Soils **$214,673**

Memo: 2,178 BCY x 1.2 = 2,614 LCY. Load into roll off bins and transfer to the WDF by truck. Assume each roll off can hold 20 CY and we can load 15 trucks per day. 2,614 / 300 = 9 days plus weather/delays = 10 days.

Estimate Tree Structure Rollups
SWMU 30 Alternative 5WDF **$8,400,284**
Capital Costs **$8,350,147**
Excavation Backfill **$1,089,160**

Backfill

Tree Depth= 5

	B10D R.S.Means Crew	25,266	E.C.Y.	$2.67	$67,396
	B34C R.S.Means Crew	25,266	L.C.Y.	$7.98	$201,604
	Backfill Delivered per CY	25,266		$16.00	$404,256

LEVEL		QTY		UNIT COST	TOTAL
	Estimate Tree Structure Rollups				
	SWMU 30 Alternative 5WDF				**$8,400,284**
	Capital Costs				**$8,350,147**
	Excavation Backfill				**$1,089,160**

Backfill

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
	LAUNDRY 2 CHANGES COST PER HOUR	1,360	hrs	$2.70	$3,672
Memo: .					
	1/2 TON 4WD TRUCKS, LARGE VANS	680	hrs	$5.45	$3,706
Memo: 2 LATAKY vehicles.					
	Geotechnical Testing Technician per hour	340		$52.19	$17,745
	Geotechnical Testing Density Testing per hour	340		$50.00	$17,000
	RSMeans Crew B-10W cost per day	34		$1,470.00	$49,980
	RSMeans Crew B-10P cost per day	34		$2,129.00	$72,386
	PPE 2 c/o per day 10 hr day cost per hr	1,360		$1.95	$2,652
LABOR	PRIME CONTRACTOR LABOR	179,915		$1.00	$179,915
Memo: 2,039 HOURS					
Subtotal					$1,020,311
1st Layer Markups assigned to Detail Items					$68,849
TOTAL Backfill					**$1,089,160**

Memo: 21,055 BCY total removed. 21,055 x 1.2 = 25,266 CY of fill needed. Assume 750 CY filled per day. 25,266 / 750 = 34 days. Fill is stockpiled during other activities and transfered to site as needed.

	Estimate Tree Structure Rollups	
	SWMU 30 Alternative 5WDF	**$8,400,284**
	Annual Costs	**$50,137**
	Five Year Reviews	**$50,137**

Five Year Reviews

Tree Depth= 5

LEVEL		QTY		UNIT COST	TOTAL
LABOR	PRIME CONTRACTOR LABOR	50,137		$1.00	$50,137
Memo: 500 HOURS					
TOTAL Five Year Reviews					**$50,137**

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APPENDIX F

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS AND TO BE CONSIDERED GUIDANCE

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CONTENTS

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TABLES

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F.1. INTRODUCTION

Section 121(d) of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) and 40 *CFR* § 300.430(f)(1)(ii)(B) of the National Contingency Plan require that remedial actions at CERCLA sites attain legally applicable or relevant and appropriate requirements (ARARs) or provide grounds for invoking a CERCLA waiver. ARARs include the substantive requirements of federal or more stringent state environmental or facility siting laws/regulations. Additionally, per 40 *CFR* § 300.400(g)(3), other advisories, criteria, or guidance may be considered in determining remedies [to be considered (TBC) category]. CERCLA § 121(d)(4) provides several ARAR waiver options that may be invoked, provided that human health and the environment are protected. ARARs do not include occupational safety or worker protection requirements. On-site activities must comply with the substantive, but not administrative requirements. Administrative requirements include applying for permits, recordkeeping, consultation, and reporting. Activities conducted off-site must comply with both the substantive and administrative requirements of applicable laws.

ARARs typically are divided into three categories: (1) chemical-specific, (2) location-specific, and (3) action-specific. "Chemical-specific ARARs usually are health- or risk-based numerical values or methodologies which, when applied to site-specific conditions, result in the establishment of numerical values" [53 *FR* 51394, 51437 (December 21, 1988)]. (In the absence of chemical-specific ARARs, cleanup criteria are based upon risk calculations.) Location-specific ARARs generally are restrictions placed upon the concentration of hazardous substances or the conduct of activities solely because they are in special locations [53 *FR* 51394, 51437 (December 21, 1988)]. Action-specific ARARs usually are technology- or activity-based requirements or limitations on actions taken with respect to hazardous wastes or requirements to conduct certain actions to address particular circumstances at a site [53 *FR* 51394, 51437 (December 21, 1988)]. ARARs and TBC guidance for the Burial Grounds Operable Unit (BGOU) Feasibility Study for Solid Waste Management Units (SWMUs) 2, 3, 7, and 30 are identified in Tables F.1 and F.2.

F.2. CHEMICAL-SPECIFIC ARARs/TBC

Chemical-specific ARARs provide health- or risk-based concentration limits or discharge limitations in environmental media (i.e., surface water, groundwater, soil, or air) for specific hazardous substances, pollutants, or contaminants. There are no chemical-specific ARARs for remediation of the contaminated soils at the SWMUs 2, 3, 7, and 30 source areas.

F.3. LOCATION-SPECIFIC ARARs/TBC

Location-specific requirements establish restrictions on activities conducted within protected or environmentally sensitive areas. In addition, these requirements establish restrictions on permissible concentrations of hazardous substances within these areas.

F.3.1 WETLANDS

A wetlands assessment would be performed prior to remedy implementation. Although it is not anticipated, if an action should involve discharge of dredge or fill material into waters of the

United States, including jurisdictional wetlands, compliance with the substantive requirements of Nationwide Permit 38, General Conditions, would be complied with, as appropriate.

F.4. ACTION-SPECIFIC ARARs/TBCs

Action-specific ARARs include operation, performance, and design requirements or limitations based on waste type, media, and remedial activities. Component actions include groundwater monitoring, institutional controls, waste management, and transportation.

F.4.1 GENERAL CONSTRUCTION ACTIVITIES

Requirements for storm-water runoff and fugitive dust emission control measures potentially provide ARARs for construction and site preparation activities. ARARs for these common activities are discussed here.

F.4.2 STORM-WATER RUNOFF

Storm-water discharges from activities involving construction operations that result in the disturbance of land equal to or greater than one acre and less than five acres require implementation of good site planning and best management practices.

F.4.3 FUGITIVE EMISSIONS

Emission of airborne particulate concentrations may result from construction activities. Fugitive emissions are regulated by Kentucky through administrative rules at 401 *KAR* 63:010. Reasonable precautions must be taken to prevent particulate matter from becoming airborne.

Radionuclide emissions, excluding radon-220 and radon-222, from the U.S. Department of Energy (DOE) facilities are addressed in 40 *CFR* § 61, Subpart H. These regulations apply to airborne emissions during construction and operation activities. National Emissions Standards for Hazardous Air Pollutants limit ambient air radionuclide emissions from DOE facilities to levels that would prevent any individual from receiving an effective dose equivalent (EDE) of 10 millirem per year (mrem/year) or more (40 *CFR* § 61.92). Nonpoint-source fugitive radionuclide emissions are estimated by plant monitoring stations.

F.4.4 COLLECTION/TREATMENT OF VOLATILE ORGANIC CONSTITUENTS

SWMU 7 Alternatives 4 (ERH) and 5 (ERH) involve *in situ* heating of soils using an electrical resistance heating (ERH) process. This will result in the collection and recovery of contaminants from the aquifer and vadose zone. Prior to emission of collection vapor/gases, contaminants must be removed to comply with 401 *KAR* 63:020. An off-gas treatment system shall be employed to ensure contaminant emissions do not exceed allowable levels. This system may include such equipment as condensers and/or filters to accomplish the required contaminant removal.

F.4.5 WASTE-WATER TREATMENT

Contaminated water, including decontamination fluid, collected storm water, and groundwater, shall be treated before discharge. Under alternatives that include ERH, dual-phase extraction, or excavation, a wastewater treatment facility may be constructed and designed to meet the ARARs.

The FFA parties have agreed to defer the establishment of radionuclide effluent limits for discharges of wastewater from this CERCLA project until the Proposed Plan and Record of Decision stage of remedy selection. Effluent limits for radionuclides will be established in accordance with CERCLA, the NCP and EPA guidance.

F.4.6 WASTE MANAGEMENT

All primary waste (i.e., groundwater and contaminated soils) and secondary waste (i.e., contaminated personal protective equipment, treatment residuals, and decontamination wastewaters) generated during remedial activities will be characterized as Resource Conservation and Recovery Act (RCRA) wastes (solid or hazardous), Toxic Substances Control Act (TSCA) waste, low-level radioactive waste(s), and/or mixed waste(s), as appropriate, and each must be managed in accordance with appropriate RCRA, TSCA, or DOE Order/Manual requirements. Waste managed on-site must comply with the substantive requirements of the aforementioned ARARs.

F.4.7 TRANSPORTATION

Any remediation waste transferred off-site or transported in commerce along public rights-of-way must be conducted in compliance with all applicable laws and regulations. These transportation requirements include provisions for proper packaging, labeling, marking, manifesting, recordkeeping, licensing, and placarding that must be complied with fully for shipment. Before shipment of CERCLA waste to any off-site facility, DOE must ensure the acceptance of the receiving site under the CERCLA Off-site Rule (40 *CFR* § 300.440 *et seq.*).

Table F.1. Location-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30

Location	Requirement	Prerequisite	Citation	SWMU 2	SWMU 3	SWMU 7	SWMU 30
Presence of wetlands as defined in 10 *CFR* § 1022.4	Avoid, to the extent possible, the long- and short-term adverse effects associated with destruction, occupancy, and modification of wetlands.	DOE actions that involve potential impacts to, or take place within, wetlands—**applicable**.	10 *CFR* § 1022.3(a)	✓	✓	✓	✓
	Take action, to extent practicable, to minimize destruction, loss, or degradation of wetlands and to preserve and enhance the natural and beneficial values of wetlands.		10 *CFR* § 1022.3(a) (7) and (8)	✓	✓	✓	✓
	Undertake a careful evaluation of the potential effects of any new construction in wetlands. Identify, evaluate, and, as appropriate, implement alternative actions that may avoid or mitigate adverse impacts on wetlands.		10 *CFR* § 1022.3(b) and (d)	✓	✓	✓	✓
	Measures that mitigate the adverse effects of actions in a wetland including, but not limited to, minimum grading requirements, runoff controls, design and construction constraints, and protection of ecologically-sensitive areas.		10 *CFR* § 1022.13(a)(3)	✓	✓	✓	✓
	If no practicable alternative to locating or conducting the action in the wetland is available, then before taking action design or modify the action in order to minimize potential harm to or within the wetland, consistent with the policies set forth in E.O. 11990.		10 *CFR* § 1022.14(a)	✓	✓	✓	✓

Table F.1. Location-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

Location	Requirement	Prerequisite	Citation	SWMU 2	SWMU 3	SWMU 7	SWMU 30
Location encompassing aquatic ecosystem as defined in 40 *CFR* § 230.3(c)	Except as provided under section 404(b)(2), no discharge of dredged or fill material is permitted if there is a practicable alternative that would have less adverse impact on the aquatic ecosystem or if it will cause or contribute to significant degradation of the waters of the United States.	Action that involves the discharge of dredged or fill material into waters of the United States, including jurisdictional wetlands—**relevant and appropriate**.	40 *CFR* § 230.10(a) and (c)	✓	✓	✓	✓
	Except as provided under section 404(b)(2), no discharge of dredged or fill material shall be permitted unless appropriate and practicable steps have been taken that will minimize potential adverse impacts of the discharge on the aquatic ecosystem. 40 *CFR* § 230.70 *et seq.* identifies such possible steps.		40 *CFR* § 230.10(d)	✓	✓	✓	✓
Nationwide Permit Program	Must comply with the substantive requirements of the NWP 38, General Conditions, as appropriate.	Discharge of dredged or fill material into waters of the United States, including jurisdictional wetlands—**relevant and appropriate**.	Nationwide Permit (38) Cleanup of Hazardous and Toxic Waste 33 *CFR* § 323.3(b)	✓	✓	✓	✓

CFR = *Code of Federal Regulations*
DOE = U.S. Department of Energy
E.O. = Executive Order
NWP = Nationwide Permit

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Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Site Preparation, Construction, and Excavation																
Activities causing fugitive dust emissions	No person shall cause, suffer, or allow any material to be handled, processed, transported, or stored; a building or its appurtenances to be constructed, altered, repaired, or demolished, or a road to be used without taking reasonable precaution to prevent particulate matter from becoming airborne. Such reasonable precautions shall include, when applicable, but not be limited to the following: • Use, where possible, of water or chemicals for control of dust in the demolition of existing buildings or structures, construction operations, the grading of roads or the clearing of land; • Application and maintenance of asphalt, oil, water, or suitable chemicals on roads, materials stockpiles, and other surfaces which can create airborne dusts; • Covering, at all times when in motion, open bodied trucks transporting materials likely to become airborne; • The maintenance of paved roadways in a clean condition; and • The prompt removal of earth or other material from a paved street which earth or other material has been transported thereto by trucking or earth moving equipment or erosion by water.	Fugitive emissions from land-disturbing activities (e.g., handling, processing, transporting or storing of any material, demolition of structures, construction operations, grading of roads, or the clearing of land, etc.)—**applicable**.	401 *KAR* 63:010 § 3(1) and (1)(a), (b), (d), (e) and (f)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	No person shall cause or permit the discharge of visible fugitive dust emissions beyond the lot line of the property on which the emissions originate.		401 *KAR* 63:010 § 3(2)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Activities causing storm-water runoff (e.g., clearing, grading, excavation)	Implement good construction techniques to control pollutants in storm-water discharges during and after construction in accordance with substantive requirements provided by permits issued pursuant to 40 *CFR* § 122.26(c).	Storm water discharges associated with small construction activities as defined in 40 *CFR* § 122.26(b)(15) and 401 *KAR* 5:002 § 1 (157)—**applicable.**	40 *CFR* § 122.26(c)(1)(ii)(C) and (D) 401 *KAR* 5:060 § 8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Activities causing storm-water runoff (e.g., clearing, grading, excavation) (Continued)	Storm water runoff associated with construction activities taking place at a facility with an existing Best Management Practices (BMP) Plan shall be addressed under the facility BMP and not under a storm water general permit.	Storm water discharges associated with small construction activities as defined in 40 *CFR* § 122.26(b)(15) and 401 *KAR* 5:002 § 1 (157)—**TBC**.	Fact Sheet for the KPDES General Permit for Storm Water Discharges Associated with Construction Activities, June 2009	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Best management storm water controls will be implemented and may include, as appropriate, erosion and sedimentation control measures, structural practices (e.g., silt fences, straw bale barriers) and vegetative practices (e.g., seeding); storm water management (e.g., diversion); and maintenance of control measures in order to ensure compliance with the standards in Section C.5. Storm Water Discharge Quality.	Storm water runoff associated with construction activities taking place at a facility (PGDP) with an existing BMP Plan—**TBC**.	Appendix C of the PGDP Best Management Practices Plan (2007)—Examples of Storm water Controls	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Air Emissions																
Activities causing radionuclide emissions	Emissions of radionuclides to the ambient air from DOE facilities shall not exceed those amounts that would cause any member of the public to receive in any year an EDE of 10 mrem/yr.	Radionuclide emissions at a DOE facility—**applicable**.	40 *CFR* § 61.92 401 *KAR* 57:002		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Activities causing toxic substances or potentially hazardous matter emissions	Persons responsible for a source from which hazardous matter or toxic substances may be emitted shall provide the utmost care and consideration in the handling of these materials to the potentially harmful effects of the emissions resulting from such activities. Shall not allow any affected facility to emit potentially hazardous matter or toxic substances in such quantities or duration as to be harmful to the health and welfare of humans, animals and plants.	Emissions of potentially hazardous matter or toxic substances as defined in 401 *KAR* 63:020 § 2 (2)—**applicable**.	401 *KAR* 63:020 § 3		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Activities heating nonhazardous material	Emission limit and work practice standards.	Roasting and desorption without hazardous waste constituents—**applicable**.	40 *CFR* § 63.7500 (a)(1)									✓		✓		

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Emission standards for stationary emergency engines (e.g., generators)	Must comply with the emission standards in table 1 Subpart IIII of Part 60.	Operation of pre-2007 model year emergency stationary compression ignition internal combustion engines as defined in 40 *CFR* § 60.4219 with a displacement of less than 10 liters per cylinder that are not fire pump engines—**applicable.**	40 *CFR* § 60.4205(a)		✓	✓					✓	✓	✓	✓		
	Must comply with the emission standards for new nonroad compression ignition engines in 40 *CFR* § 60.4202, for all pollutants, for the same model year and maximum engine power for their 2007 model year and later emergency stationary compression ignition internal combustion engines.	Operation of 2007 model year and later emergency stationary compression ignition internal combustion engines with a displacement of less than 30 liters per cylinder that are not fire pump engines—**applicable**.	40 *CFR* § 60.4205(b)		✓	✓					✓	✓	✓	✓		
	Must meet the following • Reduce nitrogen oxide (NO_X) emissions by 90 percent or more, or limit the emissions of NO_X in the stationary compression ignition (CI) internal combustion engine exhaust to 1.6 grams per KW-hour (1.2 grams per HP-hour). • Reduce particulate matter (PM) emissions by 60 percent or more, or limit the emissions of PM in the stationary CI internal combustion engine exhaust to 0.15 g/KW-hr (0.11 g/HP-hr).	Operation of emergency stationary compression ignition internal combustion engines with a displacement of greater than or equal to 30 liters per cylinder—**applicable**.	40 *CFR* § 60.4205(d)		✓	✓	✓				✓	✓	✓	✓		
General standards for process vents used in treatment of VOCs	Select and meet the requirements under one of the options specified below: • Control hazardous air pollutants (HAP) emissions from the affected process vents according to the applicable standards specified in §§ 63.7890 through 63.7893. • Determine for the remediation material treated or managed by the process vented through the affected process vents that the average total volatile organic hazardous air pollutant (VOHAP) concentration, as defined in § 63.7957, of this material is less than 10 (ppm). Determination of VOHAP concentration will be made using procedures specified in § 63.7943.	Process vents as defined in 40 *CFR* § 63.7957 used in site remediation of media (e.g., soil and groundwater) that could emit HAP listed in Table 1 of Subpart GGGGG of Part 63 and vent stream flow exceeds the rate in 40 *CFR* § 63.7885(c)(1)—**relevant and appropriate**.	40 *CFR* § 63.7885(b) 401 *KAR* 63:002, §§ 1 and 2, except for 40 *CFR* § 63.72 as incorporated in § 2(3)		✓	✓	✓	✓			✓	✓	✓	✓		

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
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SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring

SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
General standards for process vents used in treatment of VOCs (Continued)	Control HAP emissions from affected process vents subject to another subpart under 40 *CFR* part 61 or 40 *CFR* part 63 in compliance with the standards specified in the applicable subpart.	Process vents as defined in 40 *CFR* § 63.7957 used in site remediation of media (e.g., soil and groundwater) that could emit HAP listed in Table 1 of Subpart GGGGG of Part 63 and vent stream flow exceeds the rate in 40 *CFR* § 63.7885(c)(1)—**relevant and appropriate**.	40 *CFR* § 63.7885(b) 401 *KAR* 63:002, §§ 1 and 2, except for 40 *CFR* § 63.72 as incorporated in § 2(3)													
Emission limitations for process vents used in treatment of VOCs	Meet the requirements under one of the options specified below: • Reduce from all affected process vents the total emissions of the HAP to a level less than 1.4 kilograms per hour (kg/hr) and 2.8 Mg/yr (3.0 pounds per hour (lb/hr) and 3.1 tpy); or • Reduce from all affected process vents the emissions of total organic compounds (TOC) (minus methane and ethane) to a level below 1.4 kg/hr and 2.8 Mg/yr (3.0 lb/hr and 3.1 tpy); or • Reduce from all affected process vents the total emissions of the HAP by 95 percent by weight or more; or • Reduce from all affected process vents the emissions of TOC (minus methane and ethane) by 95 percent by weight or more.	Process vents as defined in 40 *CFR* § 63.7957 used in site remediation of media (e.g., soil and groundwater) that could emit hazardous air pollutants (HAP) listed in Table 1 of Subpart GGGGG of Part 63 and vent stream flow exceeds the rate in 40 *CFR* § 63.7885(c)(1)—**relevant and appropriate**.	40 *CFR* § 63.7890(b)(1)-(4) 401 *KAR* 63:002, §§ 1 and 2, except for 40 *CFR* § 63.72 as incorporated in § 2(3)		✓	✓					✓	✓	✓	✓		
Standards for closed vent systems and control devices used in treatment of VOCs	For each closed vent system and control device you use to comply with the requirements above, you must meet the operating limit requirements and work practice standards in Sec. 63.7925(d) through (j) that apply to the closed vent system and control device. NOTE: EPA approval to use alternate work practices under paragraph (j) in 40 *CFR* § 63.7925 will be obtained in FFA CERCLA document (e.g., Remedial Design).	Closed vent system and control devices as defined in 40 *CFR* § 63.7957 that are used to comply with § 63.7890(b)—**relevant and appropriate**.	40 *CFR* § 63.7890(c)		✓	✓					✓	✓	✓	✓		
Monitoring of closed vent systems and control devices used in treatment of VOCs	Must monitor and inspect the closed vent system and control device according to the requirements in 40 *CFR* § 63.7927 that apply to the affected source. *NOTE: Monitoring program will be developed as part of the CERCLA process and included in a Remedial Design or other appropriate FFA CERCLA document.*	Closed vent system and control devices as defined in 40 *CFR* § 63.7957 that are used to comply with § 63.7890(b)—**relevant and appropriate**.	40 *CFR* § 63.7892		✓	✓					✓	✓	✓	✓		

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Monitoring, Extraction, and Injection Well Installation and Abandonment																
Monitoring well installation	Permanent monitoring wells shall be constructed, modified, and abandoned in such a manner as to prevent the introduction or migration of contamination to a water-bearing zone or aquifer through the casing, drill hole, or annular materials.	Construction of monitoring well as defined in 401 *KAR* 6:001 § 1(18) for remedial action—**applicable**.	401 *KAR* 6:350 § 1(2)	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	
	All permanent monitoring wells (including boreholes) shall be constructed to comply with the substantive requirements provided in the following Sections of 401 *KAR* 6:350: • Section 2. Design Factors; • Section 3. Monitoring Well Construction; • Section 7. Materials for Monitoring Wells; and • Section 8. Surface Completion.		401 *KAR* 6:350 § 2, 3, 7, and 8	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	
	If conditions exist or are believed to exist that preclude compliance with the requirements of 401 *KAR* 6:350, may request a variance prior to well construction or well abandonment. NOTE: Variance shall be made as part of the FFA CERCLA document review and approval process and shall include: • A justification for the variance; and • Proposed construction, modification, or abandonment procedures to be used in lieu of compliance with 401 *KAR* 6:350 and an explanation as to how the alternate well construction procedures ensure the protection of the quality of the groundwater and the protection of public health and safety.		401 *KAR* 6:350 § 6 (a)(6) and (7)	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring

SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Development of monitoring well	Newly installed wells shall be developed until the column of water in the well is free of visible sediment. This well-development protocol shall not be used as a method for purging prior to water quality sampling.	Construction of monitoring well as defined in 401 *KAR* 6:001 § 1(18) for remedial action—**applicable**.	401 *KAR* 6:350 § 9	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	
Direct push monitoring well installation	Wells installed using direct push technology shall be constructed, modified, and abandoned in such a manner as to prevent the introduction or migration of contamination to a water-bearing zone or aquifer through the casing, drill hole, or annular materials.	Construction of direct push monitoring well as defined in 401 *KAR* 6:001 § 1(18) for remedial action—**applicable**.	401 *KAR* 6:350 § 5 (1)	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	
	Shall also comply with the following additional standards: (a) The outside diameter of the borehole shall be a minimum of 1 inch greater than the outside diameter of the well casing; (b) Premixed bentonite slurry or bentonite chips with a minimum of one-eighth (1/8) diameter shall be used in the sealed interval below the static water level; an (c) 1. Direct push wells shall not be constructed through more than one water-bearing formation unless the upper water bearing zone is isolated by temporary or permanent casing. 2. The direct push tool string may serve as the temporary casing.		401 *KAR* 6:350 § 5 (3)	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	
Monitoring well abandonment	A monitoring well that has been damaged or is otherwise unsuitable for use as a monitoring well, shall be abandoned within 30 days from the last sampling date or 30 days from the date it is determined that the well is no longer suitable for its intended use.	Construction of monitoring well as defined in 401 *KAR* 6:001 § 1(18) for remedial action—**applicable**.	401 *KAR* 6:350 § 11 (1)	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	
	Wells shall be abandoned in such a manner as to prevent the migration of surface water or contaminants to the subsurface and to prevent migration of contaminants among water bearing zones.		401 *KAR* 6:350 § 11 (1)(a)	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Monitoring well abandonment (Continued)	Abandonment methods and sealing materials for all types of monitoring wells provided in subparagraphs (a)-(b) and (d)-(e) shall be followed.	Construction of monitoring well as defined in 401 *KAR* 6:001 § 1(18) for remedial action—**applicable**.	401 *KAR* 6:350 § 11 (2)	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	
Extraction well installation	Wells shall be constructed, modified, and abandoned in such a manner as to prevent the introduction or migration of contamination to a water-bearing zone or aquifer through the casing, drill hole, or annular materials.	Construction of extraction well for remedial action—**relevant and appropriate**.	401 *KAR* 6:350 § 1 (2)								✓	✓	✓	✓		
Reinjection of treated contaminated groundwater	No owner or operator shall construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 *CFR* Part 142 or may otherwise adversely affect the health of persons.	Underground injection into an underground source of drinking water—**relevant and appropriate**.	40 *CFR* § 144.12(a)									✓		✓		
	Wells are not prohibited if injection is approved by EPA or a State pursuant to provisions for cleanup of releases under CERCLA or RCRA *as provided in the FFA CERCLA document*.	Class IV wells [as defined in 40 *CFR* § 144.6(d)] used to reinject treated contaminated groundwater into the same formation from which it was drawn—**relevant and appropriate**.	40 *CFR* § 144.13(c) RCRA § 3020(b)									✓		✓		
	Prior to abandonment any Class IV well, the owner or operator shall plug or otherwise close the well in a manner *as provided in the FFA CERCLA document*.	Class IV wells [as defined in 40 *CFR* § 144.6(d)] used to reinject of treated contaminated groundwater into the same formation from which it was drawn—**relevant and appropriate**.	40 *CFR* § 144.23(b)(1)									✓		✓		
Plugging and abandonment of Class IV injection wells	Prior to abandoning the well, the owner or operator shall close the well in accordance with 40 *CFR* § 144.23(b).	Operation of a Class IV injection well [as defined in 40 *CFR* § 144.6(d)]—**relevant and appropriate**.	40 *CFR* § 146.10(b)									✓		✓		

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
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SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Groundwater monitoring requirements																
Groundwater monitoring requirements for RCRA hazardous waste landfills	The owner or operator's regulated unit or units are not subject to regulation for releases into the uppermost aquifer under this subpart if: (2) He operates a unit which the Regional Administrator finds: (i) Is an engineered structure, (ii) Does not receive or contain liquid waste or waste containing free liquids, (iii) Is designed and operated to exclude liquid, precipitation, and other run-on and run-off, (iv) Has both inner and outer layers of containment enclosing the waste, (v) Has a leak detection system built into each containment layer, (vi) The owner or operator will provide continuing operation and maintenance of these leak detection systems during the active life of the unit and the closure and post-closure care periods, and (vii) To a reasonable degree of certainty, will not allow hazardous constituents to migrate beyond the outer containment layer prior to the end of the post-closure care period. *Note: The determination on use of an exemption will be documented in a CERCLA decision document (i.e. ROD, ROD Amendment, or ESD) subject to review and approval under the FFA process.*	Groundwater monitoring of hazardous constituents from a RCRA regulated unit as defined in 40 CFR 264.90(a)(2) — **applicable to SWMU 3**	40 *CFR* § 264.90(b) 40 *CFR* § 264.90(b)(2)						✓							

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Groundwater monitoring requirements for a RCRA regulated unit	The Regional Administrator may replace all or part of the requirements of §§264.91 through 264.100 applying to a regulated unit with alternative requirements for groundwater monitoring and corrective action for releases to groundwater set out in the permit (or in an enforceable document) (as defined in 40 CFR 270.1(c)(7)) where the Regional Administrator determines that:	Groundwater monitoring of hazardous constituents from a RCRA regulated unit as defined in 40 *CFR* § 264.90(a)(2) — **applicable to SWMU 3**	40 *CFR* § 264.90(f) 401 *KAR* 34:060 § 1						✓							
	(1) The regulated unit is situated among solid waste management units (or areas of concern), a release has occurred, and both the regulated unit and one or more solid waste management unit(s) (or areas of concern) are likely to have contributed to the release; and		40 *CFR* § 264.90(f)(1) 401 *KAR* 34:060 § 1													
	(2) It is not necessary to apply the groundwater monitoring and corrective action requirements of 40 *CFR* §§ 264.91 through 264.100 because alternative requirements will protect human health and the environment. *Note: Alternate groundwater monitoring requirements will be documented in a CERCLA decision document (i.e. ROD, ROD Amendment, or ESD) subject to review and approval under the FFA process.*		40 *CFR* § 264.90(f)(2) 401 *KAR* 34:060 § 1													
Point of Compliance for meeting GW protection standards	The Regional Administrator will specify in the facility permit the point of compliance at which the ground-water protection standard of §264.92 applies and at which monitoring must be conducted. The point of compliance is a vertical surface located at the hydraulically downgradient limit of the waste management area that extends down into the uppermost aquifer underlying the regulated units. *Note: Permitting is an administrative requirement and not ARAR. The point of compliance will be specified in the appropriate FFA CERCLA primary document.*	Groundwater monitoring of hazardous constituents from a RCRA regulated unit as defined in 40 CFR 264.90(a)(2) — **applicable to SWMU 3**	40 *CFR* § 264.95(a) 401 *KAR* 34:060 § 6						✓							
	The waste management area is the limit projected in the horizontal plane of the area on which waste will be placed during the active life of a regulated unit.		40 *CFR* § 264.95(b) 401 *KAR* 34:060 § 6													

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SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Point of Compliance for meeting GW protection standards (Continued)	(1) The waste management area includes horizontal space taken up by any liner, dike, or other barrier designed to contain waste in a regulated unit.		40 *CFR* § 264.95(b)(1) 401 *KAR* 34:060 § 6													
	(2) If the facility contains more than one regulated unit, the waste management area is described by an imaginary line circumscribing the several regulated units.		40 *CFR* § 264.95(b)(2) 401 *KAR* 34:060 § 6													
Compliance period for GW protection	Owners and operators subject to this subpart must conduct a monitoring and response program as follows:	Operation of a RCRA regulated unit as defined in 40 CFR § 264.90(a)(2), e.g., hazardous waste landfill — **applicable to SWMU 3**	40 *CFR* § 264.91(a)						✓							
	Whenever hazardous constituents under §264.93 from a regulated unit are detected at a compliance point under §264.95, the owner or operator must institute a compliance monitoring program under §264.99. Detected is defined as statistically significant evidence of contamination as described in §264.98(f); *Note: The decision to move from detection monitoring into compliance monitoring will be included in an ESD that identifies the substantive requirements in 40 CFR § 264.92, 264.93, 264.94, 264.96, and 264.99 as ARARs.*		40 *CFR* § 264.91(a)(1) 401 *KAR* 34:060 § 2													
	Whenever the ground-water protection standard under §264.92 is exceeded, the owner or operator must institute a corrective action program under §264.100. Exceeded is defined as statistically significant evidence of increased contamination as described in §264.99(d); *Note: The decision to move from compliance monitoring into a corrective action program will be included in a ROD Amendment that identifies the ARARs including 40 CFR § 264.100.*		40 *CFR* § 264.91(a)(2) 401 *KAR* 34:060 § 2													

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
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SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Compliance period for GW protection (Continued)	Whenever hazardous constituents under §264.93 from a regulated unit exceed concentration limits under §264.94 in ground water between the compliance point under §264.95 and the downgradient facility property boundary, the owner or operator must institute a corrective action program under §264.100; or *Note: The decision to move from compliance monitoring into a corrective action program will be included in a ROD Amendment that identifies the ARARs including 40 CFR § 264.100.*		40 *CFR* § 264.91(a)(3) 401 *KAR* 34:060 § 2													
	In all other cases, the owner or operator must institute a detection monitoring program under §264.98.	Groundwater monitoring of hazardous constituents from a RCRA regulated unit as defined in 40 CFR 264.90(a)(2) — **applicable to SWMU 3**	40 *CFR* § 264.91(a)(4) 401 *KAR* 34:060 § 2													
	The Regional Administrator will specify in the facility permit the specific elements of the monitoring and response program. The Regional Administrator may include one or more of the programs identified in paragraph (a) of this section in the facility permit as may be necessary to protect human health and the environment and will specify the circumstances under which each of the programs will be required. *Note: Permitting is an administrative requirement. Specific elements of the groundwater monitoring and response program will be included in the appropriate FFA CERCLA primary document.*		40 *CFR* § 264.91(b) 401 *KAR* 34:060 § 2						✓							
Groundwater monitoring well construction	All monitoring wells must be cased in a manner that maintains the integrity of the monitoring-well bore hole. This casing must be screened or perforated and packed with gravel or sand, where necessary, to enable collection of ground-water samples. The annular space (i.e., the space between the bore hole and well casing) above the sampling depth must be sealed to prevent contamination of samples and the ground water.	Construction of RCRA groundwater monitoring well — **applicable to SWMU 3**	40 *CFR* § 264.97(c) 401 *KAR* 34:060 § 8						✓							

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
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SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Groundwater monitoring requirements for RCRA hazardous waste landfills	The groundwater monitoring system must consist of a sufficient number of wells, installed at appropriate locations and depths to yield ground-water samples from the uppermost aquifer that:	Operation of a groundwater monitoring program under 40 *CFR* § 264.98—**applicable to SWMU 3**.	40 *CFR* § 264.97(a) 401 *KAR* 34:060 § 8						✓							
	(1) Represent the quality of background ground water that has not been affected by leakage from a regulated unit; (i) A determination of background ground-water quality may include sampling of wells that are not hydraulically upgradient of the waste management area where: (A) Hydrogeologic conditions do not allow the owner or operator to determine what wells are hydraulically upgradient; and (B) Sampling at other wells will provide an indication of background ground-water quality that is representative or more representative than that provided by the upgradient wells; and		40 *CFR* § 264.97(a)(1) 401 *KAR* 34:060 § 8													
	(2) Represent the quality of ground water passing the point of compliance; and		40 *CFR* § 264.97(a)(2) 401 *KAR* 34:060 § 8													
	(3) Allow for the detection of contamination when hazardous waste or hazardous constituents have migrated from the waste management area to the uppermost aquifer.		40 *CFR* § 264.97(a)(3) 401 *KAR* 34:060 § 8													
	The ground-water monitoring program must include consistent sampling and analysis procedures that are designed to ensure monitoring results that provide a reliable indication of groundwater quality below the waste management area. At a minimum the program must include procedures and techniques for: (1) Sample collection; (2) Sample preservation and shipment; (3) Analytical procedures; and (4) Chain of custody control.	Operation of a groundwater monitoring program under 40 *CFR* § 264.98—**applicable to SWMU 3**.	40 *CFR* § 264.97(d) 401 *KAR* 34:060 § 8						✓							
	The ground-water monitoring program must include sampling and analytical methods that are appropriate and accurately measure hazardous constituents in groundwater samples.	Operation of a groundwater monitoring program under 40 *CFR* § 264.98—**applicable to SWMU 3**.	40 *CFR* § 264.97(e) 401 *KAR* 34:060 § 8						✓							
	Groundwater monitoring program must include a determination of the groundwater surface elevation each time groundwater is sampled.	Operation of a groundwater monitoring program under 40 *CFR* § 264.98—**applicable to SWMU 3**.	40 *CFR* § 264.97(f) 401 *KAR* 34:060 § 8						✓							

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Groundwater monitoring requirements for RCRA hazardous waste landfills (Continued)	In detection monitoring or where appropriate in compliance monitoring, data on each hazardous constituent specified in the permit will be collected from background wells and wells at the compliance point(s). The number and kinds of samples collected to establish background shall be appropriate for the form of statistical test employed, following generally accepted statistical principles. The sample size shall be as large as necessary to ensure with reasonable confidence that a contaminant release to ground water from a facility will be detected. The owner or operator will determine an appropriate sampling procedure and interval for each hazardous constituent listed in the facility permit which shall be specified in the unit permit upon approval by the Regional Administrator. This sampling procedure shall be: (1) A sequence of at least four samples, taken at an interval that assures, to the greatest extent technically feasible, that an independent sample is obtained, by reference to the uppermost aquifer's effective porosity, hydraulic conductivity, and hydraulic gradient, and the fate and transport characteristics of the potential contaminants, or (2) an alternate sampling procedure proposed by the owner or operator and approved by the Regional Administrator. *Note: Permitting is an administrative requirement. The appropriate sampling procedure and sampling interval will be included in the appropriate FFA CERCLA primary document.*	Operation of a groundwater monitoring program under 40 *CFR* § 264.98—**applicable to SWMU 3**.	40 *CFR* § 264.97(g) 401 *KAR* 34:060 § 8 40 *CFR* § 264.97(g)(1) 401 *KAR* 34:060 § 8 40 *CFR* § 264.97(g)(2) 401 *KAR* 34:060 § 8						✓							
	The owner or operator will specify one of the following statistical methods to be used in evaluating ground-water monitoring data for each hazardous constituent which, upon approval by the Regional Administrator, will be specified in the unit permit. The statistical test chosen shall be conducted separately for each hazardous constituent in each well. Where practical quantification limits (PQLs) are used in any of the following statistical procedures to comply with §264.97(i)(5), the PQL must be proposed by the owner or operator and approved by the Regional Administrator. Use of any of the following statistical methods must be protective of human health and the environment and must comply with the performance standards outlined in paragraph (i) of this section.	Operation of a groundwater monitoring program under 40 *CFR* § 264.98—**applicable to SWMU 3**.	40 *CFR* § 264.97(h) 401 *KAR* 34:060 § 8						✓							

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Groundwater monitoring requirements for RCRA hazardous waste landfills (Continued)	A parametric analysis of variance (ANOVA) followed by multiple comparisons procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's mean and the background mean levels for each constituent.		40 *CFR* § 264.97(h)(1) 401 *KAR* 34:060 § 8													
	An analysis of variance (ANOVA) based on ranks followed by multiple comparisons procedures to identify statistically significant evidence of contamination. The method must include estimation and testing of the contrasts between each compliance well's median and the background median levels for each constituent.		40 *CFR* § 264.97(h)(2) 401 *KAR* 34:060 § 8													
	A tolerance or prediction interval procedure in which an interval for each constituent is established from the distribution of the background data, and the level of each constituent in each compliance well is compared to the upper tolerance or prediction limit.		40 *CFR* § 64.97(h)(3) 401 *KAR* 34:060 § 8													
	A control chart approach that gives control limits for each constituent.		40 *CFR* § 264.97(h)(4) 401 *KAR* 34:060 § 8													
	Another statistical test method submitted by the owner or operator and approved by the Regional Administrator. *Note: Permitting is an administrative requirement. The statistical method for evaluating groundwater monitoring data will be specified in the appropriate FFA CERCLA primary document.*		40 *CFR* § 264.97(h)(5) 401 *KAR* 34:060 § 8													
	Any statistical method chosen under §264.97(h) for specification in the unit permit shall comply with the following performance standards, as appropriate.	Operation of a groundwater monitoring program under 40 *CFR* § 264.98—**applicable to SWMU 3**.	40 *CFR* § 264.97(i) 401 *KAR* 34:060 § 8						✓							
	The statistical method used to evaluate ground-water monitoring data shall be appropriate for the distribution of chemical parameters or hazardous constituents. If the distribution of the chemical parameters or hazardous constituents is shown by the owner or operator to be inappropriate for a normal theory test, then the data should be transformed or a distribution-free theory test should be used. If the distributions for the constituents differ, more than one statistical method may be needed.		40 *CFR* § 264.97(i)(1) 401 *KAR* 34:060 § 8													

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Groundwater monitoring requirements for RCRA hazardous waste landfills (Continued)	If an individual well comparison procedure is used to compare an individual compliance well constituent concentration with background constituent concentrations or a ground-water protection standard, the test shall be done at a Type I error level no less than 0.01 for each testing period. If a multiple comparisons procedure is used, the Type I experimentwise error rate for each testing period shall be no less than 0.05; however, the Type I error of no less than 0.01 for individual well comparisons must be maintained. This performance standard does not apply to tolerance intervals, prediction intervals, or control charts.		40 *CFR* § 264.97(i)(2) 401 *KAR* 34:060 § 8													
	If a control chart approach is used to evaluate ground-water monitoring data, the specific type of control chart and its associated parameter values shall be proposed by the owner or operator and approved by the Regional Administrator if he or she finds it to be protective of human health and the environment. *Note: Permitting is an administrative requirement. If a control chart approach is used to evaluate ground-water monitoring data, the specific type of control chart and its associated parameter values will be included in the appropriate FFA CERCLA primary document.*		40 *CFR* § 264.97(i)(3) 401 *KAR* 34:060 § 8													
	If a tolerance interval or a prediction interval is used to evaluate groundwater monitoring data, the levels of confidence and, for tolerance intervals, the percentage of the population that the interval must contain, shall be proposed by the owner or operator and approved by the Regional Administrator if he or she finds these parameters to be protective of human health and the environment. These parameters will be determined after considering the number of samples in the background data base, the data distribution, and the range of the concentration values for each constituent of concern. *Note: Permitting is an administrative requirement. If a tolerance interval or a prediction interval is used to evaluate groundwater monitoring data, the levels of confidence and, for tolerance intervals, the percentage of the population that the interval must contain will be included in the appropriate FFA CERCLA primary document.*		40 *CFR* § 264.97(i)(4) 401 *KAR* 34:060 § 8													

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Groundwater monitoring requirements for RCRA hazardous waste landfills (Continued)	The statistical method shall account for data below the limit of detection with one or more statistical procedures that are protective of human health and the environment. Any PQL approved by the Regional Administrator under § 264.97(h) that is used in the statistical method shall be the lowest concentration level that can be reliably achieved within specified limits of precision and accuracy during routine laboratory operating conditions that are available to the facility.		40 *CFR* § 264.97(i)(5) 401 *KAR* 34:060 § 8													
	If necessary, the statistical method shall include procedures to control or correct for seasonal and spatial variability as well as temporal correlation in the data.		40 *CFR* § 264.97(i)(6) 401 *KAR* 34:060 § 8													
Detection monitoring	The owner or operator must monitor for indicator parameters (e.g., specific conductance, total organic carbon, or total organic halogen), waste constituents or reaction products that provide a reliable indication of the presence of hazardous constituents in ground water. The Regional Administrator will specify the parameters or constituents to be monitored in the facility permit, after considering the following factors:	Operation of a detection monitoring program under 40 *CFR* § 264.98—**applicable to SWMU 3**	40 *CFR* § 264.98(a) 401 *KAR* 34:060 § 9						✓							
	(1) The types, quantities, and concentrations of constituents in wastes managed at the regulated unit;		40 *CFR* § 264.98(a)(1) 401 *KAR* 34:060 § 9													
	(2) The mobility, stability, and persistence of waste constituents or their reaction products in the unsaturated zone beneath the waste management area;		40 *CFR* § 264.98(a)(2) 401 *KAR* 34:060 § 9													
	(3) The detectability of indicator parameters, waste constituents, and reaction products in ground water; and,		40 *CFR* § 264.98(a)(3) 401 *KAR* 34:060 § 9													
	(4) The concentrations or values and coefficients of variation of proposed monitoring parameters or constituents in the ground-water background. *Note: Permitting is an administrative requirement and not ARAR. The indicator parameters will be included in the appropriate FFA CERCLA primary documents.*		40 *CFR* § 264.98(a)(4) 401 *KAR* 34:060 § 9													

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Detection monitoring (Continued)	The owner or operator must install a groundwater monitoring system at the compliance point as specified under 40 *CFR* § 264.95. The ground-water monitoring system must comply with 40 *CFR* § 264.97(a)(2), (b), and (c).	Operation of a detection monitoring program under 40 *CFR* § 264.98—**applicable to SWMU 3**	40 *CFR* § 264.98(b) 401 *KAR* 34:060 § 9						✓							
	The owner or operator must conduct a ground-water monitoring program for each chemical parameter and hazardous constituent specified in the permit pursuant to paragraph (a) of this section in accordance with §264.97(g). The owner or operator must maintain a record of ground-water analytical data as measured and in a form necessary for the determination of statistical significance under §264.97(h).	Operation of a detection monitoring program under 40 *CFR* § 264.98—**applicable to SWMU 3**	40 *CFR* § 264.98(c) 401 *KAR* 34:060 § 9						✓							
	The Regional Administrator will specify the frequencies for collecting samples and conducting statistical tests to determine whether there is statistically significant evidence of contamination for any parameter or hazardous constituent specified in the permit conditions under paragraph (a) of this section in accordance with §264.97(g). *Note: Permitting is an administrative requirement. The frequencies for collecting samples and conducting statistical tests will be included in the appropriate FFA CERCLA primary document.*	Operation of a detection monitoring program under 40 *CFR* § 264.98—**applicable to SWMU 3**	40 *CFR* § 264.98(d) 401 *KAR* 34:060 § 9						✓							

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Groundwater monitoring requirements for RCRA hazardous waste landfills	The owner or operator must determine the groundwater flow rate and direction in the uppermost aquifer at least annually.	Operation of a detection monitoring program under 40 *CFR* § 264.98—**applicable to SWMU 3**	40 *CFR* § 264.98(e) 401 *KAR* 34:060 § 9						✓							
	The owner or operator must determine whether there is statistically significant evidence of contamination of any chemical parameter or hazardous constituent specified in the permit pursuant to paragraph (a) of this section at a frequency specified under paragraph (d) of this section.	Operation of a detection monitoring program under 40 *CFR* § 264.98—**applicable to SWMU 3**	40 *CFR* § 264.98(f) 401 *KAR* 34:060 § 9						✓							
	(1) In determining whether statistically significant evidence of contamination exists, the owner or operator must use the method(s) specified in the permit under §264.97(h). These method(s) must compare data collected at the compliance point(s) to the background ground-water quality data.		40 *CFR* § 264.98(f)(1) 401 *KAR* 34:060 § 9													
	(2) The owner or operator must determine whether there is statistically significant evidence of contamination at each monitoring well as the compliance point within a reasonable period of time after completion of sampling. The Regional Administrator will specify in the facility permit what period of time is reasonable, after considering the complexity of the statistical test and the availability of laboratory facilities to perform the analysis of ground-water samples. *Note: Permitting and timeframes are administrative requirements and not ARARs. The process for conducting determinations to identify statistically significant evidence of contamination will be included in the appropriate FFA CERCLA primary document.*		40 *CFR* § 264.98(f)(2) 401 *KAR* 34:060 § 9													
	If the owner or operator determines pursuant to paragraph (f) of this section that there is statistically significant evidence of contamination for chemical parameters or hazardous constituents specified pursuant to paragraph (a) of this section at any monitoring well at the compliance point, he or she must:	Operation of a detection monitoring program under 40 CFR § 264.98 —**applicable to SWMU 3**	40 *CFR* § 264.98(g) 401 *KAR* 34:060 § 9						✓							

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Groundwater monitoring requirements for RCRA hazardous waste landfills	Notify the Regional Administrator of this finding in writing within seven days. The notification must indicate what chemical parameters or hazardous constituents have shown statistically significant evidence of contamination. *Note: Notifications and timeframes are administrative requirements and are not ARARs. Notifications will be performed in accordance with the CERCLA FFA process.*	Statistically significant evidence of contamination for a specified chemical parameters or hazardous constituents at any monitoring well at the compliance point **—applicable to SWMU 3**	40 *CFR* § 264.98(g)(1) 401 *KAR* 34:060 § 9						✓							
	Immediately sample the ground water in all monitoring wells and determine whether constituents in the list of appendix IX of this part are present, and if so, in what concentration. However, the Regional Administrator, on a discretionary basis, may allow sampling for a site-specific subset of constituents from the appendix IX list of this part and other representative/related waste constituents.	Statistically significant evidence of contamination for a specified chemical parameters or hazardous constituents at any monitoring well at the compliance point **—applicable to SWMU 3**	40 *CFR* § 264.98(g)(2) 401 *KAR* 34:060 § 9						✓							
	For any appendix IX compounds found in the analysis pursuant to paragraph (g)(2) of this section, the owner or operator may resample within one month or at an alternative site-specific schedule approved by the Administrator and repeat the analysis for those compounds detected. If the results of the second analysis confirm the initial results, then these constituents will form the basis for compliance monitoring. If the owner or operator does not resample for the compounds in paragraph (g)(2) of this section, the hazardous constituents found during this initial appendix IX analysis will form the basis for compliance monitoring. *Note: Permitting and timeframes are administrative requirements and are not ARARs. Any approved use of a site-specific subset of hazardous constituents from Appendix IX and the sampling schedule will be established in an appropriate FFA CERCLA primary document.*	Operation of a detection monitoring program under 40 *CFR* § 264.98 **—applicable to SWMU 3**	40 *CFR* § 264.98(g)(3) 401 *KAR* 34:060 § 9						✓							

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Groundwater monitoring requirements for RCRA hazardous waste landfills	If the owner or operator determines, pursuant to paragraph (f) of this section, that there is a statistically significant difference for chemical parameters or hazardous constituents specified pursuant to paragraph (a) of this section at any monitoring well at the compliance point, he or she may demonstrate that a source other than a regulated unit caused the contamination or that the detection is an artifact caused by an error in sampling, analysis, or statistical evaluation or natural variation in the ground water. The owner operator may make a demonstration under this paragraph in addition to, or in lieu of, submitting a permit modification application under paragraph (g)(4) of this section; however, the owner or operator is not relieved of the requirement to submit a permit modification application within the time specified in paragraph (g)(4) of this section unless the demonstration made under this paragraph successfully shows that a source other than a regulated unit caused the increase, or that the increase resulted from error in sampling, analysis, or evaluation. In making a demonstration under this paragraph, the owner or operator must: (i) Notify the Regional Administrator in writing within seven days of determining statistically significant evidence of contamination at the compliance point that he intends to make a demonstration under this paragraph; (ii) Within 90 days, submit a report to the Regional Administrator which demonstrates that a source other than a regulated unit caused the contamination or that the contamination resulted from error in sampling, analysis, or evaluation; (iii) Within 90 days, submit to the Regional Administrator an application for a permit modification to make any appropriate changes to the detection monitoring program facility; and (iv) Continue to monitor in accordance with the detection monitoring program established under this section. *Note: Notification, reporting, timeframes, and permit applications are administrative requirements and are not ARARs. The process for making an alternative source demonstration will be included in the appropriate FFA CERCLA primary*	Statistically Significant difference for specified chemical parameters or hazardous constituents at any monitoring well at the compliance point—**applicable to SWMU 3**	40 *CFR* § 264.98(g)(6) 401 *KAR* 34:060 § 9						✓							

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Groundwater monitoring requirements for RCRA hazardous waste landfills (Continued)	*document. Any alternative source demonstration will be provided in a separate FFA CERCLA secondary document that is subject to review, approval, and dispute under the FFA process or in an appropriate FFA CERCLA primary document.*															
Capping Waste in Place—Landfill Closure and Post-Closure																
Installation of low-permeability cover for units with hazardous waste remaining in place	Must close the facility in a manner that: • minimizes the need for further maintenance; • controls minimizes or eliminates to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to the ground or surface waters or the atmosphere; and • complies with the closure requirements in this table.	Closure of units with hazardous waste remaining in place–**applicable**.	40 *CFR* § 264.111 401 *KAR* 34:070 § 2	✓	✓	✓		✓								
Installation of low-permeability cover for landfills with hazardous waste remaining in place	Must install cover designed and constructed to: • provide long-term minimization of migration of liquids through the closed landfill; • function with minimum maintenance; • promote drainage and minimize erosion or abrasion of the cover; • accommodate settling and subsidence so that the cover's integrity is maintained; and • have a permeability less than or equal to the permeability of any bottom liner system or natural subsoils present.	Design and construction of cover for disposal units with hazardous waste or PCBs remaining in place—**relevant and appropriate**.	40 *CFR* § 264.310(a) 401 *KAR* 34:230 § 7	✓	✓	✓		✓								
	EPA guidance provides technical recommendations on the design parameters for a multi-layer low permeability cover including a two component low permeability layer, a soil drainage layer, and a two component top layer. The guidance acknowledges that other final cover designs may be acceptable.	Design and construction of cover for landfills with hazardous waste remaining in place—**TBC**.	Sections 1.4.1, 2, 3, and 4 of the EPA Technical Guidance Document: Final Covers on Hazardous Waste Landfills and Surface Impoundments, EPA OSWER 530- SW-89-047, (July 1989)	✓	✓	✓		✓								

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Maintenance of low-permeability cover for landfills with hazardous waste remaining in place	Must maintain the integrity and effectiveness of the cover, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events; and	Installation of cover for landfills with hazardous waste remaining in place—**relevant and appropriate**.	40 *CFR* § 264.310(b)(1) 401 *KAR* 34:230 § 7	✓	✓	✓		✓	✓							
	Continue to operate the leachate collection and removal system until leachate is no longer detected;		40 *CFR* § 264.310(b)(2) 401 *KAR* 34:230 § 7						✓							
	Maintain and monitor the leak detection system in accordance with §§ 264.301(c)(3)(iv) and (4) and 264.303(c),		40 *CFR* § 264.310(b)(3) 401 *KAR* 34:230 § 7						✓							
	Must prevent run-on and run-off from eroding or otherwise damaging the cover.		40 *CFR* § 264.310(b)(5) 401 *KAR* 34:230 § 7	✓	✓	✓		✓	✓							
	Must continue maintenance of the cover for 30 years.		40 *CFR* § 264.117(a)(1) 401 *KAR* 34:070 § 8	✓	✓	✓		✓	✓							
Disturbance of integrity of low-permeability cover	Must never allow disturbance of the integrity of the cover, or any other components of the containment system, or the function of the facility's monitoring systems, unless the disturbance: • Is necessary to the proposed use of the property, and will not increase the potential hazard to human health or the environment; or • Is necessary to reduce a threat to human health or the environment.	Installation of cover for landfills with hazardous waste remaining in place—**relevant and appropriate**.	40 *CFR* § 264.117(c) 401 *KAR* 34:070 § 8	✓	✓	✓		✓	✓							

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Disturbance of integrity of low-permeability cover (Continued)	At a minimum the final cap shall consist of a layered system. Each layer shall have the same slope of between five (5) and twenty-five (25) percent. The components, listed from bottom to top, are: (1) A filter fabric or other material approved by the cabinet; (2) A twelve (12) inch sand gas venting system with a minimum hydraulic permeability of 1×10^{-3}; (3) A filter fabric or other material approved by the cabinet; (4) An eighteen (18) inch clay layer with a maximum permeability of 1×10^{-7} centimeters per second; (5) For areas of the final cap with a slope of less than fifteen (15) percent, a twelve (12) inch drainage layer with a minimum permeability of 1×10^{-3} centimeters per second; and (6) A thirty-six (36) inch vegetative soil layer. Specifications for these required layers are provided in 401 *KAR* 48:080 § 9.	Installation of cover for landfills with hazardous waste remaining in place—**relevant and appropriate**.	401 *KAR* 48:080 § 8 401 *KAR* 48:080 § 9								✓	✓			✓	
	A synthetic liner with a minimum thickness of forty (40) mils and a maximum coefficient of permeability of 1×10^{-12} centimeters per second may be substituted for the low-permeability soil cover.		401 *KAR* 48:080 § 9(5)								✓	✓			✓	
	Alternative specifications may be used that result in performance with regard to safety, stability, and environmental protection equal to or better than that resulting from designs complying with the specifications of this administrative regulation. NOTE: Approval to use alternate specifications under 401 *KAR* 48:080, Section 11 will be obtained in an FFA CERCLA document (e.g., Remedial Design).		401 *KAR* 48:080 § 11								✓	✓			✓	

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Maintenance of a solid waste landfill cover	The operator of a contained solid waste landfill shall close each landfill unit and phase in a manner that minimizes the need for further maintenance and minimizes the closure care formation and release of leachate to the groundwater, or surface water to the extent necessary to protect human health and the environment.	Installation of a solid waste landfill cover—**relevant and appropriate**.	401 *KAR* 48:070 § 15(1)								✓	✓			✓	
	A contained solid waste landfill site shall be maintained as necessary to prevent erosion or washing of the fill, and grade as necessary to drain rainwater from the fill area and to prevent standing water.		401 *KAR* 48:090 § 7(1)								✓	✓			✓	
	The integrity and effectiveness of any cap shall be maintained the integrity and effectiveness of any final cap, including making repairs to the cap as necessary to correct the effects of settling, subsidence, erosion, or other events, and preventing run-on and run-off from eroding or otherwise damaging the final cap.		401 *KAR* 48:090 § 13(1)(a)(1)								✓	✓			✓	
	Closure care use of the property shall not be allowed to disturb the integrity of the final cap, or any other components of the containment system, unless the activities shall not increase the potential threat to human health or the environment or the disturbance is necessary to reduce a threat to human health or the environment.		401 *KAR* 48:090 § 13(2)(c)								✓	✓			✓	
General post-closure care	Owner or operator must:	Post-closure of a RCRA landfill—**applicable**.	40 *CFR* § 264.310(b) 401 *KAR* 34:230 § 7	✓	✓	✓		✓	✓							
	• maintain the effectiveness and integrity of the final cover including making repairs to the cap as necessary to correct effects of settling, erosion, or other events;		40 *CFR* § 264.310(b)(1) 401 *KAR* 34:230 § 7	✓	✓	✓		✓	✓							
	• Continue to operate the leachate collection and removal system until leachate is no longer detected;		40 *CFR* § 264.310(b)(2) 401 *KAR* 34:230 § 7						✓							

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
General post-closure care (Continued)	• Maintain and monitor the leak detection system in accordance with §§ 264.301(c)(3)(iv) and (4) and 264.303(c);	Post-closure of a RCRA landfill—**applicable**.	40 *CFR* § 264.310(b)(3) 401 *KAR* 34:230 § 7						✓							
	• prevent run-on and run-off from eroding or otherwise damaging final cover		40 *CFR* § 264.310(b)(5) 401 *KAR* 34:230 § 7	✓	✓	✓		✓	✓							
Installation of a LLW near-surface disposal unit cover system	Covers shall be designed to minimize water infiltration, to direct percolating water or surface water away from the disposed waste, and to resist degradation by surface geologic processes and biotic activity.	Closure of a LLW disposal facility—**relevant and appropriate**.	902 *KAR* § 100:022 § 23(4) 10 *CFR* § 61.51(a)(4)	✓	✓	✓		✓	✓		✓	✓			✓	
	Surface features shall direct surface water drainage away from the disposal units at velocities and gradients that shall not result in erosion that shall require ongoing active maintenance in the future.		902 *KAR* § 100:022 § 23(5) 10 *CFR* § 61.51(a)(5)	✓	✓	✓		✓	✓		✓	✓			✓	
	The disposal facility shall be sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practicable the need for ongoing active maintenance of the disposal site following closure so that only surveillance, monitoring, or minor custodial care are required. NOTE: For purposes of this remedy only, that portion of the regulation that is relevant and appropriate is as follows: 'shall be closed to eliminate to the extent practicable the need for ongoing active maintenance of the disposal site following closure so that only surveillance, monitoring, or minor custodial care are required		902 *KAR* 100:022 § 21	✓	✓	✓		✓	✓		✓	✓			✓	

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
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SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Marking boundaries of closed LLW near surface disposal unit	The boundaries and locations of each disposal unit shall be accurately located and mapped by means of a land survey. Near-surface disposal units shall be marked in a way that the boundaries of each unit can be easily defined. Three (3) permanent survey marker control points, referenced to United States Geological Survey (USGS) or National Geodetic Survey (NGS) survey control stations, shall be established on the site to facilitate surveys. The USGS or NGS control stations shall provide horizontal and vertical controls as checked against USGS or NGS record files. NOTE: For purpose of implementation of these ARARs the "disposal unit" is defined by the boundary of the cap.	Closure of a LLW disposal facility—**relevant and appropriate**	902 *KAR* 100:022 § 24 (7)–(10)	✓	✓	✓		✓	✓		✓	✓			✓	
Waste Management																
Management of PCB waste	Any person storing or disposing of PCB waste must do so in accordance with 40 *CFR* § 761, Subpart D.	Storage or disposal of waste containing PCBs at concentrations ≥ 50 ppm—**applicable**.	40 *CFR* § 761.50(a)				✓	✓		✓	✓	✓	✓	✓		✓
Management of PCB remediation waste	Any person cleaning up and disposing of PCBs shall do so based on the concentration at which the PCBs are found.	Cleanup and disposal of PCB remediation waste as defined in 40 *CFR* § 761.3—**applicable**.	40 *CFR* § 761.61				✓	✓		✓	✓	✓	✓	✓		✓
Management of PCB/radioactive waste	Any person storing such waste must do so taking into account both its PCB concentration and radioactive properties, except as provided in 40 *CFR* § 761.65(a)(1), (b)(1)(ii) and (c)(6)(i).	Generation of PCB/radioactive waste with ≥ 50 ppm PCBs for storage—**applicable**.	40 *CFR* § 761.50(b)(7)(i)				✓	✓		✓	✓	✓	✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Management of PCB/radioactive waste (Continued)	Any person disposing of such waste must do so taking into account both its PCB concentration and its radioactive properties. If, taking into account only the PCB properties in the waste (and not the radioactive properties of the waste), the waste meets the requirements for disposal in a facility permitted, licensed, or registered by a state as a municipal or nonmunicipal nonhazardous waste landfill [e.g., PCB bulk-product waste under 40 *CFR* § 761.62(b)(1)], then the person may dispose of PCB/radioactive waste, without regard to the PCBs, based on its radioactive properties in accordance with applicable requirements for the radioactive component of the waste.	Generation of PCB/radioactive waste with ≥ 50 ppm PCBs for storage—**applicable**.	40 *CFR* § 761.50(b)(7)(ii)				✓	✓		✓	✓	✓	✓	✓		✓
Waste Characterization																
Characterization of solid waste	Must determine if solid waste is excluded from regulation under 40 *CFR* § 261.4.	Generation of solid waste as defined in 40 *CFR* § 261.2—**applicable**.	40 *CFR* § 262.11(a) 401 *KAR* 32:010 § 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Must determine if waste is listed as a hazardous waste in Subpart D of 40 *CFR* Part 261.	Generation of solid waste which is not excluded under 40 *CFR* § 261.4—**applicable**.	40 *CFR* § 262.11(b) 401 *KAR* 32:010 § 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Must determine whether the waste is characteristic waste (identified in Subpart C of 40 *CFR* Part 261) by using prescribed testing methods or applying generator knowledge based on information regarding material or processes used.	Generation of solid waste that is not listed in Subpart D of 40 *CFR* Part 261 and not excluded under 40 *CFR* § 261.4—**applicable**.	40 *CFR* § 262.11(c) 401 *KAR* 32:010 § 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Must refer to Parts 261, 262, 264, 265, 266, 268, and 273 of Chapter 40 for possible exclusions or restrictions pertaining to management of the specific waste.	Generation of solid waste which is determined to be hazardous waste—**applicable**.	40 *CFR* § 262.11(d) 401 *KAR* 32:010 § 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Characterization of hazardous waste	Must obtain a detailed chemical and physical analysis on a representative sample of the waste(s), which at a minimum contains all the information that must be known to treat, store, or dispose of the waste in accordance with pertinent sections of 40 *CFR* §§ 264 and 268.	Generation of RCRA-hazardous waste for storage, treatment or disposal—**applicable**.	40 *CFR* § 264.13(a)(1) 401 *KAR* 34:020 § 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Characterization of industrial wastewater	Industrial wastewater discharges that are point source discharges subject to regulation under § 402 of the Clean Water Act, as amended, are not solid wastes for the purpose of hazardous waste management. [Comment: This exclusion applies only to the actual point source discharge. It does not exclude industrial wastewaters while they are being collected, stored or treated before discharge, nor does it exclude sludges that are generated by industrial wastewater treatment.] NOTE: For purpose of this exclusion, the CERCLA on-site treatment system for groundwater will be considered equivalent to a wastewater treatment unit and the point source discharges subject to regulation under CWA § 402, provided the effluent meets all identified CWA ARARs.	Generation of industrial wastewater and discharge into surface water—**applicable**.	40 *CFR* § 261.4(a)(2) 401 *KAR* 31:010 § 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Determinations for management of hazardous waste	Must determine each EPA Hazardous Waste Number (Waste Code) to determine the applicable treatment standards under 40 *CFR* § 268.40 *et. seq*. NOTE: This determination may be made concurrently with the hazardous waste determination required in 40 *CFR* § 262.11.	Generation of hazardous waste—**applicable**.	40 *CFR* § 268.9(a) 401 *KAR* 37:010 § 8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Must determine the underlying hazardous constituents [as defined in 40 *CFR* § 268.2(i)] in the characteristic waste.	Generation of RCRA characteristic hazardous waste (and is not D001 non-wastewaters treated by CMBST, RORGS, or POLYM of Section 268.42 Table 1) for storage, treatment or disposal—**applicable**.	40 *CFR* § 268.9(a) 401 *KAR* 37:010 § 8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Must determine if the hazardous waste meets the treatment standards in 40 *CFR* §§ 268.40, 268.45, or 268.49 by testing in accordance with prescribed methods or use of generator knowledge of waste. NOTE: This determination can be made concurrently with the hazardous waste determination required in 40 *CFR* § 262.11.	Generation of hazardous waste—**applicable**.	40 *CFR* § 268.7(a) 401 *KAR* 37:020 § 7	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Characterization of PCB waste	Any person land disposing of non-liquid PCBs may avoid otherwise-applicable sampling requirements by presuming that the PCBs disposed of are ≥ 500 ppm (or ≥ 100 µg/100 cm^2 if no free-flowing liquids are present).	Generation of PCB waste—**applicable**.	40 *CFR* § 761.50(a)(5)				✓	✓		✓	✓	✓	✓	✓		✓
Characterization of LLW	Shall be characterized using direct or indirect methods and the characterization documented in sufficient detail to ensure safe management and compliance with the WAC of the receiving facility.	Generation of LLW for storage and disposal at a DOE facility—**TBC**.	DOE M 435.1-1(IV)(I)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Characterization data shall, at a minimum, include the following information relevant to the management of the waste: • physical and chemical characteristics; • volume, including the waste and any stabilization or absorbent media; • weight of the container and contents; • identities, activities, and concentration of major radionuclides; • characterization date; • generating source; and • any other information that may be needed to prepare and maintain the disposal facility performance assessment, or demonstrate compliance with performance objectives.		DOE M 435.1-1(IV)(I)(2)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Waste Storage and Staging																
Temporary on-site storage of hazardous waste in containers	A generator may accumulate hazardous waste at the facility provided that	Accumulation of RCRA hazardous waste on-site as defined in 40 *CFR* § 260.10—**applicable**.	40 *CFR* § 262.34(a) 401 *KAR* 32:030 § 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	• waste is placed in containers that comply with 40 *CFR* § 265.171-173;		40 *CFR* § 262.34(a)(1) (i) 401 *KAR* 32:030 § 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	• the date upon which accumulation begins is clearly marked and visible for inspection on each container;		40 *CFR* § 262.34(a)(2) 401 *KAR* 32:030 § 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Temporary on-site storage of hazardous waste in containers (Continued)	• container is marked with the words "hazardous waste."	Accumulation of RCRA hazardous waste on-site as defined in 40 *CFR* § 260.10—**applicable**.	40 *CFR* § 262.34(a)(3) 401 *KAR* 32:030 § 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Container may be marked with other words that identify the contents.	Accumulation of 55 gal or less of RCRA hazardous waste or one quart of acutely hazardous waste listed in 261.33(e) at or near any point of generation—**applicable**.	40 *CFR* § 262.34(c)(1) 401 *KAR* 32:030 § 5	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Use and management of containers holding hazardous waste	If container is not in good condition or if it begins to leak, must transfer waste into container in good condition.	Storage of RCRA hazardous waste in containers—**applicable**.	40 *CFR* § 265.171 401 *KAR* 35:180 § 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Use container made or lined with materials compatible with waste to be stored so that the ability of the container is not impaired.		40 *CFR* § 265.172 401 *KAR* 35:180 § 3	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Keep containers closed during storage, except to add/remove waste.		40 *CFR* § 265.173(a) 401 *KAR* 35:180 § 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Open, handle and store containers in a manner that will not cause containers to rupture or leak.		40 *CFR* § 265.173(b) 401 *KAR* 35:180 § 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Storage of hazardous waste in container area	Area must have a containment system designed and operated in accordance with 40 *CFR* § 264.175(b).	Storage of RCRA hazardous waste in containers with free liquids—**applicable**.	40 *CFR* § 264.175(a) 401 *KAR* 34:180 § 6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Area must be sloped or otherwise designed and operated to drain liquid from precipitation, or Containers must be elevated or otherwise protected from contact with accumulated liquid.	Storage of RCRA hazardous waste in containers that do not contain free liquids (other than F020, F021, F022, F023, F026, and F027)—**applicable**.	40 *CFR* § 264.175(c) 401 *KAR* 34:180 § 6	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Designation and management of CAMUs	To implement remedies under § 264.101 or RCRA Section 3008(h), or to implement remedies at a permitted facility that is not subject to § 264.101, the Regional Administrator may designate an area at the facility as a corrective action management unit under the requirements in this section. CAMU means an area within a facility that is used only for managing CAMU-eligible wastes for implementing corrective action or cleanup at the facility. A CAMU must be located within the contiguous property under the control of the owner or operator where the wastes to be managed in the CAMU originated. One or more CAMUs may be designated at a facility. *NOTE: Designation of a CAMU will be documented in a CERCLA decision document (i.e., ROD, ROD Amendment, or ESD) subject to review and approval under the FFA process.*	Management of CAMU-eligible wastes within a CAMU—**applicable**.	40 *CFR* § 264.552(a)				✓	✓		✓			✓	✓		✓
	CAMU-eligible waste means: All solid and hazardous wastes, and all media (including ground water, surface water, soils, and sediments) and debris that are managed for implementing cleanup. As-generated wastes (either hazardous or non-hazardous) from ongoing industrial operations at a site are not CAMU-eligible wastes.		40 *CFR* § 264.552(a)(1)(i)				✓	✓		✓			✓	✓		✓
	Wastes that would otherwise meet the description in paragraph (a)(1)(i) of this section are not "CAMU-Eligible Wastes" where: (A) The wastes are hazardous wastes found during cleanup in intact or substantially intact containers, tanks, or other non-land-based units found above ground, unless the wastes are first placed in the tanks, containers or non-land-based units as part of cleanup, or the containers or tanks are excavated during the course of cleanup;		40 *CFR* § 264.552(a)(1)(ii)				✓	✓		✓			✓	✓		✓
	Notwithstanding paragraph (a)(1)(i) of this section, where appropriate, as-generated non-hazardous waste may be placed in a CAMU where such waste is being used to facilitate treatment or the performance of the CAMU.		40 *CFR* § 264.552(a)(1)(iii)				✓	✓		✓			✓	✓		✓
	Placement of CAMU-eligible wastes into or within a CAMU does not constitute land disposal of hazardous wastes.		40 *CFR* § 264.552(a)(4)				✓	✓		✓			✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Minimum treatment requirements	Minimum treatment requirements: Unless the wastes will be placed in a CAMU for storage and/or treatment only in accordance with paragraph (f) of this section, CAMU eligible wastes that, absent this section, would be subject to the treatment requirements of part 268 of this chapter, and that the Regional Administrator determines contain principal hazardous constituents must be treated to the standards specified in paragraph (e)(4)(iii) of this section.	Treatment of CAMU-eligible wastes within a new, replacement, or laterally expanded CAMUs located within the contiguous property under the control of the owner or operator—**applicable**.	40 *CFR* § 264.552(e)(4)				✓	✓		✓			✓	✓		✓
	(i) Principal hazardous constituents are those constituents that the Regional Administrator determines pose a risk to human health and the environment substantially higher than the cleanup levels or goals at the site. (A) In general, the Regional Administrator will designate as principal hazardous constituents: (1) Carcinogens that pose a potential direct risk from ingestion or inhalation at the site at or above 10^{-3}; and (2) Non-carcinogens that pose a potential direct risk from ingestion or inhalation at the site an order of magnitude or greater over their reference dose. (B) The Regional Administrator will also designate constituents as principal hazardous constituents, where appropriate, when risks to human health and the environment posed by the potential migration of constituents in wastes to ground water are substantially higher than cleanup levels or goals at the site; when making such a designation, the Regional Administrator may consider such factors as constituent concentrations, and fate and transport characteristics under site conditions. (C) The Regional Administrator may also designate other constituents as principal hazardous constituents that the Regional Administrator determines pose a risk to human health and the environment substantially higher than the cleanup levels or goals at the site. *NOTE: Designation of principal hazardous constituents will be documented in a CERCLA decision document (i.e., ROD, ROD Amendment, or ESD) subject to review and approval under the FFA process.*		40 *CFR* § 264.552(e)(4)(i)				✓	✓		✓			✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Minimum treatment requirements (continued)	(ii) In determining which constituents are "principal hazardous constituents," the Regional Administrator must consider all constituents which, absent this section, would be subject to the treatment requirements in 40 *CFR* Part 268.		40 *CFR* § 264.552(e)(4)(ii)				✓	✓		✓			✓	✓		✓
	(iii) Waste that the Regional Administrator determines contains principal hazardous constituents must meet treatment standards determined in accordance with paragraph (e)(4)(iv) or (e)(4)(v) of this section.		40 *CFR* § 264.552(e)(4)(iii)				✓	✓		✓			✓	✓		✓
	(iv) Treatment standards for wastes placed in CAMUs. (A) For non-metals, treatment must achieve 90 percent reduction in total principal hazardous constituent concentrations, except as provided by paragraph (e)(4)(iv)(C) of this section. (B) For metals, treatment must achieve 90 percent reduction in principal hazardous constituent concentrations as measured in leachate from the treated waste or media (tested according to the TCLP) or 90 percent reduction in total constituent concentrations (when a metal removal treatment technology is used), except as provided by paragraph (e)(4)(iv)(C) of this section. (C) When treatment of any principal hazardous constituent to a 90 percent reduction standard would result in a concentration less than 10 times the Universal Treatment Standard for that constituent, treatment to achieve constituent concentrations less than 10 times the Universal Treatment Standard is not required. Universal Treatment Standards are identified in § 268.48 Table UTS of this chapter. (D) For waste exhibiting the hazardous characteristic of ignitability, corrosivity or reactivity, the waste must also be treated to eliminate these characteristics. (E) For debris, the debris must be treated in accordance with § 268.45 of this chapter, or by methods or to levels established under paragraphs (e)(4)(iv)(A) through (D) or paragraph (e)(4)(v) of this section, whichever the Regional Administrator determines is appropriate.		40 *CFR* § 264.552(e)(4)(iv)				✓	✓		✓			✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Minimum treatment requirements (continued)	(F) Alternatives to TCLP. For metal bearing wastes for which metals removal treatment is not used, the Regional Administrator may specify a leaching test other than the TCLP (SW846 Method 1311, 40 CFR 260.11(c)(3)(v)) to measure treatment effectiveness, provided the Regional Administrator determines that an alternative leach testing protocol is appropriate for use, and that the alternative more accurately reflects conditions at the site that affect leaching. *NOTE: Specification of a leaching test as an alternative to TCLP for metal bearing wastes will be documented in the appropriate-FFA CERCLA primary document and subject to review and approval under the FFA process.*															
	(v) Adjusted standards. The Regional Administrator may adjust the treatment level or method in paragraph (e)(4)(iv) of this section to a higher or lower level, based on one or more of the following factors, as appropriate. The adjusted level or method must be protective of human health and the environment: (A) The technical impracticability of treatment to the levels or by the methods in paragraph (e)(4)(iv) of this section; (B) The levels or methods in paragraph (e)(4)(iv) of this section would result in concentrations of principal hazardous constituents (PHCs) that are significantly above or below cleanup standards applicable to the site (established either site-specifically, or promulgated under state or federal law); (C) The views of the affected local community on the treatment levels or methods in paragraph (e)(4)(iv) of this section as applied at the site, and, for treatment levels, the treatment methods necessary to achieve these levels; (D) The short-term risks presented by the on-site treatment method necessary to achieve the levels or treatment methods in paragraph (e)(4)(iv) of this section;		40 *CFR* § 264.552(e)(4)(v)				✓	✓		✓			✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Minimum treatment requirements (continued)	(E) The long-term protection offered by the engineering design of the CAMU and related engineering controls: (1) Where the treatment standards in paragraph (e)(4)(iv) of this section are substantially met and the principal hazardous constituents in the waste or residuals are of very low mobility; or (2) Where cost-effective treatment has been used and the CAMU meets the Subtitle C liner and leachate collection requirements for new land disposal units at §264.301(c) and (d); or (3) Where, after review of appropriate treatment technologies, the Regional Administrator determines that cost-effective treatment is not reasonably available, and the CAMU meets the Subtitle C liner and leachate collection requirements for new land disposal units at §264.301(c) and (d); or (4) Where cost-effective treatment has been used and the principal hazardous constituents in the treated wastes are of very low mobility; or (5) Where, after review of appropriate treatment technologies, the Regional Administrator determines that cost-effective treatment is not reasonably available, the principal hazardous constituents in the wastes are of very low mobility, and either the CAMU meets or exceeds the liner standards for new, replacement, or laterally expanded CAMUs in paragraphs (e)(3)(i) and (ii) of this section, or the CAMU provides substantially equivalent or greater protection. *NOTE: Any adjusted treatment level or method, along with appropriate factor(s), will be documented in a FFA CERCLA decision document. Should it be necessary to subsequently adjust any treatment level or method after the initial signed ROD, then any such changes, along with the appropriate factor(s), will be documented in an ESD subject to review and approval under the FFA process.*	Treatment of CAMU-eligible wastes within a new, replacement, or laterally expanded CAMUs located within the contiguous property under the control of the owner or operator—**applicable**. (continued)	40 *CFR* § 264.552(e)(4)(v) (continued)													
	(vi) The treatment required by the treatment standards must be completed prior to, or within a reasonable time after, placement in the CAMU.		40 *CFR* § 264.552(e)(4)(vi)				✓	✓		✓			✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Minimum treatment requirements (continued)	(vii) For the purpose of determining whether wastes placed in CAMUs have met site-specific treatment standards, the Regional Administrator may, as appropriate, specify a subset of the principal hazardous constituents in the waste as analytical surrogates for determining whether treatment standards have been met for other principal hazardous constituents. This specification will be based on the degree of difficulty of treatment and analysis of constituents with similar treatment properties. *NOTE: Specification of a subset of the principal hazardous constituents in the waste as analytical surrogates will be included in the appropriate FFA CERCLA primary document and subject to review and approval under the FFA process.*		40 *CFR* § 264.552(e)(4)(vii)				✓	✓		✓			✓	✓		✓
Designation, design, operation, and closure of a CAMU used for storage and/or treatment only	CAMUs used for storage and/or treatment only are CAMUs in which wastes will not remain after closure. Such CAMUs must be designated in accordance with all of the requirements of this section, except as follows:	Management of CAMU-eligible wastes within a CAMU used for storage and/or treatment only—**applicable**.	40 *CFR* § 264.552(f)				✓	✓		✓			✓	✓		✓
	CAMUs that are used for storage and/or treatment only and that operate in accordance with the time limits established in the staging pile regulations at §264.554(d)(1)(iii), (h), and (i) are subject to the requirements for staging piles at 264.554(d)(1)(i) and (ii), 264.554(d)(2), 264.554(e) and (f) and §264.554(j) and (k), in lieu of performance standards and requirements for CAMUs in this section at paragraphs (c) and (e)(3) through (6). *NOTE: It is recognized that a CAMU for storage and/or treatment may need to be operated past the two-year time limit. Any time period for storage and/or treatment of waste greater than two years will be documented and justified in the appropriate FFA CERCLA primary document subject to review and approval under the FFA process.*	CAMU used for storage and/or treatment only and that operate in accordance with the time limits established in the staging pile regulations at 40 *CFR* § 264.554(d)(1)(iii), (h), and (i)—**applicable**.	40 *CFR* § 264.552(f)(1)				✓	✓		✓			✓	✓		✓
	(g) CAMUs into which wastes are placed where all wastes have constituent levels at or below remedial levels or goals applicable to the site do not have to comply with the requirements for liners at paragraph (e)(3)(i) of this section, caps at paragraph (e)(6)(iv) of this section, ground water monitoring requirements at paragraph (e)(5) of this section or, for treatment and/or storage-only CAMUs, the design standards at paragraph (f) of this section.		40 *CFR* § 264.552(g)				✓	✓		✓			✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Temporary tanks and container storage areas used to treat or store hazardous remediation wastes	(a) For temporary tanks and container storage areas used to treat or store hazardous remediation wastes during remedial activities required under § 264.101 or RCRA 3008(h), or at a permitted facility that is not subject to § 264.101, the Regional Administrator may designate a unit at the facility, as a temporary unit. A temporary unit must be located within the contiguous property under the control of the owner/operator where the wastes to be managed in the temporary unit originated. For temporary units, the Regional Administrator may replace the design, operating, or closure standards applicable to these units under this part 264 or part 265 of this chapter with alternative requirements which protect human health and the environment. (b) Any temporary unit to which alternative requirements are applied in accordance with paragraph (a) of this section shall be: (1) Located within the facility boundary; and (2) Used only for treatment or storage of remediation wastes. *NOTE: The designation of temporary units will be documented in a CERCLA decision document (e.g. ROD, ROD Amendment or ESD) subject to review and approval under the FFA process. Alternate design, operating, and/or closure requirements for a temporary unit will be documented in the appropriate FFA CERCLA primary document subject to review and approval under the FFA process.*	Use of temporary tanks and container storage areas to treat or store hazardous remediation wastes during remedial activities—**applicable**.	40 *CFR* § 264.553(a) and (b) 401 *KAR* 34:287		✓	✓	✓	✓		✓			✓	✓		✓
	In establishing standards to be applied to a temporary unit, the Regional Administrator shall consider the following factors: (1) Length of time such unit will be in operation; (2) Type of unit; (3) Volumes of wastes to be managed; (4) Physical and chemical characteristics of the wastes to be managed in the unit; (5) Potential for releases from the unit; (6) Hydrogeological and other relevant environmental conditions at the facility which may influence the migration of any potential releases; and (7) Potential for exposure of humans and environmental receptors if releases were to occur from the unit.	Use of temporary tanks and container storage areas to treat or store hazardous remediation wastes during remedial activities—**applicable**.	40 *CFR* § 264.553(c) 401 *KAR* 34:287		✓	✓	✓	✓		✓			✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Temporary tanks and container storage areas used to treat or store hazardous remediation wastes (Continued)	(d) The Regional Administrator shall specify in the permit or order the length of time a temporary unit will be allowed to operate, to be no longer than a period of one year. The Regional Administrator shall also specify the design, operating, and closure requirements for the unit. (e) The Regional Administrator may extend the operational period of a temporary unit once for no longer than a period of one year beyond that originally specified in the permit or order, if the Regional Administrator determines that: (1) Continued operation of the unit will not pose a threat to human health and the environment; and (2) Continued operation of the unit is necessary to ensure timely and efficient implementation of remedial actions at the facility. *NOTE: It is recognized that a treatment unit may need to be operated past the one-year limit. Any time period for operating greater than one year will be documented and justified in the appropriate FFA CERCLA primary document subject to review and approval under the FFA process.*	Use of temporary tanks and container storage areas to treat or store hazardous remediation wastes during remedial activities—**applicable**.	40 *CFR* § 264.553(d) and (e) 401 *KAR* 34:287		✓	✓	✓	✓		✓			✓	✓		✓
	(g) The Regional Administrator shall document the rationale for designating a temporary unit and for granting time extensions for temporary units and shall make such documentation available to the public. *NOTE: The rationale for designating temporary units will be documented in a CERCLA decision document (e.g. ROD, ROD Amendment or ESD) subject to review and approval under the FFA process. Any time extensions for a temporary unit along with the rationale will be documented in the appropriate FFA CERCLA primary document subject to review and approval under the FFA process.*	Use of temporary tanks and container storage areas to treat or store hazardous remediation wastes during remedial activities—**applicable**.	40 *CFR* § 264.553(g) 401 *KAR* 34:287		✓	✓	✓	✓		✓			✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Temporary on-site storage of remediation waste in staging piles (e.g., excavated soils/sediments, sludge)	May be temporarily stored, (including mixing, sizing, blending, or other similar physical operations intended to prepare the wastes for subsequent management or treatment) at a facility if used only during remedial operations provided that the staging pile will be	Accumulation of non-flowing hazardous remediation waste in staging pile (or remediation waste otherwise subject to land disposal restrictions)—**applicable**.	40 *CFR* § 264.554(a)(1) 401 *KAR* 34:287 § 5		✓	✓	✓	✓		✓			✓	✓		✓
	• located within the contiguous property under the control of the owner/operator where the wastes to be managed in the staging pile originated.		40 *CFR* § 264.554(a) 401 *KAR* 34:287 § 5		✓	✓	✓	✓		✓			✓	✓		✓
	• designed to facilitate a reliable, effective, and protective remedy;		40 *CFR* § 264.554(d)(1)(i) 401 *KAR* 34:287 § 5		✓	✓	✓	✓		✓			✓	✓		✓
	• designed to prevent or minimize releases of hazardous wastes and constituents into the environment, and minimize or adequately control cross-media transfer as necessary to protect human health and the environment (e.g., use of liners, covers, run-off/run-on controls, as appropriate).		40 *CFR* § 264.554(d)(1)(ii) 401 *KAR* 34:287 § 5		✓	✓	✓	✓		✓			✓	✓		✓
	In determining the design, the following factors must be considered: (i) Length of time the pile will be in operation; (ii) Volumes of wastes intended to be stored in the pile; (iii) Physical and chemical characteristics of the wastes to be stored in the unit; (iv) Potential for releases from the unit; (v) Hydrogeological and other relevant environmental conditions at the facility that may influence the migration of any potential releases; and (vi) Potential for human and environmental exposure to potential releases from the unit	Accumulation of non-flowing hazardous remediation waste in staging pile (or remediation waste otherwise subject to land disposal restrictions)—**applicable**.	40 *CFR* § 264.554(d)(2) 401 *KAR* 34:287 § 5		✓	✓	✓	✓		✓			✓	✓		✓
	Must not place ignitable or reactive remediation waste in a staging pile unless the remediation waste has been treated, rendered, or mixed before placed in the staging pile so that	Storage of ignitable or reactive remediation waste in staging piles in—**applicable**.	40 *CFR* § 264.554(e) 401 *KAR* 34:287 § 5		✓	✓	✓	✓		✓			✓	✓		✓
	• The remediation waste no longer meets the definition of ignitable or reactive under 40 *CFR* § 261.21 and §261.23; and		40 *CFR* § 264.554(e)(1)(i) 401 *KAR* 34:287 § 5		✓	✓	✓	✓		✓			✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Temporary on-site storage of remediation waste in staging piles (e.g., excavated soils/sediments, sludge) (Continued)	• You have complied with 40 *CFR* § 264.17(b), General Requirements for Ignitable, Reactive, or Incompatible Wastes.		40 *CFR* § 264.554(e)(1)(ii) 401 *KAR* 34:287 § 5		✓	✓	✓	✓		✓			✓	✓		✓
	Alternatively, instead of meeting the above requirements in 40 *CFR* 264.554(e)(1), the remediation waste may be managed to protect it from exposure to any material or condition that may cause it to ignite or react.		40 *CFR* § 264.554(e)(2) 401 *KAR* 34:287 § 5		✓	✓	✓	✓		✓			✓	✓		✓
	Must not place in the same staging pile unless you have complied with 40 *CFR* § 264.17(b).	Storage of incompatible remediation waste in staging piles in—**applicable**.	40 *CFR* § 264.554(f)(1) 401 *KAR* 34:287 § 5		✓	✓	✓	✓		✓			✓	✓		✓
	Must not pile remediation waste on the same base where incompatible wastes or materials were previously piled, unless the base has been decontaminated sufficiently to comply with 40 *CFR* § 264.17(b).	Storage of incompatible remediation waste in staging piles in—**applicable**.	40 *CFR* § 264.554(f)(3) 401 *KAR* 34:287 § 5		✓	✓	✓	✓		✓			✓	✓		✓
	Must separate the incompatible materials or protect them from one another by using a dike, berm, wall, or other device.	Storage of remediation waste in a staging pile that is incompatible with any waste or material stored nearby in containers, other piles, open tanks or land disposal units (for example, surface impoundments)—**applicable**.	40 *CFR* § 264.554(f)(2) 401 *KAR* 34:287 § 5		✓	✓	✓	✓		✓			✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring

SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Off-site disposal of CAMU-eligible wastes	The Regional Administrator with regulatory oversight at the location where the cleanup is taking place may approve placement of CAMU-eligible wastes in hazardous waste landfills not located at the site from which the waste originated, without the wastes meeting the requirements of RCRA 40 CFR Part 268, if the conditions in paragraphs (a)(1) through (3) of this section are met: (1) The waste meets the definition of CAMU-eligible waste in § 264.552(a)(1) and (2). (2) The principal hazardous constitutes in such waste are identified, in accordance with § 264.552(e)(4)(i) and (ii), and such principal hazardous constituents are treated to any of the following standards specified for CAMU-eligible wastes: (i) The treatment standards under § 264.552(e)(4)(iv); or (ii) Treatment standards adjusted in accordance with § 264.552(e)(4)(v)(A), (C), (D) or (E)(1); or (iii) Treatment standards adjusted in accordance with § 264.552(e)(4)(v)(E)(2), where treatment has been used and that treatment significantly reduces the toxicity or mobility of the principal hazardous constituents in the waste, minimizing the short-term and long-term threat posed by the waste, including the threat at the remediation site.	Placement of CAMU-eligible wastes in hazardous waste landfills not located at the site from which the waste originated—**applicable.**	40 *CFR* § 264.555(a)				✓	✓		✓			✓	✓		✓
	(3) The landfill receiving the CAMU-eligible waste must have a RCRA hazardous waste permit, meet the requirements for new landfills in Subpart N of this part, and be authorized to accept CAMU-eligible wastes; for the purposes of this requirement, "permit" does not include interim status.	Placement of CAMU-eligible wastes in hazardous waste landfills not located at the site from which the waste originated—**applicable**.	40 *CFR* § 264.555(a)													

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Storage of PCB waste and/or PCB/radioactive waste in a RCRA-regulated container storage area	Does not have to meet storage unit requirements in 40 *CFR* § 761.65(b)(1) provided the unit	Storage of PCBs and PCB items at concentrations ≥ 50 ppm designated for disposal—**applicable**.	40 *CFR* § 761.65(b)(2)				✓	✓		✓	✓	✓	✓	✓		✓
	• is permitted by EPA under RCRA § 3004 to manage hazardous waste in containers and spills of PCBs cleaned up in accordance with Subpart G of 40 *CFR* § 761; or		40 *CFR* § 761.65(b)(2)(i)				✓	✓		✓	✓	✓	✓	✓		✓
	• qualifies for interim status under RCRA § 3005 to manage hazardous waste in containers and spills of PCBs cleaned up in accordance with Subpart G of 40 *CFR* § 761; or		40 *CFR* § 761.65(b)(2)(ii)				✓	✓		✓	✓	✓	✓	✓		✓
	• is permitted by an authorized state under RCRA § 3006 to manage hazardous waste in containers and spills of PCBs cleaned up in accordance with Subpart G of 40 *CFR* § 761.		40 *CFR* § 761.65(b)(2)(iii)				✓	✓		✓	✓	✓	✓	✓		✓
	NOTE: For purpose of this exclusion, CERCLA remediation waste, which is also considered PCB waste, can be stored on-site provided the area meets all of the identified RCRA container storage ARARs and spills of PCBs cleaned up in accordance with Subpart G of 40 *CFR* § 761.						✓	✓		✓	✓	✓	✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Storage of PCB waste and/or PCB/radioactive waste in non-RCRA regulated unit	Except as provided in 40 *CFR* §§ 761.65 (b)(2), (c)(1), (c)(7), (c)(9), and (c)(10), after July 1, 1978, owners or operators of any facilities used for the storage of PCBs and PCB Items designated for disposal shall comply with the storage unit requirements in 40 *CFR* § 761.65(b)(1).	Storage of PCBs and PCB items at concentrations ≥ 50 ppm designated for disposal—**applicable**.	40 *CFR* § 761.65(b)				✓	✓		✓	✓	✓	✓	✓		✓
	Storage facility shall meet the following criteria: • Adequate roof and walls to prevent rainwater from reaching stored PCBs and PCB items;		40 *CFR* § 761.65(b)(1) 40 *CFR* § 761.65(b)(1)(i)				✓	✓		✓	✓	✓	✓	✓		✓
	• Adequate floor that has continuous curbing with a minimum 6-inch high curb. Floor and curb must provide a containment volume equal to at least two times the internal volume of the largest PCB article or container or 25% of the internal volume of all articles or containers stored there, whichever is greater. NOTE: 6-inch minimum curbing not required for area storing PCB/radioactive waste;		40 *CFR* § 761.65(b)(1)(ii)				✓	✓		✓	✓	✓	✓	✓		✓
	• No drain valves, floor drains, expansion joints, sewer lines, or other openings that would permit liquids to flow from curbed area;		40 *CFR* § 761.65(b)(1)(iii)				✓	✓		✓	✓	✓	✓	✓		✓
	• Floors and curbing constructed of Portland cement, concrete, or a continuous, smooth, non-porous surface that prevents or minimizes penetration of PCBs; and		40 *CFR* § 761.65(b)(1)(iv)				✓	✓		✓	✓	✓	✓	✓		✓
	• Not located at a site that is below the 100-year flood water elevation.		40 *CFR* § 761.65(b)(1)(v)				✓	✓		✓	✓	✓	✓	✓		✓
	Storage area must be properly marked as required by 40 *CFR* § 761.40(a)(10).		40 *CFR* § 761.65(c)(3)				✓	✓		✓	✓	✓	✓	✓		✓
Risk-based management of PCB remediation waste	May sample, cleanup, or dispose of PCB remediation waste in a manner other than prescribed in paragraphs (a) or (b) of this section, or store PCB remediation waste in a manner other than prescribed in 40 *CFR* § 761.65(b) if approved in writing from EPA provided the method will not pose an unreasonable risk of injury to human health or the environment. NOTE: EPA approval of alternative storage method will be obtained by approval of the FFA CERCLA document.	Management of waste containing PCBs in a manner other than prescribed in 40 *CFR* § 761.65(b) (see above)—**applicable**.	40 *CFR* § 761.61(c)		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Temporary storage of PCB waste (e.g., PPE, rags) in a container(s)	Container(s) shall be marked as illustrated in 40 *CFR* § 761.45(a).	Storage of PCBs and PCB items at concentrations ≥ 50 ppm in containers for disposal—**applicable**.	40 *CFR* § 761.40(a)(1)				✓	✓		✓	✓	✓	✓	✓		✓
	Storage area must be properly marked as required by 40 *CFR* § 761.40(a)(10).		40 *CFR* § 761.65(c)(3)				✓	✓		✓	✓	✓	✓	✓		✓
	Any leaking PCB Items and their contents shall be transferred immediately to a properly marked nonleaking container(s).		40 *CFR* § 761.65(c)(5)				✓	✓		✓	✓	✓	✓	✓		✓
	Container(s) shall be in accordance with requirements set forth in DOT HMR at 49 *CFR* §§ 171-180.		40 *CFR* § 761.65(c)(6)				✓	✓		✓	✓	✓	✓	✓		✓
Storage of PCB/radioactive waste in containers	For liquid wastes, containers must be nonleaking.	Storage of PCB/radioactive waste in containers other than those meeting DOT HMR performance standards—**applicable**.	40 *CFR* § 761.65(c)(6)(i)(A)				✓	✓		✓	✓	✓	✓	✓		✓
	For nonliquid wastes, containers must be designed to prevent buildup of liquids if such containers are stored in an area meeting the containment requirements of 40 *CFR* § 761.65(b)(1)(ii).		40 *CFR* § 761.65(c)(6)(i)(B)				✓	✓		✓	✓	✓	✓	✓		✓
	For both liquid and nonliquid wastes, containers must meet all substantive requirements pertaining to nuclear criticality safety. Acceptable container materials include polyethylene and stainless steel provided that the container material is chemically compatible with the waste being stored. Other containers may be used if the use of such containers is protective of health and the environment as well as public health and safety.	Storage of PCB/radioactive waste in containers other than those meeting DOT HMR performance standards—**applicable**.	40 *CFR* § 761.65(c)(6)(i)(C)				✓	✓		✓	✓	✓	✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Temporary storage of bulk PCB remediation waste or PCB bulk product waste in a waste pile	May be stored at the clean-up site or site of generation subject to the following conditions: • waste must be placed in a pile designed and operated to control dispersal by wind, where necessary, by means other than wetting; • waste must not generate leachate through decomposition or other reactions.	Storage of PCB remediation waste or PCB bulk product waste in a waste pile—**applicable**.	40 *CFR* § 761.65(c)(9)(i) 40 *CFR* § 761.65(c)(9)(ii)				✓	✓		✓	✓	✓	✓	✓		✓
	Storage site must have a liner designed, constructed, and installed to prevent any migration of wastes off or through liner into adjacent subsurface soil, groundwater or surface water at any time during the active life (including closure period) of the storage site.		40 *CFR* § 761.65(c)(9)(iii)(A)				✓	✓		✓	✓	✓	✓	✓		✓
	Liner must be: • constructed of materials that have appropriate chemical properties and sufficient strength and thickness to prevent failure because of pressure gradients, physical contact with waste or leachate to which they are exposed, climatic conditions, the stress of installation, and the stress of daily operation;		40 *CFR* § 761.65(c)(9)(iii)(A)(*1*)				✓	✓		✓	✓	✓	✓	✓		✓
	• placed on foundation or base capable of providing support to liner and resistance to pressure gradients above and below the liner to present failure because of settlement compression or uplift;		40 *CFR* § 761.65(c)(9)(iii)(A)(*2*)				✓	✓		✓	✓	✓	✓	✓		✓
	• installed to cover all surrounding earth likely to be in contact with waste.	Storage of PCB remediation waste or PCB bulk product waste in a waste pile—**applicable**.	40 *CFR* § 761.65(c)(9)(iii)(A)(*3*)				✓	✓		✓	✓	✓	✓	✓		✓
	Waste pile must have a cover that meets the above requirements and installed to cover all of the stored waste likely to be contacted by precipitation, and is secured so as not to be functionally disabled by winds expected under normal weather conditions at the storage site; and	Storage of PCB remediation waste or PCB bulk product waste in a waste pile—**applicable**.	40 *CFR* § 761.65(c)(9)(iii)(B)				✓	✓		✓	✓	✓	✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Temporary storage of bulk PCB remediation waste or PCB bulk product waste in a waste pile (Continued)	Waste pile must have a run-on control system designed, constructed, operated and maintained such that: • It prevents flow on the stored waste during peak discharge from at least a 25-year storm; • It collects and controls at least the water volume resulting from a 24-hour, 25-year storm. Collection and holding facilities (e.g., tanks or basins) must be emptied or otherwise managed expeditiously after storms to maintain design capacity of the system.		40 *CFR* § 761.65(c)(9)(iii)(C) 40 *CFR* § 761.65(c)(9)(iii)(C)(*1*) 40 *CFR* § 761.65(c)(9)(iii)(C)(*2*)				✓	✓		✓	✓	✓	✓	✓		✓
	Requirements of 40 *CFR* § 761.65(c)(9) may be modified under the risk-based disposal option of 40 *CFR* § 761.61(c).		40 *CFR* § 761.65(c)(9)(iv)				✓	✓		✓	✓	✓	✓	✓		✓
Staging of LLW	Shall be for the purpose of the accumulation of such quantities of wastes necessary to facilitate transportation, treatment, and disposal.	Staging of LLW at a DOE facility—**TBC**.	DOE M 435.1-1 (IV)(N)(7)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Temporary storage of LLW	Shall not be readily capable of detonation, explosive decomposition, reaction at anticipated pressures and temperatures, or explosive reaction with water.	Temporary storage of LLW at a DOE facility—**TBC**.	DOE M 435.1-1 (IV)(N)(1)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Shall be stored in a location and manner that protects the integrity of waste for the expected time of storage.		DOE M 435.1-1 (IV)(N)(3)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Shall be managed to identify and segregate LLW from mixed waste.	Temporary storage of LLW at a DOE facility—**TBC**.	DOE M 435.1-1 (IV)(N)(6)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Packaging of LLW for storage	Shall be packaged in a manner that provides containment and protection for the duration of the anticipated storage period and until disposal is achieved or until the waste has been removed from the container.	Storage of LLW in containers at a DOE facility—**TBC**.	DOE M 435.1-1(IV)(L)(1)(a)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Vents or other measures shall be provided if the potential exists for pressurizing or generating flammable or explosive concentrations of gases within the waste container.		DOE M 435.1-1(IV)(L)(1) (b)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Containers shall be marked such that their contents can be identified.		DOE M 435.1-1(IV)(L)(1)(c)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Packaging of LLW for off-site disposal	Waste shall not be packaged for disposal in a cardboard or fiberboard box.	Packaging of LLW for off-site shipment of LLW to a commercial NRC or Agreement State licensed disposal facility—**relevant and appropriate**.	10 *CFR* § 61.56 902 *KAR* 100:021 § 7 (1)(b)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Packaging of LLW for off-site disposal (continued)	Liquid waste shall be solidified or packaged in sufficient absorbent material to absorb twice the volume of the liquid.	Preparation of liquid LLW for off-site shipment of LLW to a commercial NRC or Agreement State licensed disposal facility—**relevant and appropriate**.	10 *CFR* § 61.56 902 *KAR* 100:021 § 7 (1)(c)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Solid waste containing liquid shall contain as little freestanding and noncorrosive liquid as is reasonably achievable. The liquid shall not exceed one (1) percent of the volume.	Preparation of solid LLW containing liquid for off-site shipment of LLW to a commercial NRC or Agreement State licensed disposal facility—**relevant and appropriate**.	10 *CFR* § 61.56 902 *KAR* 100:021 § 7 (1)(d)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Waste shall not be readily capable of • Detonation; • Explosive decomposition or reaction at normal pressures and temperatures; or • Explosive reaction with water.	Packaging of LLW for off-site shipment of LLW to a commercial NRC or Agreement State licensed disposal facility—**relevant and appropriate**.	10 *CFR* § 61.56 902 *KAR* 100:021 § 7 (1)(e)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Waste shall not contain, or be capable of generating, quantities of toxic gases, vapors, or fumes harmful to a person transporting, handling, or disposing of the waste.	Packaging of LLW for off-site shipment of LLW to a commercial NRC or Agreement State licensed disposal facility—**relevant and appropriate**.	10 *CFR* § 61.56 902 *KAR* 100:021 § 7 (1)(f)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Waste shall not be pyrophoric.	Packaging of pyrophoric LLW for off-site shipment of LLW to a commercial NRC or Agreement State licensed disposal facility—**relevant and appropriate**.	10 *CFR* § 61.56 902 *KAR* 100:021 § 7 (1)(g)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Notwithstanding the provisions in 10 *CFR* § 61.56(a) (2) and (3), liquid wastes, or wastes containing liquid, must be converted into a form that contains as little free standing and noncorrosive liquid as is reasonably achievable, but in no case shall the liquid exceed 1 percent of the volume of the waste when the waste is in a disposal container designed to ensure stability, or 0.5 percent of the volume of the waste for waste processed to a stable form.	Preparation of LLW for offsite disposal of the waste container at a commercial NRC or Agreement State licensed disposal facility—relevant and appropriate.	10 *CFR* § 61.56(b)(2)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Void spaces within the waste and between the waste and its package shall be reduced to the extent practical.	Preparation of LLW for offsite disposal of the waste container at a commercial NRC or Agreement State licensed disposal facility—relevant and appropriate.	10 *CFR* § 61.56(b)(3)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Waste treatment and disposal																
Transport or conveyance of collected RCRA wastewater to a WWTU located on the facility	Any dedicated tank systems, conveyance systems, and ancillary equipment used to treat, store or convey wastewater to an on-site KPDES-permitted wastewater treatment facility are exempt from the requirements of RCRA Subtitle C standards. NOTE: For purposes of this exclusion, any dedicated tank systems, conveyance systems, and ancillary equipment used to treat, store or convey CERCLA remediation wastewater to a CERCLA on-site wastewater treatment unit that meets all of the identified CWA ARARs for point source discharges from such a facility, are exempt from the requirements of RCRA Subtitle C standards.	On-site wastewater treatment unit (as defined in 40 *CFR* § 260.10) subject to regulation under § 402 or § 307(b) of the CWA (i.e., KPDES-permitted) that manages hazardous wastewaters—**applicable**.	40 *CFR* § 264.1(g)(6) 401 *KAR* 34:010 § 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Release of property with residual radioactive material	Residual Radioactive Material. Property potentially containing residual radioactive material must not be cleared from DOE control unless either: A. The property is demonstrated not to contain residual radioactive material based on process and historical knowledge, radiological monitoring or surveys, or a combination of these; or B. The property is evaluated and appropriately monitored or surveyed to determine: 1. The types and quantities of residual radioactive material within the property; 2. The quantities of removable and total residual radioactive material on property surfaces (including residual radioactive material present on and under any coating);	Generation of DOE materials and equipment with residual radioactive contamination—**TBC**.	DOE O 458.1 § 4.k(3)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Release of property with residual radioactive material (Continued)	3. That for property with potentially contaminated surfaces that are difficult to access for radiological monitoring or surveys, an evaluation of residual radioactive material on such surfaces is performed which is: a. Based on process and historical knowledge meeting the requirements of paragraph 4.k.(5) of this Order and monitoring and or surveys, to the extent feasible and b. Sufficient to demonstrate that applicable specific or pre-approved DOE Authorized Limits will not be exceeded; and 4. That any residual radioactive material within or on the property is in compliance with applicable specific or pre-approved DOE Authorized Limits.	Generation of DOE materials and equipment with residual radioactive contamination—**TBC**.	DOE O 458.1 § 4.k(3)													
Treatment of LLW	Treatment to provide more stable waste forms and to improve the long-term performance of a LLW disposal facility shall be implemented as necessary to meet the performance objectives of the disposal facility.	Treatment of LLW for disposal at a LLW disposal facility—**TBC**.	DOE M 435.1-1(IV)(O)		✓	✓	✓	✓		✓			✓	✓		✓
Disposal of a restricted RCRA hazardous waste soil in a land-based unit	Prior to land disposal, all "constituents subject to treatment" as defined in 40 *CFR* § 268.49(d) must be treated as follows.	Land disposal, as defined in 40 *CFR* § 268.2 of restricted hazardous waste soils—**applicable**.	40 *CFR* § 268.49(c)(1) 401 *KAR* 37:040 § 10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	For non-metals (except carbon disulfide, cyclohexanone, and methanol), treatment must achieve a 90 percent reduction in total constituent concentrations, except as provided in 40 *CFR* § 268.49(c)(1)(C).		40 *CFR* § 268.49(c)(1)(A) 401 *KAR* 37:040 § 10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	For metals and carbon disulfide, cyclohexanone, and methanol), treatment must achieve a 90 percent reduction in total constituent concentrations as measured in leachate from the treated media (tested according to TCLP) or 90 percent reduction in total constituent concentrations (when a metal removal technology is used), except as provided in 40 *CFR* § 268.49(c)(1)(C).		40 *CFR* § 268.49(c)(1)(B) 401 *KAR* 37:040 § 10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Disposal of a restricted RCRA hazardous waste soil in a land-based unit (Continued)	When treatment of any constituent subject to treatment to a 90 percent reduction standard would result in a concentration less than 10 times the Universal Treatment Standard for that constituent, treatment to achieve constituent concentrations less than 10 times the universal treatment standard is not required. [Universal Treatment Standards (UTS) are identified in 40 *CFR* § 268.48 Table UTS].	Land disposal, as defined in 40 *CFR* § 268.2 of restricted hazardous waste soils—**applicable**.	40 *CFR* § 268.49(c)(1)(C) 401 *KAR* 37:040 § 10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	In addition to the treatment requirement required by paragraph (c)(1) of 40 *CFR* § 268.49, soils must be treated to eliminate these characteristics.	Land disposal, as defined in 40 *CFR* § 268.2 of soils that exhibit the hazardous characteristic of ignitability, corrosivity, or reactivity—**applicable**.	40 *CFR* § 268.49(c)(2) 401 *KAR* 37:040 § 10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Disposal of RCRA hazardous waste soil in a land-based unit	Must be treated according to the alternative treatment standards of 40 *CFR* § 268.49(c) or according to the UTSs specified in 40 *CFR* § 268.48 applicable to the listed and/or characteristic waste contaminating the soil prior to land disposal.	Land disposal, as defined in 40 *CFR* § 268.2, of restricted hazardous soils—**applicable**.	40 *CFR* § 268.49(b) 401 *KAR* 37:040 § 10	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Disposal of prohibited RCRA hazardous waste in a land-based unit	May be land disposed if it meets the requirements in the table "Treatment Standards for Hazardous Waste" at 40 *CFR* § 268.40 before land disposal.	Land disposal, as defined in 40 *CFR* § 268.2, of prohibited RCRA waste—**applicable**.	40 *CFR* § 268.40(a) 401 *KAR* 37:040 § 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	All underlying hazardous constituents [as defined in 40 *CFR* § 268.2(i)] must meet the Universal Treatment Standards, found in 40 *CFR* § 268.48 Table UTS prior to land disposal.	Land disposal of restricted RCRA characteristic wastes (D001–D043) that are not managed in a wastewater treatment system that is regulated under the CWA, that is CWA equivalent, or that is injected into a Class I nonhazardous injection well—**applicable**.	40 *CFR* § 268.40(e) 401 *KAR* 37:040 § 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Disposal of RCRA characteristic wastewaters in an NPDES-permitted wastewater treatment unit	Are not prohibited, if the wastes are managed in a treatment system which subsequently discharges to waters of the U.S. pursuant to a permit issued under 402 of the CWA (i.e., NPDES permitted) unless the wastes are subject to a specified method of treatment other than DEACT in 40 *CFR* § 268.40, or are D003 reactive cyanide.	Land disposal of hazardous wastewaters that are hazardous only because they exhibit a hazardous characteristic and are not otherwise prohibited under 40 *CFR* Part 268—**applicable**.	40 *CFR* § 268.1(c)(4)(i) 401 *KAR* 37:010 § 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Disposal of RCRA characteristic wastewaters in an NPDES-permitted wastewater treatment unit (Continued)	NOTE: For purposes of this exclusion, a CERCLA on-site wastewater treatment unit that meets all of the identified CWA ARARs for point source discharges from such a system, is considered a wastewater treatment system that is NPDES permitted.	Land disposal of hazardous wastewaters that are hazardous only because they exhibit a hazardous characteristic and are not otherwise prohibited under 40 *CFR* Part 268—**applicable**.	40 *CFR* § 268.1(c)(4)(i) 401 *KAR* 37:010 § 2													
Disposal of RCRA hazardous debris in a land-based unit	Must be treated prior to land disposal as provided in 40 *CFR* § 268.45(a)(1)-(5) unless EPA determines under 40 *CFR* § 261.3(f)(2) that the debris no longer contaminated with hazardous waste or the debris is treated to the waste-specific treatment standard provided in 40 *CFR* § 268.40 for the waste contaminating the debris.	Land disposal, as defined in 40 *CFR* § 268.2, of RCRA-hazardous debris—**applicable**.	40 *CFR* § 268.45(a) 401 *KAR* 37:040 § 7	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Disposal of treated hazardous debris	Debris treated by one of the specified extraction or destruction technologies on Table 1 of 40 *CFR* § 268.45 and which no longer exhibits a characteristic is not a hazardous waste and need not be managed in RCRA Subtitle C facility. Hazardous debris contaminated with listed waste that is treated by immobilization technology must be managed in a RCRA Subtitle C facility.	Treated debris contaminated with RCRA-listed or characteristic waste—**applicable**.	40 *CFR* § 268.45(c) 401 *KAR* 37:040 § 7	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Disposal of hazardous debris treatment residues	Except as provided in 268.45(d)(2) and (d)(4), must be separated from debris by simple physical or mechanical means, and such residues are subject to the waste-specific treatment standards for the waste contaminating the debris.	Residue from treatment of hazardous debris —**applicable**.	40 *CFR* § 268.45(d)(1) 401 *KAR* 37:040 § 7	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Disposal of bulk PCB remediation waste off-site (self-implementing)	May be sent off-site for decontamination or disposal provided the waste either is dewatered on-site or transported off-site in containers meeting the requirements of DOT HMR at 49 *CFR* Parts 171-180.	Generation of bulk PCB remediation waste (as defined in 40 *CFR* § 761.3) for off-site disposal—**relevant and appropriate**.	40 *CFR* § 761.61(a)(5)(i)(B)				✓	✓		✓	✓	✓	✓	✓		✓
	Must provide written notice including the quantity to be shipped and highest concentration of PCBs [using extraction EPA Method 3500B/3540C or Method 3500B/3550B followed by chemical analysis using Method 8082 in SW 846 or methods validated under 40 *CFR* § 761.320-26 (Subpart Q)] before the first shipment of waste, to each off-site facility where the waste is destined for an area not subject to a TSCA PCB Disposal Approval.	Bulk PCB remediation waste (as defined in 40 *CFR* § 761.3) destined for an off-site facility not subject to a TSCA PCB Disposal Approval—**relevant and appropriate**.	40 *CFR* § 761.61(a)(5)(i)(B)(2)*(iv)*				✓	✓		✓	✓	✓	✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
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SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Disposal of bulk PCB remediation waste off-site (self-implementing) (Continued)	Shall be disposed of in accordance with the provisions for cleanup wastes at 40 *CFR* § 761.61(a)(5)(v)(A).	Off-site disposal of dewatered bulk PCB remediation waste with a PCB concentration < 50 ppm—**relevant and appropriate**.	40 *CFR* § 761.61(a)(5)(i)(B)(2)*(ii)*				✓	✓		✓	✓	✓	✓	✓		✓
	Shall be disposed of • in a hazardous waste landfill permitted by EPA under § 3004 of RCRA; • in a hazardous waste landfill permitted by a State authorized under §3006 of RCRA; or • in a PCB disposal facility approved under 40 *CFR* § 761.60.	Off-site disposal of dewatered bulk PCB remediation waste with a PCB concentration ≥ 50 ppm—**relevant and appropriate**.	40 *CFR* § 761.61(a)(5)(i)(B)(2)*(iii)*				✓	✓		✓	✓	✓	✓	✓		✓
Disposal of PCB-contaminated nonporous surfaces on-site	• Decontamination procedures under 40 *CFR* § 761.79, • Technologies approved under 40 *CFR* § 761.60(e), or • Risk-based procedures/technologies under 40 *CFR* § 761.61(c).	PCB remediation waste porous surfaces as defined in 40 *CFR* § 761.3 for on-site disposal—**applicable**.	40 *CFR* § 761.61(a)(5)(ii)(A)				✓	✓		✓	✓	✓	✓	✓		✓
Disposal of PCB-contaminated nonporous surfaces off-site	Shall be disposed of in accordance with 40 *CFR* § 761.61(a)(5)(i)(B)(3)(ii) [sic] 40 *CFR* § 761.61(a)(5)(i)(B)(2)(ii). Metal surfaces may be thermally decontaminated in accordance with 40 *CFR* § 761.79(c)(6)(i).	PCB remediation waste nonporous surfaces as defined in 40 *CFR* § 761.3 having surface concentrations < 100 µg/100 cm^2 for off-site disposal—**applicable**.	40 *CFR* § 761.61(a)(5)(ii)(B)(1)				✓	✓		✓	✓	✓	✓	✓		✓
	Shall be disposed of in accordance with 40 *CFR* § 761.61(a)(5)(i)(B)(3)(iii) [sic] [40 *CFR* § 761.61(a)(5)(i)(B)(2)(iii)]. Metal surfaces may be thermally decontaminated in accordance with 40 *CFR* § 761.79(c)(6)(ii).	PCB remediation waste nonporous surfaces having surface concentrations ≥ 100 µg/100 cm^2 for off-site disposal—**applicable**.	40 *CFR* § 761.61 (a)(5)(ii)(B) (2)				✓	✓		✓	✓	✓	✓	✓		✓
Disposal of PCB-contaminated porous surfaces	Shall be disposed on-site or off-site as bulk PCB-remediation waste according to 40 *CFR* § 761.61(a)(5)(i) or decontaminated for use according to 40 *CFR* § 761.79(b)(4).	PCB remediation waste porous surfaces (as defined in 40 *CFR* § 761.3)—**applicable**.	40 *CFR* § 761.61(a)(5)(iii)				✓	✓		✓	✓	✓	✓	✓		✓
Disposal of liquid PCB remediation waste (self-implementing)	Shall either • decontaminate the waste to the levels specified in 40 *CFR* § 761.79(b)(1) or (2); or	Liquid PCB remediation waste (as defined in 40 *CFR* § 761.3)—**applicable**.	40 *CFR* § 761.61(a)(5)(iv)(A)		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
	• dispose of the waste in accordance with the performance-based requirements of 40 *CFR* § 761.61(b) or in accordance with a risk-based approval under 40 *CFR* § 761.61(c).		40 *CFR* § 761.61(a)(5)(iv)(B)		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (SS): Containment, Stabilization/Solidification, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 4 (CI): Containment, Chemical Injection, Surface Controls, LUCs, and Monitoring
SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Disposal of PCB cleanup wastes (e.g., PPE, rags, non-liquid cleaning materials) (self-implementing)	Shall be either decontaminated in accordance with 40 *CFR* § 761.79((b) or (c), or disposed of in one of the following facilities: • a facility permitted, licensed or registered by a State to manage municipal solid waste under 40 *CFR* § 258; • a facility permitted, licensed, or registered by a State to manage non-municipal non-hazardous waste subject to 40 *CFR* § 257.5 thru 257.30, as applicable; or • a hazardous waste landfill RCRA permitted by EPA under Section 3004 of RCRA, or a state authorized under Section 3006 of RCRA; or • in a PCB disposal facility approved under 40 *CFR* § 761; or NOTE: or otherwise authorized under CERCLA	Generation of non-liquid cleaning materials at any PCB concentration resulting from the cleanup of PCB remediation waste—**applicable**.	40 *CFR* § 761.61(a)(5)(v)(A)		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Reuse of PCB cleaning solvents, abrasives and equipment	May be reused after decontamination under 40 *CFR* § 761.79.	Generation of PCB wastes from the cleanup of PCB remediation waste—**applicable**.	40 *CFR* § 761.61(a)(5)(v)(B)		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Performance-based disposal of PCB remediation waste	May dispose by one of the following methods • in a high-temperature incinerator under 40 *CFR* § 761.70(b); • by an alternate disposal method under 40 *CFR* § 761.60(e); • in a chemical waste landfill under 40 *CFR* § 761.75; • in a facility under 40 *CFR* § 761.77; or	Disposal of non-liquid PCB remediation waste (as defined in 40 *CFR* § 761.3)—**applicable**.	40 *CFR* § 761.61(b)(2) 40 *CFR* § 761.61(b)(2)(i)				✓	✓		✓	✓	✓	✓	✓		✓
	• through decontamination in accordance with 40 *CFR* § 761.79.		40 *CFR* § 761.61(b)(2)(ii)				✓	✓		✓	✓	✓	✓	✓		✓
	Shall be disposed according to 40 *CFR* § 761.60(a) or (e), or decontaminate in accordance with 40 *CFR* § 761.79.	Disposal of liquid PCB remediation waste—**applicable**.	40 *CFR* § 761.61(b)(1)				✓	✓		✓	✓	✓	✓	✓		✓

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SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Risk-based disposal of PCB remediation waste	May dispose of in a manner other than prescribed in 40 *CFR* § 761.61(a) or (b) if approved in writing from EPA and method will not pose an unreasonable risk of injury to [sic] human health or the environment. NOTE: EPA approval of alternative disposal method will be obtained by approval of the FFA CERCLA document.	Disposal of PCB remediation waste—**applicable**.	40 *CFR* § 761.61(c)				✓	✓		✓	✓	✓	✓	✓		✓
Disposal of PCB decontamination waste and residues	Such waste shall be disposed of at their existing PCB concentration unless otherwise specified in 40 *CFR* § 761.79(g)(1-6).	PCB decontamination waste and residues—**applicable**.	40 *CFR* § 761.79(g)		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Disposal of LLW	LLW shall be certified as meeting waste acceptance requirements before it is transferred to the receiving facility.	Disposal of LLW at a DOE facility—**TBC**.	DOE M 435.1-1(IV)(J)(2)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Discharge of Treated Water to Surface Water																
General duty to mitigate for discharge of wastewater from groundwater treatment system	Take all reasonable steps to minimize or prevent any discharge or sludge use or disposal in violation of effluent standards which has a reasonable likelihood of adversely affecting human health or the environment.	Discharge of pollutants to surface waters—**applicable**.	401 *KAR* 5:065 § 2(1) 40 *CFR* §122.41(d)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Operation and maintenance of treatment system	Properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) which are installed or used to achieve compliance with the effluent standards. Proper operation and maintenance also includes adequate laboratory controls and appropriate quality assurance procedures.	Discharge of pollutants to surface waters—**relevant and appropriate**.	401 *KAR* 5:065 § 2(1) 40 *CFR* § 122.41(e)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Technology-based treatment requirements for wastewater discharge	To the extent that EPA promulgated effluent limitations are inapplicable, shall develop on a case-by-case Best Professional Judgment (BPJ) basis under § 402(a)(1)(B) of the CWA, technology based effluent limitations by applying the factors listed in 40 *CFR* § 125.3(d) and shall consider: • The appropriate technology for this category or class of point sources, based upon all available information; and • Any unique factors relating to the discharger.	Discharge of pollutants to surface waters from other than a POTW—**applicable**.	40 *CFR* § 125.3(c)(2)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
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SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring

SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Water quality-based effluent limits for wastewater discharge	Must develop water quality based effluent limits that ensure that: • The level of water quality to be achieved by limits on point source(s) established under this paragraph is derived from, and complies with all applicable water quality standards; and • Effluent limits developed to protect narrative or numeric water quality criteria are consistent with the assumptions and any available waste load allocation for the discharge prepared by the State and approved by EPA pursuant to 40 *CFR* § 130.7.	Discharge of pollutants to surface waters that causes, or has reasonable potential to cause, or contributes to an instream excursion above a narrative or numeric criteria within a State water quality standard established under § 303 of the CWA—**applicable**.	40 *CFR* § 122.44(d)(1)(vii) 401 *KAR* 5:065 § 2(4)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	Must attain or maintain a specified water quality through water quality related effluent limits established under § 302 of the CWA.	Discharge of pollutants to surface waters that causes, or has reasonable potential to cause, or contributes to an instream excursion above a narrative or numeric criteria within a State water quality standard—**applicable**.	40 *CFR* § 122.44(d)(2) 401 *KAR* 5:065 § 2(4)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	If a discharge causes, has the reasonable potential to cause, or contribute to an in-stream excursion above the numeric criterion for whole effluent toxicity using the procedures in paragraph (d)(1)(ii), must develop effluent limits for whole effluent toxicity.	Discharge of wastewater that causes, has the reasonable potential to cause, or contributes to an in-stream excursion above the numeric criterion for whole effluent toxicity—**applicable**.	40 *CFR* § 122.44(d)(1)(iv) 401 *KAR* 5:065 § 2(4)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Monitoring requirements for groundwater treatment system discharges	In addition to 40 *CFR* §122.48(a) and (b) and to assure compliance with effluent limitations, one must monitor, as provided in subsections (i) thru (iv) of 122.44(i)(1). NOTE: Monitoring parameters, including frequency of sampling, will be developed as part of the CERCLA process and included in a Remedial Design, RAWP, or other appropriate FFA CERCLA document.	Discharge of pollutants to surface waters—**applicable**.	40 *CFR* § 122.44(i)(1) 401 *KAR* 5:065 § 2(4)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	All effluent limitations, standards, and prohibitions shall be established for each outfall or discharge point, except as provided under § 122.44(k).		40 *CFR* § 122.45(a) 401 *KAR* 5:065 § 2(5)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	All effluent limitations, standards and prohibitions, including those necessary to achieve water quality standards, shall unless impracticable be stated as: • Maximum daily and average monthly discharge limitations for all discharges.	Continuous discharge of pollutants to surface waters—**applicable**.	40 *CFR* § 122.45(d)(1) 401 *KAR* 5:065 § 2(5)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

SWMU 2: Alt 3 Containment, Surface Controls, LUCs, and Monitoring
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SWMU 2: Alt 5: Excavation, Treatment, Disposal, LUCs, and Monitoring
SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Mixing zone requirements for discharge of pollutants to surface water	The relevant requirements provided in 401 *KAR* 10:029 § 4 shall apply to a mixing zone for a discharge of pollutants. NOTE: Determination of the appropriate mixing zone will, if necessary, involve consultation with KDEP and will be documented in the CERCLA Remedial Design or other appropriate FFA CERCLA document.	Discharge of pollutants to surface waters of the Commonwealth [*Bayou Creek*]—**applicable**.	401 *KAR* 10:029 § 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Surface Water Standards	Table 1 of 401 *KAR* 10:031 § 6(1) provides allowable instream concentrations of pollutants that may be found in surface waters or discharged into surface waters.	Discharge of pollutants to surface waters of the Commonwealth designated as *Warm Water Aquatic Life Habitat*—**applicable**.	401 *KAR* 10:031 § 6(1)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Decontamination/Cleanup																
Decontamination of PCB-contaminated water	For discharge to a treatment works as defined in 40 *CFR* § 503.9 (aa), or discharge to navigable waters, meet standard of < 3 ppb PCBs; or	Water containing PCBs regulated for disposal—**applicable**.	40 *CFR* § 761.79 (b)(1)(ii)		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
	For unrestricted use, meet standard of 0.5 ppb PCBs.		40 *CFR* § 761.79(b)(1)(iii)		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Decontamination of PCB-contaminated liquids	Meet standard of < 2 ppm PCBs.	Organic liquids and nonaqueous inorganic liquids containing PCBs—**applicable**.	40 *CFR* § 761.79(b)(2)		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Decontamination of PCB containers (self-implementing option)	Must flush the internal surfaces of the container three times with a solvent containing < 50 ppm PCBs. Each rinse shall use a volume of the flushing solvent equal to approximately 10% of the PCB container capacity.	Decontaminating a PCB Container as defined in 40 *CFR* § 761.3—**applicable**.	40 *CFR* § 761.79(c)(1)		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓
Decontamination of movable equipment contaminated by PCBs (self-implementing option)	May decontaminate by • swabbing surfaces that have contacted PCBs with a solvent; • a double wash/rinse as defined in 40 *CFR* § 761.360-378; or • another applicable decontamination procedure under 40 *CFR* § 761.79.	Decontaminating movable equipment contaminated by PCB, tools and sampling equipment—**applicable**.	40 *CFR* § 761.79(c)(2)		✓	✓	✓	✓		✓	✓	✓	✓	✓		✓

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SWMU 2: Alt 6: Targeted Excavation, Treatment, Disposal, Containment, LUCs, and Monitoring
SWMU 3: Alt 3: Cap, Surface Controls, LUCs, and Monitoring
SWMU 3: Alt 5: Excavation and Disposal, LUCs, and Monitoring
SWMU 7: Alt 4 (P&T): Cap, P&T, LUCs, and Monitoring
SWMU 7: Alt 4 (ERH): Cap, ERH, LUCs, and Monitoring
SWMU 7: Alt 5 (P&T): Excavation and Disposal, P&T, LUCs, and Monitoring
SWMU 7: Alt 5 (ERH): Excavation and Disposal, ERH, LUCs, and Monitoring
SWMU 30: Alt 3: Cap, LUCs, and Monitoring
SWMU 30: Alt 5: Excavation and Disposal, LUCs, and Monitoring

Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Unit Closure																
Closure performance standard for RCRA container storage unit	Must close the facility (e.g., container storage unit) in a manner that: • Minimizes the need for further maintenance; • Controls minimizes or eliminates to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated run-off, or hazardous waste decomposition products to the ground or surface waters or the atmosphere; and • Complies with the closure requirements of part G, but not limited to, the requirements of 40 *CFR* § 264.178 for containers.	Storage of RCRA hazardous waste in containers—**applicable**.	40 *CFR* § 264.111 401 *KAR* 34:070 § 2	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Closure of RCRA container storage unit	At closure, all hazardous waste and hazardous waste residues must be removed from the containment system. Remaining containers, liners, bases, and soils containing or contaminated with hazardous waste and hazardous waste residues must be decontaminated or removed. [Comment: At closure, as throughout the operating period, unless the owner or operator can demonstrate in accordance with 40 *CFR* § 261.3(d) of this chapter that the solid waste removed from the containment system is not a hazardous waste, the owner or operator becomes a generator of hazardous waste and must manage it in accordance with all applicable requirements of parts 262 through 266 of this chapter].	Storage of RCRA hazardous waste in containers in a unit with a containment system—**applicable**.	40 *CFR* § 264.178 401 *KAR* 34:180 § 9	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Closure of staging piles of remediation waste	Must be closed by removing or decontaminating all remediation waste, contaminated containment system components, and structures and equipment contaminated with waste and leachate.	Storage of remediation waste in staging pile located in previously contaminated area—**relevant and appropriate**.	40 *CFR* § 264.554(j)(1) 401 *KAR* 34:287 § 5		✓	✓	✓	✓		✓			✓	✓		✓
	Must decontaminate contaminated sub-soils in a manner that will protect human and the environment.		40 *CFR* § 264.554(j)(2) 401 *KAR* 34:287 § 5		✓	✓	✓	✓		✓			✓	✓		✓
Closure of staging piles of remediation waste (Continued)	Must be closed according to substantive requirements in 40 *CFR* § 264.258(a) and 264.111.	Storage of remediation waste in staging pile located in uncontaminated area—**relevant and appropriate**.	40 *CFR* § 264.554(k) 401 *KAR* 34:287 § 5		✓	✓	✓	✓		✓			✓	✓		✓
Clean closure of TSCA storage facility	A TSCA/RCRA storage facility closed under RCRA is exempt from the TSCA closure requirements of 40 *CFR* § 761.65(e).	Closure of TSCA/RCRA storage facility—**relevant and appropriate**.	40 *CFR* § 761.65(e)(3)				✓	✓		✓			✓	✓		✓

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Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Waste Transportation																
Transportation of samples (i.e., contaminated soils and wastewaters)	Are not subject to any requirements of 40 *CFR* Parts 261 through 268 or 270 when: • The sample is being transported to a laboratory for the purpose of testing; or • The sample is being transported back to the sample collector after testing.	Samples of solid waste or a sample of water, soil for purpose of conducting testing to determine its characteristics or composition—**applicable**.	40 *CFR* § 261.4(d)(1)(i) and (ii) 401 *KAR* 31:010 § 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
	In order to qualify for the exemption in paragraphs (d)(1)(i) and (ii), a sample collector shipping samples to a laboratory must: • Comply with U.S. DOT, U.S. Postal Service, or any other applicable shipping requirements. • Assure that the information provided in (1) thru (5) of this section accompanies the sample. • Package the sample so that it does not leak, spill, or vaporize from its packaging.		40 *CFR* § 261.4(d)(2)(i) 401 *KAR* 31:010 § 4 40 *CFR* § 261.4(d)(2)(i)(A) 401 *KAR* 31:010 § 4 40 *CFR* § 261.4(d)(2)(i)(B) 401 *KAR* 31:010 § 4	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Transportation of RCRA hazardous waste on-site	The generator manifesting requirements of 40 *CFR* § 262.20–262.32(b) do not apply. Generator or transporter must comply with the requirements set forth in 40 *CFR* § 263.30 and 263.31 in the event of a discharge of hazardous waste on a private or public right-of-way.	Transportation of hazardous wastes on a public or private right-of-way within or along the border of contiguous property under the control of the same person, even if such contiguous property is divided by a public or private right-of-way—**applicable**.	40 *CFR* § 262.20(f) 401 *KAR* 32:020 § 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Transportation of RCRA hazardous waste off-site	Must comply with the generator requirements of 40 *CFR* § 262.20–23 for manifesting, Sect. 262.30 for packaging, Sect. 262.31 for labeling, Sect. 262.32 for marking, Sect. 262.33 for placarding, Sect. 262.40, 262.41(a) for record keeping requirements, and Sect. 262.12 to obtain EPA ID number.	Preparation and initiation of shipment of hazardous waste off-site—**applicable**.	40 *CFR* § 262.10(h) 401 *KAR* 32:010 § 1	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Transportation of PCB wastes off-site	Must comply with the manifesting provisions at 40 *CFR* § 761.207 through 218.	Relinquishment of control over PCB wastes by transporting, or offering for transport—**applicable**.	40 *CFR* § 761.207(a)				✓	✓		✓	✓	✓	✓	✓		✓

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Table F.2. Action-Specific ARARs and TBC Guidance for BGOU FS—SWMUs 2, 3, 7, and 30 (Continued)

				SWMU 2					SWMU 3		SWMU 7				SWMU 30	
Action	**Requirement**	**Prerequisite**	**Citation**	**Alt 3**	**Alt 4 (SS)**	**Alt 4 (CI)**	**Alt 5**	**Alt 6**	**Alt 3**	**Alt 5**	**Alt 4 (P&T)**	**Alt 4 (ERH)**	**Alt 5 (P&T)**	**Alt 5 (ERH)**	**Alt 3**	**Alt 5**
Determination of radionuclide concentration	The concentration of a radionuclide may be determined by an indirect method, such as use of a scaling factor which relates the inferred concentration of one (1) radionuclide to another that is measured or radionuclide material accountability if there is reasonable assurance that an indirect method may be correlated with an actual measurement. The concentration of a radionuclide may be averaged over the volume or weight of the waste if the units are expressed as nanocuries per gram.	Preparation for off-site shipment of LLW to a commercial NRC or Agreement State licensed disposal facility—**relevant and appropriate**.	10 *CFR* § 61.55 (a)(8) 902 *KAR* 100:021 § 6(8)(a) and (b)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Labeling of LLW packages	Each package of waste shall be clearly labeled to identify if it is Class A, Class B, or Class C waste, in accordance with 10 *CFR* § 61.55 or Agreement State waste classification requirements.	Preparation for off-site shipment of LLW to a commercial NRC or Agreement State licensed disposal facility—**relevant and appropriate**.	10 *CFR* § 61.57 902 *KAR* 100:021 § 8	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Transportation of radioactive waste	Shall be packaged and transported in accordance with DOE Order 460.1B and DOE Order 460.2.	Preparation of shipments of radioactive waste—**TBC**.	DOE M 435.1-(I)(1)(E)(11)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Transportation of LLW	To the extent practicable, the volume of the waste and the number of the shipments shall be minimized.	Preparation of shipments of LLW—**TBC**.	DOE M 435.1-1(IV)(L)(2)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Transportation of hazardous materials	Shall be subject to and must comply with all applicable provisions of the HMR at 49 *CFR* §§ 171–180 related to marking, labeling, placarding, packaging, emergency response, etc.	Any person who, under contract with a department or agency of the federal government, transports "in commerce," or causes to be transported or shipped, a hazardous material—**applicable**.	49 *CFR* § 171.1(c)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Transportation of hazardous materials on-site	Shall comply with 49 *CFR* Parts 171-174, 177, and 178 or the site- or facility-specific Operations of Field Office approved Transportation Safety Document that describes the methodology and compliance process to meet equivalent safety for any deviation from the HMR [i.e., *Transportation Safety Document for On-Site Transport within the Paducah Gaseous Diffusion Plant*, PRS-WSD-0661 (PRS 2007b)].	Any person who, under contract with the DOE, transports a hazardous material on the DOE facility—**TBC**.	DOE O 460.1B(4)(b)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Transportation of hazardous materials off-site	Off-site hazardous materials packaging and transfers shall comply with 49 *CFR* Parts 171–174, 177, and 178 and applicable tribal, State, and local regulations not otherwise preempted by DOT and special requirements for Radioactive Material Packaging.	Preparation of off-site transfers of LLW—**TBC**.	DOE O 460.1B(4)(a)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

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ARAR = applicable or relevant and appropriate requirement
BMP = Best Management Practices
CAMU = corrective action management unit
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CI = compression ignition
CR = contingent remedy includes LUCs and monitoring
CWA = Clean Water Act
DOE = U.S. Department of Energy
DOE M = DOE Manual
DOE O = DOE Order
DOT = U.S. Department of Transportation
DPE = dual-phase extraction
EDE = effective dose equivalent
E.O. = Executive Order
EPA = U.S. Environmental Protection Agency
ERH = electrical resistance heating
FFA = Federal Facility Agreement
HAP = hazardous air pollutant
HMR = Hazardous Material Regulations
KAR = Kentucky Administrative Regulations
KPDES = Kentucky Pollutant Discharge Elimination System
mrem = millirem
NO_x = nitrogen oxide
NRC = Nuclear Regulatory Commission
NWP = Nationwide Permit
PCB = polychlorinated biphenyl
PGDP = Paducah Gaseous Diffusion Plant
PPE = personal protective equipment
PQL = practical quantitation limit
RCRA = Resource Conservation and Recovery Act
ROD = record of decision
SWMU = solid waste management unit
TBC = to be considered
TCLP = Toxicity Characteristic Leaching Procedure
TOC = total organic compound
TSCA = Toxic Substances Control Act
UTS = Universal Treatment Standards
VOC = volatile organic compound
VOHAP = volatile organic hazardous air pollutant
WAC = waste acceptance criteria
WWTU = wastewater treatment unit
ZVI = zero-valent iron

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APPENDIX G

SWMU 3 RCRA POST-CLOSURE PERMIT CONDITIONS SUMMARY

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APPENDIX I-2

C-404 LANDFILL POST CLOSURE PLAN

1. POSTCLOSURE CARE PLAN
C-404 LANDFILL

This plan identifies all steps that will be necessary for the U.S. Department of Energy (DOE) Paducah Gaseous Diffusion Plant (PGDP) to perform postclosure care meeting requirements of 401 *KAR* 34:070, Section 8 (incorporating 40 *CFR* § 264.117) at the C-404 Landfill. The C-404 Landfill began postclosure care under the permit issued in 1992 and will continue for a minimum of 30 years after landfill closure.

The C-404 Low-Level Radioactive Burial Ground is located in the west-central portion of the security-fenced area of PGDP. The C-404 unit originally was constructed in the early 1950s as a rectangular aboveground surface impoundment with a floor area of approximately 53,000 ft^2 (387 ft by 137 ft). The floor of the surface impoundment was constructed of well-tamped earth, and clay dikes provide liquid containment to an operating depth of 6 ft. From 1952 through 1957, the surface impoundment was operated as a neutralization/sedimentation treatment facility for uranium-contaminated waste water generated at the C-400 decontamination facility. From 1957 through 1976, the impoundment was used for the bulk disposal of uranium-contaminated solid waste. The surface impoundment thus was filled with bulk solid wastes to within 1–2 ft of the top of the original dikes. The facility then was covered with compacted earth to the top of the original dikes and sloped to facilitate runoff. The exit weir was converted to an enclosed concrete basin for use as a leachate collection sump.

In 1977, bulk and containerized uranium-contaminated solid wastes were placed on top of the previously filled area. These wastes were then covered with earth. In 1983, the eastern quarter of the site was covered with a clay cap that extends over the out-slope of the dike. One of the types of containerized solid wastes disposed of in the upper portion of the facility was gold dissolver precipitate, a solid waste containing no free liquid. During a routine testing program, the gold dissolver precipitate disposed of in early 1986 was found to be hazardous based upon the Extraction Procedure Toxicity. The C-404 Landfill subsequently was closed by placement of a final cover over the facility.

Postclosure use of the C-404 Landfill never will be allowed to disturb the integrity of the final cover, liner(s), or any other component of the containment system or the function of the facility's monitoring systems, unless the disturbance is necessary and 1) will not increase the potential hazard to human health or the environment or 2) is necessary to reduce a threat to human health or the environment. Access to the landfill will be restricted and maintained through existing security measures including checkpoints, fences, and postings.

1.1 GENERAL FACILITY INSPECTION AND MAINTENANCE

The primary objective of routine inspection is to identify potential problems at an early stage prior to the need for significant maintenance. General facility inspections will be performed on security fences, gates, locks, and HWFP required warning signs quarterly, as applicable. Possible problems may include deterioration, erosion, frost heaves of fence post anchors, normal wear, or vandalism. Maintenance activities may include erosion or sediment control and the repair or replacement of damaged fences, locks, or warning signs.

1.1.1 Landfill Cover

As described in the C-404 Closure Plan, the synthetic liner and vegetative cover installed on the C-404 Landfill is designed to minimize maintenance requirements. The cover shall be inspected quarterly and following any major precipitation event approaching or exceeding a 24-hour, 25-year storm (5.8 inches within 24-hours). The cover will be inspected for surface cracks, erosion, depressions or subsidence, damage to cover by burrowing animals, vegetative stress, or any other factors that might adversely affect proper functioning of the vegetative and landfill cover.

The vegetative cover shall be mowed regularly during the active growing season to discourage the growth of weeds, competitive species, or deep-rooted vegetation. Since C-404 has been designated a radiological contaminated area, mowing will be conducted in such a way as to prevent airborne contaminants.

Damage to the cover by erosion greater than 6-inches deep will be repaired by restoring the cover to its original grade with soil and reseeding. Differential settlement or subsidence will be repaired by restoring the site to its original grade with soil and reseeding. Other repairs, such as eradicating burrowing animals, will be performed as necessary.

1.1.2 Cover Drainage System

The synthetic liner is anchored using a French-type drainage system. Construction details are described in the C-404 Closure Plan. The area surrounding the C-404 Landfill will be inspected quarterly and following any precipitation event approaching or exceeding a 24-hour, 25-year storm (5.8 inches within 24-hours). The area will be inspected for washouts or depressions, which could indicate that the system is plugged or that the drainage pipe has ruptured or collapsed. Drainage pipe failures shall be repaired by removing the failed piece, installing a new section, and replacing the fill material as necessary.

The drain exits shall be monitored following one rainfall event each quarter to check for unusual flow or lack of discharge.

1.2 OPERATION OF THE LEACHATE COLLECTION SYSTEM

The leachate collection system shall be maintained until leachate no longer is generated by the landfill. The quantity of liquid in the leachate collection system shall be monitored at least monthly. Preparation to remove the leachate shall begin when the depth of leachate in the sump exceeds 3 ft. The removed leachate shall be sampled and analyzed for the parameters in Table 1. The results of the leachate analysis will be reviewed prior to proper disposal. Sampling and analytical procedures shall be conducted according to Part C, Waste Analysis Plan, of the HWFP application.

Table 1. List of C-404 Leachate Characterization Analytes

Mercury	Fluoride
Arsenic	Ammonia Nitrate
Selenium	pH
Silver	Trichloroethylene
Barium	Neptunium 237
Cadmium	Technetium 99
Chromium	Thorium 230
Copper	Uranium 234
Iron	Uranium 235
Nickel	Uranium 238
Lead	Plutonium 239
Zinc	

The leachate shall be pumped to a portable tank(s) and stored awaiting appropriate treatment and/or disposition. The leachate collection pit will be inspected quarterly including when the leachate is removed for any major structural deterioration. Cracks and other damage will be repaired as necessary. A leachate sump integrity test will be conducted annually.

1.3 MAINTENANCE OF THE LEAK DETECTION SYSTEM

The C-404 Landfill does not have a leak detection system.

1.4 MAINTAIN AND OPERATE THE GROUNDWATER MONITORING SYSTEM

All groundwater monitoring wells at C-404 will be inspected annually during the third quarter of the calendar year. The wells will be inspected for the condition of the AKGWA identification, the outer casing, the concrete pad, the bumper posts, painting, the well cap, the lettering and numbers, lock and hasp, well access, vegetation control, and well fittings and tubing. Items will be repaired as necessary.

The wells will be inspected annually for excessive sedimentation by performing a depth sounding at each monitoring well.

1.5 RUN ON AND RUNOFF CONTROL SYSTEM

Run on and runoff control is provided by a series of ditches surrounding the C-404 Landfill. This system is discussed in detail in the C-404 Closure Plan. These ditches shall be inspected quarterly and following any major precipitation event approaching or exceeding a 24-hour, 25-year storm (5.8-inches in 24-hours) for obstructions such as debris, excessive sediment, erosion, or any deterioration that might adversely affect the drainage from the landfill cover. Repairs or maintenance may include removal of accumulated debris, sediment, and restoration of the ditch to the original grade. Ditches will be reseeded or additional gravel placed as needed.

1.6 PROTECT AND MAINTAIN SURVEY BENCHMARKS

Benchmarks have been permanently installed at the groundwater monitoring wells. Benchmarks will be inspected annually with the groundwater monitoring wells, and new benchmarks will be installed if necessary.

1.7 RECORDKEEPING AND REPORTING

Inspection records will be recorded on an inspection log or summary. The records will include the date and time of inspection, the name of the inspector, a notation of the observation, and the date and nature of any repairs. Inspection records will be maintained for three years from the date of inspection. Records concerning the operation of the leachate system, including inspection, leachate removal volumes, damage assessment, and repairs undertaken, will be maintained at the facility during the postclosure care period and available for inspection by Kentucky Division of Waste Management (KDWM.)

The annual groundwater flow rate and direction shall be submitted by November 30 of each year of the postclosure period. Analytical results of leachate sampling will be submitted to the KDWM along with semiannual groundwater sampling results. Copies of these groundwater reports, containing analytical data, will be maintained for inspection at the facility.

All Resource Conservation and Recovery Act permitted treatment and storage facilities at the PGDP are owned by DOE. The DOE point of contact during the postclosure care period is as follows.

Mr. William E. Murphie, Manager
Portsmouth/Paducah Project Office
U.S. Department of Energy
1017 Majestic Drive, Suite 200
Lexington, Kentucky 40513

1.8 EXAMPLE INSPECTION FORMS

Attached are examples of the inspection forms that will be used for C-404 inspections.

C-404 Monthly Inspection Summary[1]

Period of Inspection: ______________________________

Leachate Level	Date (M/D/YY)	Level (inches deep)*	Inspector(s)
First monthly leachate level determination			
Second monthly leachate level determination			
Third monthly leachate level determination			

* If the leachate level in the sump is at **3 feet (36 inches)**, then contact the appropriate personnel to initial removal and sampling of leachate AND when leachate is removed, complete the "**C-404 Inspection Checklist for Leachate Removal**."

Notes:

1. If any item is found to be unacceptable and cannot be explained in the space available, the inspector must identify the specific observation and nature of the problem on the "C-404 Inspection Addendum" Form.

C-404 Quarterly Inspection Checklist[1]

Item No.	Inspection Item	Item Description	Inspection Results		Comments/Observations
			A	U	
A	Warning Signs	Four signs around landfill			
B	Vegetative Cover	Gully erosion depth > 6 inches			
		Vegetative die-off			
		Varmint intrusion/burrowing from animals			
		Overgrowth			
		Depressions			
C	Ditches	Debris in ditches			
		Excessive sediment			
		Drainage			
		Erosion			
D	Anchor Trench	Washouts or depressions			
		Lack of discharge			
		Unusual volume or color			
		Drainage (4 drains from landfill)			
E	Leachate System	Level			
		Cracks or damage			
Inspector: ______________________ (Printed Name)			Signature: ______________________ Date:______________Time:__________		

A=Acceptable
U=Unacceptable

Notes:

1. If any item is found to be unacceptable, the inspector must identify the specific observation and nature of the problem on the "C-404 Inspection Addendum" Form.

C-404 Annual Inspection Checklist[1,2,3]

Item No.	Inspection Item	Item Description	Inspection Results		Comments
			A	U	
A	Wells	Attach well inspection form			
B	Leachate Pit	Interior malformations			
		Exterior malformations			
		Integrity test (attach data)			
Inspector: ____________________ (Printed Name)			Signature: ____________________ Date: ______________ Time: __________		

A=Acceptable
U=Unacceptable

Notes:

1. If any item is found to be unacceptable, the inspector must identify the specific observation and nature of the problem on the "C-404 Inspection Addendum" Form.
2. Annual inspection performed during the third quarter of the calendar year.
3. For the integrity test of the leachate pit during the annual inspection, data from the datalogger is downloaded electronically and printed annually, and the attached to the annual inspection checklist for maintaining in the file.

C-404 Inspection Checklist for a 24-Hour Rain Event[1]

Item No.	Inspection Item	Item Description	Inspection Results		Comments/Observations
			A	U	
A	Vegetative Cover	Gully erosion depth > 6 inches			
		Vegetative die-off			
		Varmint intrusion/burrowing from animals			
		Overgrowth			
		Depressions			
B	Ditches	Debris in ditches			
		Excessive sediment			
		Drainage			
		Erosion			
C	Anchor Trench	Washouts or depressions			
		Lack of discharge			
		Unusual volume or color			
		Drainage (4 drains from landfill)			
Inspector:______________________ (Printed Name)			Signature: ______________________ Date:____________ Time:____________		

A=Acceptable
U=Unacceptable

Notes:

1. If any item is found to be unacceptable, the inspector must identify the specific observation and nature of the problem on the "C-404 Inspection Addendum" Form.

C-404 Inspection Checklist for Leachate Removal[1,2]

Leachate Removal Inspection	YES	NO	N/A	Date (M/D/YY)	Volume (gallons)
Was any removal necessary during the quarter?					
Has any leachate removed during the quarter been sampled?					
Date of superficial inspection upon removal of leachate.					
Date of sampling of leachate after removal.					

Item No.	Inspection Item	Item Description	Inspection Results A	Inspection Results U	Comments
A	Leachate Pit	Interior malformations			
		Exterior malformations			

Inspector: ______________________ (Printed Name)	Signature: ______________________ Date:____________Time:__________

A=Acceptable
U=Unacceptable

Notes:

1. This form is completed if the leachate level in the sump is at **3 feet (36 inches)** and is being removed.
2. If any item is found to be unacceptable, the inspector must identify the specific observation and nature of the problem on the "C-404 Inspection Addendum" Form.

C-404 Inspection Addendum

Date	Item No.	Observation	Repairs Completed

INSPECTIONS FORM

Inside

SAMPLE POINT :
Location: C-404 Landfill
AKGWA Number:

	Accept	Reject	N/A
AKGWA Number Tag	☐	☐	☐
Stamped AKGWA Number	☐	☐	☐
Outer Casing	☐	☐	☐
Concrete Pad	☐	☐	☐
Bumper Post	☐	☐	☐
Painting	☐	☐	☐
Cap	☐	☐	☐
Road Access	☐	☐	☐
Brush/Weed eating/Mowing	☐	☐	☐
Fittings/Tubing/Pump Repair	☐	☐	☐
Lettering/Numbers	☐	☐	☐
Lock and Hasp	☐	☐	☐

Comments:

Signature: ______________________ Time: __________ Date: ______________

APPENDIX H

ANALYTICAL DATA

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APPENDIX H

ANALYTICAL DATA (CD)

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