US Army Corps
of Engineers®
Buffalo District
BUILDING STRONG®

Feasibility Study

Balance of Plant and Groundwater Operable Units

Niagara Falls Storage Site

Authorized under the
Formerly Utilized Sites Remedial Action Program

Niagara Falls Storage Site
Lewiston, New York

U.S. Army Corps of Engineers Buffalo District
1776 Niagara Street
Buffalo, New York 14207

Revised April 2020 from September 2019

US Army Corps of Engineers®
Buffalo District
BUILDING STRONG®

THIS PAGE INTENTIONALLY LEFT BLANK

US Army Corps of Engineers®
Buffalo District
BUILDING STRONG®

FEASIBILITY STUDY REPORT
FOR THE
BALANCE OF PLANT
AND
GROUNDWATER OPERABLE UNITS
AT THE
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK

Prepared for:

U. S. Army Corps of Engineers
Buffalo District
Contract Number W912QR-13-D-0048
Delivery Order Number 01

Revised April 2020 from September 2019

CONTENTS

APPENDICES

FIGURES

TABLES

ABBREVIATIONS AND ACRONYMS

Ac	actinium
AEC	Atomic Energy Commission
ALARA	as low as reasonably achievable
ALM	adult lead methodology
ARAR	applicable or relevant and appropriate requirement
BNI	Bechtel National, Inc.
BOP	Balance of Plant
BRA	baseline risk assessment
CDD	Central Drainage Ditch
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
Ci	Curies
cis-1,2-DCE	cis-1,2-dichloroethene
CFR	Code of Federal Regulationscm
cm	centimeter
COC	chemical of concern
COPC	chemical of potential conern
cu	cubic
CVOC	chlorinated volatile organic compound
CWM	CWM Chemical Services, LLC
CWQG	water quality guidance
DCGL	derived concentration guideline level
DNAPL	dense nonaqueous phase liquid
dpm	disintegrations per minute
DOH	Department of Health
ERH	electrical resistive heating
ESP	environmental surveillance program
EU	exposure unit
ft	foot (feet)
FR	Federal Register
FS	feasibility study
FUSRAP	Formerly Utilized Sites Remedial Action Program
g	gram
GRA	general response actions
ha	hectare
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
IC	institutional control
in	inch(es)
IWCS	Interim Waste Containment Structure
K_d	partition coefficient
kg	kilogram
km	kilometer
l	liter
lbs	pounds
LOOW	Lake Ontario Ordnance Works
LUC	land use control
LWBZ	lower water-bearing zone
m	meter, milli
mg	milligram
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual

MCL	maximum contaminant level
MED	Manhattan Engineer District
µ	micro
ml	milliliter
mi	mile
mrem	millirem
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFSS	Niagara Falls Storage Site
NORM	naturally occurring radioactive material
NRC	Nuclear Regulatory Commission
NY	New York
NYCRR	New York Codes, Rules, and Regulations
NYSDEC	New York State Department of Environmental Conservation
O&M	operations and maintenance
ORNL	Oak Ridge National Laboratory
OU	operable unit
Pa	protactinium
PAH	polycyclic aromatic hydrocarbon
Pb	lead
PbB	blood lead
PCB	polychlorinated biphenyl
PCE	tetrachloroethylene
p	pico
pCi/g	picocuries per gram
PRG	preliminary remediation goal
Ra	radium
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
RESRAD	RESidual RADioactive materials (computer code)
RG	remediation goal
RI	remedial investigation
Rn	radon
ROC	radionuclide of concern
ROD	record of decision
ROPC	radionuclide of potential concern
SCO	soil cleanup objective
SLERA	screening-level ecological risk assessment
SOR	sum of the ratios
SRC	site-related constituent
SVOC	semivolatile organic compounds
TCE	trichloroethylene
TDS	total dissolved solids
TEDE	total effective dose equivalent
Th	thorium
TN	Tennessee
TNT	trinitrotoluene
trans-1,2-DCE	trans-1,2-dichloroethene
TSCA	Toxic Substances Control Act
U	uranium
UCL	upper confidence limit
UMTRCA	Uranium Mill Tailings Radiation Control Act
U.S.	United States
USACE	U.S. Army Corps of Engineers

U.S. DOE	U.S. Department of Energy
U.S. EPA	U.S. Environmental Protection Agency
UWBZ	upper water-bearing zone
VC	vinyl chloride
VOC	volatile organic compound
WDD	West Drainage Ditch
yd	yard
yr	year

METRIC CONVERSION CHART

To Convert to Metric			To Convert from Metric		
If You Know	**Multiply By**	**To Get**	**If You Know**	**Multiply By**	**To Get**
Length					
inches	2.54	centimeters	centimeters	0.3937	inches
feet	30.48	centimeters	centimeters	0.0328	feet
feet	0.3048	meters	meters	3.281	feet
yards	0.9144	meters	meters	1.0936	yards
miles	1.60934	kilometers	kilometers	0.6214	miles
Area					
square inches	6.4516	square centimeters	square centimeters	0.155	square inches
square feet	0.092903	square meters	square meters	10.7639	square feet
square yards	0.8361	square meters	square meters	1.196	square yards
acres	0.40469	hectares	hectares	2.471	acres
square miles	2.58999	square kilometers	square kilometers	0.3861	square miles
Volume					
fluid ounces	29.574	milliliters	milliliters	0.0338	fluid ounces
gallons	3.7854	liters	liters	0.26417	gallons
gallons	0.00378	cubic meters	cubic meters	264.55	gallons
cubic feet	0.028317	cubic meters	cubic meters	35.315	cubic feet
cubic yards	0.76455	cubic meters	cubic meters	1.308	cubic yards
Weight					
ounces	28.3495	grams	grams	0.03527	ounces
pounds	0.4536	kilograms	kilograms	2.2046	pounds
Temperature					
Fahrenheit	Subtract 32 then multiply by 5/9ths	Celsius	Celsius	Multiply by 9/5ths then add 32	Fahrenheit
Radiation					
picocurie	0.037	becquerel	becquerel	27.027027	picocuries
curie	3.70E+10	becquerel	becquerel	2.703E-11	curies
rem	0.01	sievert	sievert	100	rem
RAD	0.01	gray	gray	100	RADs

EXECUTIVE SUMMARY

This report presents the feasibility study (FS) of the Balance of Plant (BOP) and Groundwater operable units (OUs) at the Niagara Falls Storage Site (NFSS) located in the Town of Lewiston, New York. This FS evaluates remedial action alternatives in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedy evaluation process.

The lead Federal Agency responsible for CERCLA actions at the NFSS is the United States Army Corps of Engineers (USACE) Buffalo District. Remedial actions at the NFSS are being addressed as part of the Formerly Utilized Sites Remedial Action Program (FUSRAP). The United States Department of Energy (U.S. DOE) managed FUSRAP until October 1997 when the United States Congress transferred responsibility for FUSRAP from the U.S. DOE to USACE.

As the lead Federal Agency for FUSRAP, USACE has authority per Engineer Regulation 200-1-4, Section 6.b.(2)(b) to address:

(i) Radioactive contamination (primarily uranium and thorium and associated radionuclides) resulting from the Nation's early atomic energy program activities (i.e., related to Manhattan Engineer District (MED) or Atomic Energy Commission (AEC) activities) and hazardous substances associated with these activities (e.g., chemical separation, purification, beryllium work, metallurgy);

(ii) Other radioactive contamination or hazardous substances that are mixed or commingled with contamination from the early atomic energy program activities; and

(iii) Any other hazardous substances found on property owned by the U.S. Government, for which the U.S. Government is liable under CERCLA and is at sites transferred for action to USACE during the transfer of responsibility for execution of the program from U.S. DOE to USACE.

For the NFSS, USACE determined it was appropriate to encompass all contamination (i.e., radioactive and chemical) because NFSS is a federally-owned property.

SITE HISTORY

The NFSS is a 77.3-hectare (ha) (191-acre) property that occupies a portion of the former Lake Ontario Ordnance Works (LOOW). In 1944, the MED was granted use of a portion of the LOOW for the storage of radioactive uranium ore residues generated through the processing of uranium ore for development of the atomic bomb. During the 1940s and 1950s, the MED and its successor, the AEC, brought various radioactive wastes and uranium processing byproducts (residues) to the site for storage. In the 1980s, the U.S. DOE performed cleanup and consolidation of the radioactive residues, wastes, and debris at the NFSS. Some materials were transferred off-site. Materials that remained on-site were placed in the 4.0-ha (10-acre) Interim Waste Containment Structure (IWCS) on the west side of the NFSS property. Today, the IWCS contains radioactive residues, contaminated rubble and debris from the demolition of buildings, and contaminated soil from the NFSS and vicinity properties (note: NFSS vicinity properties are areas adjacent to or near the NFSS that were once part of the LOOW; in the 1980s, the U.S. DOE designated them potentially radioactively impacted by past government activities).

Based on historical documents, areas where wastes or residues were temporarily stored or areas that were impacted by past government operations within the NFSS boundary but outside the IWCS footprint include the following:

- Building 401, former LOOW boiler house
- Building 403, former LOOW laboratory
- Building 409, former LOOW fire reservoir, located just south of the IWCS
- Building 430, former LOOW combined shops
- Building 431/432 and adjacent trench, former LOOW Vaults A and B
- Building 433, former LOOW hose house, also referred to as the radium vault
- Building 434, former LOOW water storage tower (silo), located in the eastern portion of the NFSS
- Buildings 443, 444, 445, 446, 447, and 448, former LOOW maintenance buildings located in the Baker-Smith area in the northwestern portion of the NFSS
- Along Castle Garden Road, northeast of Building 401 Naval Waste Area (between O and N streets, east of Campbell Street)
- Organic Burial Area (southeast of intersection of Lutts Road and O Street)
- Area north of Building 430 between N and O Streets
- Northeast portion of the site at the intersection of O and MacArthur Streets

Except for Building 433, the buildings listed above have been demolished, and only some of the building foundations remain. Building 433 is a one-story cinder block structure approximately 9 square meters (m^2) (100 square feet [ft^2]) in size.

SITE AREA LAND USE

The NFSS property is bordered on the north and northeast by the CWM Chemical Services, LLC (CWM), a hazardous waste disposal facility; on the east and south by the Modern Landfill, Inc., a solid waste disposal facility; and on the west by a transmission corridor owned by National Grid. All the aforementioned properties were once part of the LOOW. Access to the site is from Pletcher Road on the south.

The nearest residences to the NFSS are approximately 0.8 kilometers (km) (0.5 mile [mi]) west-southwest of the site on Pletcher Road. Other residences are located along the roadways that run north-south and east-west around the site.

The Lewiston Porter public school complex is 2.4 km (1.5 mi) due west of the site at 4061 Creek Road. Enrollment is approximately 2,100 students with 200 faculty members.

Per Town of Lewiston zoning, the NFSS site land use is identified as light industrial. Given the current zoning of the NFSS, and the presence of adjacent municipal and hazardous waste landfills, the reasonably anticipated future land use for the NFSS is industrial.

SITE CONDITIONS

The NFSS is relatively flat. The NFSS in underlain by approximately 27 m (90 ft) of unconsolidated deposits consisting of, from top to bottom: surficial soil and fill, brown clay till, glacio-lacustrine clay (or gray clay), middle silt till (a discontinuous layer in the gray clay), alluvial sand and gravel, and basal red till. Shale bedrock of the Queenston Formation underlies the unconsolidated deposits.

Groundwater at the NFSS is split into three principal hydrostratigraphic zones (listed from top to bottom):

- Upper water-bearing zone (UWBZ) (surface fill and upper brown clay till unit)
- Aquitard or confining unit (the gray clay and middle silt till units)
- Lower water-bearing zone (LWBZ) (alluvial sand and gravel, basal red till, and upper Queenston Formation)

There are no public water supply wells in the site area. Public water is supplied to county residents from the upper Niagara River.

A March 2006 private well study identified 117 private wells near the LOOW property and that only 19 of the 117 wells were active. Thirteen of the 19 active wells were sampled and analyzed for various chemical and radioactive constituents; all 13 wells met safe drinking water standards with respect to radiological quality.

Groundwater underlying the NFSS reflects the United State Environmental Protection Agency (U.S. EPA) Class IIIB criteria for nonpotable and limited beneficial use water.

There are no perennial natural streams, navigable waterways, or impoundments at the NFSS. Several east-west ditches collect surface water runoff that empties into the Central Drainage Ditch (CDD). The CDD traverses the entire north-south length of the NFSS property. Surface water runoff from the western periphery of the site flows to the West Drainage Ditch (WDD). The CDD and WDD flow north and join approximately 0.8 km (0.5 mi) north of the NFSS. The CDD joins Four Mile Creek about 2.4 km (1.5 mi) north of the NFSS. Four Mile Creek, in turn, flows to Lake Ontario.

NATURE AND EXTENT OF CONTAMINATION

This FS is based on information gained from numerous investigations, monitoring events, and studies. The following is a list of impacted media addressed by this FS:

- Soil
- Road bedding
- Building 433
- Building foundations
- Groundwater
- Utilities (former Building 401 drain system)

SITE-RELATED CONSTITUENTS

To facilitate accurate estimation of exposure and dose, a baseline risk assessment (BRA) was completed in 2007. In the BRA, the NFSS was divided into 18 exposure units (EUs). An EU is the geographic area in which a receptor is assumed to work or live, and where a receptor may be exposed to contaminants detected during the remedial investigation (RI). These EUs provided the geographical framework for the determination of site-related constituents (SRCs), which are defined as those compounds that exceed background screening levels in their respective EUs.

While numerous radionuclide and chemical parameters were identified at the NFSS, some are naturally occurring and/or are not considered SRCs. Determination of whether constituents are SRCs and whether those SRCs are radionuclides of concern (ROCs) or chemicals of concern (COCs) was made during the 2007 BRA based on current and potential future risks to human health and the environment from site contamination. The COCs and ROCs are constituents that exceed a target cancer risk levels of 10^{-5} (if total risk exceeds 10^{-4}) or a noncancer risk threshold identified by a hazard index greater than 1. Radionuclides that present a dose greater than 2.5 millirem per year (mrem/yr) (if total dose exceeds 25 mrem/yr) were also identified as ROCs.

The 2007 BRA considered all potential current and future exposure pathways; however, the list of site ROCs and COCs is limited to receptors under the current and reasonably anticipated future land use scenario, which is industrial. Under industrial use, the construction worker was selected as the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity for any applicable set of circumstances. A summary of ROCs and COCs for the industrial land use scenario/construction worker receptor is provided in **Table ES-1.**

REMEDIAL ACTION OBJECTIVES

Remedial action objectives (RAOs) consist of media-specific goals for protecting human health and the environment. These goals take into consideration contaminants and media of interest, exposure pathways, and associated risk to human health or ecological receptors. The RAOs for this FS are:

- Prevent unacceptable exposure of the construction worker to hazardous substances (ROCs and COCs) via incidental ingestion, inhalation, dermal contact (for COCs) and external gamma (for ROCs) present within the BOP soils, road bedding, buildings/foundations, and utilities by reducing/removing contaminant concentrations to applicable or relevant and appropriate requirement (ARAR)-based remediation goals.

- Prevent unacceptable exposure of the construction worker to hazardous substances (chlorinated volatile organic compounds [CVOCs]) and polychlorinated biphenyls [PCBs]) present within the groundwater and utilities by reducing/removing contaminant concentrations to risk-based remediation goals.

APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

CERCLA requires the selection of a remedial action that is protective of human health and the environment and complies with ARARs. The ARARs identified for this FS are:

- Title 10 Code of Federal Regulations (CFR) Part 40 Appendix A, Criterion 6(6) is considered relevant and appropriate for radionuclides in BOP soil, MED-impacted road bedding, and building foundations. 10 CFR Part 40, Appendix A, Criterion 6(6) is used as an ARAR to derive cleanup goals for nonradium radionuclides, particularly uranium and thorium.
- The Toxic Substances Control Act (TSCA), codified under Title 40 CFR 761, is considered applicable for PCBs in building foundations, and relevant and appropriate for PCBs in utility sediments.
- Title 6 New York Codes, Rules, and Regulations (NYCRR) Part 375-6.8(b) for restricted industrial use, is relevant and appropriate for polycyclic aromatic hydrocarbons (PAHs) in BOP soil.

PRELIMINARY REMEDIATION GOALS

Preliminary remediation goals (PRGs) are contaminant concentration goals for various media (e.g., soil, groundwater) that are considered protective to human health and the environment. The PRGs comply with all ARARs and serve as a target during the initial development, analysis, and selection of cleanup alternatives.

Some PRGs are risk-based. The USACE calculated site-specific risk-based cleanup criteria for PCBs in utility water in former Building 401 drains and CVOCs in soil and groundwater in EU4. The criteria are based on a target cancer risk level of 10^{-5} for carcinogens and a hazard index greater than 1 for noncarcinogens for the critical group (i.e., construction worker). **Table ES-2** presents the PRGs per media.

SUMMARY OF EXTENT OF CONTAMINATION TO BE ADDRESSED

Based on the findings of previous investigations and assessing contaminant conditions and the FS PRGs, the volumes associated with the impacted materials are identified in **Table ES-3**. **Figure ES-1** shows the estimated extent of areas requiring remediation.

SUMMARY OF FEASIBILITY STUDY REMEDIAL ALTERNATIVES

In this FS, potential remedial technologies and process options were identified and screened to identify those that might have potential application at the NFSS.

Five remedial alternatives were developed in the FS and evaluated using the seven criteria outlined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). The NCP was developed by the U.S. EPA in response to the Congressional enactment of CERCLA, as amended by the Superfund Amendments and Reauthorization Act of 1986, and by Section 311(d) of the Clean Water Act.

Alternative 1, No Action

Alternative 1 includes no remedial actions for the BOP and Groundwater OUs. The no action alternative provides a baseline against which to compare other remedial alternatives and is required by CERCLA guidance. This alternative assumes that no additional remedial actions would be implemented – the site would be left as is and the baseline maximum potential exposure would be compatible with industrial use. Site security (i.e., fencing) would be left in place, but would not be maintained. Continued routine monitoring of air, groundwater, surface water and sediment would not be performed.

Technologies and Processes Common to Alternatives 2 through 5

Alternatives 2 through 5 include removal and off-site disposal of radioactive impacts exceeding the FS PRGs. Remediation of COCs would include removal and/or on-site treatment. Options such as consolidation and on-site disposal or capping in-place were determined not to be technically or administratively feasible and were eliminated as possible options during the screening process.

Excavated materials would be screened and sorted to conform to the proper disposal requirements of those materials (e.g., off-site disposal as radioactive waste, solid waste).

Groundwater or precipitation entering any remedial excavation would be recovered for storage, testing, and off-site permitted treatment and disposal.

For each alternative, five-year reviews would be conducted pursuant to CERCLA as conditions would not allow for unlimited use and unrestricted exposure.

Alternative 2, Complete Removal

Alternative 2 includes the removal and off-site disposal of radioactive and chemical impacts exceeding their FS PRGs; this includes soil, road bedding, Building 401 foundation and drains, Building 433, other building foundations, and CVOC-impacted groundwater in EU4. Groundwater remediation would include an *in situ* polishing step (e.g., application of bioremediation amendment) to enhance degradation of residual CVOC impacts remaining around the CVOC excavation. Following completion of Alternative 2, the site would be remediated to levels suitable for industrial use (i.e., protective of both construction and industrial workers).

Alternative 3, Removal with Building Decontamination

Alternative 3 includes the removal and off-site disposal of radioactive and chemical impacts in soil, road bedding, and groundwater to below FS PRG levels, removal of the Building 401 foundation and drains, and decontamination of other building foundations through scarifying. Groundwater remediation would include an *in situ* polishing step (e.g., application of bioremediation amendment) to enhance degradation of CVOC residual impacts remaining around the CVOC excavation.

> *Scarifying* – Scarifying is the process of removing surface contamination in concrete through physical pulverization or scraping. Using this process, the outer, impacted surface of the concrete is removed to below FS PRG levels, leaving the remaining unimpacted concrete in place.

Alternative 4, Removal with Building Decontamination and* In Situ *Remediation

Alternative 4 includes the removal and off-site disposal of all radioactive impacts in soil and road bedding to below FS PRG levels, removal of the Building 401 foundation and drains, decontamination of other building foundations through scarifying, and *in situ* remediation of CVOC-impacted soil and groundwater in EU4 through thermal treatment.

> In Situ *Thermal Treatment – In situ* thermal treatment is a process of heating impacted soil to temperatures that would remove, through volatilization, CVOC impacts in the soil and groundwater to levels below the FS PRGs. The heat is applied to the subsurface using electrodes. The process has a high power demand and may require an extended period to achieve treatment goals. Treated soil and groundwater would remain in place and not require off-site disposal. Off-gases would be collected and treated to destroy contaminants.

Alternative 5, Removal with Building Decontamination with* Ex Situ *Remediation

Alternative 5 includes the removal and off-site disposal of radioactive impacts in soil and road bedding to below FS PRG levels, removal of the Building 401 foundation and drains, decontamination of Building 433 and other building foundations through scarifying, and *ex situ* treatment of excavated CVOC plume soil and groundwater in EU4 through thermal treatment. Groundwater in the excavation would be recovered for off-site treatment and disposal. Groundwater remediation would include an *in situ* polishing step (e.g., application of bioremediation amendment) to enhance degradation of residual VOC impacts remaining around the CVOC excavation.

> Ex Situ *Thermal Treatment – Ex situ* thermal treatment involves excavation and transfer of impacted soil to an on-site treatment area where the soil would be heated to temperatures that would volatilize VOC impacts in the soil to levels below the FS PRGs. The soil would be placed into a fully enclosed containment cell and heated air would be applied using blowers. Volatilized impacts would be collected and treated in an off-gas system. The process has a high power demand and may require an extended period to achieve treatment goals. Treated soil could remain on-site. Groundwater would be recovered during the excavation process and taken off-site for disposal. Off-gases would be collected and treated to destroy contaminants.

Evaluation Criteria

There are nine evaluation criteria specified in the NCP, of which seven are considered in the FS and two are considered after public comment is received on the proposed plan. The seven criteria considered in the FS are grouped into two categories: threshold criteria and balancing criteria.

The threshold criteria include:

- Overall protection of human health and the environment.
- Compliance with ARARs.

The balancing criteria include:

- Long-term effectiveness and permanence.
- Reduction of toxicity, mobility, or volume through treatment.
- Short-term effectiveness.
- Implementability.
- Cost.

The two remaining criteria, under the modifying criteria category, are state acceptance and community acceptance. The modifying criteria are not evaluated in this FS but would be evaluated after public comment is received on the preferred alternative in the forthcoming proposed plan. A summary of the analysis of each alternative against the threshold and balancing criteria is presented in **Table ES-4**.

This FS report does not select the proposed alternative; rather, it provides information for the subsequent stages of the CERCLA process-the proposed plan, which proposes the preferred remedial alternative, and the record of decision, which documents the selected alternative.

1 INTRODUCTION

This report presents the feasibility study (FS) for the Balance of Plant (BOP) and Groundwater operable units (OUs) at the Niagara Falls Storage Site (NFSS) located in the township of Lewiston, New York (**Figure 1-1**). This FS evaluates remedial action alternatives in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) remedy evaluation process. The lead Federal Agency responsible for CERCLA actions at the NFSS is the United States Army Corps of Engineers (USACE), Buffalo District. Remedial actions at the NFSS are being addressed as part of the Formerly Utilized Sites Remedial Action Program (FUSRAP).

As the lead Federal Agency for FUSRAP, USACE has authority per Engineer Regulation 200-1-4, Section 6.b.(2)(b) to address:

(i) Radioactive contamination (primarily uranium and thorium and associated radionuclides) resulting from the Nation's early atomic energy program activities (i.e., related to Manhattan Engineer District (MED) or Atomic Energy Commission (AEC) activities) and hazardous substances associated with these activities (e.g., chemical separation, purification, beryllium work, metallurgy);

(ii) Other radioactive contamination or hazardous substances that are mixed or commingled with contamination from the early atomic energy program activities; and

(iii) Any other hazardous substances found on property owned by the U.S. Government, for which the US Government is liable under CERCLA, and is at sites transferred for action to USACE during the transfer of responsibility for execution of the program from United States Department of Energy (U.S. DOE) to USACE.

For the NFSS, USACE determined it was appropriate to encompass all contamination, i.e., radioactive and chemical, because NFSS is a federally-owned property.

The NFSS is a 77.3-hectare (ha) (191-acre) property that occupies a portion of the former Lake Ontario Ordnance Works (LOOW) (**Figure 1-2**). In 1944, the MED was granted use of a portion of the LOOW for the storage of radioactive uranium ore residues generated through the processing of uranium ore for development of the atomic bomb. During the 1940s and 1950s, the MED and its successor, the AEC, brought various radioactive wastes and uranium processing byproducts (residues) to the site for storage. In the 1980s, the U.S. DOE performed cleanup and consolidation of the radioactive residues, wastes, and debris at the NFSS. These materials were placed into the Interim Waste Containment Structure (IWCS), a 4.0-ha (10-acre) engineered structure on the west side of the NFSS property (**Figure 1-2**). The IWCS contains radioactive residues, contaminated rubble and debris from demolition of buildings, and contaminated soil from the NFSS and vicinity properties (note: NFSS vicinity properties are areas adjacent to or near the NFSS that were once part of the LOOW and in the 1980s were designated by the U.S. DOE as radioactively impacted by past government activities).

Site investigations and monitoring performed prior to and subsequent to the construction of the IWCS identified residual impacts in soil, buried utilities, building foundations, and localized groundwater. To manage the CERCLA activities at the NFSS, USACE has established three separate OUs: the IWCS OU, BOP OU, and Groundwater OU. The IWCS OU is the engineered landfill within the diked area of the NFSS and applies to all the material within the IWCS. The BOP OU includes all the material at the NFSS not in the IWCS and excluding groundwater; this includes soils, buildings and building foundations, utilities, roads, and railroads. The

Groundwater OU refers to groundwater contamination remaining after implementation of the selected remedial action for the IWCS. Depending on the remedial approach, groundwater remediation may occur concurrent and/or subsequent to the implementation of the selected remedial actions for the BOP OU.

The OU approach is commonly used under CERCLA to define logical groupings of environmental issues at a single site to incrementally address site problems. By employing the OU approach at the NFSS, decisions about the primary sources of contamination at the site can be incorporated into the final site-wide remedial approach.

The IWCS FS and proposed plan were issued in 2016. The IWCS OU was the first OU to proceed through the FS stage of the CERCLA process because disposition (i.e., presence or absence) of the IWCS would impact the future land use. This report presents the FS process for the BOP and Groundwater OUs.

1.1 Purpose and Organization of the Document

This BOP OU and Groundwater OU FS identifies potential remedial alternatives and presents a detailed and systematic analysis of the alternatives. These steps are performed following the United States Environmental Protection Agency (U.S. EPA) *Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA* (U.S. EPA 1988).

The body of this FS report follows the CERCLA FS outline:

- Chapter 1 – Introduction, including site background information.
- Chapter 2 – Identification and Screening of Technologies.
- Chapter 3 – Development of Remedial Alternatives.
- Chapter 4 – Detailed Analysis of Remedial Alternatives.
- Chapter 5 – Comparative Analysis of Remedial Alternatives.
- Chapter 6 – References.

The detailed analysis of remedial alternatives in Chapter 4, combined with the comparative analysis in Chapter 5, provides information for evaluating potential remedial options for the BOP and Groundwater OUs. This analysis is prescribed by the CERCLA statute (Section 121[b] [1][A]) and includes consideration of the following evaluation criteria:

- Overall protection of human health and the environment
- Compliance with applicable or relevant and appropriate requirements (ARARs)
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost

This FS does not select the proposed alternative; rather, it provides information for the subsequent stages of the CERCLA process-the proposed plan, which proposes the preferred remedial alternative, and the record of decision (ROD), which documents the selected alternative.

Following remediation of the three OUs, the NFSS would be transferred from the USACE to the U.S. DOE Office of Legacy Management.

1.2 Site Background

During World War II, the U.S. Federal Government built several facilities across the United States to manufacture munitions for the military effort. To this end, the Government acquired 3,035 ha (7,500 acres) of agricultural land in northwestern New York State which became the LOOW site, where a plant was constructed to produce trinitrotoluene (TNT). Beginning in 1942, six TNT production lines, several storage facilities for raw materials and finished products, and several miscellaneous shops and support facilities were built on 1,012-ha (2,500-acres) located in the east-central portion of the LOOW. The LOOW produced TNT for only about eight months before the government determined that there was excess TNT production capacity in the United States. As a result, TNT production ceased at the LOOW at the end of July 1943 (USACE 2007a). During the eight months of operation, the LOOW produced approximately 18,894,844 kilograms (kg) (41,656,000 pounds [lbs]) of TNT (NY State Assembly 1979).

In February 1944, the USACE's MED was granted use of a portion of the LOOW for the storage of radioactive residues generated through the processing of uranium ore (Bechtel National, Inc. [BNI] 1990). With this action, the NFSS was created. Aerial photos from 1944 show the main features of the NFSS at that time. The first residues to be shipped to the site, designated as "L-50" and "R-10", were from the Linde Air Products facility in Tonawanda, New York. The L-50 residue was transported to the site in bulk and was stored in buildings near the southwest corner of the NFSS. The R-10 residue was placed on the site in a pile on open ground north of the LOOW water treatment plant (The Aerospace Corporation 1982). The MED and its successor agencies continued to periodically ship radioactive residues and materials to the NFSS for storage through the early 1950s. The materials were placed on the ground surface, on building foundations, in a water storage silo, and in the LOOW water treatment plant buildings; there were no confirmed areas where waste was buried below grade. **Figure 1-3** shows the locations of LOOW buildings located within the boundary of the NFSS.

The K-65 residues located in the IWCS originated from the processing of Belgian Congo "pitchblende" ores of very high uranium concentration (35-60 percent). The digestion of these high-grade uranium ores provided the feed material (uranium) required for the World War II Manhattan Project. After most of the uranium had been removed, the waste stream contained uranium progeny (thorium and radium) and was dubbed K-65.

The F-32 residues placed at the site resulted from the Linde Ceramics' extraction of Q-20 pitchblende ore from the Belgian Congo. Approximately 336 cubic meters (m^3) (440 cubic yards [yd^3]) of material was stored in the recarbonation pit west of Building 411 (Battelle 1981). This residue contained approximately 0.2 Curies (Ci) of Radium-226 (Ra-226) and 0.2 Ci of Thorium-230 (Th-230).

The MED transferred control of the radioactive residues at the NFSS to the AEC in 1946. A 1970 investigation by AEC resulted in a 1972 action to remove impacted soil from the NFSS and adjacent properties. In 1975, the AEC was dissolved and the responsibility for the site was transferred to the Energy Research and Development Administration. The Energy Research and Development Administration was abolished in 1977 and the responsibility for the site was then transferred to the U.S. DOE.

In 1979, the Battelle Columbus Laboratory (Battelle), under the direction of the U.S. DOE, performed a radiological characterization of the NFSS (Battelle 1980 and 1981). That year, the U.S. DOE initiated a yearly monitoring program to assess the radon (Rn) emissions from the NFSS and the potential for transport of the radiological constituents to the surface water, sediment, and groundwater. In 1980, a geological investigation of the site was conducted.

Prior to 1979, no accurate records were maintained on waste characterization, inventories, or exact locations of stored wastes. The Battelle radiological survey was performed to provide the U.S. DOE with accurate information on which to base a cost-effective remedial action plan (Battelle 1980).

Based on historical documents and the Battelle survey, areas where wastes or residues were temporarily stored or areas that were impacted by past government operations within the NFSS boundary, but outside the IWCS footprint, are identified in **Table 1-1**.

In the 1980s, the U.S. DOE and its contractor BNI, performed remedial actions at the site and vicinity properties. These remedial actions culminated with the construction of the IWCS from 1982 to 1986 (BNI 1983, 1984, 1985, 1986a, 1986b, 1986c, and 1989).

During the remedial activities, materials such as vegetation removed during brush clearing activities were buried in an area north of the IWCS referred to as the Organic Burial Area. Subsequent monitoring and sampling have determined the presence of radioactive contamination in some of the materials in the Organic Burial Area (USACE 2015a).

The IWCS is the dominant site feature, occupying approximately 4 ha (10 acres) in the west portion of the site. The IWCS is an engineered landfill that was built over the locations of the LOOW freshwater treatment plant and the R-10 pile. The IWCS was engineered to retard radon emissions, infiltration from precipitation, and migration of contamination to groundwater (USACE 2007a).

Within the IWCS, the radioactive residues, K-65, L-30, L-50, and F-32, were placed in existing concrete structures that had been part of the freshwater treatment plant. These buildings, located in the southern end of the IWCS, were made of reinforced concrete and originally designed to securely hold liquids. The R-10 residues remained on the ground in the north end of the IWCS where they were originally placed. In addition to the residues, soil and debris generated from U.S. DOE cleanup activities at the site and vicinity properties were placed over the residues. By 1986, the IWCS was covered by a multi-layered cap (BNI 1990).

The IWCS is approximately 300 meters (m) (990 feet (ft)) long by 140 m (450 ft) wide and reaches a maximum height of 10 m (34 ft) above ground surface. A clay dike, which is keyed into the underlying native gray clay, surrounds the stored radioactive materials. The IWCS is covered with an interim clay cap consisting of three layers. The cap is considered “interim” because it does not include a barrier layer (typically a riprap layer at least 1 m (3 ft) thick) and the side slopes of the structure, currently 3:1, were not constructed with a slope of 5:1.

In 1988, isolated areas of residual radioactivity from across the NFSS were excavated and placed into temporary storage on the slab of Building 430. A limited chemical characterization was performed in 1990 and in 1991 these materials placed in temporary storage were incorporated into the IWCS (BNI 1994a).

The U.S. DOE maintained control of the site until 1997, and during this time, it performed annual monitoring of environmental media at the site to ensure that the IWCS maintained its protectiveness. In 1997, Congress authorized the USACE to become the lead Federal Agency for FUSRAP, at which time it instituted its own operations and maintenance (O&M) plan for the site. The O&M plan included continuation of the environmental surveillance program for which data is collected and reported on an annual basis.

From 1997 to 1999, USACE transitioned tasks from the U.S. DOE contractor BNI and prepared a report to Congress that provided major scoping and costing of the program at the NFSS. In February of 1999, USACE issued the first scope of work directing the performance of a remedial investigation (RI) in accordance with CERCLA. Additional information pertaining to subsequent RI activities is presented in Subsection 1.4.

In 2000, Building 403, originally a laboratory and office building, was decontaminated and demolished. Building 401, the LOOW facility power house later used for boron-10 manufacturing and radiological waste storage, underwent an interior asbestos abatement in 2002 in preparation for radiological decontamination and demolition. Building 401 was subsequently deconstructed in 2011. The only LOOW era buildings remaining at the site are Building 433 (radium vault) and Building 429, which is used as an office.

In addition to managing the site through the CERCLA process, the USACE continues to perform environmental monitoring, site security, and maintenance of physical components of the site (e.g., fencing, roads, and IWCS cover).

1.3 Site Description

1.3.1 Current and Projected Land Use

The NFSS is located in the Town of Lewiston, Niagara County, New York, which lies in western New York State near the south shore of Lake Ontario. The population of Niagara County in 2010 was 216,469 (U.S. Census Bureau 2010a), with a population density of 414 persons per square mile. Lewiston is located in the westernmost portion of the county. The population estimate for Lewiston in 2010 was 16,262 (U.S. Census Bureau 2010b). The Village of Youngstown and the Hamlet of Ransomville, located approximately 4.8 kilometers (km) (3 miles [mi]) northwest and northeast of the NFSS, respectively, comprise the nearby Town of Porter. The Town of Porter had a population of 6,771 in 2010 (U.S. Census Bureau 2010c).

Land use in the vicinity of the NFSS is shown on **Figure 1-4**. The NFSS property is bordered on the north and northeast by the CWM Chemical Services, LLC (CWM), a hazardous waste disposal facility; on the east and south by the Modern Landfill, Inc., a solid waste disposal facility; and on the west by a transmission corridor owned by National Grid (formerly Niagara Mohawk). All the aforementioned properties were once part of the LOOW, including an 8.9-ha (22-acre) portion (waste water treatment plant) located north of the NFSS that was transferred to the Town of Lewiston.

To the south, H2Gro Greenhouses, LLC, operates a 5-ha (12.5-acre) hydroponic greenhouse that produces over 1.3 million kg (3 million lbs.) of tomatoes per year using generators powered by methane gas collected from Modern Landfill, Inc.

The nearest residences to the NFSS are located approximately 0.8 km (0.5 mi) west-southwest of the site on Pletcher Road. Other residents are located along the roadways that run north-south and east-west around the site.

The Lewiston-Porter public school complex is 2.4 km (1.5 mi) due west of the site at 4061 Creek Road. The complex covers 64.8 ha (160 acres) and consists of five buildings: district offices, the Primary building (Grades K through 2), the Intermediate building (Grades 3 through 5), the Middle School (Grades 6 through 8), and the High School (Grades 9 through 12). Enrollment is approximately 2,100 students with 200 faculty members (Lewiston-Porter Central School District 2016). There are two stadiums behind the high school.

Per Town of Lewiston zoning, the site land use is currently identified as light industrial, which is intended as a transition zone between residential and heavy industrial areas. Light industrial use includes manufacturing, processing, and wholesale/warehousing.

Given the current zoning of the NFSS, and the presence of adjacent municipal and hazardous waste landfills, the reasonably anticipated future land use for the NFSS is industrial.

1.3.2 Site Geology

The NFSS and surrounding region are located in the Ontario Lake Plain and are generally flat to gently rolling. The Niagara Escarpment sits about 5.2 km (2 mi) south of the site and is the result of a division in bedrock stratigraphy in the region. North of the escarpment, where the NFSS is located, erosion wore away the upper 300 meters (m) (1,000 ft) of Silurian deposits, leaving the Queenston Formation as the uppermost bedrock layer. The Queenston Formation, composed of shale, siltstone, and sandstone, is approximately 300 m (1,000 ft) thick and overlies thick layers of Ordovician shale and limestone units (Acres American, Inc. 1981; BNI 1986a; USACE 2007b).

Approximately 27 m (90 ft) of unconsolidated deposits overlie the bedrock and include five stratigraphic units, in order of increasing depth: surficial soil and fill, brown clay till containing isolated sand lenses, glacio-lacustrine clay (or gray clay), alluvial sand and gravel, and basal red till.

The surficial soil and fill at the NFSS is made up of unconsolidated materials that have been altered or deposited by human activities, such as site grading. Sand and gravel also are generally found in this unit. The thickness of this unit varies between 0 and 1.5 m (0 and 5 ft), with an average of 0.3 to 0.6 m (1 to 2 ft). Generally, the unit is dry to moist, although commonly saturated throughout late winter through spring (Acres American, Inc. 1981; BNI 1994b).

Underlying the surficial soil is the brown clay till, which is predominantly brown or reddish-brown clay that is referred to as the upper clay till in various sources. The thickness of this unit near the IWCS varies between 1.8 and 7.0 m (6 and 23 ft), although site-wide thickness ranges between 1.5 and 7.6 m (5 to 25 ft) (BNI 1984, USACE 2007b). Sand and gravel lenses are common within the brown clay till and vary in thickness from 0.3 to 6 m (1 to 20 ft). A 2007 lithological study of geotechnical logs from NFSS and surrounding landfill sites found that the sand lenses within the brown clay till are discontinuous features (BNI 1986a, USACE 2007 b). This has been confirmed by subsequent subsurface investigations (e.g., trenching to sample sewer lines and isolate utilities) by the USACE (USACE 2007b, USACE 2013, USACE 2015a).

Underlying the brown clay till is the glacio-lacustrine clay unit, also referred to as the gray clay unit. This unit typically consists of a homogeneous gray clay with occasional laminations of red-brown silt and minor amounts of sand and gravel. The clay is saturated and softer and more plastic than the overlying brown clay till. In some locations, there is a discontinuous silty layer within the gray clay called the middle silt till. Under the IWCS, the gray clay unit varies in thickness from less than 0.3 m (1 ft) to a maximum of 9 m (30 ft); the thickness varies between 1.5 and 9 m (5 to 30 ft) throughout the balance of the NFSS (BNI 1984, USACE 2007b). The contact between the brown clay till and gray clay units is topographically variable under the NFSS, as is the gray clay contact with the underlying courser-grained glacial sediments discussed below. (BNI 1986a, USACE 2007b). The gray clay appears contiguous under the NFSS and acts as a hydrogeologic aquitard separating the surficial clay till from the deeper geologic zones.

The alluvial sand and gravel unit underlying the glacio-lacustrine clay consists of stratified coarse sands, nonstratified coarse silt and sand, or interlayered silt, sand, and clay. It is saturated and usually compact to very dense and averages about 2.4 m (8 ft) in thickness. In some parts of the NFSS, a basal red till underlies the alluvial sand and gravel unit. This lodgement till is discontinuous throughout the NFSS and, where present, is generally thin. The thickness of the red till varies from 0 to 3 m (0 to 10 ft) (USACE 2015b).

The Queenston Formation is the uppermost bedrock unit that underlies the glacial overburden deposits. It consists of a reddish-brown fissile shale that exhibits a fractured and permeable contact zone in the upper 5 to 7 m (15 to 20 ft).

1.3.3 <u>Site Hydrogeology</u>

Groundwater at the site is defined in terms of the unconsolidated geologic units and one bedrock unit split into three principal hydrostratigraphic zones (listed from top to bottom):

- Upper water-bearing zone (UWBZ) (surface fill and upper brown clay till unit)
- Aquitard or confining unit (the gray clay and middle silt till units)
- Lower water-bearing zone (LWBZ) (alluvial sand and gravel, basal red till, and upper Queenston Formation)

Recent findings for the UWBZ and LWBZ groundwater flow systems are presented in the *2017 Environmental Surveillance Technical Memorandum, Niagara Falls Storage Site* (USACE 2018).

The UWBZ is composed of two hydrogeologic media: 1) continuous, low-permeability clays and silts, and 2) embedded, discontinuous lenses of sand and gravel. The sand lenses in the UWBZ appear uncorrelated over distances greater than 6.1 m (20 ft) and, thereby, spatially discontinuous (USACE 2007b). This has been confirmed by subsequent subsurface investigations conducted by the USACE. The discontinuity of sand lenses creates immobilized pockets of water resulting in a low yield from a water supply perspective and limited transport of contaminants (i.e., the surrounding clay till governs the overall transport in the UWBZ).

Generally, groundwater flows northwestward across the NFSS at a gradient of about 0.0004 to 0.002 ft/ft in the area around the IWCS (USACE 2007b). However, the regional flow in the UWBZ is interrupted by the Central Drainage Ditch (CDD) due to seasonally deep-rooted wetland vegetation that grows in the ditch during the late-spring, summer, and early fall periods. The vegetation absorbs groundwater below and along the ditch via evapotranspiration, which lowers groundwater levels and interrupts the gradual flow across the site. In general, water levels are highest in February and lowest in October (USACE 2007b). The depth to water ranged from 0.60 m to 6.71 m (1.96 ft to 22.02 ft) during calendar year 2017. During high water level conditions, there is greater downward flow from the UWBZ to the LWBZ than during low water level conditions due to a greater downward hydraulic gradient.

The UWBZ is separated from the LWBZ by an aquitard that corresponds to the gray clay and the middle silt till units (i.e., an aquitard underlies the brown clay till and overlies the alluvial sand and gravel unit). It ranges from 0.3 to 9 m (1 to 30 ft) in thickness and acts as a confining layer for the LWBZ (Acres American, Inc. 1981; BNI 1984; USACE 2007b); sporadic sand lenses in the gray clay are generally unsaturated to dry.

Below the confining unit, groundwater in the alluvial sand and gravel unit, the basal red till/red silt unit, and the upper Queenston Formation flows northwesterly under a gradient of 0.0006 to 0.001 ft/ft. The depth of water in the LWBZ ranged from 0.98 m to 5.88 m (3.23 ft to 19.29 ft) below ground surface during calendar year 2017. Quarterly water level fluctuations showed high and low elevations in February and November, respectively, during calendar year 2017. Because the LWBZ is under confined conditions, the hydraulic head of the groundwater can rise above the confining unit. This could result in water levels measured in LWBZ wells to be above water levels in the UWBZ. This seasonal condition is also referred to as an upward hydraulic gradient.

1.3.4 Surface Water

There is limited surface water at the site; no perennial natural streams, navigable waterways, or impoundments are maintained at the site. Several east-west ditches at the NFSS collect surface water runoff that empties into the northerly flowing CDD. Surface water runoff from the western periphery of the site flows to the West Drainage Ditch (WDD), which flows northerly from a watershed that drains land south of the NFSS.

Surface water discharges onto the site from the Modern Landfill, Inc., property and from the properties to the south of the site that feed the CDD and WDD. Surface water is present during part of the year only in some of these drainage ways.

The CDD and WDD join 0.8 km (0.5 mi) north of the NFSS, then discharge to Four Mile Creek 2.4 km (1.5 mi) north of the NFSS. Four Mile Creek eventually empties into Lake Ontario (USACE 2015b).

1.3.5 Current and Potential Groundwater Use

There are no public water supply wells (i.e., greater than 25 connections) in the site area. Public water is supplied to county residents from the upper Niagara River, which has been utilized by almost all county residents for several decades. The Niagara County Water District obtains water from the west branch of the Niagara River and supplies water to the residents of Lewiston and Porter.

Current use of private wells near the NFSS for drinking water is uncommon. In March 2006, the Niagara County Department of Health (DOH) issued the results of a private well study (Niagara County DOH 2006). One-hundred seventeen private wells were identified near the LOOW property. Of the 117 wells identified, 11 (9.4 percent) were reported as potable, eight (6.8 percent) were reported as nonpotable, 20 (17.1 percent) were reported as not accessible, and 78 (66.7 percent) were reported as not in use. Of the 11 private wells reported as potable, six were identified as secondary groundwater sources (i.e., public water was the primary drinking water source). Well construction information was typically not available. It is unlikely that any of the wells in the area are set in the UWBZ or the Queenston Shale due to the low yield and poor quality (Niagara County DOH 2006, U.S. DOE 1991a, USACE 2016b).

The Niagara County DOH study concluded that only 19 of the 117 wells were active. Thirteen of the 19 wells were sampled and analyzed for various constituents including metals, nuclear chemistry parameters, pesticides, polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), and polycyclic aromatic hydrocarbons (PAHs – a group of semivolatile organic compounds [SVOCs]). Five wells exceeded the regulatory maximum contaminant level (MCL) for a single parameter (arsenic, chloride, lead, manganese, and phenol). All 13 wells sampled met safe drinking water standards with respect to radiological quality (Niagara County DOH 2006).

Both water-bearing zones also exhibit significant concentrations of naturally occurring total dissolved solids that indicate the NFSS groundwater is a NY State Class GSA water resource (saline groundwater). Groundwater resources underlying the NFSS reflect the U.S. EPA Class IIIB criteria for nonpotable and limited beneficial use water (U.S. EPA 1986). To be a potable water source, groundwater at the NFSS would require expensive and energy intensive treatment by reverse osmosis (desalination). Since there is a replaceable surface water source via the Niagara River/Lake Ontario and groundwater south of the site (Lockport Formation), it is reasonable to assume that no municipality or service would find NFSS groundwater economically viable.

1.4 Summary of Previous Investigations and Reports

This FS is based on information gained from numerous investigations, monitoring events, and studies. Pertinent documents used in the development of this FS are briefly discussed below. Copies of the referenced documents and other site information are available at the USACE NFSS website: (https://www.lrb.usace.army.mil/Missions/HTRW/FUSRAP/Niagara-Falls-Storage-Site/).

1.4.1 Environmental Surveillance, Ongoing

In 1979, prior to construction of the IWCS at the NFSS, the U.S. DOE initiated the environmental surveillance program (ESP) to assess the radon emissions from the NFSS and the potential for transport of radiological constituents to surface water, sediment, and groundwater.

In implementing the ESP, the USACE monitors air, water, external gamma radiation, and streambed sediments and reports its findings annually in the form of the technical memoranda, which are posted to the NFSS website.

The ESP is designed to achieve the following objectives:

- Ensure protection of human health and the environment.
- Verify compliance with environmental regulatory standards.
- Verify the IWCS is performing as designed.

In addition to collecting and analyzing environmental samples, the ESP calculates the dose to off-site receptors from airborne emissions of site soil. To do this, the USACE uses annual weather data collected at the Niagara Falls International Airport by the National Weather Service. The dose to off-site receptors based on gamma radiation measurements is also calculated and added to the airborne emissions dose to determine the cumulative dose to the public from the NFSS.

Over 30 years of ESP data collected at the NFSS indicate that site controls are performing as designed to protect human health and the environment (USACE 2018).

1.4.2 Remedial Investigations

Consistent with the CERCLA RI/FS process, the USACE completed an RI to define the identity, amount, and location of chemicals and radionuclides of concern at the NFSS, and to provide primary data for the FS that would be used to identify and evaluate various remedial action alternatives and assist in the development of a protective and cost-effective remedy for the site.

Several phases of the RI were performed, the findings of which were compiled into two documents: a 2007 RI report and a 2011 RI report addendum (USACE 2007a; USACE 2011). The RI included a records review, sampling and analysis of various media, geophysical and radiological surveys, a baseline risk assessment (BRA), and fate and transport groundwater flow modeling in support of RI objectives.

The USACE performed the 2007 RI in three phases:

- Phase 1 fieldwork started in November 1999 and concluded in January 2000.
- Phase 2 fieldwork started in August 2000 and concluded in October 2000.
- Phase 3 fieldwork started in May 2001 and continued on an intermittent basis until October 2003.

The investigations included:

- Collecting samples of surface water and sediment from ditches across the site, groundwater from existing and new temporary well points, surface and subsurface soil from locations at which historical information suggested the potential presence of contamination, railroad ballast, pavement cores, and drums.
- Gamma walkover surveys across the entire NFSS, including building foundations.
- Geophysical investigations consisting of ground penetrating radar, seismic reflection and refraction, electromagnetic frequency domain and time domain, and electrical imaging/induced polarization.
- Exploratory trenches at locations of geophysical anomalies and at locations where the historical record indicated contamination might be present.
- Detailed reconnaissance of the pipelines and sewers and collection of samples from manholes, pipes, and sumps.
- Collecting background groundwater samples.

To facilitate accurate estimation of exposure and dose in the BRA, the USACE divided the NFSS into 18 exposure units (EUs). An EU is the geographic area in which a receptor is assumed to work or live, and where a receptor may be exposed to constituents detected during the RI. These EUs provided the geographical framework for the determination of site-related constituents (SRCs), which are defined as those compounds that exceed background screening levels in their respective EUs.

The USACE divided the NFSS and neighboring National Grid property into 14 of the 18 physical EUs, numbered 1 through 14 as shown on **Figure 1-3**. A brief description of the 14 physical EUs is provided in **Table 1-2**.

The remaining four EUs (EUs 15 through 18) are site-wide EUs the USACE created to accommodate special circumstances of the site or needs of the BRA. Exposure Unit 15 consists of interconnected drainage ways; EU16 contains pipelines and subsurface utilities; EU17 includes site-wide media (includes all soil, sediment, surface water, and pipeline material in EUs 1 through 16 and site-wide groundwater, including both the UWBZ and the LWBZ); and EU18 consists of all background samples that were used for the determination of SRCs in EUs 1 through 17.

The USACE performed a BRA as part of the RI, which evaluated current and potential future risks to human health and the environment from site contamination for a full range of current and potential future on-site receptors, including adult and adolescent trespassers, construction workers, maintenance workers, industrial workers, adult and adolescent recreational visitors, adult and child residents, and adult and child subsistence farmers. Chemicals of concern (COCs) and radionuclides of concern (ROCs) were identified and presented in Table ES-1 of the BRA. As documented in the BRA, constituents identified as COCs and ROCs pose a cancer risk greater than 1×10^{-5} or a noncancer hazard index (HI) greater than 1, and ROCs may also result in a dose greater than 2.5 millirem per year (mrem/yr) (USACE 2007c). Additional discussion pertaining to the development of COCs and ROCs is provided in Section 1.7 of this FS.

A fate and transport groundwater model was developed as part of the RI and is detailed in the modeling report prepared by HydroGeoLogic, Inc. (USACE 2007b). The model considered a select list of COCs and ROCs and predicted the maximum concentrations of various constituents migrating vertically and laterally in groundwater over set periods of time (e.g., 1,000 years). The results of the model showed that organic and metal plumes located outside the area of the IWCS would exhibit only minor dispersion due to low infiltration rates and post-remedial actions that have removed sources (e.g., VOCs in groundwater would continue to degrade and maximum concentrations of metals would not increase above the current concentrations of the plumes).

In general, the scope of the 2011 RI Addendum focused on additional site characterization, assessment of the integrity of the IWCS, and presentation of supplemental information and data needed to move forward into the FS process. The 2011 RI addressed the following general topics:

- Refinement of the nature and extent of select radiological and chemical groundwater plumes near the NFSS property boundary and in the vicinity of the IWCS
- Evaluation of the integrity of the IWCS
- Reexamination and justification of soil and groundwater background data sets
- Screening of railroad ballast and building/road core samples
- Evaluation and screening of 2008/2009 ESP radiological and chemical data
- Screening of split sample results collected during the LOOW Underground Utility RI
- Reevaluation of plutonium data
- Presentation of supplemental documentation
- Corrections and revisions to the 2007 RI and BRA

The USACE conducted the RI Addendum fieldwork from mid-November 2009 to the end of January 2010.

The USACE evaluated the fate and transport of uranium isotopes for the site in 2007 and 2011. Conclusions made in the 2007 RI regarding the fate and transport of uranium isotopes in site groundwater were somewhat dependent on the conservative partition coefficient (K_d) value of 3.6 liters per kilogram (L/kg) that was used in the modeling simulations. Use of this K_d value caused the model to predict greater concentrations of radionuclides in groundwater due to increased leaching of site soil (USACE 2007b). Analysis of supplementary water quality data since submission of the 2007 RI suggested that several of the groundwater contaminant plumes were overly conservative in the 2007 RI report. The 2011 RI modeling effort was performed to update the groundwater flow model and incorporate the most recent data set and data evaluations. The update included determining a K_d value of 122 L/kg for soil outside the IWCS and accounted for sand lenses in the flow modeling (USACE 2014).

1.4.3 BOP Investigation Report, August 2013

The USACE performed the 2013 BOP field investigation to provide additional information for specific areas of the site. The objectives of the investigation included:

- Delineate groundwater constituents in EUs 1, 2, 4, and 10.
- Identify the source of increasing uranium concentrations in groundwater in well OW11B.
- Eliminate potential preferential pathways for off-site migration of groundwater constituents via subsurface pipelines located near site boundaries.
- Evaluate potential groundwater constituents along the 25-cm (10-in) diameter water line near the southeast corner of the IWCS and eliminate the water line as a potential preferential pathway.

The scope of work for the field investigation included:

- Installing, developing, and sampling 17 monitoring wells (MW944 through MW960).
- Exposing, sampling, and plugging pipelines.
- Plugging two manholes (MH08 and MH41).
- Excavating eight investigative trenches (referred to as Investigative Excavations 1 through 8 [IE1 through IE8]).
- Conducting a geophysical survey.
- Conducting radiation surveys.
- Excavating/dewatering pipeline.

The absence of groundwater in five of the newly installed wells confirmed that groundwater flow in the UWBZ is discontinuous in some areas. Excavations adjacent to the grit chamber, decontamination pad, and near OW11B indicated that groundwater flow in these areas occurs predominantly along the concrete-encased sanitary sewer system. With the exception of the OW11B area, groundwater was absent in the excavations of the LOOW-era pipelines (USACE 2013).

The investigation determined that the sanitary sewer does not cross South31 Ditch and that it had been cut and capped by the U.S. DOE. However, the sewer line still crosses below the CDD between manhole locations MH07 and MH08.

1.4.4 BOP Investigation Report, February 2015

The objective of the 2015 BOP investigation was to delineate the vertical and horizontal extent of contamination in surface and subsurface soil at locations across NFSS in support of this FS. The effort resulted in:

- Soil delineated for select PAH and radionuclide constituents at 478 locations across the NFSS.
- Six trenches excavated along the sanitary sewer in the area near manhole MH06 and well OW11B to investigate the source of localized, elevated uranium concentrations in groundwater (and subsequently removed manhole MH06).
- Geophysical survey performed in the area south of the IWCS to identify the presence of buried structures.
- Global positioning system gamma walkover surveys completed.
- Soil and trench radiological surveys performed.

A total of 478 borings were advanced during the investigation with 461 of those borings advanced to better delineate radionuclide areas of concern and 34 borings to better define PAH areas of concern; some borings were used to delineate both radionuclide and PAH areas of concern (USACE 2015a).

1.4.5 IWCS FS and Proposed Plan, December 2015

The IWCS FS report presented the FS for the IWCS OU (USACE 2015b). The IWCS FS evaluated remedial action alternatives in accordance with the CERCLA remedy evaluation process. The IWCS OU was the first OU to proceed through the FS stage of the CERCLA process because disposition of the IWCS impacts the future land use for the BOP and Groundwater OUs, and the BOP OU would include remediation of impacted soils within the IWCS footprint following IWCS remediation.

The proposed plan identified the preferred alternative for addressing the material contained in the IWCS OU. The proposed plan summarized information found in greater detail in the 2007 and 2011 RI reports and the IWCS FS report. The USACE proposed that the final remedial action for the IWCS OU be the alternative designated as Alternative 4, excavation, partial treatment, and off-site disposal of the entire contents of the IWCS. After evaluating this alternative pursuant to the criteria described in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Section 300.430I(9)(iii), the USACE considered it to be protective of human health and the environment and cost effective (USACE 2015b).

1.5 Nature and Extent of Contamination

The previous investigations and monitoring activities have generated a significant amount of information. The USACE maintains a database of analytical results for different environmental media (e.g., soil, water, etc.). The database includes over 134,400 analytical results for soil, 78,100 results for groundwater, 32,600 results for surface water, 37,500 results for sediments, 10,000 results for water (manholes and pipelines), and 2,000 results for building core samples. **Figure 1-5** identifies the site investigation locations. In addition, mobile radiological surveys have included hundreds of thousands of radiological survey data points across the NFSS. **Figure 1-6** presents radiological survey results from the 2007 RI. Additional surveys have been conducted since 2007.

As previously noted, storage of radioactive materials at portions of the LOOW began in 1944 when the MED was granted use of Building 411, the LOOW freshwater storage reservoir, for storage of material that needed to be contained in a watertight structure for security and health purposes. Subsequent to that, the MED and its successor, AEC, placed additional radioactive wastes and residues at what is now NFSS. Some wastes and residues were taken off-site to Oak Ridge, TN (EA Engineering, Science, Technology 1998). As part of the U.S. DOE's remedial efforts in the 1980s, wastes and residues from various locations across the site were placed in the IWCS.

The following is a list of media impacted by apparent contamination:

- Soil
- Railroad ballast and road bedding
- Buildings and building foundations
- Surface water
- Sediment
- Groundwater
- Utilities (sewer and building drain systems)

The following subsections summarize the results of the nature and extent of contamination. The above-mentioned reports contain detailed descriptions of sampling activities and results.

1.5.1 Surface and Subsurface Soil

During MED activities, radiological materials were temporarily stored on the ground surface, on building foundations, and inside buildings. As a result of these activities, radiological constituents have been identified in surface and near surface soil at locations spread across the NFSS. Impacts are present primarily in areas adjacent to site roadways and areas of known past materials storage operations. Some deeper impacts were also found, but those impacts were primarily limited to the Organic Burial Area in EU7 where waste is known to have been buried during U.S. DOE remediation activities.

Chemical constituents, specifically chlorinated volatile organic compounds (CVOCs), were identified in EU4 (herein also referred to as the EU4 VOC plume) and in EU13. Some PCB impacts were found in surface soil, subsurface soil, and pipeline sediments (e.g., Building 401 drains). Surface and near surface soil impacted with PAHs were identified in several EUs.

1.5.2 Railroad Ballast and Road Bedding

During the original construction of the LOOW, over 150,000 yd^3 of slag were brought on site for use as railroad ballast and road bedding. Subsequent investigations have found that some of the slag used in the Niagara County area was produced by a foundry in Niagara Falls, New York, and contained elevated levels of radionuclides due to the presence of a radioactive phosphate mineral in the slag (Oak Ridge National Laboratory [ORNL] 1986). While some impacts at the NFSS may be due to past waste and residue storage, some impacts may be due to this non-MED slag used for railroad ballast and road bedding.

Much of the railroad infrastructure has been removed from the site. Analytical and radiological survey results indicate elevated levels of radionuclides along and adjacent to some sections of the railroad and site roads.

1.5.3 Buildings and Building Foundations

Following cessation of TNT production activities, some of the buildings were known to have temporarily stored radioactive materials. Only two LOOW buildings remain; Building 429, which is used as an office, and Building 433 (radium vault), which is a small, one story cinder block structure, which was reportedly used for sealed radium source storage.

A radiological survey performed by the USACE of Building 433 (radium vault) identified elevated levels of radionuclides. Radiological surveys during the RIs also identified elevated levels in the foundations of Buildings 401, 430, and 431/432. Core samples from the Building 401 foundation also identified radiological impacts.

Except for Building 401, no samples were collected from the other buildings and foundations to confirm the presence of contamination. Building 433 and the building foundations identified in this FS are assumed to be contaminated based on one or more factors, such as gamma survey results, history of use, and/or presence of adjacent soil contamination. All building foundations and Building 433 would be evaluated as part of remedial design work to definitively determine the presence of contamination.

1.5.4 Utilities

Utilities consist of buried sewer and water distribution pipelines and manholes and drains accessible at the ground surface. Elevated levels of constituents were found at various utility locations. These included:

- Elevated levels of radionuclides and PAHs in some manhole and pipeline solids.
- Elevated levels of radionuclides in some manhole and pipeline water.
- Elevated metals, PCBs, VOCs, PAHs, and pesticides in the Building 401 floor drains.

1.5.5 Surface Water and Sediment

Constituents including radionuclides, VOCs, PAHs, and metals were found in surface water and sediment in the site drainage systems. In some instances, elevated concentrations were detected at upgradient locations suggesting that some impacts are not site-related.

1.5.6 Groundwater

Elevated levels of radionuclides, predominantly total uranium, were found in groundwater at various locations on the site. These areas include south of the IWCS (EU10 and EU11) and east of the IWCS including the MH06 and well OW11B area (EU11) (USACE 2013). Drilling and groundwater level monitoring and sampling have confirmed that the impacts are localized and are not migrating. The identified impacts are located in areas where radioactive materials storage or remedial activities are known to have occurred. Extensive soil sampling and radiation surveys during drilling and excavation activities near groundwater impacts have not identified current source terms for the concentrations observed in the groundwater. Consequently, the USACE suspects that the elevated uranium concentrations observed in groundwater are legacy impacts from the infiltration and deposition of contaminated leachate, runoff, and sediments during previous waste storage and remediation activities. This conceptual site model is assessed in Appendix A and summarized in Section 1.6.1.

Elevated levels of organic constituents, primarily tetrachloroethylene (PCE) and its related daughter products, were found in EU4 (i.e., EU VOC plume). The source of the PCE is unknown, but similar to radionuclide contamination, the limited extent of PCE impacts suggest that the impacts are in an area where both storage and operational activities likely occurred.

1.6 Contaminant Fate and Transport

Potential contaminant pathways through which contaminants can move include atmospheric dispersion, physical contact, surface water runoff, and groundwater migration. A discussion of site-related contaminant fate and transport mechanisms and modeling results are presented in the following sections.

1.6.1 Radionuclides

The following radionuclides were detected at various locations across the NFSS in surface soil, subsurface soil, surface water and sediment, and groundwater:

- Actinium-227 (Ac-227)
- Protactinium-231 (Pa-231)
- Lead-210 (Pb-210)
- Radium-226 (Ra-226)
- Thorium-230 (Th-230)
- Uranium-234 (U-234)
- Uranium-235 (U-235)
- Uranium-238 (U-238)

Potential release mechanisms for radionuclides in surface and subsurface soil include:

- Displacement and transport by the action of humans or animals.
- Displacement and transport by wind and air.
- Release and transport by water.

While most of the areas where radionuclides have been identified are vegetated, some exposed areas may exist and access to these areas is not totally precluded. Consequently, there is a potential for dust generation from off-road vehicles and other intrusive activities. The potential for displacement of contaminants by the wind (fugitive dust emissions), with subsequent transport in the air as particulate material, is always present where soil is directly exposed to the wind. The particulate size, moisture content, degree of vegetative cover, degree of soil disturbance, and other factors, as well as wind speed, direction, and persistence, determine the rate of dust emissions. The potential for fugitive dust emissions is highest in hot and dry conditions and may be persistent for a short term during intrusive activities such as construction or other activities involving vehicles (trucks, landscaping, etc.).

The presence of Ra-226 results in the potential for the emission of the Ra-226 decay product, radon 222 (Rn-222 gas), from the ground surface to the air if an adequate radon barrier is not in place. Rn-222 concentrations and gamma emissions are measured semiannually around the perimeter of the IWCS and at the NFSS property boundary. The November 2018 ESP report shows that in 2017, site Rn-222 concentrations were below the U.S. DOE off-site limit of 3.0 picocuries/liter (pCi/L) (USACE 2018). The calculated dose to a receptor due to airborne particulates was below the U.S. EPA guideline of 10 mrem/yr (excluding radon). The cumulative dose, which is calculated by adding the maximum external gamma dose to the maximum airborne particulate dose, was significantly less than the U.S. DOE limit of 100 mrem/yr (U.S. EPA 2016). These results were similar to past results.

The ROCs in sediment are subject to a number of physical and chemical processes that can affect their migration. Adsorption onto sediment particles may prevent or delay ROC migration by varying degrees depending on displacement and downstream transport by surface water flow in the site drainage system. The ROC constituents may also be introduced into the site drainage sediment column as a result of transport of upland soil particles via stormwater flow, ROCs dissolved in stormwater, and groundwater discharge that may subsequently precipitate to sediment particles under anaerobic conditions.

Dissolved-phase surface water and groundwater impacts are derived from the dissolution and migration of impacts from historical storage areas and soil-based sources. The mobilization of ROCs is governed by the solubility of those compounds in water and the soil-partitioning conditions. As this liquid moves through the impacted material, some compounds (e.g., uranium) may preferentially dissolve into the water, whereas others (e.g., radium and thorium isotopes) have much less solubility and high soil-water partitioning coefficients. Dissolved oxygen also drives the precipitation/solubility of ROCs in groundwater, surface water, and sediment.

The USACE completed groundwater modeling in 2007 (USACE 2007b) to predict the migration of contaminants originating from the site and to determine future migration under baseline (current) conditions. The 2007 groundwater modeling was completed in three stages including: 1) conceptual model development, 2) groundwater flow model development and calibration, and 3) solute transport model development and application.

The 2007 groundwater model results for source term(s) depicted model simulations for current conditions, 1,000 years, and 10,000 years. The 2007 groundwater model results concluded the following for the ROC constituents:

- IWCS-based sources, on-site exceedances of the screening level (i.e., the more conservative of the Upper Tolerance Limit for NFSS or the MCL) are predicted to occur for U-238, U-234, and U-235 (Table 4.2 USACE 2007b). Property boundary exceedances are not predicted to occur for any of the IWCS-based sources within the first 1,000 years.
- Soil-based plumes cause on-site screening level exceedances within 1,000 years for U-238, U-234, U-235. Of the constituents predicted to exceed on-site screening level values, U-238 and U-234 also exceed the screening level at the property boundary as a result of soil-based plumes and groundwater plumes. The modeling results showed property boundary exceedances occurring in EUs 1 and 11 for U-238 and EUs 1, 2, and 11 for U-234.
- The prescribed initial condition for groundwater plumes causes on-site screening level exceedances at t=0 (i.e., current at the time of the modeling) for U-238, U-234, Th-230, and U-235. These results indicate that an on-site screening level exceedance occurs by all groundwater plume sources simulated.

In 2011, the USACE updated the NFSS groundwater flow and solute transport model to ensure that the groundwater flow and solute transport model conservatively predicted contaminant migration. The groundwater flow model was revised to more explicitly represent the distribution of sand lenses within the brown clay till by adjusting hydraulic conductivity values assigned in the model in areas characterized by sand lenses. The groundwater flow field using the updated model was evaluated to confirm that the model accurately simulates observed conditions. The solute transport model update included using a revised Kd value of 122 L/kg for soil outside the IWCS (USACE 2014) and updated model source terms based on supplementary RI efforts.

The 2011 groundwater model results for source term(s) depicted model simulations for current conditions, 1,000 years, and 10,000 years. The 2011 groundwater model results concluded the following for the ROC constituents:

- The brown clay till and glacio-lacustrine clay effectively inhibit the downward migration of the ROC constituents.
- None of the radionuclides are predicted to occur in the alluvial sand and gravel groundwater within 10,000 years.
- RI field investigations indicate that ROCs are present in groundwater off-site and near the NFSS boundary. Groundwater at these locations is not used for drinking water purposes.
- The potential for transport from the localized impacted areas is limited assuming the characteristic low permeability of the brown clay till observed on the NFSS and surrounding properties.

In 2017, USACE updated the groundwater model to assess the potential impact of uranium in groundwater on surface water within site drainage ditches (see **Appendix A-1**). The USACE notes that these screening levels are not applicable guidelines per upcoming Section 2.2.2.2, but only comparative values that exemplify the protectiveness of site conditions. The assessment, which considered total and isotopic uranium, was done in three phases. The first phase was a screening level evaluation and identified areas at the NFSS where modeled uranium concentrations in unsaturated soil could lead to uranium concentrations in adjacent pore water that may exceed surface water screening levels. For the evaluation, surface water screening levels used in the model were the uranium MCL (30 micrograms per liter [µg/L]), the Canadian Water Quality Guideline[1] for protection of aquatic life from long-term exposure to uranium of 15 µg/L (discussed in more detail in Section 1.7.9), and the annual limit of 300 pCi/L of total isotopic uranium in uncontrolled effluent, which was converted to a mass concentration of 439 µg/L. This initial model identified site-wide areas where pore water exceeded the MCL and Canadian screening level, with eight areas exceeding the 439 µg/L screening level.

The eight high-concentration areas were then evaluated to determine if the uranium could migrate to groundwater and eventually a drainage ditch within a 1,000-year period. The site groundwater model defined areas of contribution to the ditches, which showed two of the eight areas are located within the 1,000-year groundwater contribution zone; the remaining six areas would not be expected to reach the drainage ditches via groundwater within 1,000 years.

The eight areas identified as having the potential to negatively impact surface water were then carried into the second modeling phase. A one-dimensional transport model predicted where uranium in pore water in the unsaturated soil would enter groundwater and potentially result in elevated uranium concentrations in nearby surface water ditches. Six of the eight areas were predicted to have uranium concentrations attenuate in groundwater to levels below both the MCL (30 µg/L) and Canadian screening level (15 µg/L). In the two remaining areas, the predicted uranium concentrations in groundwater seeping into the ditches would be higher than the Canadian screening level, but lower than the MCL. This estimate only accounts for baseflow and not any attenuation that would occur from surface water flow in the ditches.

[1] The Canadian Water Quality Guideline is the most recent and relevant scientifically-derived risk-based screening level for protection of aquatic life against exposure to uranium in surface water. The U.S. currently does not have an equivalent screening value. The Canadian value is used as a convenient risk-based screening level for assessing potential ecological risk for surface water exposures.

The second-phase assessment used the results of the first phase to focus on uranium concentrations in UWBZ groundwater in the areas south and east of the IWCS, which are significantly higher than concentrations predicted by the soil-leaching model. This finding suggests that uranium observed in UWBZ south and east of the IWCS is derived from highly contaminated ore residues historically stored on the ground surface and remedial activities performed in these areas (see Section 1.5.6). Based on these modeling results, uranium in the unsaturated soils south and east of the IWCS would not produce uranium concentrations that exceed the MCL or Canadian screening level in the future (i.e., past remedial actions appear protective of groundwater). Based on the phase one and phase two modeling conclusions, uranium leaching from unsaturated soil is not considered a future source for contamination to surface water and thus not evaluated in the phase three modeling.

The third phase employed the three-dimensional groundwater flow and contaminant-transport model to assess whether observed uranium impacts (isolated plumes) in UWBZ could potentially impact site surface water. The model predicted that uranium concentrations in groundwater are expected to migrate very slowly to site ditches due to 1) the very low hydraulic conductivity and gradients associated with the glacial tills that underlie the site, 2) low precipitation recharge rates due to seasonal wetting and drying cycles reflected in water-level variations, and 3) attenuation of uranium due to chemical absorption.

The modeling predicted that 1) localized groundwater discharge (baseflow) to many segments of on-site ditches would exceed the Canadian screening level (15 µg/L) and 2) six small segments are predicted to receive uranium in excess of the 30 µg/L MCL. However, due to mixing with other unimpacted baseflow entering the ditches, the uranium concentration will only exceed the Canadian screening level in the northern portion of the WDD and multiple reaches in the CDD, South16, and South31 drainage ditches. Cumulative concentrations in surface water from baseflow are not expected to exceed the 30 µg/L MCL at the site boundary. This computation only accounts for groundwater baseflow to the ditches and ignores the significant dispersion of the uranium that would occur from overland surface-water flow to the ditches, as exemplified in Appendices A-1, A-3, and A-4. The actual dispersive condition is exemplified by the surface water sampling results reported by the annual environmental surveillance program, which show that the 30 µg/L MCL has not been exceeded in the CDD at the point at which it exits the site to the north (i.e., baseline conditions observed through 2017 are expected to persist into the future). These analyses together indicate the uranium impacts in site groundwater do not require remediation to protect surface water.

1.6.2 Chemicals

Chemicals consist of CVOCs, PAHs, and PCBs that were detected at various locations across the NFSS in surface soil, subsurface soil, surface water, sediment, and groundwater.

1.6.2.1 CVOCs

There were CVOCs detected in soil in EU4 and EU13 and in the groundwater in EU4. The primary CVOCs at the site consist of PCE and its daughter products. While the specific historical use of PCE at the site is unknown, a common use for PCE was as a degreaser and cleaner for metallic parts. The release of PCE into the environment is usually through surface spills, leaking tanks/drums, or release to sewers or impoundments.

Tetrachloroethylene is a dense non-aqueous phase liquid (DNAPL). It has a specific gravity greater than water and tends to follow topographic relief through its downward migration, first through the vadose (unsaturated) zone and then into the aquifer. Based on PCE concentrations in groundwater, a DNAPL phase is suspected to exist in EU4.

Tetrachloroethylene is volatile and a portion of the compound tends to change to a vapor phase in the vadose zone and can migrate into areas with more porous media where open subterranean voids exist due to partial pressure influences. This can lead to vapor accumulation in basements and structures due to air diffusion gradients, although no buildings currently exist in either EU4 or EU13.

Tetrachloroethylene is also a wetting fluid, which means as fine-grained materials are encountered it is preferentially imbibed in the small pore spaces. The PCE liquid is highly hydrophobic with a very low solubility in water. During gravity migration through the vadose zone, PCE can accumulate in pools on low-permeable layers, compaction transition between bedding planes, or fractures, and spread laterally. It often accumulates on top of the groundwater within the capillary fringe until sufficient pooling promotes breakthrough pressures that overcome surface tension and promote contaminant movement below the water table. The PCE in the water table can be distributed as a discontinuous mass of globules or ganglia. In this form, it is relatively immobile and referred to as residual DNAPL. As such, residual DNAPL functions as a long-term source of groundwater contamination.

Tetrachloroethylene undergoes biological reductive dechlorination into its daughter products in both the water table and the capillary fringe. The PCE dechlorinates through biological processes to trichloroethylene (TCE). The TCE then degrades to cis-1,2-dichloroetheylene (cis-1,2-DCE), which degrades to vinyl chloride (VC), and subsequently to ethene, which is inert in the environment.

Groundwater modeling results from the 2011 RI indicate that the chlorinated solvent plumes are predicted to reach steady-state conditions after approximately 350 years (i.e., the plume would be stable or shrinking due to natural attenuation). In EU4, the maximum extent of contamination is only slightly bigger than the DNAPL source area. The additional mass input from the fixed source (i.e., DNAPL) is balanced by dispersive effects and the loss of mass due to biodegradation. Simulation results indicate that under a fixed concentration scenario, higher concentrations are predicted for each constituent in lower stratigraphic units, compared to the initial condition source term representation. However, the fixed concentration source does not cause screening level exceedances (MCLs were used as screening levels in the modeling; USACE 2007b, Table 4.2) at the NFSS property boundary.

The modeling report stated that the maximum on-site concentrations for PCE, TCE, cis-1,2-DCE in groundwater at the time of the modeling, would be degraded to concentrations below their respective screening level values (i.e., MCLs) in less than 200 years, and for VC (i.e., upper tolerance limit) in less than 300 years. However, as noted above, PCE in the DNAPL phase functions as a long-term source of groundwater contamination and degradation to below screening levels would take considerably longer. Using Natural Attenuation Software (NAS) developed by the U.S. Geological Survey, Virginia Polytechnic Institute and State University, and Naval Facilities Engineering Command (NAS, 2005), it is estimated that it would take more than 2,000 years for the DNAPL phase to degrade to a concentration below NY State groundwater criteria (see **Appendix A-2**).

1.6.2.2 Polycyclic Aromatic Hydrocarbons

Polycyclic aromatic hydrocarbons were detected in soil and groundwater at various locations across the NFSS. The PAHs are a group of SVOCs formed by the incomplete combustion of coal, oil, gas, wood, and other organic substances.

Polycyclic aromatic hydrocarbons are released to the environment through natural and synthetic sources with emissions largely to the atmosphere. Natural sources include emissions from volcanoes and forest fires. Synthetic sources include burning of wood in homes and vehicle emissions. In soil and sediments, microbial metabolism is the major process for degradation of PAHs. The PAHs in soil may result from atmospheric deposition after local and long-range transport. Other potential sources of PAHs in soil include sludge disposal from public sewage treatment plants, automotive exhaust, irrigation with coke oven effluent, leachate from bituminous coal storage sites, and use of soil compost and fertilizers. The principal sources of PAHs in soil along highways and roads are vehicular exhausts and emissions from wearing of tires and asphalt.

The movement of PAHs in the environment depends primarily on physical properties such as aqueous solubility and vapor pressure. They are typically present in air as vapors or absorbed to the surfaces of solids such as soil. The PAHs that become vapors can travel long distances before they are removed by precipitation or particle settling. Polycyclic aromatic hydrocarbons are not very soluble in water. Most PAHs absorb to solid particles and settle to the bottoms of rivers or lakes, but some can volatilize from surface water. The PAHs are most likely to adhere tightly to soil. Limited evaporation of PAHs from surface soil can occur.

The PAHs in soil can volatilize, undergo abiotic degradation (photolysis and oxidation), biodegrade, or accumulate in plants. The PAHs in soil can also enter groundwater and be transported within an aquifer.

The 2007 RI groundwater modeling evaluated transport of bis(2-ethylhexyl)phthalate. The maximum on-site concentration of bis(2-ethylhexyl)phthalate was predicted to remain constant (at 12.0 μg/L) for the duration of the 10,000 year simulation. The maximum concentration of bis(2-ethylhexyl)phthalate is not predicted to exceed screening levels within the simulation time period (i.e., 10,000 years).

1.6.2.3 Polychlorinated Biphenyls

Polychlorinated biphenyls were detected in pipeline sediment at the NFSS. The PCBs are nonpolar and only slightly soluble in water, which makes them bind strongly to soil. Most transport occurs by soil movement by mechanical or hydraulic entrainment of soil particles. Polychlorinated biphenyls have relatively low vapor pressures but do volatilize. The volatilized PCBs can be transported long distances in air and be redeposited by settling or scavenging by rain precipitation.

Polychlorinated biphenyls can be transformed by both abiotic and biotic means. Under the right anaerobic conditions, PCBs can undergo reductive dechlorination transforming to less chlorinated congeners. Congeners having very few chlorines can undergo aerobic degradation that breaks the double bonds in the dual benzene rings that can lead to mineralization. However, such conditions are rare and degradation rates are typically very slow. The abiotic transformation of PCBs is limited to hydrolysis and oxidation in water or atmospheric photolysis of PCBs exposed to ultraviolet light or oxidation of atmospheric PCBs by free radicals. Polychlorinated biphenyls are not a COC in groundwater at the NFSS and were not included in the 2007 groundwater modeling effort.

1.7 Summary of Baseline Risk Assessment

Sections 1.5 and 1.6 above identified radionuclide and chemical constituents that were found at relatively elevated concentrations in various media at the NFSS. Section 1.6 provided a general discussion of fate and transport of those constituents in the environment. While numerous radionuclide and chemical constituents were identified, some are naturally occurring and/or are not considered SRCs. In the BRA, SRCs were subjected to screening steps, including a comparison to conservative risk-based concentrations, to determine which constituents warrant quantitative risk evaluation. These constituents are referred to as chemicals of potential concern (COPCs) and radionuclides of potential concern (ROPCs). Determining whether SRCs are ROCs or COCs was made by screening the maximum detected concentration of an SRC against a preliminary remediation goal (herein referred to as BRA PRG) for potential receptors such as a maintenance worker, trespasser, construction worker, etc. This process is discussed in more detail below.

The 2007 BRA evaluated current and potential future risks to human health and the environment from site contamination. The current and reasonable future land use for the site is industrial. However, for the 2007 BRA all land use scenarios were considered, ranging from subsistence farming to industrial. Therefore, the hypothetical future on-site receptors included construction workers, maintenance workers, industrial workers, adult and adolescent recreational visitors, and adult and child residents, trespassers, and subsistence farmers. All those potential receptors were evaluated in the BRA. However, because the current and reasonable future use is industrial, for remediation consideration it is assumed that only construction workers, maintenance workers, industrial workers, adult and adolescent trespassers would be potentially exposed and of those, the construction worker provides the most conservative protection criteria.

The purpose of the BRA was to provide the USACE, the regulatory agencies, and other stakeholders with a decision-making tool for use in determining the need for further investigation or cleanup based upon present site conditions. The modeled receptors do not live at the site; therefore, their presence at the site was "hypothetical", meaning that they may or may not occupy the site in the future (e.g., modeled receptors ranged from farmers to industrial workers). The modeled exposures for these receptors were based on U.S. EPA-approved models and parameters such that a reasonable estimate of the risk to these receptors could be calculated. The mathematical models were based on guidance documents prepared by the regulatory agencies. These models were recommended as a reasonable means to provide a conservative estimate of the effect of COCs and ROCs on human receptors.

U.S. EPA and USACE guidance documents were used to prepare the BRA. It relied on modeled risk estimates for representative receptors that may be exposed to chemical and radiological constituents at the site. The risk estimates were not based on observed impacts to actual people, plants, or animals at the site, nor were they based on measured levels of chemicals within the tissues of these potential receptors. The risk estimates were developed using mathematical models as opposed to actual observed or measured effects. Therefore, the risk estimates should be used only within the CERCLA framework for which they are intended and not for any other purpose such as wildlife management or the development of health advisories.

The BRA evaluated both chemical and radiological constituents. The human health risk assessment (HHRA) for chemical constituents was conducted according to the methodology presented by the U.S. EPA in the *Risk Assessment Guidance for Superfund* (RAGS) (U.S. EPA 1989) and other guidance documents. The HHRA for radiological constituents was conducted in accordance with RAGS using the residual radioactivity (RESRAD) computer code Version 6.2. The screening-level ecological risk assessment (SLERA) followed RAGS and associated guidance for chemical constituents. For radiological constituents, the SLERA followed *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota* (U.S. DOE 2002).

The USACE divided the NFSS into 17 EUs for purposes of quantifying risks in the BRA. Exposure Units 1 through 14 are terrestrial (also referred to as physical) EUs. Soil was evaluated in each of these 14 EUs. Exposure Unit 15 is the Central Drainage Ditch (including the South16, South31 and Modern Ditches) and EU 16 is the site utilities. These EUs include soil 0 to 3 m (0 to 10 ft), surface soil 0 to 15 cm (0 to 0.5 ft), sediment, and surface water. For defining environmental media within EUs, sediments were operationally defined as being in ditches that are submerged (wet) for at least six months of the year (i.e., 50 percent of the year). Areas submerged for less than 50 percent of the year were defined as soil areas. Only EUs 5, 9, 15, 16, and 17 contain surface water and sediment. EU 17 is a site-wide unit for all media and data. Exposure Unit 18 contains off-site areas where background samples were collected, but the USACE did not quantify any risk for this EU.

The 2007 BRA considered all potential current and future exposure pathways and receptors; however, this summary is limited to receptors under the current and reasonably anticipated future land use scenario, which is industrial. On-site receptors for industrial land use include adult and adolescent trespassers, construction workers, maintenance workers, and industrial workers (other receptors evaluated in the BRA included recreational users, residents, and subsistence farmers). Exposure pathways include incidental ingestion, inhalation, dermal contact (for COPCs) and external gamma for ROPCs) present within BOP soils, buildings/foundations, utilities, upper groundwater, and ditch sediments and surface water. Considering that the reasonably anticipated future land use scenario is industrial, selection of the construction worker as the representative critical group results in the most comprehensive (combined) list of ROCs and COCs and the most conservative PRGs for ROCs. It is noted that these PRGs were for the BRA only. Following the FS process, those BRA PRGs that exceed ARARs or risk-based levels are retained as FS PRGs.

The 2007 BRA HHRA and SLERA are briefly discussed below.

1.7.1 Human Health Risk Assessment

The HHRA evaluated risk to humans currently exposed to SRCs or reasonably anticipated to be exposed in the future. Under NFSS's current land use scenario, these on-site receptors included adult and adolescent trespassers and maintenance workers. To be all inclusive, the HHRA considered all possible future land use scenarios-from industrial to residential to subsistence farming. Therefore, the "hypothetical" future on-site receptors included construction workers, maintenance workers, industrial workers, adult and adolescent recreational visitors, adult and child residents, and adult and child subsistence farmers. The subsistence farmer land use scenario was evaluated in the HHRA as an overly conservative worst case even though this scenario is highly unlikely due to the proximity of the site to surrounding landfills and the poor yield and quality of on-site groundwater resources. Only those receptors associated with the reasonable future land use (industrial) will be discussed further in this FS.

To determine which chemicals and radionuclides need to be retained for full quantitative risk analysis, the USACE used a series of screening steps to evaluate environmental data collected during the RI. Site data for all detected constituents were first compared to background concentrations to determine which constituents exceed background levels and thus are considered SRCs. The SRCs were then subjected to additional screening steps, including a comparison to conservative risk-based concentrations, to determine which constituents warrant quantitative risk evaluation. These constituents are referred to as COPCs or ROPCs.

1.7.1.1 Maintenance Worker

The site is currently maintained as a government-owned facility. Maintenance activities include mowing, site inspections, and general maintenance of security barriers. These or similar activities will continue indefinitely for the IWCS (as long as it is present) even if the site is transformed into an industrial area. For other areas at NFSS (e.g., BOP), continued maintenance is also a possible future use scenario. It is assumed that these workers could be exposed to contaminated surface soil and surface water/sediment while on-site. Exposure to surface water/sediment would occur during routine ditch maintenance. Specifically, exposure pathways for a maintenance worker include:

- Inhalation of volatiles from surface soil, surface water, and sediment.
- Inhalation of fugitive dust from surface soil and dry sediment.
- Dermal contact with surface soil and surface water/sediment.
- Incidental ingestion of surface soil, surface water, and sediment.
- External gamma exposure to surface soil and sediment evaluated in the radiological HHRA.

1.7.1.2 Trespassers/Recreational Receptors

Deer and other game animals are known to exist within the fenced boundary of NFSS, and there have been anecdotal accounts of hunters trespassing on the site while hunting local game. Under current land use, the receptors are called trespassers. Future land use could permit hunting on-site; therefore, the receptors are called recreational visitors under the future use scenario. Exposure pathways and parameters are the same regardless of current or future land use. It is assumed that these receptors could be exposed to contaminated surface soil and surface water/sediment while on-site and could consume contaminated meat from site-impacted game. Fish consumption is not considered a complete exposure pathway because NFSS does not contain bodies of water capable of supporting game fish populations. Specifically, exposure pathways for a trespasser/recreational visitor include:

- Inhalation of volatiles from surface soil, surface water, and sediment.
- Inhalation of fugitive dust from surface soil and dry sediment.
- Dermal contact with surface soil and surface water/sediment.
- Incidental ingestion of surface soil and sediment.
- External gamma exposure to surface soil and sediment.
- Consumption of meat from impacted game.

1.7.1.3 Construction Worker

Future land use scenarios include the development of NFSS for industrial use. There are currently no habitable structures on the site; there is no useable utility infrastructure; there is inadequate vehicle access. Therefore, construction workers likely represent the first group of receptors that could be exposed if the site is developed for industrial use. It is assumed that these workers could be exposed to contaminated surface soil, subsurface soil (below the top 15 cm [6 in]), surface water/sediment, and upper groundwater while on-site. Specifically, exposure pathways for a construction worker include:

- Inhalation of volatiles from surface soil, subsurface soil, surface water, upper groundwater, and sediment.
- Inhalation of fugitive dust from surface soil, subsurface soil, and dry sediment.
- Dermal contact with soil (surface and subsurface), sediment (including pipe sludge), and water (surface and upper groundwater).
- Incidental ingestion of soil, surface water, sediment, and upper groundwater.
- External gamma exposure to soil and sediment.

1.7.1.4 Industrial Worker

Future land use scenarios include the development of NFSS for industrial use. This scenario could include the construction of office space or warehouses that would be occupied by full-time employees (i.e., industrial workers). It is assumed that these workers could be exposed to contaminated surface soil and surface water/sediment while on-site. Specifically, exposure pathways for an industrial worker include:

- Inhalation of volatiles from surface soil, surface water, and sediment.
- Inhalation of fugitive dust from surface soil and dry sediment.
- Dermal contact with surface soil and surface water/sediment.
- Incidental ingestion of surface soil surface water, and sediment.
- External gamma exposure to surface soil and sediment.

Quantitative risk characterizations were performed for COPCs/ROPCs in each EU and human health risk estimates were calculated for all potential scenarios and pathways. Reasonable maximum exposure risk estimates were presented first, followed by central tendency exposure risk estimates. The resulting risk characterization identified COCs and ROCs. These were defined based on total risk by medium and then by COPC/ROPC-specific risk. Cancer risk must exceed 1 x 10^{-4} within the EU in a specific medium for any COCs/ROCs to be identified. When medium-specific risk exceeds 1 x 10^{-4}, any individual COPC/ROPC posing 1 x 10^{-5} risk, or greater, was identified as a COC/ROC. The ROCs were also identified based on exceedance of a 25 mrem/yr dose.

Noncancer HI values for any medium must be greater than 1 within an EU for any non-cancer COCs to be identified. When medium-specific HI exceeds 1, individual COPCs with an HI greater than 1 are identified as COCs. When medium-specific risks exceed 1 x 10^{-4} and/or HI greater than 1, but no COPC/ROPC-specific risks exceed 1 x 10^{-5} or noncancer hazard quotient (HQ) greater than 1, then the COPC/ROPC contributing the greatest cancer risk/HQ is used in the risk summary.

The resulting COCs/ROCs from each exposure unit are summarized in Table ES-1 of the 2007 BRA. **Table 1-3** condenses that information by indicating which constituents are present above these risk, hazard, and radiological dose limits for the various potential industrial land use receptors (e.g., industrial worker, maintenance worker) across the NFSS.

Based on this evaluation, radiological contaminants are more widespread than chemical contaminants. The ROCs were identified in all 14 physical EUs, whereas COCs were identified in seven of the 14 physical EUs. The ROCs and COCs are present in surface soils and at various depths, with most of the contamination limited to the top 0.6 m (2 ft) of soil. There were also COCs present in the pipelines. Groundwater COCs and ROCs were limited to the UWBZ.

1.7.2 Screening-Level Ecological Risk Assessment

The scope of the SLERA was to determine the potential for adverse ecological impacts resulting from exposure to chemicals and radionuclides present from past MED/AEC activities at the site. The SLERA provides information to help determine whether ecological risks at the site are negligible, if further information and evaluation are necessary to better define potential ecological risks at the site, or if mitigation should be done without further evaluation.

The NFSS landscape consists of predominately low-lying land or terrestrial habitats and water or aquatic habitats. Terrestrial habitats include maintained turf/mowed grass; sedges, reeds, rushes, and cattails; and, mixtures of various forests. Wildlife species include white-tailed deer, rabbits, raccoons, groundhogs, and other rodents as well as hawks, herons, pheasants, doves, and other birds. Other terrestrial organisms like reptiles and amphibians are also present. Aquatic habitats drain poorly among the various man-made ditches and there is only one perennially flowing ditch. This limits the types and numbers of aquatic organisms that can and do live at NFSS. There are no significant or unique ecological resources and likely land use is commercial/industrial or other intensive human use. Not one sensitive and/or significant habitat exists at NFSS; there is no critical habitat for threatened and endangered species and scattered wetlands and ditches are of low quality. It is important to note that low quality habitats in some NFSS areas are the result of past physical disturbance rather than consequences of chemical contaminants. Physical disturbance includes soil excavation/movement, past construction and equipment usage, ditch dredging with steep banks, and clear-cutting.

The SLERA used available site analyte concentrations in soil, sediment, and surface water. Risks to ecological receptors were evaluated by performing a multistep screen that identified EUs and media where specific analyte concentrations were above values that were deemed safe for one or more receptors. The SLERA also identified receptors that are particularly at risk. The results also provide information about the relative magnitude of risk from different analytes. For the SLERA, future risks are assumed to be the same as current risks; however, this may be overly conservative due to degradation of some chemicals.

The problem formulation for the SLERA included two levels of screening: a general screening followed by a site-specific analysis. These screens were applied to COPCs and ROPCs. The general screening compared the maximum detected concentration of COPCs against screening benchmarks and ROPCs against generic biota concentration guides developed by the U.S. DOE. The site-specific analysis used site-specific information to calculate HQs for chemical constituents, and site-specific biota concentration guides for radionuclides to evaluate whether EUs or receptors can be eliminated from further analysis due to negligible risk.

For chemicals, there were two EU-specific steps where reasonable maximum exposure concentrations are compared to ecological screening values to develop HQs. For radionuclides, a site-wide screen of maximum concentration was used to determine whether further analysis was required. The EU-specific steps followed in which concentrations were compared to biota concentration guides to develop overall radiation doses.

For radionuclides, all EUs were eliminated by application of the various site-wide and EU-specific screens. For chemicals, none of the soil EUs could be dismissed at the initial screening phases because one or more chemicals were present at sufficiently high concentrations to produce an HQ greater than 1.

The SLERA results are intended to facilitate decision-making relative to the protection of the habitats and ecological receptors at NFSS. Given that it is a screening level process, it may not be conclusive regarding remedial actions. However, the SLERA information may be used in conjunction with the HHRA to determine if 1) a weight-of-evidence evaluation of the screening results should be carried out; 2) a definitive baseline ecological risk assessment should be performed; and 3) the screening level information is sufficient to identify remedial actions for the site.

The SLERA advanced and applied eight weight-of-evidence elements to each of the EUs at NFSS. Three of the weight-of-evidence elements discriminate or rank the EUs while the other five elements equally apply to all the EUs. Seven of the eight elements supported no further action. The one contrary element recognized the mathematically predicted ecological risk for chemicals at NFSS as possibly leading to a different outcome. However, field observations show relatively healthy and functioning terrestrial and aquatic ecosystems. Forest and other vegetation and wildlife, such as deer, are abundantly present in the EUs. After weighing this apparent contradiction through mathematical risk predictions and actual field observations, it was concluded that the reality of functioning vegetation and wildlife, as well as lack of sensitive habitats or species, indicate no further action for ecological receptors is warranted.

1.7.3 Updated Baseline Risk Assessment 2017 – Lead

As part of the 2007 BRA, the USACE identified lead as a COC in soil, sediment, and groundwater. The BRA PRGs were derived for lead in soil and sediment. The BRA PRGs were not derived for lead in groundwater. The 2007 BRA identified lead as a COC for the following receptors, exposure units, and media associated with current and future industrial land use:

Receptor	Exposure Unit	Medium
Construction Worker	EU 2, EU 4	Soil
Construction Worker	EU 16	Sediment
Construction Worker	EU 17	Groundwater
Maintenance Worker	EU 4	Soil

In the 2007 BRA, PRGs for lead in soil and sediment were derived using U.S. EPA's Adult Lead Methodology (ALM) (U.S. EPA 2016). The U.S. EPA model is designed to estimate an average (arithmetic mean) soil or sediment lead concentration that is not expected to result in a greater than 5 percent probability that the fetus of a woman of child-bearing age has a blood lead (PbB) exceeding the level of concern of 10 micrograms per deciliter. Therefore, the soil or sediment lead concentration so derived is considered protective of all workers, including pregnant women.

The U.S. EPA ALM default values were used in the soil/sediment BRA PRG derivation except for the exposure frequency and soil ingestion rate. Values for the soil ingestion rate and exposure frequency were consistent with those used in the risk characterization calculations for other constituents. Derived soil/sediment PRGs for maintenance and construction workers were 420 milligrams per kilogram (mg/kg) and 88 mg/kg, respectively.

The lead MCL (15 µg/L) was used in the BRA as the risk screening level for groundwater and surface water. Total lead was detected in several EUs at concentrations above the MCL. In addition to construction workers and maintenance workers, receptors also include industrial workers and recreational users/trespassers (adult/adolescent). Although the lead exposure point concentration exceeded the drinking water MCL, it was not a COC for these receptors because groundwater and surface water ingestion are incidental. Therefore, groundwater and surface water BRA PRGs were not developed.

In the time since the BRA PRGs were derived in 2007, the U.S. EPA updated default values in the ALM in 2009 and 2016. As a result of the updates, the soil and sediment BRA PRGs were recalculated using U.S. EPA's baseline PbB and geometric standard deviations for PbB levels recommended by U.S. EPA in the most recent August 2016 update (see **Appendix B**).

The U.S. EPA recommends the use of central tendency exposure factors for input in the ALM because the model output is an estimate of the 95 percent of PbB levels. As a result, a soil ingestion rate of 100 mg/kg was used in the BRA PRG derivation, consistent with recommendations by U.S. EPA's Technical Review Workgroup for Lead, rather than the high-end soil ingestion rate of 480 mg/kg used in the 2007 BRA. Consistent with the BRA approach, 1/10 the soil ingestion rate was assumed for the incidental sediment ingestion rate.

The U.S. EPA does not recommend the ALM for use in exposure scenarios with an exposure frequency of less than one day per week. Infrequent exposures (i.e., less than one day per week) over a minimum duration of 90 days would be expected to produce oscillations in blood lead concentrations associated with the absorption and subsequent clearance of lead from the blood between each exposure event (U.S. EPA 2016). The exposure factors for worker exposure to sediment met the minimum requirements of the ALM. However, because those exposure factors were close to the minimum, the BRA PRG generated demonstrates that exposure to lead in sediment is not likely to be a concern due to the infrequent exposures.

As noted above, due to the incidental groundwater/surface water ingestion combined with the infrequent exposure frequency, the derivation of a BRA PRG for groundwater/surface water was not previously conducted. However, to provide comparison criteria for the FS, the ALM was modified to derive a BRA PRG protective of construction-maintenance worker or trespasser exposure. Although the ALM was not used to estimate a BRA PRG for potential exposures by industrial workers (due to the exposure frequency of 26 days per year, which does not meet the model threshold), as a conservative measure, the BRA PRG generated for construction/maintenance workers was used to assess industrial worker exposure. A summary of the updated BRA lead PRGs is provided below. A comparison to the 2007 values (where applicable) is also shown.

Receptor	2007 BRA Lead PRG (mg/kg)	Updated Soil BRA Lead PRG (mg/kg)	Updated Sediment BRA Lead PRG (mg/kg)	Updated Groundwater/Surface Water BRA Lead PRG (mg/L*)
Construction Worker	88	1,199	57,640	144,099
Maintenance Worker	420	1,199	57,640	144,099
Trespasser (Adult/Adolescent)	-	-	-	144,099

Note: * milligrams per liter

1.7.4 Soil

The COCs and ROCs identified below pose an unacceptable risk or radiological dose to the construction worker exposed to site soils in the absence of remedial action:

- ROCs:
  - Ac-227
  - Pa-231
  - Pb-210
  - Ra-226
  - Th-230
  - U-234
  - U-235
  - U-238
- COCs:
  - Benzo(a)pyrene
  - Benzo(a)anthracene
  - Benzo(b)fluoranthene
  - Dibenz(a,h)anthracene
  - Lead

The USACE identified PCBs as COCs in EU4 soil in the 2007 BRA. In reviewing the USACE NFSS database, two soil samples contained PCBs at levels above the TSCA cleanup level of 25 mg/kg for a low occupancy area. Both samples were from the same location, identified as Drum07 in EU4 (70.2 mg/kg and 25.1 mg/kg). In 2016, USACE resampled the Drum07 location and at four cardinal compass points located approximately 0.6 m (2 ft) away from the original Drum07 location and analyzed the samples for PCBs. All the sample results were below the TSCA cleanup level. Based on these results, USACE concluded that PCB remediation is not warranted. Therefore, PCBs are not included as COCs for soils.

In addition to the COCs identified above, the following chlorinated compounds in soil could leach into groundwater and pose unacceptable risk to the construction worker:

- PCE
- TCE
- Cis-1,2-DCE
- VC

1.7.5 Groundwater

The COCs identified below pose an unacceptable risk to the construction worker exposed to site groundwater in the absence of remedial action:

- Arsenic
- Lead
- PCE
- TCE
- Cis-1,2-DCE
- VC

While the concentrations of uranium in site groundwater have potential to pose an unacceptable risk to hypothetical residents if they were to use the groundwater below the site as a drinking water source, they do not pose a risk to the construction worker due to the incidental nature of construction worker exposure to groundwater. It is further noted that groundwater beneath the site is not a suitable source of drinking water without extensive treatment due to high salinity and total dissolved solids.

No ROCs in groundwater were identified.

1.7.6 Building 433 and Building Foundations

Constituents in Building Foundations

Since building foundations would be contaminated by the same activities that impacted soil, the COCs and ROCs identified below pose an unacceptable risk or radiological dose to the construction worker exposed to building foundations in the absence of remedial action:

- ROCs:
  - Ac-227
  - Pa-231
  - Pb-210
  - Ra-226
  - Th-230
  - U-234
  - U-235
  - U-238
- COCs:
  - Benzo(a)pyrene
  - Benzo(a)anthracene
  - Benzo(b)fluoranthene
  - Dibenz(a,h)anthracene
  - Lead

Constituents in Building 433

Because of its past use for radium storage, the ROCs listed above for the building foundations also apply to Building 433.

1.7.7 Railroad Ballast and Road Bedding

As reported in the RI Addendum (USACE 2011), it was not possible to determine if any parameter found in railroad ballast and road bedding exceeded background levels due to a lack of suitable background data sets for comparison. Consequently, the NFSS RI did not identify SRCs for these media. Although the materials used to construct the NFSS roadways and railroad ballast are not directly comparable to surface soil, to ensure that no SRCs were missed, USACE decided to screen road bedding and railroad ballast samples against NFSS site-specific background levels for surface soil. The results of this evaluation were presented in the RI Addendum, which found that radiological SRCs identified for railroad ballast and road bedding samples are Ra-226, Th-230, total uranium, and isotopic uranium (U-234, U-235, and U-238).

The next step in the evaluation was screening the railroad ballast and road bedding samples to determine whether they were MED-impacted or naturally-occurring radioactive material (NORM). In NORM, radium and uranium are present at roughly equal levels on a picocurie per gram (pCi/gm) basis (National Academy of Sciences 1999). Since the Manhattan Project involved uranium enrichment and extraction processes, materials associated with the MED operations have concentrations of uranium relative to radium that would be significantly different from naturally occurring material. As reported in the 2011 RI Addendum:

One example of NORM is elevated concentrations of uranium associated with phosphate ores. A phosphate slag material, identified as cyclowollastonite, was used throughout the Niagara Falls area for bedding under asphalt and for general gravel applications. Cyclowollastonite was once involved in the electrochemical production of elemental phosphorous using uranium-bearing raw materials and reportedly originated from the former Oldbury Furnace in Niagara Falls, New York (ORNL 1986). Cyclowollastonite may have been used as railroad ballast or roadway construction at the NFSS.

The phosphate slag material identified as cyclowollastonite is distinct from the MED-impacted radiological materials connected with the NFSS because it contains approximately equal concentrations of Ra-226 and U-238. At the NFSS, roughly equal concentrations of Ra-226 and U-238 in slag materials associated with railroad ballast and road cores indicate that these materials are most likely from a natural source. By contrast, the MED-related materials at the NFSS are residues resulting from uranium extraction processes conducted at other locations. Therefore, the concentration of U-238 in MED-related materials is expected to be significantly lower than the concentration of Ra-226 on a pCi/gm basis. Based on this characteristic, the relative abundance of Ra-226 and U-238 can be used to distinguish MED-related materials from slag or other naturally-occurring materials with elevated radiation levels.

At the NFSS, the mean ratio of Ra-226 to U-238 detected in railroad ballast samples was calculated to be 0.99, which is consistent with NFSS background soil that had a mean ratio of Ra-226 to U-238 of 1.04. The uniformity in the levels of U-238 and Ra-226 on a pCi/gm basis found in railroad ballast samples and their similarity to the NFSS background soil samples suggests that these locations have not been impacted by MED-related materials. In contrast, the mean ratio of Ra-226 to U-238 detected in road bedding samples was 4.84, which is considerably higher than 1.04, the ratio found in background soil. This suggests that the road bedding has been impacted by MED-related materials at many locations.

The USACE performed an evaluation of the slag found in the railroad ballast and road bedding using MicroShield Version 7.02 (Grove Software). MicroShield is a point kernel code for calculating the exposure rate to a point from different source geometries of radioactive materials. It was used to calculate the potential exposure to non-MED slag to a hypothetical receptor, a construction worker, at the NFSS. Two receptor scenarios were assessed, a construction worker working in proximity to a pile of slag and a construction worker performing work on top of or in the vicinity to a bed of slag.

The average radionuclide concentration of the slag was calculated from the historical site database for railroad ballast and road cores at NFSS. In addition, Pro UCL Version 5.1, was used on the same dataset to calculate the 95 percent Upper Confidence Limit (UCL) of the mean and a third analysis was performed with data outliers calculated by the program removed from the database.

The 2007 BRA used 25 mrem/yr as a screening dose and the MicroShield-calculated doses for the railroad slag were well below this level. Therefore, the railroad ballast (slag) does not need to be considered further. However, the road bedding is considered MED-impacted at several locations.

For road bedding, the following ROCs pose an unacceptable risk for the construction worker:

- Ac-227
- Pa-231
- Pb-210
- Ra-226
- Th-230
- U-234
- U-235
- U-238

1.7.8 Utilities

Previous sampling and/or information on past use has identified chemical and radiological impacts in portions of the sanitary sewer system. The sanitary sewer is no longer used and is not connected to any town sewer system. The USACE plugged/sealed the sewer system at the property boundaries during previous field work.

The potential for direct exposure to impacts within the sewers is limited to the future construction worker who may be exposed to these materials during construction and/or sewer removal activities.

In the 2007 BRA, the USACE sampled and analyzed sludge and water inside underground utilities for the presence of chemicals and radionuclides and estimated subsequent risk from exposure to the utility contents. It was assumed that of all the receptors evaluated during the BRA, only the construction worker would have substantial exposure to pipeline contents, which could occur during future cleanup and/or redevelopment of the site. It was also assumed that the construction worker would be exposed to pipeline sediment for 8 hours per week, for 52 weeks per year, for 1 year. The incidental ingestion rate of sediment was set to 10 percent of the soil ingestion rate (10 percent of 480 mg/day, based on a value for "outdoor summer activities" from Table 4-16 of the U.S. EPA 1997 Exposure Factors Handbook (U.S. EPA 1997)).

The 2007 BRA indicated that exposure to PCBs and lead in sediment could pose an unacceptable risk to a construction worker.

For exposure to radionuclides in sediment, the BRA results show that the incremental cancer risk is only 9×10^{-7}, and the radiological dose is 1.3 mrem/year, indicating that radionuclides in utility sludge do not pose an unacceptable risk (or radiological dose) to a construction worker.

Using new analytical results obtained from excavations at and near manhole MH06 during the 2015 BOP investigation, USACE re-assessed the potential risks and radiological doses from exposure to radioactivity in the sediments and water present in the sewers. The radiological risk and dose from construction worker exposure to radionuclides in the utility water are 4×10^{-9} (risk) and 0.013 (mrem/year), respectively. These risks and doses are below the screening level of 25 mrem/yr, the Nuclear Regulatory Commission's (NRC's) radiological dose limit for unrestricted use. Incidental direct contact with water in the utilities in a construction setting should not pose an unacceptable risk.

At the time of the 2007 BRA, the maximum detected concentration of Ra-226 in any sewer sediment sample was 10.3 pCi/g. In comparison, the 2015 results revealed an Ra-226 concentration in the MH06 sediment at 3.428 pCi/g. This concentration is within the historical range and the sediment in the sewer is not considered to pose an unacceptable risk.

Based on the findings of the BRA, the USACE identified PCBs as COCs in pipeline sediment and water for the future construction worker.

1.7.9 Surface Water and Sediment

As discussed above in Sections 1.7.1 and 1.7.2, and in the 2007 RI, the USACE did not identify any COCs or ROCs in sediment or surface water (EU 15) for either human health or ecological receptors. However, due to the dynamic nature of these media and the long duration between the BRA and this FS (over 10 years), as well as the facts that the SLERA relied on a weight-of-evidence approach in making the scientific management decision point, and no remedial action is warranted for protection of human health for on-site surface water or sediment in the ditches, a confirmation of the ecological risk assessment conclusion is warranted.

The two aspects of ecological risk characterization, the exposure assessment and the effects (or toxicity) assessment, were reviewed to determine whether updates are warranted that may change the conclusions of the SLERA for the ditch system.

The exposure assessment evaluated the magnitude of the source term, the quantity and quality of available habitat, and the potential for sensitive ecological populations (such as threatened and endangered species) to be exposed to site contamination. The USACE has reviewed the 22 years of environmental surveillance data collected in the sediment and surface water of the CDD and WDD since 1997 and determined that conditions at the site in sediment and surface water have not changed significantly over time.

Since the main constituents of potential concern across the site are radionuclides, and the most water soluble (and hence present and mobile in an aquatic system) is uranium, this reevaluation focused especially on uranium concentrations in surface water over time (see Section 1.6.1). **Figure 1-7** presents trends of total uranium concentrations measured in NFSS drainage ditch surface water sampling locations from 1997 through 2015. This figure indicates that surface water concentrations of uranium in the ditches fluctuate but are not exhibiting an overall increasing trend over time. In addition, USACE has reviewed habitat conditions at the site and determined that adequate quality habitat on-site is still lacking, and there are no sensitive populations on the site warranting special protection. These observations of more recently collected data and review of site conditions affirm that the exposure assessment portion of the 2007 SLERA remains valid.

With respect to the effects assessment, in 2011, the Canadian Council of Ministers of the Environment developed a water quality guidance (CWQG) for the protection of aquatic life from exposure to total uranium (as a metal) (CCME 2011). In the 2007 SLERA, the risk-based screening level and toxicity reference value for protection of aquatic life against uranium exposures was 2.6 µg/L, which was developed as a secondary chronic value or "Tier II value." As explained in the 1996 derivation document, the secondary (Tier II) chronic toxicity values were developed so that aquatic benchmarks could be established with fewer data than are required by U.S. EPA in its development of National Ambient Water Quality Criteria (Suter and Tsao 1996). Neither the U.S. EPA nor any individual state has developed any ambient (surface) water quality criterion for uranium.

The uranium CWQG is based on generic environmental fate and behavior and toxicity data. The guideline is a conservative value below which all forms of aquatic life, during all life stages and in all Canadian aquatic systems, should be protected.

The CWQG is a more recently and robustly developed screening level than is the Tier II value and takes advantage of several more recently developed toxicity studies. Because of the proximity to the Great Lakes and the Canadian border, the CWQG is an appropriate risk-based screening level and toxicity reference value for use at the NFSS as well. The Canadian water quality guideline for uranium consists of guidance for both short- and long-term exposure (33 µg/L and 15 µg/L, respectively). The long-term exposure value of the water quality guideline (15 µg/L) is intended to protect against negative effects to aquatic organisms during indefinite exposures. The short-term water quality guideline is intended to evaluate the impacts of severe, but transient situations to sensitive freshwater life (e.g., spill events to aquatic receiving environments and infrequent releases of short-lived/nonpersistent substances). The effects assessment was used to characterize risk in the 2007 NFSS SLERA by proceeding through a series of three steps. In the third step, the average concentration of uranium in surface water at the site is compared to the aquatic screening level (Table C-249, USACE 2007b). If the aquatic screening level is raised from 2.6 µg/L to 15 µg/L, and the average concentration of uranium in surface water is approximately the same as it was at the time of the 2007 risk assessment (as noted above and indicated in Table C-249 as 7.24 µg/L), then the ecological effects quotient drops from 2.8 to less than 0.5. The ecological effects quotient is mathematically equivalent to the human risk assessment hazard quotient used to indicate potential for noncancer adverse health effects to occur. A quotient of 1 represents a threshold below which no adverse effects are expected. Therefore, this update to the effects assessment portion of the 2007 SLERA confirms the earlier conclusion that no further action is warranted for any ecological exposures to the surface water in site ditches. Surface water discharges from the site are further evaluated in Appendix A-3 and A-4 and summarized in Section 1.6.1.

2 IDENTIFICATION AND SCREENING OF TECHNOLOGIES

This section describes the identification and screening of remedial action technologies for the BOP and Groundwater OUs. Identifying and screening technologies establish a range of suitable remedial action technologies to consider further in the detailed analysis.

The purpose of this identification and screening process is to produce a range of suitable remedial action technologies and process options that can be assembled into remedial alternatives capable of mitigating the existing contamination in the BOP and Groundwater OUs. This discussion follows a structured process developed by the U.S. EPA under CERCLA for identifying and screening relevant technologies for site remediation. Selection of a response action proceeds in a series of steps designed to reduce the number of potential alternatives to a smaller group of viable alternatives from which a final remedy may be selected.

2.1 Remedial Action Objectives

Remedial action objectives (RAOs) consist of media-specific goals for protecting human health and the environment. These goals take into consideration contaminants and media of interest, exposure pathways, and associated risk to human health or ecological receptors. The RAOs for this FS are:

- Prevent unacceptable exposure of the construction worker to hazardous substances (ROCs and COCs) via incidental ingestion, inhalation, dermal contact (for COCs) and external gamma for (ROCs) present within the BOP soils, road bedding, buildings/foundations, and utilities by reducing/removing contaminant concentrations to ARAR-based remediation goals.
- Prevent unacceptable exposure of the construction worker to hazardous substances (CVOCs and PCBs) present within the groundwater and utilities by reducing/removing contaminant concentrations to risk-based remediation goals.

2.2 Applicable or Relevant and Appropriate Requirements

2.2.1 Introduction

This section describes the general process used to identify and evaluate ARARs. It presents a brief overview of how ARARs support the CERCLA remedy selection process and describes the factors that must be considered during development of ARARs.

Applicable or relevant and appropriate requirements are developed in accordance with the process set forth in the NCP [Subpart E, Section 300.400(g)]. The ARARs are identified in the RI, refined and developed during the FS, limited during the stage of the CERCLA remedy selection process, and finalized in the ROD. When identifying ARARs, CERCLA Section 121 (d) “Degree of cleanup” directs that any remedial action selected shall attain a degree of cleanup of hazardous substances, pollutants and contaminants released into the environment, or control of further release, that at a minimum assures the protection of human health and the environment.

Regulatory language interpreting and implementing the statutory directive within the NCP [40 CFR§ 300.400(g)] provides that the lead agency (USACE) and support agencies (e.g., New York State Department of Environmental Conservation [NYSDEC]) shall identify applicable requirements. These requirements shall be based on an objective determination of whether the requirement specifically addresses a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. If it is determined that a requirement is not applicable to a specific release, the requirement may still be relevant and appropriate to the circumstances of the release. As discussed below, that determination is made in accordance with 40 CFR §300.400(g)(2). Under 40 § CFR 300.430(e), USACE has the ultimate responsibility to identify what requirements are ARARs for remedial alternatives.

The general process to develop ARARs for the BOP and Groundwater OUs begins with a review of the specific language used to describe the concept of ARARs in Section 121(d) of CERCLA and the NCP provisions in 40 CFR § 300.5. To be considered an ARAR, a requirement must consist of a "standard, requirement, criteria, or limitation" that has been formally promulgated as a statute or regulation under a federal environmental law, or a state environmental or facility siting law [CERCLA § 121(d)(2)(A)]. Thus, nonpromulgated requirements are not ARARs. In addition, Section 121(d)(2)(A) of CERCLA states that ARARs apply "with respect to any hazardous substance, pollutant, or contaminant that will remain on-site." Regulations that relate to activities associated with the implementation of a remedial action, such as U.S. Department of Transportation requirements governing the shipment of radioactive waste and Occupational Safety and Health Act requirements that address worker health and safety, have been determined not to be environmental requirements and thus they do not meet the definition of an ARAR. Further, some of these requirements only apply off-site and ARARs only apply on-site.

Only the substantive requirements within a regulation can be considered an ARAR; administrative and procedural requirements do not qualify. In accordance with the NCP, on-site disposal actions need to comply only with substantive requirements (55 Federal Register [FR] 8758, March 8, 1990).

Examples of administrative/procedural requirements include administrative approvals, inspections, permits, consultations, definitions, and reporting requirements. Administrative/procedural requirements also include methodologies or procedures applicable only to the regulatory agency.

The next step in identifying ARARs is to determine whether a requirement is legally applicable. Applicable requirements are those cleanup standards, standards of control, and other substantive requirements, criteria, or limitations promulgated under federal environmental or state environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those promulgated state standards identified in a timely manner and that are more stringent than the federal requirements may be applicable [CERCLA (§ 121(d)) and NCP (40 CFR § 300.5)]. A requirement is applicable if all of the jurisdictional prerequisites of the law or rule are satisfied. These jurisdictional prerequisites are:

- Specified by the statute or regulation and subject to the authority of such statute or regulation.
- The types of substances or activities listed as falling under the authority of the statute or regulation.
- The time period for which the statute or regulation is in effect.
- The type of activities the statute or regulation requires, limits, or prohibits.

If it is determined that a requirement is not legally applicable to a specific release, the requirement may instead be relevant and appropriate to the circumstances of the release. Determining whether a rule is relevant and appropriate is a two-step process that involves determining whether the rule is relevant, and, if so, whether it is also appropriate. A requirement is relevant if it addresses problems or situations sufficiently similar to the circumstances of the remedial action contemplated. It is appropriate if its use is well suited to the site.

In evaluating relevance and appropriateness, the eight factors listed below, from 40 CFR § 300.400(g)(2), are examined, where pertinent, to determine whether a requirement addresses problems or situations sufficiently similar to the circumstances of the release or remedial action contemplated, and whether its use is well suited to the site, and therefore is both relevant and appropriate.

(i) The purpose of the requirement and the purpose of the CERCLA action.
(ii) The medium regulated or affected by the requirement and the medium contaminated or affected at the CERCLA site.
(iii) The substances regulated by the requirement and the substances found at the CERCLA site.
(iv) The actions or activities regulated by the requirement and the remedial action contemplated at the CERCLA site.
(v) Any variances, waivers, or exemptions of the requirement and their availability for the circumstances at the CERCLA site.
(vi) The type of place regulated and the type of place affected by the release or CERCLA action.
(vii) The type and size of structure or facility regulated and the type and size of structure or facility affected by the release or contemplated by the CERCLA action.
(viii) Any consideration of use or potential use of affected resources in the requirement and the use or potential use of the affected resource at the CERCLA site.

In addition to ARARs, USACE and support agencies may identify other advisories, criteria, or guidance "to be considered" for a particular release. The "to be considered" category consists of advisories, criteria, or guidance that were developed by U.S. EPA, other federal agencies, or states that may be useful in developing CERCLA remedies. The "to be considered" will be considered as guidance or justification for a standard used in the remediation if no other standard is available for a situation to help determine the necessary level of cleanup for protection of human health or the environment. This may occur if no ARAR is available for a particular constituent of concern, or if there are multiple constituents of concern and/or pathways not considered when establishing the standards in the ARAR.

2.2.2 Evaluation of Potential ARARs

2.2.2.1 Soil, Building/Building Foundations, Road Bedding, and Utility Sediment

The following federal and state regulations are identified as potential ARARs for soil, building/building foundations, road bedding, and utility sediment based on 40 CFR § 300.400(g):

- 40 CFR Part 192, Subparts A, B, and C: Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings

- 10 CFR Part 40 Appendix A: Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Waste Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content
- 10 CFR Part 20, Subpart E: Radiological Criteria for License Termination
- 40 CFR 761.61: PCB Remediation Waste
- 6 NYCRR Part 375: Environmental Remediation Programs

The regulations cited above are not considered applicable, but may be relevant and appropriate, and are further evaluated below.

40 CFR Part 192, Subparts A, B, and C

The NFSS is a federally owned site assigned to the U.S. DOE for long-term stewardship. The residual uranium mill tailings at the NFSS were generated before the Uranium Mill Tailings Radiation Control Act (UMTRCA) modified the Atomic Energy Act in 1978 to authorize regulation of active uranium processing sites by the NRC and remediation of inactive processing sites containing tailings or residual radioactive material by the U.S. DOE.

Pursuant to UMTRCA, the U.S. EPA was directed to develop "standards of general application for the protection of the public health, safety, and the environment from radiological and nonradiological hazards associated with [uranium mill tailings]" for both the active and inactive processing sites. These standards were promulgated in 40 CFR Part 192 on September 30, 1983.

Concurrently, the U.S. DOE was authorized to regulate uranium mill tailings associated with past operations, commonly referred to as UMTRCA Title I sites, and the NRC was given the responsibility to regulate all existing and future uranium milling operations (Title II sites). In response to UMTRCA, NRC initially promulgated Appendix A of 10 CFR Part 40 on October 3, 1980, almost three years before the U.S. EPA promulgated 40 CFR Part 192. Given this timeline, the NRC issued promulgated amendments to Appendix A criteria on October 16, 1985. In July of 1999, the NRC amended Criterion 6(6) in Appendix A to include criteria for nonradium radiological constituents in soil and radiological constituents in buildings. This rule is not applicable to the NFSS BOP OU but may be relevant and appropriate.

(i) *Purpose:* The goals and objectives of 40 CFR Part 192 Subparts A, B, and C: Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings are to provide for the long-term stabilization (containment or disposal) or clean up (for unrestricted land use) of uranium/thorium mill tailings at closed or inactive uranium/thorium processing or milling operations. Since remedial action considered for the BOP includes removal/excavation of soil and MED-impacted road bedding and building/building foundations contaminated with radium, the purpose of this requirement is consistent with the remedial action considered for the BOP.

(ii) *Medium regulated:* This rule addresses soil, which is a medium of concern for the BOP OU.

(iii) *Substances regulated:* Cleanup criteria provided in Subpart B pertain to radium in soil and radon in buildings. Other radionuclides known to be present in BOP soil, such as thorium and uranium, are not covered by this regulation. Radon and its short-lived decay products are not a concern for the only BOP building (i.e., radium vault – Building 433) that is in disrepair, open to the elements, and slated for removal.

(iv) *Actions or activities regulated:* This rule includes removal of radium-impacted soil, which is similar to the remedial actions contemplated for the BOP.

(v) *Variances/Waivers:* Variances are allowed if it is possible that a long-term containment situation may be an interim remedial action, particularly if the human health and environmental consequences of moving the waste material are more harmful than the consequences of leaving the material in place. However, moving contaminated soil from the BOP would not be more harmful than leaving the material in place.

(vi) *Type of place:* The type of site or facility regulated by this rule is a closed or inactive uranium or thorium mill processing facility or uranium mill tailing disposal site. The BOP is not a designated Title 1 site covered by the regulation and is not a uranium mill tailing disposal facility; however, contaminated soil and MED-impacted road bedding at the BOP contains residual uranium mill tailings covered by the regulation, so the type of place envisioned under the rule is similar to the BOP.

(vii) *Type and size of structure or facility:* The type and size of structure or facility regulated by this rule is a milling facility with wastes contained on-site in some manner. At closed or inactive sites, the wastes are typically contained in large or widespread waste piles. Active facilities may contain the waste in some type of closed structure. Since contaminated soil (not mill tailing piles) is located in small discrete areas scattered throughout the BOP with a total volume much less than the waste volumes typically found at facilities covered by this regulation, the type and size of the BOP is not similar to those facilities regulated under this part.

(viii) *Consideration of use or potential use of affected resources:* Inactive mill tailing sites will either remain in government control or be released to the public if cleanup criteria for radium are met. This requirement is consistent with conditions at the site since ownership and control of the NFSS (and BOP) is currently with the Federal Government and will remain so for any alternative requiring control of future land use. For an alternative that achieves cleanup criteria, the reasonably anticipated future land use is industrial.

10 CFR Part 40 Appendix A

Since uranium mill tailings at the NFSS were not explicitly addressed by UMTRCA because the NFSS was owned by the federal government as of January 1, 1978, and does not meet the definition of a "processing site," the NRC licensing requirements do not apply. Also, NFSS is not an UMTRCA Title I site designated under Section 102(a)(1) of UMTRCA, so NRC and U.S. EPA regulations, 10 CFR Part 40 Appendix A and 40 CFR Part 192, respectively, are not applicable. Although these regulations are not applicable, they address uranium mill tailings and may be relevant and appropriate for the site.

> "The design requirements in this criterion for longevity and control of radon releases apply to any portion of a licensed and/or disposal site unless such portion contains a concentration of radium in land, averaged over areas of 100 m^2, which, as a result of byproduct material, does not exceed the background level by more than: (i) 5 picocuries per gram (pCi/g) of Ra-226, or, in the case of thorium byproduct material, Ra-228, averaged over the first 15 centimeters (cm) below the surface, and (ii) 15 pCi/g of Ra-226, or, in the case of thorium byproduct material, Ra-228, averaged over 15-cm thick layers more than 15 cm below the surface.
>
> Byproduct material containing concentrations of radionuclides other than radium in soil, and surface activity on remaining structures, must not result in a total effective dose equivalent exceeding the dose from cleanup of radium contaminated soil to the above standard (benchmark dose), and must be at levels which are as low

as is reasonably achievable (ALARA). If more than one residual radionuclide is present in the same 100 m^2 area, the sum of the ratios for each radionuclide of concentration present to the concentration limit will not exceed "1" (unity). A calculation of the potential peak annual total effective dose equivalent within 1,000 years to the average member of the critical group that would result from applying the radium standard (not including radon) on the site must be submitted for approval. The use of decommissioning plans with benchmark doses which exceed 100 mrem/yr, before application of ALARA, requires the approval of the Commission after consideration of the recommendation of the NRC staff. This requirement for dose criteria does not apply to sites that have decommissioning plans for soil and structures approved before June 11, 1999."

(i) *Purpose:* The purpose of 10 CFR Part 40, Appendix A: Criteria Relating to the Operation of Uranium Mills and the Disposition of Tailings or Waste Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for Their Source Material Content is to provide standards for long-term management and disposal of 11e.(2) byproduct material or residual radioactive material, consisting of mill tailings and other waste, from active mill processing facilities or inactive facilities subject to NRC licensing requirements, in a manner that is protective of human health and the environment. Specifically, 10 CFR Part 40, Appendix A Criterion 6(6) provides cleanup criteria such that byproduct material containing concentrations of radionuclides other than radium in soil and surface activity on remaining structures must not result in a total effective dose equivalent exceeding the dose from cleanup of radium to the above standard (benchmark dose) and must be at levels that are ALARA. Under this approach, dose assessments (excluding radon) are conducted to convert the radium soil standards into a benchmark dose for all the radionuclides at the site. Since remedial action at the BOP includes removal/excavation of soil, MED-impacted road bedding, and building/building foundations contaminated with radium and other radionuclides, the purpose of this requirement is consistent with remedial actions considered for the BOP.

(ii) *Medium regulated:* This regulation [under Criterion 6(6)] provides for a benchmark dose for constituents in soil and surface activity on structures that would be used to determine the extent of excavation of contaminated soil, MED-impacted road bedding, and building/building foundations at the BOP.

(iii) *Substances regulated:* 10 CFR Part 40 regulates uranium mill tailings at active milling sites as of 1978, which are defined as 11e.(2) byproduct materials that are subject to NRC licensing requirements. Substances to be addressed at the BOP are residuals from uranium mill tailings or waste associated with the processing of uranium ores generated before 1978, and are consistent with the substances being regulated.

(iv) *Actions regulated*: The benchmark dose in Criterion 6(6) allows for the development of cleanup levels for excavation/removal of soil, MED-impacted road bedding, and building/building foundations contaminated with radium and other radionuclides, which is consistent with remedial actions being considered for the BOP.

(v) *Variances/Waivers*: No variances/waivers are discussed for this requirement (i.e., provisions to develop standards other than those included within the regulations).

(vi) *The type of place*: The type of site or facility regulated by 10 CFR Part 40 Appendix A is a uranium or thorium mill processing facility licensed by the NRC. Appendix A specifically addresses the operation of uranium mills and the disposition of uranium mill tailings. The NFSS is not a NRC-licensed facility;

however, contaminated soil at the BOP contains residual uranium mill tailings covered by the regulation, so the type of place envisioned under the rule is similar to the BOP.

(vii) *Type and size of structure or facility:* The type and size of structure or facility regulated by this rule is a milling facility with wastes typically contained on-site in some manner. At closed or inactive sites, the wastes are typically contained in large or widespread waste piles. Active facilities may contain the waste in some type of closed structure. Since contaminated soil (not mill tailing piles) is located in small discrete areas scattered throughout the BOP with a total volume much less than the waste typically found at facilities covered by this regulation, the type and size of the BOP is not similar to those facilities regulated under this part.

(viii) *Consideration of use or potential use of affected resources:* This regulation (via Criterion 11) provides for ownership by the Federal Government or agreement state government when a site undergoes long-term stabilization (containment of uranium mill tailings on-site). This requirement is consistent with conditions at the NFSS since ownership and control of the NFSS (and BOP) is currently with the Federal Government and will remain so for any alternative requiring control of future land use. For an alternative that achieves cleanup criteria, the reasonably anticipated future land use is industrial.

10 CFR Part 20, Subpart E

Standards for Protection Against Radiation, 10 CFR Part 20, establish standards for protection against ionizing radiation resulting from activities conducted under licenses issued by the NRC. The regulations were issued under the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, as amended. The purpose of the regulations is to control the receipt, possession, use, transfer, and disposal of licensed material by any licensee in such a manner that the total dose to an individual (including doses resulting from licensed and unlicensed radioactive material and from radiation sources other than background radiation) does not exceed the standards for protection against radiation prescribed in the regulations in this part. Subpart E, Radiological Criteria for License Termination, provides cleanup requirements for NRC licensees and serves as the primary remediation standard for non-U.S. DOE organizations in the U.S.

These regulations apply to persons licensed by the NRC to receive; possess; use; transfer; or dispose of byproduct, source, or special nuclear material; or to operate a production or utilization facility. Although the NFSS is not a licensed facility, and therefore the regulations are not applicable, the regulations do provide guidance on radiation screening that may be relevant and appropriate as a potential ARAR.

(i) *Purpose:* The specific purpose of 10 CFR Part 20, Subpart E: Radiological Criteria for License Termination is to provide cleanup requirements for NRC licensees; it serves as the primary remediation standard for non-U.S. DOE organizations in the U.S. Subpart E provisions address radionuclides of the type and quantity encountered at the BOP with the explicit exclusion of "uranium and thorium recovery facilities already subject to Appendix A to 10 CFR Part 40." The exclusion of facilities subject to 10 CFR Part 40 effectively excludes uranium mill tailings, which are the primary source of the radiological constituents in BOP soil, MED-impacted road bedding, and building/building foundations. Therefore, the purpose of this requirement is not consistent with the purpose of this CERCLA action.

(ii) *Medium regulated*: 10 CFR Part 20, Subpart E regulates soil (as well as water and air), which is a medium of concern at the site.

(iii) *Substances regulated*: 10 CFR Part 20, Subpart E applies to source, special nuclear, and byproduct material but excludes uranium mill tailings and facilities associated with them that are regulated under 10 CFR Part 40 Appendix A and 40 CFR Part 192. Since uranium mill tailings are the primary source of the radiological constituents in BOP soil, MED-impacted road bedding, and building/building foundations, use of this requirement is not appropriate.

(iv) *Actions regulated*: Actions or activities regulated by the rule are decontamination and decommissioning of NRC-licensed sites and release of land to the public. Release can be either unrestricted or restricted. Excavation and removal actions under consideration for the BOP can be considered similar to decontamination and decommissioning.

(v) *Variances/Waivers*: No variances or waivers are considered for the requirements of this rule.

(vi) *The type of place*: The type of place regulated under the rule is any NRC-licensed facility except for uranium or thorium processing and disposal facilities subject to 10 CFR Part 40 Appendix A. Since uranium mill tailings are the primary source of the radiological constituents in BOP soil, MED-impacted road bedding, and building/building foundations, the type of place regulated under 10 CFR Part 20, Subpart E is not similar to the BOP.

(vii) *Type and size of structure or facility*: The type and size of structure or facility regulated under 10 CFR Part 20, Subpart E is not similar to the BOP because uranium or thorium processing and disposal facilities subject to 10 CFR Part 40 Appendix A are excluded from this regulation, and uranium mill tailings are the primary source of the radiological constituents in BOP soil, MED-impacted road bedding, and building/building foundations.

(viii) *Consideration of use or potential use of affected resources*: Under NRC license termination proceedings in 10 CFR Part 20, Subpart E, land can be released for unrestricted use or for restricted use, with land use controls in place. At the BOP, both options are under consideration for future land use.

40 CFR 761

Polychlorinated Biphenyls Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions, 40 CFR 761, establishes prohibitions of, and requirements for, the manufacture, processing, distribution in commerce, use, disposal, storage, and marking of PCBs and PCB items in compliance with the Toxic Substances Control Act. Part 761.61 provides cleanup options for PCB remediation waste based on the degree of potential exposure to an area with residual contamination. The areas have been classified as high occupancy areas or low occupancy areas and cleanup levels are provided for each use classification. Based on the current and reasonably anticipated future use as industrial, the site would qualify as a low occupancy area.

The rule 40 CFR 761 addresses materials such as soil, gravel, sediment, and concrete. As it addresses concrete, this rule is considered applicable for the Building 401 foundation.

While 40 CFR 761 addresses sediment, the reference to sediment is interpreted to be deposits associated with a surface water body, not in a pipeline. However, 40 CFR 761 may be relevant and appropriate for the Building 401 drain sediments and it is evaluated below.

(i) *Purpose:* 40 CFR 761.61 provides cleanup and disposal options for bulk PCB remediation waste, which includes, but is not limited to, soil, sediments, dredged materials, muds, PCB sewage sludge, and industrial sludge. Since remedial actions considered for the BOP include removal/excavation of Building

401 drain sediments contaminated with PCBs, the purpose of this requirement is consistent with the remedial action considered for the BOP OU.

(ii) *Medium regulated:* This rule addresses materials such as soil, gravel, sediment, and concrete, which are media of concern for the BOP OU.

(iii) *Substances regulated*: Cleanup criteria in Part 761 apply to PCBs, which are known to be present in the BOP OU.

(iv) *Actions regulated*: Actions or activities regulated are cleanup and disposal of PCB remediation waste. Excavation and removal actions under consideration for the BOP are considered cleanup activities. Under Part 761, the use of a property is classified as high occupancy or low occupancy. High occupancy is defined as any area where the annual occupancy of any individual not wearing dermal or respiratory protection is 335 hours or more (an average of 6.7 hours or more per week) for bulk remediation waste. Low occupancy is defined as any area where the annual occupancy of any individual not wearing dermal or respiratory protection is 335 hours or less for bulk remediation waste. The NFSS is considered a low occupancy area.

(v) *Variances/Waivers*: Part 761.61(c) allows for the development of site-specific risk-based cleanup criteria.

(vi) *The type of place*: This part applies to all persons who manufacture, process, distribute in commerce, use, or dispose of PCBs or PCB items. The rule does not specify a site type or place.

(vii) *Type and size of structure or facility*: Part 761.61(a) addresses self-implementing on-site cleanup and disposal of PCB remediation waste. The self-implementing procedure was designed for a general, moderately sized site where there should be low residual environmental impact from remedial activities. The current and reasonably anticipated land use at NFSS is industrial, which would have low residual environmental impact from remedial activities.

(viii) *Consideration of use or potential use of affected resources*: High occupancy areas where bulk PCB remediation waste remains at concentrations greater than 1 mg/kg (1 part per million (ppm)) and less than or equal to 10 mg/kg must be covered with a cap meeting the requirements of paragraphs 761.61(a)(7) and (a)(8). At low occupancy areas, bulk PCB remediation wastes may remain at concentrations greater than 25 mg/kg and less than or equal to 50 mg/kg if the area is secured by a fence and marked with a sign. Bulk PCB remediation wastes may remain at a low occupancy area at concentrations greater than 25 mg/kg and less than or equal to 100 ppm if the area is covered with a cap.

6 NYCRR Part 375

Title 6 NYCRR Part 375, Environmental Remediation Programs, establish the development and implementation of remedial programs for inactive hazardous waste disposal sites, specifically under subpart 375-2, including, but not limited to, sites listed in the New York State Registry which are either on the National Priorities List (NPL) or are being addressed by the Department of Defense or the DOE; brownfield sites; and site environmental restoration sites. 6 NYCRR Part 375 (Subpart 375-6.8) provides numerical cleanup goals for chemicals in soil, known as Soil Cleanup Objectives (SCOs), that are specific to land-use categories.

(i) *Purpose:* The soil cleanup objectives presented in 6 NYCRR Part 375 apply to the development and implementation of the remedial programs for soil media at inactive hazardous waste disposal sites (listed in the New York State Registry which are either on the national priorities list or are being addressed by the Department of Defense or the DOE), Brownfield sites, and Environmental Restoration sites. Since the BOP OU (NFSS) is not an inactive hazardous waste site listed on the Registry, a Brownfield site, or an Environmental Restoration site, this regulation does not apply to the BOP OU.

(ii) *Medium regulated:* This rule addresses soil, which is a medium of concern for the BOP OU.

(iii) *Substances regulated:* Soil cleanup objectives (SCOs) listed in Part 375-6.8 include some but not all of the hazardous constituents found in BOP OU soil.

(iv) *Actions or activities regulated:* This rule includes remediation of impacted soil, which is similar to the remedial actions contemplated for the BOP OU.

(v) *Variances/Waivers:* This regulation includes no variances or waivers.

(vi) *Type of place:* The type of site or facility regulated by this rule is an inactive hazardous waste disposal site (listed in the Registry which is either on the national priorities list or is being addressed by the Department of Defense or the DOE), Brownfield site, or Environmental Restoration site. Although the BOP OU (or NFSS) is not regulated by this part, the type of place envisioned under the rule is similar to the BOP OU given that the contaminants covered by Part 375 are contaminants of concern in BOP OU soil.

(vii) *Type and size of structure or facility:* The size of structure or facility envisioned by this rule appears unlimited. However, the type of facility would be one contaminated by the hazardous constituents included in 375-6. Therefore, the BOP OU would be considered similar to typical facilities regulated under Part 375-6.8.

(viii) *Consideration of use or potential use of affected resources:* The reasonably anticipated future land use for the BOP OU (NFSS) is industrial, which is consistent with the land use covered by Part 375-6.8.

2.2.2.1.1 Conclusions

The USACE drew the following conclusions from the evaluation of potential ARARs:

- 6 NYCRR Part 375 (Subpart Table 375-6.8, which provides numerical SCOs) is considered relevant and appropriate for SVOCs in soil.
- 10 CFR Part 40 Appendix A, Criterion 6(6), which addresses uranium mill tailings, is considered relevant and appropriate for radionuclides in BOP soil, MED-impacted road bedding, and building/building foundations.
- 40 CFR 761.61, which provides cleanup options for PCB remediation waste based on the degree of potential exposure to an area with residual contamination, is considered applicable for PCB impacts in the Building 401 foundation and relevant and appropriate for PCB impacts in Building 401 utility sediment.

The USACE found other potential ARARs relevant but not appropriate based on the following reasons:

- 40 CFR Part 192, Subparts A, B, and C focuses on radium contamination, which is only one of several ROCs identified in BOP soil; MED-impacted road bedding; and building/building foundations.
- 10 CFR Part 20, Subpart E, explicitly excludes facilities already subject to 10 CFR Part 40 Appendix A, which is considered a relevant and appropriate ARAR for the BOP OU.

2.2.2.2 Groundwater and Utility Water

The following federal and state regulations are identified as potential ARARs for groundwater based on the criteria outlined in 40 CFR § 300.400(g):

- 40 CFR Part 141
- 6 NYCRR Part 701
- 6 NYCRR Part 703

40 CFR Part 141

The rule 40 CFR Part 141 establishes primary drinking water regulations pursuant to Section 1412 of the Public Health Service Act, as amended by the Safe Drinking Water Act (Public Law 93-523), and related regulations applicable to public water systems. Public water system means a system for the provision to the public of water for human consumption through pipes or other constructed conveyances if such system has at least 15 service connections or regularly serves on average at least 25 individuals daily at least 60 days out of the year. Part 141.61 of 40 CFR established the MCLs for organics, and 40 CFR Part 141.62 established MCLs for inorganics. The MCLs are the maximum permissible levels of a contaminant in water that is delivered to any user of a public water system.

The shallow groundwater (UWBZ) at the NFSS is of poor quality with chloride concentrations as high as 6,950 mg/L and total dissolved solids (TDS) as high as 9,200 mg/L. The UWBZ also has low yield with several on-site wells being dry.

As discussed in Section 1.3.5, groundwater within the UWBZ is considered an U.S. EPA Class IIIB groundwater which has a low degree of interconnectivity to other groundwater. Because groundwater beneath NFSS is not a source of public water supply, 40 CFR Part 141.61 and 40 CFR Part 141.62 are not applicable or relevant and appropriate. Similarly, 40 CFR 141 is not applicable or relevant and appropriate for utility water.

6 NYCRR Parts 701 and 703

Part 701 of 6 NYCRR identifies different classes of groundwater, starting with the determination whether the groundwater is either saline or fresh. Fresh groundwater has a chloride concentration of less than 250 mg/L and TDS concentration of less than 1,000 mg/L. Saline groundwater is identified as having a chloride concentration of more than 250 mg/L or a total dissolved solids concentration of more than 1,000 mg/L.

New York State has three classifications for groundwater:

- Class GA groundwater is fresh groundwater that has a best usage as a source of potable water supply.
- Class GSA groundwater is a saline groundwater with a best usage as a source of potable mineral water, conversion to fresh potable water, or as raw material for the manufacture of sodium chloride or similar products.
- Class GSB groundwater is a saline groundwater with a chloride concentration in excess of 1,000 mg/L and a TDS concentration in excess of 2,000 mg/L and has a best usage as a receiving water for disposal of wastes.

Based on the chloride and TDS concentrations, both the UWBZ and LWBZ exhibit significant concentrations of naturally occurring total dissolved solids that indicate the NFSS groundwater is a Class GSA or GSB water resource.

The water present in the utilities is not considered groundwater. Therefore, 6 NYCRR Part 701 is not considered applicable or relevant and appropriate for the utilities.

6 NYCRR Part 703.5

Part 703.5 of 6 NYCRR presents water quality standards for groundwater. The Part 703.5 groundwater standards only apply to Class GA groundwater-there are no standards for Class GSA/GSB groundwater. The Class GA groundwater standards are based on federal drinking water standards. Because there are no Class GSA/GSB groundwater standards, Part 703.5 is not applicable. Also, because groundwater at the site is not a drinking water source, the Part 703.5 Class GA groundwater standards are not relevant or appropriate. Similarly, the water in the utilities is not considered groundwater or a drinking water source. Therefore, Part 703.5 groundwater standards are not applicable or relevant and appropriate.

2.2.2.2.1 Conclusions

None of the federal and state regulations identified as potential ARARs for groundwater are considered applicable or relevant and appropriate for the NFSS. To establish FS PRGs for groundwater and utility water, site-specific risk-based criteria are provided as discussed in Section 2.3 below.

2.2.3 Potential ARARs Identified by Federal and State Regulators

The NYSDEC provided a list of potential ARARs to USACE on August 31, 2016. Each potential ARAR was reviewed for the following criteria:

- applicability
- relevance and appropriateness
- type (chemical/location/action-specific)

CERCLA states that ARARs apply "with respect to any hazardous substance, pollutant or contaminant that will remain onsite…" Thus, citations provided by NYSDEC, such as land disposal restrictions which pertain to off-site disposal, do not pertain to impacts remaining on-site. Also, nonpromulgated requirements are not ARARs. While many of the citations provided by the NYSDEC will be complied with as part of a remedial activity, with the exception of 6 NYCRR Part 375-6.8(b), none of the citations were identified as ARARs. The USACE's response to the NYSDEC list of potential ARARs is provided in **Appendix C**.

2.3 Feasibility Study Preliminary Remediation Goals

In the 2007 BRA, SRCs were compared to conservative risk-based concentrations referred to as BRA PRGs to determine which constituents warrant quantitative risk evaluation. These constituents are referred to as COPCs or ROPCs. The BRA identified COCs and ROCs that are constituents that exceed target cancer risk levels of 10^{-4} or a noncancer risk threshold of a HI greater than 1. Radionuclides that present a total dose greater than 25 mrem/yr were also identified as ROCs. Considering the current and reasonably anticipated future use of the NFSS property as industrial, the BRA identified COCs and ROCs for soil, including road bedding, buildings and foundations, utility sediment and water, and groundwater. Taking into consideration ARARs and risk-based criteria, the BRA COCs and ROCs were further evaluated during the FS process resulting in the FS COCs and ROCs identified in **Table 2-1**.

Based on current ownership of the site and the adjacent land use, the reasonable future land use for the NFSS BOP would be either restricted access or industrial/commercial use, with or without redevelopment, depending on final disposition of the wastes inside the IWCS. To be conservative, redevelopment under an industrial land use is considered because this would entail some type of construction at the site. The protection of a construction worker from unacceptable radiological exposures would drive soil cleanup goals lower (for radionuclides other than Ra-226 and Th-230) than the cleanup goals that may be developed for a restricted access land use for these other radionuclides. Therefore, cleanup goals presented here were developed to protect construction workers from exposure to site media.

Depending on the COC, the FS PRGs for COCs are either site-specific risk-based levels or ARAR-based for an industrial use site.

Following the evaluation of ARARs, and site-specific conditions described below, the list of BRA ROCs and COCs was refined resulting in a list of contaminants, now referred to as FS ROCs and COCs, which warrant remediation. The following subsections identify FS PRGs for FS ROCs and COCs for each media of concern at the site. **Table 2-2** summarizes the FS PRGs for each media of concern for the industrial land use scenario.

2.3.1 <u>Radionuclides</u>

2.3.1.1 Soil and Road Bedding

The USACE identified the following FS ROCs for the construction worker (critical group):

- Ac-227
- Pa-231
- Pb-210
- Ra-226
- Th-230
- U-234
- U-235
- U-238

Per 10 CFR Part 40, Appendix A, Criterion 6(6) provides a means to derive cleanup goals for radionuclides other than radium. As per 10 CFR Part 40, Appendix A, Criterion 6(6), radium is limited to 5 pCi/g in the top 15 cm (6 in) of soil. If other radionuclides are present, their cleanup goals are the concentration of the radionuclide that would produce the same dose as 5 pCi/g of radium in the top 15 cm (6 in). This dose for radium is called the "benchmark" dose. The cleanup goals for radionuclides other than radium must also be ALARA. Also, 10 CFR Part 40, Appendix A, Criterion 6(6) states if more than one residual radionuclide is present in the same 100 m^2 (1,076 sq ft) area, the SOR shall not exceed 1.

Derived concentration guideline levels (DCGLs) were developed for the ROCs listed above except Pb-210, using the construction worker as the critical group and the benchmark dose (as per 10 CFR 40 Appendix A Criterion 6(6)) as the dose limit. Although Pb-210 is listed as an ROC, a separate DCGL was not developed for Pb-210 because it was never measured at the site. One way to account for its presence would be to add its dose to the dose of its parent Ra-226; however, this was not done for the NFSS BOP because the dose contribution from Pb-210 is orders of magnitude smaller than the Ra-226 dose. Furthermore, adding the Pb-210 dose contribution to the Ra-

226 dose would increase the benchmark dose used to calculate cleanup goals under 10 CFR 40 Appendix A Criterion 6(6), which would result in larger DCGLs for other radionuclides (i.e., it would not be conservative).

RESidual RADioactive (RESRAD) is a computer model designed by the U.S. DOE to estimate radiation doses and risks from residual radioactive materials. The RESRAD computer code (version 6.5) is used to convert the benchmark dose to a DCGL for each ROC. The RESRAD input parameters used in the BRA for the construction worker were reviewed and updated, mainly by using the additional soil and subsurface characterization that occurred as part of the 2007 groundwater modeling. The resulting RESRAD run was examined for the times of peak dose (for total dose and doses from individual radionuclides) and dose-to-source ratios at times of peak dose were extracted from the RESRAD output into a Microsoft Excel file (see **Appendix D**). The minimum DCGL (at time of peak dose per individual nuclide) was chosen as the DCGL for the FS.

To simplify the presentation of DCGLs, as well as the resulting sampling and analysis that would be needed to plan for and verify remediation, the USACE calculated a combined total isotopic U DCGL. The USACE then determined the U-238 concentration that could be used as a surrogate for the total U DCGL. This was done by combining the DCGLs for the uranium isotopes (U-234, U-235, and U-238) according to the ratio of the activity in which they occur naturally (1:0.046:1). Results for U-238 can then be used to substitute for total U by multiplying the total U DCGL by 0.489. In addition, the dose contributions from Ac-227 and Pa-231 were added to their parent radionuclide U-235 in order to allow these daughter nuclides to be accounted in the overall benchmark dose and DCGL, without necessitating that these nuclides be measured and evaluated in the SOR calculation to show benchmark dose compliance during remediation. Therefore, only the DCGLs for Ra-226, Th-230, and U-238 are used in the SOR calculation. The surface and subsurface soil DCGLs, which are considered FS PRGs and include contributions from all ROCs previously listed, are:

Parameter	**FS PRG Surface Soil (top 15 cm (6 in)) (pCi/g)**	**FS PRG Subsurface Soil (>15 cm (6 in)) (pCi/g)**
Ra-226	5	15
Th-230	18	55
U-238	115	346

Using the DCGLs (FS PRGs) identified above and site background values determined during the 2007 RI, the USACE calculated SOR scores using the following equations:

$$SOR_{surface\ soil} = \frac{Ra\text{-}226 - Ra\text{-}226_{background}}{5\ pCi/g} + \frac{Th\text{-}230 - Th\text{-}230_{background}}{18\ pCi/g} + \frac{U\text{-}238 - U\text{-}238_{background}}{115\ pCi/g}$$

$$SOR_{subsurface\ soil} = \frac{Ra\text{-}226 - Ra\text{-}226_{background}}{15\ pCi/g} + \frac{Th\text{-}230 - Th\text{-}230_{background}}{55\ pCi/g} + \frac{U\text{-}238 - U\text{-}238_{background}}{346\ pCi/g}$$

Where:

$Ra\text{-}226_{background} = 0.79\ pCi/g$
$Th\text{-}230_{background} = 0.90\ pCi/g$
$U\text{-}238_{background} = 0.82\ pCi/g$

2.3.1.2 Building/Building Foundations

Multiple building foundations remain within the NFSS BOP. These foundations are primarily concrete; most are flush with the ground surface, and some extend above the ground surface. Decontamination of some of the foundations was conducted in the late 1980s and included postremediation radiological contamination scans.

Most of the building foundations remaining at the site have been exposed to the elements for more than 45 years and have become overgrown with vegetation. Given that concrete will continue to degrade and function more like soil, from a practical standpoint, it is conservative to use the DCGLs calculated for soil as the FS PRGs for building foundations.

2.3.1.3 Utilities

The USACE identified BRA ROCs in some utility sediment. However, the ROC concentrations did not exceed the risk-based levels for the construction worker developed in the BRA.

2.3.1.4 Groundwater

No ROCs were identified in groundwater.

2.3.2 <u>Chemicals</u>

2.3.2.1 Soil

The following FS PRGs for soil are based on 6 NYCRR Part 375 industrial use SCOs:

Parameter	FS PRG (mg/kg)
Benzo(a)pyrene	1.1
Benzo(a)anthracene	11
Benzo(b)fluoranthene	11
Dibenz(a,h)anthracene	1.1

The USACE identified PCBs as COCs in soil in the 2007 BRA. In reviewing the USACE NFSS database, two soil samples contained PCBs (Aroclor 1260) at levels above the TSCA cleanup level of 25 mg/kg. Both samples were from the same location, identified as Drum07 in EU4 (70.2 mg/kg and 25.1 mg/kg). In 2016, USACE resampled the Drum07 location and at four cardinal compass points located approximately 0.6 m (2 ft) away from the original Drum07 location and analyzed the samples for PCBs. All the sample results were below the TSCA cleanup level. Based on these results, USACE concluded that PCB remediation in the area is not warranted. Therefore, PCBs are not included as FS COCs for soils.

The USACE identified lead as a COC in soil in the 2007 BRA. As mentioned above in Section 1.7.3, the BRA PRGs were recalculated using U.S. EPA's most recent August 2016 update of the ALM (U.S. EPA 2016). The recalculated PRG for lead is 1,199 mg/kg (see **Appendix B**). A review of all the soil data collected from the NFSS shows the maximum concentration of lead is 240 mg/kg, which is well below the PRG. Therefore, lead is not considered further.

Using updated FS PRGs for groundwater for protection of the construction worker receptor, as discussed below, the USACE calculated soil FS PRGs in 2016 (see **Appendix E**). The calculated values used as FS PRGs for CVOCs in soils are:

Parameter	FS PRG Calculated* (mg/kg)
PCE	1.53
TCE	0.33
Cis-1,2-DCE	0.75
VC	0.07

* Calculated groundwater PRGs for protection of the construction worker

2.3.2.2 Groundwater

The USACE developed and presented BRA PRGs for COCs in groundwater in the 2007 BRA. In the absence of promulgated groundwater standards, the USACE developed in the 2007 BRA risk-based site-specific cleanup criteria that represent a target cancer risk level of 10^{-5} for carcinogens and a HI greater than 1 for noncarcinogens for the critical group (i.e., construction worker). In February 2014, the U.S. EPA released Office of Solid Waste and Emergency Response (OSWER) Directive 9200.1-120 titled *Human Health Evaluation Manual Supplemental Guidance: Update to Standard Default Exposure Factors* (U.S. EPA 2014). Using the updated toxicity values, the USACE recalculated in 2016 some of the site-specific CVOC criteria for groundwater. The groundwater FS PRGs presented in the table below reflect criteria that would be protective of the construction worker receptor.

Parameter	FS PRG (mg/L)
PCE	1.5
TCE	0.33
Cis-1,2-DCE	2.4
VC	0.17

Arsenic and lead were identified as COCs in the 2007 BRA. Arsenic was not detected at concentrations exceeding the BRA PRG. Therefore, arsenic is not included as a COC for groundwater.

The 2007 BRA identified lead as a COC. It used the MCL for lead, 15 µg/L, as the risk screening level for groundwater. A BRA PRG was not calculated because groundwater ingestion is incidental. Using updated blood lead default values developed by the U.S. EPA (U.S. EPA 2016), USACE's contractor calculated a PRG for lead in groundwater of 144,099 mg/L for the critical group (construction worker, see **Appendix B**). This elevated PRG reflects the very limited exposure potential due to incidental ingestion. As a result, lead is not considered a COC for groundwater.

2.3.2.3 Building/Building Foundations

The USACE selected some foundations for consideration in this FS based on adjacent soil impacts, specifically PAHs. Therefore, FS PRGs for building foundations include 6 NYCRR Part 375 industrial use SCOs for PAHs.

Polychlorinated biphenyls (Aroclor 1254 and 1260) were detected in the concrete core samples from Building 401. The maximum PCB concentration in the core samples was Aroclor 1254 at 26 mg/kg. Consistent with the above discussion with regards to building foundations functioning more like soil, the TSCA cleanup level for PCBs (25 mg/kg) would be appropriate for the Building 401 foundation.

The FS PRGs for chemical impacts in building foundations are:

Parameter	FS PRG (mg/kg)
PAHs	
Benzo(a)pyrene	1.1
Benzo(a)anthracene	11
Benzo(b)fluoranthene	11
Dibenz(a,h)anthracene	1.1
PCBs	
Aroclor 1254	25
Aroclor 1260	25

2.3.2.4 Utilities

The FS PRGs for the utilities are as follows:

Parameter	Utility Water FS PRG (mg/L)	Utility Sediment FS PRG (mg/kg)
PCBs		
Aroclor 1254	0.0001*	25**
Aroclor 1260	0.0001*	25**

Note: * – BRA, **– TSCA

The BRA identified lead and PCBs as COCs for the utility sediment and water. However, the BRA did not include a PRG for lead. As discussed in Section 1.7.3, the recalculated utility water PRG for lead is 144,099 mg/L. The maximum concentration of lead in the utility water is 4.51 mg/L, which is well below the PRG. The maximum concentration of lead in the utility sediment is 8,020 mg/kg, which is below the recalculated PRG of 57,640 mg/kg. Therefore, lead in utilities is not considered further.

The maximum concentration of PCBs (Aroclor 1254) in the utility sediments is 84.9 mg/kg. Sampling of the utility also identified free phase PCBs (Aroclor 1254) with a concentration of 214 mg/kg. The maximum concentration of Aroclor 1254 in the utility water is 0.86 mg/L and the maximum concentration of Aroclor 1260 in the utility water is 0.00017 mg/L.

2.4 Summary of Extent of Contamination to Be Addressed

For investigation and remediation purposes, the USACE divided the NFSS into three OUs: the IWCS OU, the BOP OU, and the Groundwater OU. Site investigations and monitoring identified elevated levels of radionuclides and chemicals in various media. Site investigations and risk assessments identified which constituents are SRCs, and which SRCs occur at levels of concern.

The USACE addressed the IWCS OU through a separate FS. The preferred alternative outlined in the proposed plan for the IWCS OU is removal of the IWCS with off-site disposal. The BOP OU includes impacted soils remaining following the removal of the IWCS; those locations and volumes will not be known until after the IWCS has been removed. The BOP OU includes all media, except groundwater, located outside the IWCS. This includes ROC-impacted soils that occur at isolated locations across the site. The depth of ROC contamination ranges from ground surface to 2 to 3 m (7 to 9 ft) below grade, with the majority within the surface soils in the 0- to 15-cm (0- to 6-in) interval.

The delineation of the extent of ROC soil contamination involved overlaying a random-start 100 m^2 grid over the entire NFSS and calculating the average SOR scores for the set of data located within each 100 m^2 area. If the average SOR score within an area of 100 m^2 was greater than 1, a contaminated soil area of concern was identified. The extent of the contaminated soil area of concern was estimated using Bayesian Approaches to Adaptive Spatial Sampling software, which is similar to kriging, and considers the nearest "clean" data point (i.e., a sample location with an SOR score of less than 1). Consequently, the FS PRGs are the DCGLs averaged over each 100 m^2 area across the site.

The BOP OU includes COC-impacted soils. Chemicals of concern consist of PAHs and VOCs at isolated locations within the surface soils at the site. Impacts at depth are limited; CVOC-impacted soils are present at depths of at least 4.9 m (16 ft) in EU4 (referred to in this FS as the EU4 VOC plume) and EU13.

The BOP OU includes buildings and foundations. Polychlorinated biphenyl impacts are present in the Building 401 foundation. The foundations of Buildings 430 and 431/432, the Building 431/432 trench, and Building 433, for the purpose of this FS, are assumed to be impacted with ROCs based on past usage and/or RI screening and will be further characterized during remedial design.

The BOP OU includes buried utilities. Only the utilities in the Building 401 foundation (floor drains) contain COCs above the PRGs. The Building 401 foundation contains 14 drains that were sampled during the 2007 RI. Impacts in the drains included PCBs and lead. The routing of the drain system is unknown. The drain inlets were capped in 2011 prior to dismantling the building.

The Groundwater OU consists of the groundwater underlying the site. No ROCs were identified in groundwater. Chemical of concern impacts have been identified in the groundwater. As mentioned in Section 1.3.5, groundwater quality at the site is naturally poor and it meets the U.S. EPA Class IIIB criteria for nonpotable and limited beneficial use water. As such, drinking water standards do not apply. The USACE performed a risk assessment that concluded that potentially unacceptable risks for construction worker exposure is limited to CVOC impacts, primarily PCE, in the EU4 VOC plume; all other constituents occur at levels below which unacceptable risks may occur.

In summary, for the BOP and Groundwater OUs, site-specific ROC and COC FS PRGs were identified for each media of concern (e.g., soil, foundations, groundwater). The ROC FS PRGs are driven by potential exposures from Ra-226, Th-230, and U-238, and associated decay products, based on a specific exposure scenario. The ROC FS PRGs are the DCGLs that would result in a radiological exposure above the regulatory threshold. Selection of the construction worker as the representative critical group results in the most comprehensive list of ROCs and the most conservative cleanup goals. Depending on the COC, the FS PRGs for COCs in soil and building foundations are either site-specific risk-based levels or promulgated standards. For the Groundwater OU, site-specific risk-based PRGs were initially calculated for PCE and several associated daughter products during the 2007 BRA and recently recalculated using updated toxicity data. There are no promulgated or site-specific risk-based criteria for lead in utility water, so the MCL was used as a screening tool.

Table 2-2 presents a summary of the FS PRGs per media for the industrial land use scenario. Using the FS PRGs, **Figure 2-1** presents the estimated extent of area requiring remediation, and **Table 2-3** presents the estimated *in situ* volumes requiring remediation.

Bayesian Approaches to Adaptive Spatial Sampling (BAASS) software was used to estimate contaminated soil volumes. The method used data including aerial photographs, nonintrusive geophysics, gamma walkover surveys, anecdotal information, and historical site/process knowledge, along with physical data such as boring observations and analytical results. The BAASS model results were exported to ArcGIS and using the 3-D analyst extension, contaminant probability contours were converted into volumes.

For the EU4 VOC plume, boring information indicated that contamination was detected at the bottom of the deepest boring advanced in this area, TWP930, which was sampled to a depth of 5.1 m (16.8 ft). This boring, and other borings in the area, were terminated in the glacio-lacustrine clay layer. To avoid contaminating the underlying water bearing zone, no boring in this area was advanced through the clay. Typically, such a clay unit would function as a confining layer. However, it is known that chlorinated VOCs can migrate into clay. Therefore, the text stated that the contamination extends to depths of 4.9 m (16 ft) or more. Additional delineation will be required during a per-design investigation.

The estimated volume of water per cubic yard of soil removed presented in **Table 2-3** was determined based on the seepage velocity calculated using the EU4 plume area and site-specific hydraulic conductivity and depth to groundwater. The calculation is provided in **Appendix A-5**.

In the volume estimates, it is assumed that the building foundations are 0.3-m (1-ft) thick. The foundation volumes presented include the entire foundations. However, some remedial alternatives evaluated in this FS do not include remediating the entire foundations.

The utilities (drains) are included in the Building 401 foundation volume estimate. Information from the LOOW (construction) Completion Report, dated April 1, 1943, states that the pipelines in the “shop & power” area are 10 cm (4 in) and 15 cm (6 in) in diameter (USACE 1943). Conservatively assuming that the entire 49 m (161 ft) of 10 cm (4 in) pipeline and 691 m (2,266 ft) of 15 cm (6 in) pipeline identified in the completion report are beneath Building 401 and that the pipelines are half full of sediment, the total sediment volume would be approximately 6.7 m^3 (8.5 yd^3). This sediment volume is included in the above Building 401 foundation volume estimate.

2.5 General Response Actions

This section describes the general response actions (GRAs) potentially applicable to the BOP and Groundwater OUs. General response actions are broad categories of response actions that are capable of satisfying the RAOs for the site. Some response actions are sufficiently broad to be able to satisfy all RAOs for the site. Other response actions must be combined to satisfy the RAOs. Each GRA includes several technology types and process options that will be evaluated in the following sections. General descriptions of the GRAs identified for the site are provided in the following subsections.

2.5.1 Land Use Controls

Land use controls (LUCs) are administrative, legal, and/or physical mechanisms used to protect human health and the environment from potential exposure to residual contamination by limiting land use, groundwater use, and on-site activities without physically addressing the contamination. Land use controls are typically used in tandem with physical or engineering measures.

Land use controls are considered a type of remedial action. CERCLA only allows for remedial measures that would protect users of the site based on the current and anticipated future land use, which is industrial. Interim LUCs may be used until the remedial goal has been achieved. ***Land use controls have been identified as a GRA for soil and other contaminated materials.***

2.5.2 Containment

Containment measures are those remedial actions intended to contain and/or isolate contamination without treating, disturbing, or removing the contamination. Containment provides protection to human health and the environment by preventing, or significantly reducing, the exposure to contaminants and/or migration of contaminants from contaminated media via physical means. Containment actions often require other actions such as LUCs to ensure the protectiveness of the remedial actions.

In general, containment is preferred only when extensive subsurface contamination at a site precludes excavation and removal of wastes because of potential hazards, unrealistic cost, or lack of adequate treatment technologies. ***Containment is considered a viable GRA.***

2.5.3 Removal

Removal actions remove contaminated material from its current location for subsequent treatment and/or disposal. Treatment can be conducted either on-site or off-site. Removal of the contaminated material protects human health and the environment by reducing or eliminating the potential for exposure and/or migration of contaminants. ***Removal has been identified as a viable GRA.***

2.5.4 Treatment

Treatment actions reduce the mobility, toxicity, and/or volume of the contaminants through one or more of several methods. Treatment actions may be physical, chemical, or biological and may be conducted either *ex situ* or *in situ*, although the methods between them may differ.

The main advantage of *ex situ* treatment is that it generally requires shorter time periods than *in situ* treatment. There is also more certainty about the uniformity of treatment because of the ability to homogenize, screen, and/or mix the soil or other materials being addressed. However, *ex situ* treatment requires excavation of soil and/or other materials handling prior to implementation, which leads to increased costs and engineering for equipment, possible permitting, and material handling/worker exposure conditions. ***Both* in situ *and* ex situ *treatment are considered viable GRAs.***

2.5.5 Disposal

Disposal actions for the soil and other contaminated materials involve the permanent and final placement of the waste materials in a manner that protects human health and the environment. Contaminated material is removed from its current location and placed in a permitted disposal facility. Some pretreatment of the contaminated material may be required to meet land disposal restrictions. ***Disposal has been identified as a viable GRA.***

2.6 Identification and Screening of Technology Types and Process Options

This section identifies potentially applicable technology types and process options for each viable GRA identified above and then screens them with regard to the RAOs. The term “technology type” refers to general categories of technologies, such as chemical treatment or capping. The term “process options” refers to specific processes within each technology type. It is noted that a technology type and/or process option may apply to several contaminated materials/media (e.g., soil and concrete foundations) or only to one media. A summary of the GRAs, technology types, and associated process options considered for the BOP and Groundwater OUs after the initial screening is shown in **Table 2-4**. The summary below and accompanying tables identify which media the technology type or process option is applicable to.

In the initial screening phase, technology types and process options are evaluated on the basis of technical implementability. Technical implementability is based upon the following criteria:

- Site Characteristics – These (e.g., geologic conditions and soil characteristics) were examined to determine whether the technology was appropriate for the site.

- Contaminant Characteristics – Technologies may be ineffective, unsafe, or otherwise unsuitable for achieving RAOs because of the characteristics (e.g., volatility, solubility, density) of the contaminants and the contaminated materials.

- Technology Development – This refers to those emerging technologies that appear to be applicable to a general group of contaminants but have not been evaluated for specific compounds or have only been tested at a laboratory scale with minimal published data concerning effectiveness. An emerging technology is different than an innovative technology, which has been demonstrated more at a pilot- or full-scale operation and for which more performance data are available. Full-scale development of an emerging technology requires extensive work prior to implementation. For this reason, this type of technology would be eliminated.

Based on these criteria, all process options considered potentially implementable for remediation of contaminated materials at the BOP and Groundwater OUs are retained in this initial screening process. Technologies and process options not considered technically implementable for remediation of the contaminated materials are eliminated from further consideration.

2.6.1 Land Use Controls

Land use controls consist of institutional controls and engineering controls. Institutional controls, or administrative or legal mechanisms, are types of LUCs that protect human health and the environment from residual contamination via nonphysical means. Engineering controls are types of LUCs that protect human health and the environment from residual contamination via physical means. These LUCs are applicable to both ROC and COC impacts and to all contaminated materials at the site. ***Because the site would be remediated to the FS PRG levels, LUCs would not be required and are not retained for further consideration.***

2.6.2 Containment – Capping

Containment response actions prevent contaminant migration and eliminate exposure paths by physically blocking contact with the contamination. The contaminated media are neither chemically nor physically changed, nor are the volumes of contaminated media reduced.

Capping is a containment technology that utilizes a barrier between the contaminated media and the surface, thereby reducing the exposure of humans and the environment to the contaminated media. Several cap options are available, each of which involves covering the contaminated media with a cap specifically designed to prevent specific potential routes of contact.

Capping is applicable to both ROC and COC impacts as outlined below. Capping would be applicable to contaminated soil and the EU4 VOC plume, but generally would not be applicable to the buildings, building foundations, and drains. The numerous ROC areas across the site would require the construction and maintenance of numerous caps, which would negatively impact the implementability of capping. However, it may be possible to consolidate contaminated soil from some areas of the site prior to capping and therefore the capping options are considered technically implementable as outlined below.

2.6.2.1 Permeable Cap

Permeable caps are designed to minimize or prevent exposure to contaminants and contaminated media, but not to prevent the infiltration of precipitation or the escape of any gases generated by the capped materials. Soil covers are a common permeable capping option. For both the ROCs and COCs, a permeable cap would minimize direct contact and exposure and provide distance and shielding but would not prevent migration of ROCs and COCs in groundwater due to the continued infiltration of precipitation. A permeable cap would still allow radioactive daughter products such as radon gas to pass through at low levels. Long-term maintenance and monitoring of the cap to ensure its purpose is being met would be required. Caps are often used as a component of other remedial actions to provide additional protection. ***This capping option is retained for further consideration.***

2.6.2.2 Impermeable Cap

Impermeable caps are designed to minimize or prevent exposure to contaminants and contaminated media, but additionally, they minimize the infiltration of precipitation that would otherwise spread or mobilize the contaminant. Impermeable cap options include geosynthetic materials or low-permeability clays. For both the ROCs and COCs, an impermeable cap would minimize direct contact and exposure and provide distance and shielding and would also prevent mobilization of the ROCs and COCs from the capped area due to infiltration or surface runoff. An impermeable cap would also limit the migration of radon gas. Long-term maintenance and monitoring of the cap to ensure its purpose is being met would be required. Caps are often used as a component of other remedial actions (e.g., horizontal or vertical containment) to provide additional protection. ***This capping option is retained for further consideration.***

2.6.2.3 Multilayered Cap

A multilayered or composite cap combines the impermeable cap with a permeable gas collection layer beneath that can be passively or actively vented for the control of gas migration while still preventing infiltration of precipitation. Geosynthetic materials and/or low-permeability clays are used for the impermeable barrier layers while stone or gravel are used for the gas collection and venting layers. For both ROCs and COCs, this type of cap would minimize direct contact and exposure and also minimize the mobilization of contaminants. Caps are often used as a component of other remedial actions (e.g., horizontal or vertical containment) to provide additional protection. ***This capping option is retained for further consideration.***

2.6.2.4 Evapotranspiration Cap

An evapotranspiration cap is a capping option often used in arid environments as an alternative to the clay or synthetic liners typically used in impermeable or multilayered caps. The cap is constructed from silty loam materials such as loess and is covered with vegetation. This type of cap is permeable to precipitation and gas emissions. However, the precipitation typically does not penetrate beneath the cap layers since precipitation is held in the soil until it dissipates via a combination of evaporation and plant transpiration. The NFSS is not located in a climate suitable for this type of cap, nor is the type of material required for construction of the cap readily available. ***This capping option is not retained for further consideration.***

2.6.3 Containment – Horizontal Migration Barrier

Horizontal or lateral migration of contaminated materials can be minimized or prevented via the use of vertical barriers. Many options and materials are available for the construction of vertical barriers. Soil containment can be achieved by diverting groundwater flow around the contaminated soil or by capturing contaminated groundwater from soil areas.

Vertical barriers are typically combined with other treatment options, including caps, *in situ* treatment, or groundwater treatment, to produce a complete containment system. Vertical barriers are typically used at sites to confine impacted groundwater, but several types of vertical barriers can also be used to contain contaminated soil including slurry walls, sheetpile walls, grouting, and cryogenic walls.

2.6.3.1 Slurry Wall

Slurry walls are the most common type of vertical barrier due to their low relative cost. Slurry walls are subsurface barriers that consist of a vertically excavated trench filled with slurry (generally a mix of bentonite and water or cement, bentonite, and water). The bottom of the slurry wall is typically tied into a competent underlying impermeable layer. Constructing a vertical barrier also typically requires the minimization or prevention of infiltration by either an impermeable cap or other means within the contained area. Slurry walls are typically installed at depths of less than 15.2 m (50 ft). The use of slurry walls can be limited by the topography, geology, and the type of contamination at the site.

Slurry wall materials would be evaluated prior to construction with regard to the contaminants of concern to ensure compatibility for long-term effectiveness. Slurry walls require long-term maintenance. For some COCs identified at the site, in particular PCE and its daughter products, the tendency of the solvent to dissolve the clay matrices could lead to migration through the underlying confining units by gravity and migration to underlying more permeable zones in the future.

Slurry walls are primarily used as groundwater remedies or to prevent flow of groundwater to a landfill or capped soil area. Due to the low-permeability soils and limited extent and discontinuity of sand lenses, groundwater flow is minimal. ***Slurry walls are not retained for further consideration.***

2.6.3.2 Sheet-Pile Wall

Sheet-pile cutoff walls are constructed by driving vertical strips of steel, precast concrete, aluminum, or wood into the soil forming a subsurface barrier wall. The sheets are assembled before installation and driven or vibrated into the ground, a few feet at a time, to the desired depth. A continuous wall can be constructed by joining the sheets together. The joints between the sheet piles are vulnerable to leakage, and a number of patented techniques have evolved to seal them. In addition to different types of joints, a variety of sealants including grout, fly ash, and cement have been used to seal joints. The bottom of the sheet pile wall is typically tied into a competent underlying impermeable layer. Constructing a vertical barrier also typically requires the minimization or prevention of infiltration by either an impermeable cap or other means within the contained area.

Sheet pile wall materials would be evaluated prior to construction with regard to the COCs to ensure compatibility for long-term effectiveness. For example, PCE and its daughter products can lead to significant corrosion of steel. For some COCs identified at the site, in particular PCE and its daughter products, the tendency of the solvent to dissolve the clay matrices could lead to migration through the underlying confining units by gravity and migrate to underlying more permeable zones in the future.

Sheet pile walls are primarily used as groundwater remedies or to prevent flow of groundwater to a landfill or capped soil area; however, with the exception of the EU4 VOC plume area, groundwater is not a medium of concern at this site. Due to the low-permeability soils and limited extent and discontinuity of sand lenses, groundwater flow is minimal. ***Sheet pile walls are not retained for further consideration.***

2.6.3.3 Grout Curtains

Grout curtains are narrow, vertical grout walls installed in the ground by drilling a borehole and pressure-injecting grout directly into the surrounding soil at closely spaced intervals. The spacing is such that each borehole with grout intersects the next and forms a continuous wall or curtain. The grout solidifies and reduces water flow through the contaminated region. Grout curtains are generally used at shallow depths (9.1 to 12.2 m [30-40 ft] maximum depth). Grout curtains may be used upgradient of the contaminated soil area to prevent clean groundwater from migrating through waste, or downgradient of the contaminated soil area to limit the migration of contaminants. Barriers could be created by grouting fractures or identified permeable zones.

Constructing a vertical barrier also typically requires the minimization or prevention of infiltration by either an impermeable cap or other means within the contained area. This technology would require long-term maintenance into the future. This would also require an evaluation of material compatibility with the constituents of concern to ensure long-term effectiveness.

Grout curtains are primarily used as groundwater remedies or to prevent flow of groundwater to a landfill or capped soil area. Due to the low-permeability soils and limited extent and discontinuity of sand lenses, groundwater flow is minimal. ***Grout curtains are not retained for further consideration.***

2.6.3.4 Cryogenic

Cryogenic walls are subsurface barriers created with a wall of frozen soil. A system of pipes containing coolant is installed to slowly freeze the groundwater in the soil. The bottom of the wall would be tied into a competent underlying impermeable layer. This technology would require long-term maintenance into the future. As with the other vertical barrier technologies, minimization or prevention of infiltration by either an impermeable cap or other means within the contained area would be required. This technology would require a significant quantity of long-term maintenance to maintain the wall. Although used as temporary walls for construction activities, the use of walls in remediation is limited and would have significant concerns. ***A cryogenic wall is not retained for further consideration.***

2.6.4 Containment – Vertical Migration Barrier

The vertical migration of contaminants can be minimized or prevented via the use of horizontal barriers placed either above or below the contaminated media. Horizontal barriers are typically combined with other treatment options, including caps, *in situ* treatment, or groundwater treatment to produce a complete containment system.

Vertical migration barriers could be applicable to both ROC and COC impacts. These barriers are applicable to contaminated soil and the VOC plume, but generally would not be applicable to the buildings, building foundations, and drains.

2.6.4.1 Jet Grouting/Horizontal Grout Wells

Horizontal barriers can be constructed by injecting grout or other materials through fractures or potential permeable zones to limit or prevent vertical migration of contaminants. Complete containment may require the addition of hydraulic controls and/or capping to ensure an inward gradient is maintained to minimize potential migration. Long-term monitoring and maintenance would be required to ensure the barrier was working as planned. This would also require an evaluation of material compatibility with the constituents of concern to ensure long-term effectiveness. Based on modeling, the existing soil and confining layers at the site have sufficiently low permeability to prevent the vertical migration of groundwater contaminants. Horizontal barriers would also be very difficult to install. ***This containment option is not retained for further consideration.***

2.6.5 Containment – Hydraulic Control

Hydraulic control utilizes the extraction of groundwater to reverse natural hydraulic gradients and thus prevent the migration of contaminants away from the contaminated media.

2.6.5.1 Pump and Treat

Pump and treat systems achieve hydraulic control via the extraction of groundwater from wells or trenches at a rate high enough to reverse the natural hydraulic gradient and thus minimize or prevent migration of contaminants at a site. Extracted groundwater often requires treatment prior to discharge. Field tests may be required to better estimate the actual aquifer parameters and determine the extraction rate required to maintain the desired control. The use of pump and treat in conjunction with other containment barriers as discussed above could also be effective. Pump and treat systems require long-term operation, maintenance, and monitoring to ensure that the system operates and continues to be effective. If properly maintained, pump and treat has the potential to control the slow flux of impacted groundwater and reduce potential impacts to surface water along preferential pathways such as utilities. Due to the low-permeability soils and limited extent and discontinuity of sand lenses, groundwater flow is minimal. Pump and treat would have limited effectiveness at the site for the purpose of hydraulic control. This constraint is also exemplified on adjacent properties (e.g., CWM) where extraction systems exhibited poor performance and were abandoned as a remedial measure. ***Pump and treat systems are not retained for further consideration.***

2.6.6 <u>Containment – Encapsulation</u>

Containment via encapsulation is any form of matrix that entraps the contamination and prevents migration of contaminants. Encapsulation is applicable to both ROC and COC impacts. Encapsulation would be applicable to contaminated soil and the VOC plume soil, but generally would not be applicable to the buildings, building foundations, and drains. However, as discussed below, grouting is an encapsulation option that may be applicable to treat the contaminated drains.

2.6.6.1 Pozzolanic Encapsulation

Pozzolanic encapsulation solidifies and/or stabilizes contaminated material with pozzolanic material such as fly ash, lime, or cement to trap the contaminants within the mix matrix. Pozzolanic stabilization would require significant pilot testing to ensure the material would be trapped within the matrix and not readily leached out. However, radioactive materials could still be an exposure pathway and might require capping or combining other technologies to prevent risk.

This process produces monolithic blocks of waste with high structural integrity. The radionuclides do not necessarily interact chemically with the solidification reagents (typically cement or ash) but are mechanically locked within the solidified matrix. Materials can be further stabilized by the addition of chemical binders, such as cement, silicates, or pozzolans, which limit the solubility or mobility of waste constituents even though the physical handling characteristics of the waste may not be changed or improved.

The encapsulation process can be employed *in situ* or *ex situ*. *In situ* technologies use auger and injector head systems to apply agents to *in situ* soil. *Ex situ* technologies involve excavating contaminated soil and machine-mixing it with the solidifying or stabilizing agent. Long-term monitoring would be necessary to ensure contaminants do not remobilize.

This technology could also be utilized in conjunction with other options such as stabilizing soil prior to transportation and disposal. The effectiveness of pozzolanic encapsulation is limited to soil. ***Pozzolanic encapsulation is retained for further consideration.***

2.6.6.2 Grouting

Grouting technology and materials would be similar to the grout curtains used for migration barriers, except that the grout would be injected into the drains or other potential preferential pathways to encapsulate and prevent contaminant migration. Grouting would solidify and stabilize the impacted materials. Grouting does not reduce contaminant concentrations but grout injection into drains would eliminate these as potential contaminant migration pathways. Grouting is not considered implementable for soil. ***This encapsulation option is retained for further consideration.***

2.6.6.3 Cryogenic Encapsulation

Cryogenic stabilization is similar to the cryogenic barriers as outlined above, except that the entire existing soil matrix would be frozen to prevent migration and trap the contaminants. However, radioactive materials would still be present and a potential exposure pathway. Cryogenic encapsulation might require capping or other technologies to prevent risk. Cryogenic stabilization requires substantial maintenance to keep the material in the frozen state. If it is not maintained, it would revert back to the initial exposure risk. Full scale demonstration of this technology is limited and has several concerns. ***Cryogenic encapsulation is not retained for further consideration.***

2.6.6.4 Vitrification

Vitrification is an *in situ* process that heats the soil to extreme temperatures to melt the matrix and convert the waste materials into glass or other glass and crystalline products, thereby trapping any remaining contaminants. The high temperatures of the process destroy any organic constituents with very few byproducts. Heavy metals and radionuclides are incorporated into the glass structure. Vitrification has a high energy demand to dry and vitrify the site soil matrix. Leachability of the final matrix would need to be evaluated to ensure sustainability. In addition to its high cost, this process option would not be applicable since the contamination is spread across the site at numerous locations. ***Vitrification is not retained for further consideration.***

2.6.7 Removal –- Excavation

Excavation is not a stand-alone technology but is a requirement in conjunction with many other technologies and process options. Removal technologies involve the active excavation, handling, and management of contaminated materials prior to some type of treatment and/or disposal action to control further migration of contaminants or to remove the contamination from the site. Removal technology is applicable to both ROC and COC impacts and to all contaminated materials at the site.

2.6.7.1 Earth Moving Equipment

Mechanically or hydraulically operated units such as excavators, front-end loaders, bulldozers and/or hand tools are used to remove soil and debris from the surface and subsurface. Excavation and removal apply to almost all site conditions; however, such actions may become cost-prohibitive at great depths or in complex hydrogeologic conditions. As noted above, removal is required in conjunction with other technologies and process options. ***Removal via excavation is retained for further consideration.***

2.6.8 Removal – Volume Reduction

Volume reduction is not a stand-alone technology but is used in conjunction with many other technologies and process options. As outlined below, volume reduction technologies are generally applicable only to ROC impacts and may not be applicable to all contaminated materials at the site.

2.6.8.1 Decontamination – Scarification

Decontamination is essentially transferring contamination from one media to a smaller more manageable media. Decontamination would not be applicable to all contaminated materials but could be used for the decontamination of concrete foundations and pads and thus reduce the volume of radiologically contaminated materials. Decontamination processes may include chemical extraction and precipitation, gel application, or physical removal (scarification). The extracted media would be managed as a reduced volume waste as applicable. ***Decontamination via scarification is retained for further consideration for treatment of the building foundations.***

2.6.9 Removal – Dewatering

Dewatering is not a stand-alone technology but is a requirement in conjunction with excavation where groundwater or surface runoff water is encountered in the excavated area. Dewatering technology is applicable to excavation of both ROC and COC impacts, and to all contaminated materials at the site where excavation is required.

2.6.9.1 Pump and Treat

As compared to pump and treat systems for hydraulic control, dewatering systems are typically small and temporary systems designed specifically for the removal of ancillary groundwater or precipitation entering an open excavation. Well points or submersible trash pumps are used to collect any water that accumulates. Only deeper excavations may require dewatering, depending on the elevation of the groundwater table in the area at the time of excavation. Water within an excavation would be removed (pumped) and transferred into a temporary storage container for subsequent off-site disposal/treatment. ***Pump and treat for the purpose of dewatering excavations is retained for further consideration.***

2.6.10 Treatment – Thermal

Thermal treatment uses high temperatures to volatilize and physically separate the contamination from the soil. These technologies would be applicable to the COC-contaminated soil and groundwater, but not the ROC-contaminated soil, buildings, and building foundations. The following sections describe the thermal treatment technologies that were considered for the NFSS.

2.6.10.1 *In Situ* Thermal Treatment

There are several methods for the *in situ* heating of soil. All methods involve either delivering heat to the subsurface (e.g., steam injection) or creating heat in the subsurface by resistance or conductive methods. Electrical resistive heating (ERH) is an example of the resistance method and one of the more common technologies that has been implemented full-scale. Electrical resistive heating uses an electrode system to pass an electrical current through the soil at very high voltages. The resistance of the soil to the flow of the current creates heat which then volatilizes the contaminant. The contaminant is collected in the vapor phase via vapor extraction wells. The contaminant vapors are collected or treated via carbon or other off-gas treatment systems. An alternate *in situ* thermal treatment technology is to provide heat to probes installed into the subsurface, relying on the conductance of the heat through the material to heat the subsurface. Similar to ERH, the heat volatilizes the contaminants, but the density of probes needs to be much higher to ensure even heating occurs.

This technology is suited to multiple soils type and many types of contaminants including PAHs and PCE. *In situ* thermal treatment would also address groundwater impacts in the zone of soil treatment. **In situ *thermal treatment is retained for further consideration.***

2.6.10.2 *Ex situ* Thermal Treatment

As with the *in situ* thermal technologies, *ex situ* heating involves delivering heat to the soil to volatilize the contamination. The soil and wastes are heated to volatilize water and organic contaminants. A carrier gas or vacuum system transports volatilized water and organics to the gas treatment system. The bed temperatures and residence times designed into these systems would volatilize selected contaminants, but typically would not oxidize them. Based on the operating temperature of the desorber, thermal desorption processes can be categorized into two groups: high-temperature thermal desorption and low-temperature thermal desorption. High- or low-temperature thermal desorption would work to treat the COCs in soil including PAHs and VOCs. This would include excavation and transportation to the treatment area and processing through the treatment equipment. This would also require additional off-gas treatment. The posttreatment soil can then be used as clean backfill on-site or off-site, depending on postremediation characterization. **Ex situ *thermal treatment is retained for further consideration.***

2.6.11 <u>Treatment – Chemical</u>

The chemical treatment process options evaluated here utilize the addition of chemical reagents to the contaminated material to degrade and destroy (i.e., chemically convert) the contamination. These technologies would be applicable to the COC-contaminated soil and groundwater, but not the ROC-contaminated soil, buildings, and building foundations. The following sections describe the chemical treatment technologies that were considered for the NFSS.

2.6.11.1 *In Situ* Chemical Oxidation

Chemical oxidation (and reduction) is based on the delivery of chemical oxidants to the contaminated soil to destroy contaminants by converting them to innocuous compounds. The methods for delivery of the chemical oxidant may vary. This could be performed by direct injection into the subsurface or direct mixing in place with traditional or specialized earth moving equipment. The injection or in-place mixing of an oxidant with the contaminated soil and groundwater chemically mineralizes the COCs through oxidation reactions. Examples of oxidants applicable for the treatment of PCE and its daughter products include sodium permanganate, activated persulphate, catalyzed hydrogen peroxide, etc. Chemical oxidation has been used for groundwater, sediment, and soil remediation and would work to treat the COCs in soil including PAHs and VOCs. However, the fine-grained nature of the soil at the site would complicate the effectiveness and viability of this technology. The higher permeability lenses of sand and gravel would complicate the effective distribution of the oxidation reagents in the subsurface since the reagents would preferentially flow into the higher permeability areas and avoid the lower permeability fine-grained soil. **In situ** ***chemical oxidation is not retained for further consideration.***

2.6.11.2 *Ex situ* Chemical Oxidation

Ex situ chemical oxidation would be based on the same chemical processes and oxidants as utilized for *in situ* oxidation. Conducting the process *ex situ* requires the excavation and transportation of the soil to the treatment area and processing through the treatment equipment. Although there is additional handling and processing of the soil, conducting the treatment *ex situ* can be effective and efficient in destroying the contamination since it allows for more effective distribution of the chemical reagents through the soil compared to *in situ* treatment. Oxidation technologies require that the chemical reagents be in direct contact with the target contaminant to destroy the contaminant. Conducting the process *ex situ* eliminates the problem of distribution with the *in situ* option. Chemical oxidation has been used for groundwater, sediment, and soil remediation and would work to treat the COCs in soil, including PAHs and VOCs. **Ex situ** ***chemical oxidation is retained for further consideration.***

2.6.12 <u>Treatment – Biological</u>

Biological treatment utilizes microorganisms to remediate contaminated soil. These technologies would be applicable to the COC-contaminated soil and groundwater, but not the ROC-contaminated soil, buildings, and building foundations. The following sections describe the biological treatment technologies that were considered for the NFSS.

2.6.12.1 *In Situ* Biostimulation

In situ biostimulation (i.e., enhanced bioremediation) is a remedial process in which the indigenous microorganisms (e.g., fungi, bacteria, and other microbes) degrade (metabolize) organic contaminants in soil and/or groundwater, converting them to innocuous end products. Nutrients, oxygen, or other amendments (depending on the target contaminants) may be added to the treatment area to stimulate and enhance the naturally occurring bioremediation processes. In the case of chlorinated compounds, the indigenous microorganisms that biodegrade the waste are anaerobic. Injection or in-place mixing of an electron donor substrate would stimulate reductive dechlorination of contaminants with the native bacteria. This technology has the potential to establish conditions where long-term flux of contamination from the fine-grained soil matrix is readily dechlorinated to nontoxic end products such as ethene. This technology may create more toxic daughter products (e.g., VC) if not properly performed or maintained. While radioactive contaminants cannot be biodegraded, biological organisms can alter the oxidation state and solubility of those contaminants, thus increasing their mobility. While potentially suitable for the treatment of PCE, this technology may not be well suited to the other COCs at the site. The fine-grained nature of the soil at the site would also complicate the effectiveness and long-term viability of this technology. **In situ** ***biostimulation is not retained for further consideration.***

2.6.12.2 *In Situ* Bioaugmentation

In situ bioaugmentation relies on the same methods and processes by which microorganisms are used to degrade the organic contaminants in soil and/or groundwater, converting them to innocuous end products. Microorganisms specifically designed to remediate the target contamination are introduced to the subsurface in addition to the nutrients, oxygen, or other amendments, depending on the target contaminants. This technology ensures that adequate microorganisms suitable for the degradation of waste are present in the subsurface rather than relying on the suitability of the native organisms. Injection or in-place mixing of nonindigenous organisms in addition to the electron donor substrate would stimulate reductive dechlorination of contaminants. This technology has the potential to establish conditions where long-term flux of contamination from the fine-grained soil matrix is readily dechlorinated to nontoxic end products such as ethene. This technology may create more toxic daughter products (e.g., VC) if not properly performed or maintained. While radioactive contaminants cannot be biodegraded, biological organisms can alter the oxidation state and solubility of those contaminants, thus increasing their mobility. While better suited for the treatment of PCE than biostimulation, this technology also may not be well suited to the other COCs at the site. The fine-grained nature of the soil at the site would also complicate the effectiveness and long-term viability of this technology. **In situ *bioaugmentation is not retained for further consideration.***

2.6.13 <u>Disposal – On-Site Disposal</u>

Disposal is not a stand-alone technology but is a requirement in conjunction with many other technologies and process options. On-site disposal could be used in conjunction with excavation, handling, treatment, and/or management of contaminated soil or other contaminated material as a means to isolate the wastes from the environment and mitigate the associated risks. Disposal technology is applicable to both ROC and COC impacts and to all contaminated materials at the site.

2.6.13.1 New Engineered Structure

A new disposal facility would need to be constructed on site that meets all of the criteria for a long-term waste storage facility. The disposal facility would incorporate engineered barriers and a multilayered cover system to provide isolation of the waste from the environment. Various federal and state laws would apply regarding design and waste acceptance criteria. An engineered waste disposal facility requires long-term maintenance and may limit future land use. This technology could be used in conjunction with other components of a remedial action to ensure compliance with ARARs. Due to the permitting and construction difficulties, community opposition, and the fact that the proposed plan for the IWCS is removal and off-site disposal, ***construction of a new engineered structure is not retained for further consideration.***

2.6.13.2 Existing Engineered Structure

The existing IWCS disposal facility could be modified and used for the storage of additional wastes. However, the existing facility is to be removed under the proposed plan for that operable unit. ***Disposal in the existing facility is not retained for further consideration.***

2.6.14 Disposal – Off-Site Disposal

Disposal is not a stand-alone technology but is a requirement in conjunction with many other technologies and process options. Off-site disposal could be used in conjunction with excavation, handling, treatment, and/or management of contaminated soil or other contaminated materials as a means to remove the wastes from the site and mitigate the associated risks. Disposal technology is applicable to both ROC and COC impacts and to all contaminated materials at the site.

2.6.14.1 New Engineered Facility

A new disposal facility could be constructed off-site that meets all of the criteria for a long-term waste storage facility. The disposal facility would incorporate engineered barriers and a multilayered cover system to provide isolation of the waste from the environment. Various federal and state laws would apply regarding design requirements and waste acceptance criteria. An engineered waste disposal facility requires long-term maintenance and may limit future land use. This technology could be used in conjunction with other components of a remedial action to ensure compliance with ARARs. Treated and/or untreated soil and debris meeting the waste acceptance criteria would be transported to the new facility.

Design, construction, and operation and maintenance of a new on-site disposal facility would require meeting the substantive requirements of state and federal landfill permits. The site does have sufficient area to construct a new landfill. However, considering that the proposed plan for the IWCS is off-site disposal, construction of a new landfill would not likely be supported by the NYSDEC. ***Construction of a new engineered structure is not retained for further consideration.***

2.6.14.2 Existing Permitted Facility

Under the existing permitted disposal facility process option, treated and/or untreated soil and debris meeting the waste acceptance criteria would be excavated and transported to an appropriately-permitted disposal facility. For this disposal option, the receiving facility would be responsible for conducting long-term maintenance during the lifetime of the radiological landfill cell. The receiving facility would need to have all appropriate permits or licenses. ***An appropriately-permitted existing disposal facility is retained for further consideration.***

2.6.15 Monitored Natural Attenuation

Monitored natural attenuation (MNA) relies on natural processes to degrade contaminant concentrations to acceptable levels. For NFSS, MNA could be considered for CVOCs. It was previously stated that the current PCE and VC concentrations in groundwater beneath the NFSS would degrade to below screening level concentrations within approximately 300 to 350 years, respectively. However, with the presence of a DNAPL phase, which represents a continuing source, the timeframe would be considerably longer, estimated at more than 2,000 years. It is reasonable to state that attaining remediation objectives is a site-specific determination. The NCP suggests that a "reasonable" timeframe for a remedy relying on natural attenuation is generally a timeframe comparable to that which could be achieved through active restoration. Thus, determination of the most appropriate timeframe would be through a comparison of estimates of the remediation timeframe for all appropriate remedy alternatives. The remedial technologies for CVOCs being evaluated in this FS are on the order of several months to a few years. Due to the disparity of time required for passive remediation, ***monitored natural attenuation is not retained for further consideration***.

2.6.16 Summary of Initial Screening of Technology Types and Process Options

The initial screening results for these potentially applicable technology types and associated process options are shown in **Table 2-5**. Shaded entries in **Table 2-5** indicate that the technology type or process option was eliminated from further consideration. In accordance with the RI/FS guidance (U.S. EPA 1988), these options were initially evaluated with respect to technical implementability. Those technology processes considered implementable are then evaluated in greater detail in Section 2.7.

2.7 Evaluation of Technologies and Process Options

In this section, the technologies and processes considered technically implementable in Section 2.6 are evaluated in greater detail before the selection of representative technologies that are then assembled as remedial alternatives. The technologies are evaluated in terms of effectiveness, implementability and cost criteria, as described below. Each process option is rated low, moderate, or high for each of the three criteria. A summary of the retained remedial technologies and process options to be evaluated is presented in **Table 2-6**.

Effectiveness considers the ability of the alternative to protect human health and the environment by reducing the mobility or volume of contaminants and the ability to meet the RAOs defined for the site. Process options providing significantly less effectiveness than other more promising options are rated low and eliminated from further consideration.

Implementability considers practical issues such as the ability to construct, reliably operate, and monitor the implementation of the remedial action, as well as administrative issues such as the ability to gain acceptance among the stakeholders of the alternative. Process options that are technically or administratively infeasible or require equipment, specialists, or facilities not available within a reasonable time period are rated low and eliminated from further consideration.

Costs for each technology are rated qualitatively on the basis of engineering judgment as high, moderate, or low by comparison to the costs of similar technologies. The cost criterion includes capital costs and operation and maintenance (O&M) costs.

Table 2-7 summarizes the technologies and process options that passed the initial screening and are retained for further consideration. Below, each technology and associated process option listed in **Table 2-7** is screened further based upon its effectiveness, implementability, and cost.

2.7.1 Capping – Permeable, Impermeable, and Multilayered

Capping is a containment technology that provides a barrier between the contaminated material and the potential receptors, resulting in reduced exposures. In addition, capping reduces the mobility of the contaminants. The capping process options considered technically implementable were permeable, impermeable, and multilayered caps. Capping is applicable to both ROC and COC impacts as outlined below. Capping would be applicable to contaminated soil and the VOC plume, but generally would not be applicable to the buildings, building foundations, and drains.

<u>Effectiveness</u>: Capping does not reduce the volume of the contaminated material. However, capping does reduce exposures to both ROCs and COCs by physically separating the contaminated materials from any potential receptors. The impermeable and multilayer caps would also reduce the mobility of contaminants because they would reduce rainwater infiltration and vertical contaminant transport if properly maintained. However, horizontal migration is not limited unless the technology is combined with surrounding vertical barriers. All caps, with regular maintenance, would eliminate the potential for direct contact (absorption, ingestion, or inhalation) and minimize potential exposure to radon gas.

Permeable caps are considered only moderately effective since they would not mitigate migration of COC contamination. Impermeable caps are considered moderately to highly effective. If sufficient radon gas is generated, there is the possibility that the radon would be trapped and result in radon exposure in the vicinity. The effectiveness of a multilayered cap is high since this cap would allow for the venting and/or control of the radon gas.

<u>Implementability</u>: Capping is a proven technology that is relatively easy to physically implement. Materials and equipment are readily available for cap construction, although weather, topography, and subsurface conditions may affect the ease of implementation. No off-site activity is required to treat, store, or otherwise manage the contaminated material because the technology is *in situ*. Installation of a gas collection and treatment system may be an option for managing radon emissions, although a properly designed cap would retard transport to the point that radon emissions are essentially eliminated.

The focus of a capping alternative at the site would be to contain any contaminated areas on-site to prevent exposure and minimize infiltration. The numerous ROC areas across the site would require the construction and maintenance of numerous caps which would negatively impact the implementability of capping, although it may be possible to consolidate contaminated soil from some areas of the site prior to capping. The implementability of a permeable cap is considered low since it would not address the COC contamination at the site. Although no significant problems are anticipated that would limit the technical implementability of the other capping options, containment options where the waste is left in place untreated, such as capping, often have a low favorability with local communities and other stakeholders. Capping is also unlikely to be acceptable to the regulatory agencies, especially in light of the fact that complete removal of the existing IWCS is the preferred alternative in the proposed plan for the IWCS OU. The administrative implementability is therefore rated as low and the overall implementability is rated as low.

<u>Cost</u>: Implementing capping would require moderate to high capital costs and moderate O&M costs. Construction costs associated with containment options could be estimated with a relatively high degree of accuracy since the impacted areas of the site are accurately defined. The numerous areas of contamination across the site would increase the complexity and cost of cap construction. Due to its greater complexity, the costs to construct and maintain a multilayered cap would likely be higher than those for an impermeable cap. The costs for the construction of a permeable cap would be lower.

Screening: ***Due to the low likelihood of acceptance by the community and the low administrative implementability, the capping options are not retained since they are not a likely component of other remedial alternatives.***

2.7.2 Encapsulation – Pozzolanic and Grouting

Encapsulation is a containment technology that reduces the mobility of contaminants though physical and chemical processes. Pozzolanic stabilization and grouting are the only process options retained for further consideration after the initial screening. In the encapsulation process, contaminants are physically bound or enclosed in an impervious matrix. Encapsulation is applicable to both ROC and COC impacts. Pozzolanic encapsulation would be applicable to contaminated soil and the VOC plume, but would not be applicable to the buildings, building foundations, and drains. Grouting is necessary to treat the contaminated building drains.

Effectiveness: Encapsulation does not reduce the volume of contaminants; however, the technology has been proven to greatly reduce the mobility of the contaminants, thus protecting human health and the environment by reducing some potential exposure routes. With pozzolanic encapsulation, the volume of treated material increases due to the addition of the solidification and/or stabilization agents. The increase in volume depends on the amount of additives required to achieve the desired end product. Encapsulation would be effective in stabilizing soil and trapping moisture to facilitate the transportation and disposal of the material; however, considering the high clay content and cohesiveness of the soils, this is likely not required for this site. The effectiveness of encapsulation is considered low to moderate given that this is a technology proven to be effective in reducing mobility of contaminants, but it may increase volume and thus disposal costs. Pozzolanic encapsulation by itself would not be sufficient to achieve all of the RAOs.

Grouting can be used to limit the migration of contamination along preferential pathways such as drains, utility bedding, and other high-permeability media. Grouting would be conducted via boreholes and/or pressure injection to target the grout to the desired locations. The effectiveness for grouting of the drains and other permeable material is considered low as the contamination would remain in place.

Implementability: Encapsulation is well demonstrated and easy to implement, as conventional materials and widely available equipment are used in the process. Chemicals of concern, metals, and all classes of radioactive contamination are treatable by this technology. Treatability studies may be required to determine the quantities of additives required. The implementability of encapsulation is considered high.

Grouting is well demonstrated and easy to implement. The technology utilizes conventional materials and widely available equipment in the process. Studies and investigation may be required to determine the extent of the areas where grouting would be useful. The implementability of grouting to address the building drains is considered high.

Cost: Costs for encapsulation and grouting are expected to be moderate to low; however, grouting would also entail additional excavation costs. The materials used in the grouting process are relatively low-cost materials, and the physical processing/mixing equipment is relatively simple. There are no long-term maintenance costs associated with either option.

Screening: ***Because contamination would remain in place, pozzolanic encapsulation and grouting are not retained for further consideration.***

2.7.3 Excavation – Earth-Moving Equipment

Removal technologies protect human health and the environment by physically separating the contaminated material from potential receptors. Excavation is not a stand-alone technology but is a requirement in conjunction with many other technologies and process options. Excavation is applicable to both ROC and COC impacts and to all contaminated materials at the site.

Effectiveness: Removal of contaminated materials increases the protection of human health and the environment by reducing future potential exposures. During implementation, there is possible short-term risk from vapors and fugitive dust emissions, which would be readily managed by implementing a health and safety plan and an environmental protection plan. Although air quality could be adversely affected by the release of particulates, mitigation measures, such as dust suppression methods and use of proper safety procedures and equipment, would be implemented to minimize any increased risk to on-site workers during remedial activities. Short-term risks, including occupational injuries and a risk of fatalities, increase as the volume of soil being handled increases.

Excavation is more effective when used with characterization activities to identify excavation boundaries, which limit under-excavation and over-excavation. Due to the various areas and types of contamination at the site, effective stockpile management would be required to ensure the proper handling and ultimate placement of all excavated materials.

Removing contaminated materials reduces the mobility and exposures of radiological contaminants to humans and the environment at the site; therefore, the effectiveness of excavation is rated high.

Implementability: Excavation uses readily available resources and conventional earth-moving equipment. Construction of temporary roads and a staging area for loading and unloading, soil erosion control, excavation dewatering, water treatment, dust control, and additional clearing and grubbing may be necessary. Transportation and disposal are technologies that are generally combined with excavation. The implementability of excavation is rated high.

Cost: Costs related to excavation depend upon the volume of contaminated material requiring excavation. The cost of excavation for the site is rated moderate; however, excavation must be combined with treatment or disposal and those costs would be additional. There are no long-term maintenance costs associated with excavation.

Screening: ***Excavation is retained for further consideration and for use in conjunction with other options.***

2.7.4 Dewatering – Pump and Treat

Dewatering is not a stand-alone technology but is a requirement in conjunction with excavation where groundwater or surface runoff water is encountered in the excavated area. Dewatering is applicable to excavation of both ROC and COC impacts, and to all contaminated materials at the site where excavation is required.

Effectiveness: The pump and treat option by itself would significantly reduce the volume of the contaminated groundwater. It would not reduce or eliminate soil contamination. However, it would be effective in controlling the groundwater and other water incidental to the excavation process.

Pump and treat is a proven technology that is highly effective in collecting and treating contaminants from the groundwater. Based on the information available, it is likely that only minimal dewatering at a relatively low flow rate would be adequate to accomplish all of the excavation implemented at this site.

Implementability: Pump and treat is a very well-developed technology that has been used for many years for the extraction and/or treatment of groundwater for dewatering, remediation of groundwater, and to maintain hydraulic control. All of the materials and equipment required for the construction of a system are readily available.

Cost: Pump and treat systems for dewatering are typically small rental systems consisting of pumps, filters, and tanks. Capital and O&M costs would be low. Construction costs could be estimated with a relatively high degree of accuracy.

Screening: ***The pump and treat system for dewatering will be retained for further consideration for dewatering in conjunction with excavation.***

2.7.5 Thermal (Desorption) Treatment – *In Situ* and *Ex situ*

Thermal desorption treatment uses high temperatures to volatilize and help physically separate volatile and semivolatile contamination from soil, groundwater, and/or other contaminated media. Thermal desorption can be performed by a wide variety of technologies, which are summarized below:

- Thermal Conduction Heating (both *in situ* or *ex situ*)
    - Uses heated probes to heat soil and groundwater to the required temperature, relying on direct contact to transfer heat via conduction.
- ERH (primarily *in situ*)
    - Relies on current passing through the soil between electrodes to heat the soil in place induced by phased high voltage applied to the electrodes installed in the soil.
- Hot Gas Thermal Desorption (primarily *ex situ*)
    - Uses heated air drawn through the soil/material via extraction and injection piping to heat the mass and desorb the compounds.
- Direct Thermal Desorption (*ex situ* only)
    - Feeds screened soil into a heating drum/dryer or screw conveyor which mechanically moves the soil through the drum at a controlled rate. Gases are fed through the drum/dryer to collect the volatilized contaminants for off-gas treatment. The gas and/or drum are heated directly by burning fuel to provide design temperature which can be controlled by soil throughput rate.

For the purpose of evaluation, ERH has been selected for cost and evaluation for *in situ* thermal treatment and hot gas thermal desorption, also known as thermally enhanced vapor extraction technology, has been selected for the *ex situ* option.

The VOCs extracted from the soil/groundwater/other solid media would be driven to the gas/vapor phase along with water as steam. The process requires a condensation step in off-gas collection and treatment to remove the steam condensate and allow the relatively dry vapors to proceed to off-gas treatment. Some PAHs will condense out in the steam separation phase and may require further treatment of the condensate. Off-gas treatment would consist of destruction through on-site thermal oxidation or sorption on vapor phase granular activated carbon for off-site disposal as solid waste or off-site regeneration allowing carbon to be reused.

Effectiveness: Thermal treatment technologies would only be applicable to reduce or eliminate the quantity of soil contaminated with COCs. The technologies would need to be combined with other remedial actions at the site to achieve all of the RAOs.

Both *in situ* and *ex situ* treatment options would be highly effective in treating the COC constituents in the soil including VOCs (e.g., PCE) and PAHs. There would likely be additional risks associated with *ex situ* treatment since excavation, handling, and stockpiling of both the untreated and treated soil would be required in addition to the thermal treatment operations. Both *in situ* and *ex situ* systems include controls and/or treatment for off-gases and emissions generated as a result of the treatment processes.

Implementability: Multiple vendors are available for the both in *situ* and *ex situ* treatment options.

In situ treatment requires a suitable power or fuel supply for the heating system. Design and construction of a thermal system is relatively straightforward and would require preparation of a work plan for heating probe installation for induced soil heating or conductive heating probes for direct heating. Both systems would require a layout of vapor recovery points along with steam condensing systems/condensate treatment and postcondensate vapor treatment systems. An *in situ* treatment system is considered moderately to highly implementable.

As with *in situ* treatment, *ex situ* treatment requires suitable power, fuel, and other utilities. The treatment area could be relocated to an area with readily available power/fuel, if needed. The *ex situ* system may use impermeable bags around excavated soil to reduce or prevent fugitive emissions and improve soil heating rates and vapor recovery. *Ex situ* treatment would require the preparation of work plans for the soil excavation and handling as well as for the layout and treatment system equipment options at the treatment site. *Ex situ* treatment is also considered highly implementable.

Both *in situ* and *ex situ* systems would require a design evaluation and/or meet substantive portions of applicable regulations for air emissions generated by the systems.

Cost: The capital costs to implement *in situ* or *ex situ* thermal treatment are expected to be relatively high. For *in situ* treatment, much of the cost is associated with the depth and extent of the contamination, and the duration of treatment which determines the electrical/fuel and other utility costs. The conductive heating probes or induced heating electrodes, vapor extraction wells, and off-gas treatment systems are only a small fraction of the cost. The major cost item for thermal treatment consists of fuel or electricity used to heat and maintain the required temperature of the soil over the duration required for the project to be successful.

The capital cost for *ex situ* treatment would depend on the depth and extent of the contamination as it relates to the soil excavation and handling, along with the treatment method to be performed.

There are no long-term operations or maintenance costs associated with either option once the treatment has been completed successfully.

Screening: ***Since both* in situ *and* ex situ *thermal treatment of soil/groundwater are considered moderately to highly effective and moderately to highly implementable, both treatment options are retained for further evaluation.***

2.7.6 Chemical Treatment – *Ex situ*

Chemical treatment processes utilize chemical reagents to degrade and destroy contaminants by converting them to innocuous compounds. Only *ex situ* chemical oxidation was considered technically implementable for further evaluation. Chemical treatment technologies are applicable only to COC impacts, and only for the VOC-contaminated soil.

Effectiveness: Chemical oxidation treatment would only be applicable to reduce or eliminate the quantity of soil and groundwater contaminated with COCs. The technologies would need to be combined with other remedial actions at the site to achieve all of the RAOs.

Ex situ oxidation would be moderately effective in treating the COC constituents in the soil such as PCE. Polycyclic aromatic hydrocarbons and other organic constituents may be less amenable to effective treatment via oxidation. Oxidation is a process that is only effective if the oxidation reagents are in direct contact with the contamination. However, there would likely be additional risks associated with *ex situ* treatment since excavation, handling, and stockpiling of both the untreated and treated soil would be required. Control of air emissions including particulates and vapor would be required.

Chemical oxidation is less effective if there are significant quantities of natural organic material in the soil. These other organic materials also react with the oxidants and may greatly increase the total quantity of oxidant required to achieve the desired contaminant destruction. The low permeability of the soil may also require additional handling or treatment steps to ensure that the oxidation agents effectively distribute through the soil.

Implementability: Multiple vendors and contractors are available for the *ex situ* oxidation treatment.

Ex situ oxidation is considered highly implementable. *Ex situ* treatment would require the preparation of work plans for the soil excavation and handling. Containment around the treatment area would be required to ensure that there would be no contaminated runoff to other areas of the site. The equipment required should be readily available.

Cost: The capital costs to implement the *ex situ* chemical oxidation is expected to be relatively high based on the quantity of reagents and the amount of soil handling that would be required. The capital costs for *ex situ* treatment would depend on the depth and extent of the contamination as it relates to the soil excavation and handling. There are no long-term operations or maintenance costs associated with chemical oxidation.

Screening: ***Ex situ chemical oxidation of soil is considered only low to moderately effective, moderately implementable, and at a relatively high cost. This treatment option is not retained for further evaluation.***

2.7.7 Off-Site Disposal – Existing Facility

The only off-site disposal option under consideration is disposal at an existing facility. Off-site disposal is applicable to both ROC and COC impacts and to all contaminated materials at the site. Disposal of contaminated material in an off-site landfill would reduce mobility and exposures to radiologically contaminated soil at the site. An existing facility would have appropriate federal and state permitting requirements in place.

Implementation of off-site disposal would first involve characterizing the materials designated for off-site disposal, confirming that the materials are in conformance with the acceptance criteria specified by the designated disposal facility, and determining whether any treatment is required prior to disposal. After soil has been excavated and any necessary treatment implemented, sampling and analysis of soil would be conducted to develop a waste profile to confirm that the waste meets any applicable waste acceptance criteria before disposal.

Soil must be appropriately disposed of at a properly permitted disposal facility. Soil that exhibits Resource Conservation and Recovery Act (RCRA) hazardous characteristics (e.g., toxic characteristic leaching procedure) must be appropriately treated and disposed of in a properly permitted facility.

Similarly, radiologically contaminated materials must be disposed of in a properly permitted RCRA facility or licensed byproduct facility consistent with regulations and applicable waste acceptance criteria. Subtitle C landfill facilities are commonly permitted to accept both RCRA and TSCA hazardous waste, along with material that meets the unimportant quantities of source material exemption criteria of 10 CFR 40.13(a).

Based on a review of site soil investigation data, it is anticipated that the contaminated soil requiring off-site disposal will consist of soil and debris containing natural radioactive constituents, and possibly some level of RCRA hazardous waste, that must be disposed of in a properly permitted facility. Confirmatory waste characterization evaluations would be performed as an integral part of remedial actions.

Effectiveness: No reduction in the volume of contaminated material would be achieved by this option, but future risk to on-site receptors would be reduced by removing the contaminated material from the site; risk is transferred to the off-site facility that is located and designed to manage the associated risk. There would be some risk of exposure during the transportation phase of the project. The effectiveness of the off-site disposal option is rated as moderate to high.

Implementability: The implementability of off-site disposal at an existing facility would largely depend on the availability of appropriate disposal facilities. Properly licensed or permitted disposal facilities exist in the United States that can accept the waste from the site. The volume of radiological soil that requires disposal is not prohibitive for acceptance at these facilities. In addition, regulated or licensed transporters are available to handle the waste.

Implementation of off-site disposal would involve characterizing the materials designated for off-site disposal and confirming that the materials are in conformance with the acceptance criteria specified by the designated disposal facility. Off-site disposal is the most common remedial response action currently implemented to remediate radionuclides in soil.

Off-site disposal would be completed with conventional equipment and techniques. Labor requirements are not considered problematic. The most difficult aspect of off-site disposal implementation would likely involve the arrangement of transportation of material from the NFSS to the disposal site.

Administrative tasks associated with off-site disposal would be difficult during remediation, but nonexistent after remediation, assuming successful cleanup is achieved. However, transportation of low-activity radioactive materials through communities en route to the closest railroad would likely be a concern to the public. If removal and off-site disposal is implemented, a long-term environmental monitoring program would not be required since the impacted material would be removed from the site.

This is a common remedial action on many similar sites and is readily implementable by USACE. The implementability of an existing off-site permitted and/or licensed disposal facility is rated as high.

Cost: Costs associated with off-site disposal of contaminated soil and other materials are variable, and depend on the volume to be disposed of, the levels of contamination, the proximity of the disposal site, and the materials handling and required packaging. Overall, the costs associated with off-site disposal are rated as medium capital costs; there would be no long-term operations or maintenance costs for off-site disposal.

Screening: ***Off-site disposal at an existing facility is retained for further consideration and for use in conjunction with other options.***

2.8 Retained Process Options

Table 2-8 shows the technologies and process options that have been retained for use individually or in combination for the development of remedial alternatives. Remedial alternatives will be assembled from these categories and evaluated in detail in Section 3.0.

3 DEVELOPMENT OF REMEDIAL ALTERNATIVES

This section combines the remedial action technologies and process options retained from screening in Section 2 to form site-wide remedial action alternatives for detailed analysis and comparison. The rationale for combining response actions, technologies, and process options is summarized below.

3.1 Development of Remedial Alternatives

Table 2-8 summarizes the retained process options and indicates which media could be addressed by each option. For most of the media, only a few remedial process options were considered viable for the development of alternatives, although some may be interdependent (e.g., off-site disposal of soil also requires the excavation of soil and possibly dewatering during excavation). The media-specific alternatives selected for each of the site media are summarized below:

Soil (ROCs and PAHs)

- No action
- Excavation, including dewatering and disposal

Building Foundations (ROCs)

- No action
- Excavation, including disposal
- Decontamination via scarifying, including disposal

Soil (Chlorinated COCs)

- No action
- Excavation, including dewatering and disposal
- *In situ* thermal treatment
- *Ex situ* thermal treatment, including excavation and disposal

Building 401 Drains (COCs)

- No action
- Excavation, including disposal

Groundwater (COCs)

- No action
- Dewatering and disposal
- *In situ* thermal treatment

The various site-wide alternatives were developed with the intent to cover a broad range of actions, from no action to complete removal of all contaminated materials. Emphasis was placed on developing alternatives that provide adequate protection of human health and the environment; achieve ARARs; and permanently and significantly reduce the volume, toxicity, or mobility of site-related constituents. The development of remedial alternatives for the site focused on those alternatives that achieve the RAOs presented in Section 2.1.

The USACE has developed remedial action alternatives for the site in accordance with NCP and U.S. EPA (CERCLA) guidance. Each of the alternatives includes a component to address each of the five media types identified as requiring remedial action. The five remedial alternatives developed are summarized below and presented in **Table 3-1**.

Alternative 1 – No Action

Alternative 2 – Complete Removal

Alternative 3 – Removal with Building Decontamination

Alternative 4 – Removal with Building Decontamination with *In Situ* Remediation

Alternative 5 – Removal with Building Decontamination with *Ex Situ* Remediation

The selected remedial alternative would be implemented following completion of, or in conjunction with, the IWCS removal.

With the exception of the Building 401 foundation where impacts have been confirmed, Building 433 and the foundations identified in the FS were selected based on an evaluation of previous building use, radiation survey results, and/or impacts in adjacent soils. Preremedial work would be required to evaluate impacts to building foundations. If it is determined that the foundations are not impacted, Alternatives 2 and 3 would be the same. The assembled alternatives are described in the following sections.

3.2 Alternative 1 – No Action

Alternative 1 includes no remedial actions for the BOP and Groundwater OUs. The no action alternative provides a baseline against which to compare other remedial alternatives and is required under the NCP (40 CFR §300.430[e][6]). This alternative assumes that no additional remedial actions would be implemented-the site would be left as is. Site security (i.e., fencing) would be left in place but would not be maintained. Continued routine monitoring of air, groundwater, surface water, and sediment would not be performed.

3.3 Alternative 2 – Complete Removal

Alternative 2 consists of excavating all impacted soil and other media that exceeds the FS PRGs and disposing the materials off-site. This includes the excavation and removal of ROC/PAH-contaminated soil, VOC-contaminated soil, Building 401 drains (incidental to removal of Building 401), and ROC-contaminated Building 433, and ROC/PAH-contaminated building foundations. Volatile organic compound-contaminated groundwater in EU4 would be removed via dewatering during the excavation of the impacted soil from that area.

It is noted that because of contamination at depth within the former Building 401 concrete slab, decontamination of the foundation would not be appropriate. The contamination is also widespread, so targeted removal would not be appropriate. Therefore, the entire Building 401 foundation would be removed under each alternative (with the exception of the No Action alternative). Even if the foundation were to remain, there are no plans or drawings that identify the drain system layout. Also, some of the drains were plugged following sampling in 2003. Therefore, cleaning the drains is not a remedial option, nor is targeted removal of the drains. Following the removal of all materials exceeding the FS PRGs, the excavated areas would be backfilled with clean fill and the site would be restored.

Components of this alternative include:

- remediation work plans.
- excavation.
- water collection and control.
- transportation.
- off-site disposal.
- confirmatory sampling.
- site restoration.
- five-year reviews.

Each of the components of this alternative is further described in the following sections.

The estimated duration for this remedial alternative is 28.5 months (24 months for design and plans, 4.5 months for construction).

3.3.1 Remediation Work Plans

The USACE would develop remediation work plans before the initiation of any remedial actions at the site. These plans would detail site preparation activities, the extent of excavation and removal, excavation plans and supports (if required), excavation controls (e.g., dust or emissions controls), dewatering procedures, water handling and disposal procedures, the implementation and sequence of excavation and other construction activities, personnel and equipment decontamination procedures, transportation plans, and disposal plans for the contaminated soil and other media. The plans would be developed with information specific to each of the contaminated media at the site.

The USACE would address the safety of remediation workers, on-site employees, and the general public in a site operations plan along with a site-specific health and safety plan. The health and safety plan would address potential exposures and monitoring requirements for personnel, equipment, and the public to ensure the protection of the remediation workers as well as any potential off-site receptors. Monitoring plans would include analysis and screening for dust, VOCs, and radiation, as well as field screening via instrumentation and monitoring for personnel and equipment.

3.3.2 Excavation

This alternative involves the excavation of impacted soil above FS PRGs and other contaminated site media for disposal at a permitted off-site disposal facility.

Site preparation would include clearing and grubbing of trees and vegetation to allow access to the excavation areas. Excavation supports (e.g., shoring, benching, etc.) and/or dewatering may be required in conjunction with excavation. Standard construction equipment, such as excavators, bulldozers, and front-end loaders, would be used to remove contaminated material. Excavated soil may be processed (e.g., passed through screens) to segregate large stones and other objects present in the material.

The USACE would screen excavated materials in the field for contamination. Clean soil from areas of over-excavation would be stockpiled and later reused as backfill. Impacted soil and debris (e.g., concrete) would be characterized in accordance with the waste acceptance criteria of the disposal facility. The materials would then be transported off-site for disposal. Concrete and oversized debris would be crushed or otherwise processed to meet disposal facility requirements.

For the ROC-impacted soil areas, waste minimization practices such as radiological scanning and soil sorting may be employed to reduce the volume of soil requiring off-site disposal. Excavation activities would be guided by various methods to detect radionuclides including the use of handheld radiation meters, *in situ* gamma spectrometry, and a specific quantity of analytical samples.

The over-excavated soil (i.e., uncontaminated soil physically located over contaminated soil) and cutback soil (i.e., uncontaminated soil excavated to provide adequate sloping and benching to access contaminated soil) would be removed and stockpiled on-site. The USACE would field-screen and sample this soil to demonstrate compliance with ARARs and then use it as backfill on-site.

Other contaminated media at the site would be excavated and removed using a similar approach. Building foundations would be broken using standard hydraulic tools and then loaded into stockpiles for further handling as required by the disposal facility.

Impacted areas, details regarding the associated excavation areas and depths, and estimated volumes are discussed in Section 2.3. **Figure 2-1** identifies the estimated extent of areas requiring remediation. There is an estimated 6,582 m^3 (8,609 yd^3) *in situ* of contaminated soil and concrete (including buildings and building foundations) that exceed the PRGs and require remediation.

3.3.3 Water Collection and Control

Groundwater in the UWBZ at the NFSS can be relatively shallow. Most of the soil impacts are shallow and located above the water table. However, it is expected that some of the ROC and COC excavation areas (e.g., Organic Burial Area in EU7 and VOC plume in EU4) would be deep enough that groundwater may accumulate in the excavation. During the excavation of areas where groundwater is encountered, dewatering would be performed before and/or during the excavation process, until confirmatory soil samples have been collected. The UWBZ has a relatively low yield so groundwater would likely be collected using a combination of sumps and trash pumps.

The USACE would temporarily store collected groundwater on-site (e.g., in a Baker tank) and then sample it as required for discharge. Direct discharge into on-site drainage systems or into nearby municipal sewers would be prohibited. The collected water would be transported to an off-site, licensed facility permitted to accept the waste stream for treatment and/or disposal.

In addition to the dewatering activities, provisions would be made to protect the open excavation areas from the infiltration of surface runoff until confirmatory sampling can be conducted and the areas are released and approved for backfill and restoration.

3.3.4 Transportation

For the purpose of this FS, it is assumed that ROC-impacted soil and other media would be hauled a significant distance from the site by rail to an out-of-state licensed or permitted disposal facility (e.g., Texas, Utah, etc.). The exact location(s) where the material would be disposed of will be dependent upon several factors, including waste classification, the facility's waste acceptance criteria, and the facility's available capacity at the time of remediation.

The ROC-impacted soil and other solid media would be loaded into appropriate shipping containers specifically designed for the transport of ROC-impacted materials. The appropriate shipping documentation would accompany the waste shipment. A regulated and licensed mode of transportation would be used to transport shipping containers along pre-designated routes to the rail loading site, and an emergency response plan would be developed.

Soil and media impacted only by PAHs or VOCs likely can be disposed of at a facility located closer to the site. In that case, the soil would be transported via truck.

3.3.5 Off-Site Disposal

The USACE would dispose of impacted soil and other media at a facility licensed or permitted to accept the characterized waste stream. The selection of an appropriate facility would consider the types of wastes, location, transportation options, and cost.

3.3.6 Confirmatory Sampling

The USACE would conduct confirmatory sampling after the excavation of each impacted area of soil or other impacted media. The purpose of the sampling would be to confirm that all the impacted media above the FS PRGs have been removed to the extent practicable. For ROC impacts, the USACE would develop and implement a Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM)-type final status survey plan. It would detail the radiological screening and sampling to be done in remediated areas prior to backfilling. Confirmatory soil samples would be collected from both the excavation sidewalls and the bottom of the excavation. Soil from the ROC-impacted areas would be minimally analyzed for Ra-226, Th-230, and U-238. A final status survey report would be generated to document the results and that the excavated areas meet the ARARs.

The USACE would minimally analyze confirmation soil samples from COC-impacted areas for VOCs and PAHs to confirm that remaining contaminant concentrations are in compliance with the FS PRGs. Prior to backfilling, as a groundwater polishing step, amendments (e.g., bioremediation agents) would be added to the EU4 VOC plume excavation to enhance degradation of residual dissolved-phase VOCs.

3.3.7 Site Restoration

After confirmatory sampling has shown that an excavation area has met cleanup criteria, the USACE would backfill and seed or repave the area in accordance with the approved site restoration plan. Other disturbed areas of the site (e.g., building foundation areas) would be backfilled and restored to acceptable conditions.

Prior to placement, the backfill materials would be tested to ensure that the material meets the design criteria.

Confirmatory sampling and site restoration would progress area by area to minimize safety concerns, erosion, dust generation, and water collection in the excavation areas. The restoration components and configuration would be designed to ensure general compatibility with potential future actions outlined in a site maintenance plan.

3.3.8 Five-Year Reviews

CERCLA 121 requires five-year reviews when a remedial action leaves hazardous substances on a site at levels that do not allow for unlimited use and unrestricted exposure. Unlimited use and unrestricted exposure mean that there are no restrictions placed on the potential use of land or other natural resources. Five-year reviews are used to determine whether the remedy is still protective of human health and the environment. Because contaminants would remain at NFSS at levels that would not allow for unlimited use and unrestricted exposure, five-year reviews would be required. A 1,000-year duration is assumed for the five-year reviews.

3.4 Alternative 3 – Removal with Building Decontamination

Alternative 3 consists of excavating all impacted soil at the site that exceeds the FS PRGs and disposing of the materials off-site. This includes the excavation and removal of ROC/PAH-contaminated soil and VOC-contaminated soil. The Building 401 foundation, including drains, would be removed. Volatile organic compound-contaminated groundwater in EU4 would be removed via dewatering ancillary to the excavation of the impacted soil. Following the removal of all soil and media exceeding the FS PRGs, the excavated areas would be backfilled, and the site would be restored.

The Building 430, 431/432, and 433 foundations would be left in place, but the USACE would decontaminate them to remove the risk associated with these media.

Components of this alternative include:

- remediation work plans.
- excavation.
- foundation scarification.
- water collection and control.
- transportation.
- off-site disposal.
- confirmatory sampling.
- site restoration.
- five-year reviews.

Each of the components of this alternative is further described in the following sections.

The estimated duration for this remedial alternative is 28.5 months (24 months for design and plans, 4.5 months for construction).

3.4.1 Remediation Work Plans

The USACE would develop remediation work plans as discussed in Alternative 2.

3.4.2 Excavation

The USACE would excavate as discussed for Alternative 2 with the exception that the Buildings 430, 431/432, and 433 foundations would not be removed. The Building 401 foundation and drains would be removed.

There is an estimated 1,529 m^3 (2,000 yd^3) *in situ* of ROC- and PAH-contaminated soil, 764 m^3 (1,000 yd^3) of soil and concrete in the trench adjacent to Building 431/432, 556 m^3 (727 yd^3) of concrete from the Building 401 foundation, and 2,600 m^3 (3,400 yd^3) of VOC-contaminated soil that exceeds the FS PRGs for the site. These materials require remediation.

3.4.3 Foundation Scarification

Under Alternative 3, the Building 430, 431/432, and 433 foundations would remain in place, but the concrete slabs would be decontaminated to remove radiological contamination. The total area of the building slabs to be remediated is estimated to be 4,973 square meters (53,510 square feet). The thickness of the concrete slabs is assumed to be approximately 0.3 m (1 ft); however, the ROC contamination is likely present only in the surface layer of the concrete.

Physical decontamination techniques for concrete include scarification technologies such as shaving, grinding, and spalling (see **Figure 3-1**). A concrete shaving system is assumed for the purpose of this FS. Either self-propelled electric units or skid steer-mounted units are available. The shaver consists of a rotating cutting head with diamond-impregnated cutting blades. The shaving unit would be driven across the building foundations to remove the surface layer (approximately 0.6 cm [0.25 in]) of the concrete; variable shaving depths are available but conservatively the top 1.2 cm (0.5 in) of the slab is assumed to be removed for this FS. The actual thickness removed to achieve the FS PRGs may be significantly less. The USACE would conduct a radiological contamination survey in accordance with MARSSIM after treatment to determine if the building foundation slab meets FS PRGs or if additional surface removal is necessary.

The technique is a dry decontamination method and no water or chemicals are required. A dust collection shroud attaches to the device to collect and control the concrete dust and debris. Both the filters and the collected dust and debris would be radiologically surveyed and sampled prior to disposal. Compared to complete foundation removal, using the decontamination techniques, the total volume of contaminated building foundation material for disposal would be decreased by more than 95 percent.

3.4.4 Water Collection and Control

Collection and disposal of groundwater from the excavation would be performed as discussed for Alternative 2.

3.4.5 Transportation

The USACE would transport impacted materials as discussed for Alternative 2.

3.4.6 Off-Site Disposal

Impacted soil and groundwater would be disposed of at a facility licensed or permitted to accept the characterized waste streams. The selection of an appropriate facility would consider the types of wastes, location, transportation options, and cost.

3.4.7 Confirmatory Sampling

Confirmatory soil sampling would be conducted as discussed for Alternative 2. Confirmation sampling of the building foundations would be performed through gamma surveys of the foundation surface and the collection and laboratory analysis of surficial concrete.

3.4.8 Site Restoration

Site restoration would be conducted as discussed for Alternative 2. However, the decontaminated building foundations would remain in place and would not require further restoration.

3.4.9 Five-Year Reviews

Five-year reviews would be the same as discussed for Alternative 2.

3.5 Alternative 4 – Removal with Building Decontamination and *In Situ* Remediation

Alternative 4 consists of excavating all ROC, PAH-, and VOC-(EU13) impacted materials and soil that exceeds the FS PRGs and disposing the materials off-site. Following the removal of all ROC, PAH, and VOC (EU13) materials exceeding the FS PRGs, the excavated areas would be backfilled, and the site would be restored. The Building 401 foundation and drains would be removed. Volatile organic compound-contaminated soil and groundwater in EU4 would be treated via *in situ* thermal treatment methods.

The Building 430, 431/432, and 433 foundations would be left in place, but would be decontaminated (scarified) to remove the risk associated with these media.

Components of this alternative include:

- remediation work plans.
- ROC, PAH, and EU13 soil excavation.
- *in situ* EU4 VOC plume soil and groundwater treatment.

- foundation scarification.
- water collection and control.
- transportation.
- off-site disposal.
- confirmatory sample collection and analysis.
- site restoration.
- five-year reviews.

Each of the components of this alternative is further described in the following sections.

The estimated duration for this remedial alternative is 37 months (24 months for design and plans, 13 months for construction).

3.5.1 Remediation Work Plans

Remediation work plans would be developed as discussed in Alternative 2.

3.5.2 Excavation

Excavation would be performed as discussed in Alternative 2. However, the 2,600 m^3 (3,400 yd^3) of VOC plume soil would not be excavated but treated *in situ*.

3.5.3 *In Situ* Soil and Groundwater Treatment

Thermal (desorption) treatment would consist of using high temperatures to volatilize and help physically separate VOC contamination from soil and groundwater (see **Figure 3-2**). Thermal desorption would be performed using either Thermal Conduction Heating or ERH. Both systems would require the installation of a network of electrical resistance probes or heating electrodes and a system to collect and treat off-gases. A final step in the thermal treatment process would be destruction of VOCs collected in off-gases.

Energy demand for *in situ* treatment would be high. However, following successful treatment, formerly impacted soil and groundwater would remain on-site and not require off-site disposal. Confirmation sampling would be performed to demonstrate successful treatment of the soil and groundwater.

3.5.4 Foundation Scarification

Building foundation scarification would be the same as discussed for Alternative 3.

3.5.5 Water Collection and Control

Water collection and control would be performed as discussed in Alternative 2.

3.5.6 Transportation

Transportation would be performed as discussed in Alternative 2.

3.5.7 Off-Site Disposal

Impacted materials disposal would be performed as discussed in Alternative 2.

3.5.8 Confirmatory Sampling

Confirmatory sampling would be performed as discussed in Alternative 2.

3.5.9 Site Restoration

Site restoration would be performed as discussed in Alternative 2.

3.5.10 Five-Year Reviews

Five-year reviews would be the same as discussed for Alternative 2.

3.6 Alternative 5 – Removal with Building Decontamination and *Ex Situ* Remediation

Alternative 5 consists of excavating all ROC, PAH, and VOC (EU13) impacted materials and soil that exceed the FS PRGs and disposing of the materials off-site. Following the removal of soil exceeding the FS PRGs, the excavated areas would be backfilled, and the site would be restored. The Building 401 foundation and drains would be removed. The VOC plume soil would be excavated and treated via *ex situ* thermal treatment methods. A final step in the thermal treatment process would be destruction of VOCs collected in off-gases.

Following successful treatment, the soil would remain on-site. Groundwater would not be treated on-site but taken off-site for treatment/disposal.

The Building 430, 431/432, and 433 foundations would be left in place, but would be decontaminated to remove the risk associated with these media.

Components of this alternative include:

- remediation work plans.
- ROC, PAH, and EU13 soil excavation.
- *ex situ* EU4 VOC plume soil and groundwater treatment.
- foundation scarification.
- water collection and control.
- transportation.
- off-site disposal.
- confirmatory sample collection and analysis.

- site restoration.
- five-year reviews.

Each of the components of this alternative is further described in the following sections.

The estimated duration for this remedial alternative is 37 months (24 months for design and plans, 13 months for construction).

3.6.1 Remediation Work Plans

Remediation work plans would be developed as discussed in Alternative 2.

3.6.2 Excavation

Excavation would be performed as discussed in Alternative 2.

Impacted areas, details regarding the associated excavation areas and depths, and estimated volumes are discussed in Section 2.3.

This alternative assumes that the EU4 VOC plume soil treated *ex situ* would meet the FS PRGs and therefore would be reused on-site. However, it is assumed the VOC plume excavation would be backfilled with clean, imported fill instead of leaving the excavation open during the *ex situ* treatment process.

3.6.3 *Ex Situ* Soil Treatment

Ex situ treatment would require excavation of impacted soil and recovery and off-site treatment/disposal of impacted groundwater. Excavated soil would be transferred to an on-site treatment area where a network of heating pipelines would be used to heat and volatilize the impacted soil (see **Figure 3-3**). The treatment system would require off-gas collection and treatment. A final step in the thermal treatment process would be destruction of VOCs collected in off-gases. Confirmation sampling would be performed to demonstrate successful treatment of the soil.

Prior to backfilling, as a groundwater polishing step, amendments (e.g., bioremediation agents) would be added to the EU4 VOC plume excavation to enhance degradation of residual dissolved-phase VOCs.

3.6.4 Foundation Scarification

Building foundation scarification would be the same as discussed for Alternative 3.

3.6.5 Water Collection and Control

Water collection and control would be performed as discussed in Alternative 2.

3.6.6 Transportation

Transportation would be performed as discussed in Alternative 2.

3.6.7 Off-Site Disposal

Impacted materials, excluding the VOC plume soil to be treated on-site, would be performed as discussed in Alternative 2.

3.6.8 Confirmatory Sampling

Confirmatory sampling would be performed as discussed in Alternative 2. In addition, soil treated *ex situ* would be sampled and analyzed to confirm success of the treatment process.

3.6.9 Site Restoration

Site restoration would be performed as discussed in Alternative 2.

3.6.10 Five-Year Reviews

Five-year reviews would be the same as discussed for Alternative 2.

4 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

4.1 Introduction

This section presents a detailed analysis of the five site-wide remedial action alternatives that were developed in Section 3. From this set of alternatives, one would ultimately be chosen as the preferred remedy for the site. Under the CERCLA remedy selection process, the preferred remedial alternative is presented in the proposed plan and the selected remedial alternative is set forth in final form in the ROD after community and state review. A detailed evaluation of each alternative is performed in this section to provide the basis and rationale for identifying a preferred remedy and preparing the proposed plan.

To ensure the FS analysis provides information of sufficient quality and quantity to justify the selection of a remedy, it must meet the requirements of the remedy selection process. This process is driven by the requirements set forth in CERCLA Section 121. In accordance with these requirements (U.S. EPA 1988), remedial actions must:

- be protective of human health and the environment.
- attain ARARs or provide grounds for justifying a waiver.
- be cost effective.
- use permanent solutions and alternative treatment technologies to the maximum extent practicable.
- satisfy the preference for treatment that reduces volume, toxicity, or mobility.

CERCLA emphasizes long-term effectiveness and related considerations for each remedial alternative. These considerations include:

- long-term uncertainties associated with land disposal.
- the goals, objectives, and requirements of the Solid Waste Disposal Act.
- the persistence, toxicity, and mobility of hazardous substances, and their propensity to bioaccumulate.
- short- and long-term potential for adverse health effects from human exposure.
- long-term maintenance costs.
- the potential for future remedial action costs if the remedial alternative in question were to fail.
- the potential threat to human health and the environment associated with excavation, transportation, and re-disposal, or containment.
- state acceptance.
- community acceptance.

These concerns are applied through the use of nine evaluation criteria presented in the NCP. These criteria are grouped into threshold criteria, balancing criteria, and modifying criteria. Section 4 provides a detailed analysis of each alternative using each of the evaluation criteria. The analysis includes a definition of each alternative and, where necessary, a more precise description of the volumes or areas of contaminated media or technologies. Following this detailed analysis is a comparative analysis of the alternatives in Section 5 that evaluates how each alternative would perform with respect to each other.

4.1.1 Threshold Criteria

Two of the NCP evaluation criteria relate directly to statutory findings that must be made in the ROD. These criteria are thus considered threshold criteria that must be met by any remedy selected. The criteria are:

- overall protection of human health and the environment.
- compliance with ARARs.

Each alternative must be evaluated to determine whether it achieves and maintains protection of human health and the environment. An alternative is considered protective of human health and the environment if it complies with media-specific cleanup goals. Similarly, each remedial alternative must be assessed to determine whether it complies with ARARs, or if a waiver is required, and an explanation of why a waiver is justified.

4.1.2 Balancing Criteria

The five balancing criteria represent the primary criteria upon which the detailed analysis and comparison of alternatives are based. These criteria include:

- long-term effectiveness and permanence.
- reduction of toxicity, mobility, or volume through treatment.
- short-term effectiveness.
- implementability.
- cost.

Long-term effectiveness and permanence is an evaluation of the magnitude of residual risk (risk remaining after implementation of the alternative) and the adequacy and reliability of controls used to manage the remaining waste (untreated waste and treatment residuals) over the long term. Alternatives that provide the highest degree of long-term effectiveness and permanence leave little or no untreated waste at the site and make long-term maintenance and monitoring unnecessary.

Reduction of toxicity, mobility, or volume through treatment emphasizes the statutory preference for alternatives that result in such reduction. The irreversibility of the treatment process and the type and quantity of residuals remaining after treatment are also assessed.

Short-term effectiveness addresses the protection of workers and the community during the remedial action, the environmental effects of implementing the action, and the time required to achieve media-specific cleanup goals.

Implementability addresses the technical and administrative feasibility of implementing an alternative and the availability of various services and materials required during implementation. Technical feasibility means the ability to construct and operate a technology, the reliability of the technology, the ease in undertaking additional remedial actions, and the ability to monitor the effectiveness of the alternative. Administrative feasibility is the ability to obtain approval from federal, state, and local agencies.

Cost analyses evaluate the capital and annual O&M costs of each alternative, as well as the total present worth of the capital and O&M costs. Capital costs consist of design and construction costs. The O&M costs consist of the post-construction costs necessary to ensure the continued effectiveness of the remedy. These costs include remedial action operating costs, costs associated with maintenance, and the cost of performance evaluations and monitoring. For five-year reviews, a period of 1,000 years was used for cost estimation purposes. The cost estimates are for guidance in project evaluation and implementation. They are believed to be accurate within a range of –30 percent to +50 percent in accordance with U.S. EPA guidance (U.S. EPA 1988). Actual costs could be higher than estimated due to unexpected site conditions or potential delays. The FS cost estimates for the BOP and Groundwater OUs' remedial alternatives include estimated contingency dollars to account for unknown or unplanned circumstances that could occur as cleanup decisions proceed. It is not typical to include contingency dollars at the FS stage; however, due to the importance of remediation costs in the decision process, it was deemed necessary to more accurately forecast project budget and schedule early in the process.

To improve USACE's ability to communicate uncertainty associated with remediation costs, the USACE Great Lakes and Ohio River Division identified a method of identifying, analyzing, and accounting for a wide range of risks that can affect a project's cost and schedule, referred to as cost and schedule risk analysis. The BOP and Groundwater OU cost and schedule risk analysis was prepared in accordance with the following guidance:

- Cost and schedule risk analysis guidance prepared by the Cost Engineering Mandatory Center of Excellence/Technical Expertise
- Memorandum from Major General Don T. Riley (US Army Director of Civil Works), dated July 3, 2007
- Engineering and Construction Bulletin issued by James C. Dalton, P.E. (Chief, Engineering and Construction, Directorate of Civil Works), dated September 10, 2007
- Engineering Regulation 1110-2-1150, dated August 31, 1999
- Engineering Regulation 1110-2-1302, dated September 15, 2008

The process for identifying contingency dollars in the cost and schedule risk analysis process included the following steps:

1. Identify project risks associated with each alternative using a multidisciplinary team of professionals.

2. Categorize the risks based on A) the likelihood of occurrence, ranging from "very unlikely" to "very likely"; and B) the potential impact of the occurrence, ranging from "negligible" to "crisis".

3. Rank risks as either "low," "moderate," or "high" based on likelihood and impact.

4. Identify the quantitative impacts of the risks using available statistical information about the potential costs (e.g., what is the range and most likely cost value for a given cost variable?).

5. Perform a Monte Carlo computer simulation to determine the cumulative impact of the various risks.

6. Based on USACE guidance, identify the 80 percent confidence level for each alternative to serve as criteria for identifying needed contingency.

4.1.3 Modifying Criteria

The two modifying criteria below would be evaluated as part of the ROD after the public has had an opportunity to comment on the proposed plan. They are:

- state acceptance.
- community acceptance.

State acceptance considers comments received from agencies of NY State. The primary state agency supporting this RI/FS process is the NYSDEC. Community acceptance considers comments made by the community, including stakeholders, on the alternatives being considered.

Because state and community review of the preferred alternative has not yet taken place, the detailed analysis of alternatives presented below cannot account for these criteria at this time. Therefore, the detailed analysis is carried out only for the first seven of the nine criteria. The preferred alternative would be presented to the public during a public meeting(s) and again in the proposed plan for review and comment. Public input on the remedial alternatives is important in the selection process. Based on the comments received, the preferred remedy may be modified, or another remedy may be selected.

The final remedy would be formalized in a ROD.

4.2 Detailed Analysis of Remedial Alternatives

This section presents a detailed analysis of the retained remedial alternatives. Each of the remedial alternatives is described below and evaluated against seven of the nine CERCLA criteria outlined in Sections 4.1.1 and 4.1.2. Results of the detailed analysis of the remedial alternatives are summarized in **Table 4-1**.

4.2.1 Alternative 1 – No Action

In accordance with the NCP, the No Action alternative is developed. This action is considered by U.S. EPA to equate with baseline conditions and defines baseline conditions (and baseline risk) to be those "associated with a site in the absence of any remedial action or control" (National Oil and Hazardous Substances Pollution Contingency Plan 55 Federal Register 8666). "No Action" is intended to account for maximum potential exposure, which means that exposure could be experienced in the absence of any form of active control (federal or otherwise).

Under Alternative 1, No Action, no remedial actions would be taken. The residues and waste materials in the BOP and Groundwater OUs would be left as-is, without the implementation of any other GRA, such as LUCs or any containment, removal, treatment, or other mitigating actions. No Action also would not provide other access controls (e.g., physical barriers and deed restrictions) to reduce the potential for exposure. All existing site controls, routine environmental monitoring, and maintenance activities would cease. Because no actions would be taken, the No Action alternative has no remedial components.

The BRA identified COCs and ROCs which are constituents that exceed target cancer risk levels of 10^{-5} (if total risk exceeds 10^{-4}) or a noncancer risk threshold of a HI greater than 1. Radionuclides that present a dose greater than 2.5 mrem/yr (if total dose exceeds 25 mrem/yr) were also identified as ROCs. The BRA considered all potential current and future exposure pathways; however, for this FS, the potential receptors under the current and reasonably anticipated future land use scenario (i.e., industrial) was limited to adult and adolescent trespassers, construction workers, maintenance workers, and industrial workers and selection of the construction worker as the representative critical group resulted in the most comprehensive list of ROCs and COCs and the most conservative cleanup goals.

4.2.1.1 Overall Protection of Human Health and the Environment

Alternative 1 would not meet any of the RAOs developed for the site for the purpose of protecting human health and the environment. Since no remedial action would be implemented, this alternative would not comply with any of the media-specific cleanup goals that were developed, and therefore is not considered protective of human health and the environment. Under Alternative 1, the exposure from direct contact, ingestion, and inhalation would continue and could increase since current access control measures (such as the existing site security fence) would not be maintained and no additional controls would be implemented. The potential for human exposure to FUSRAP-related materials and the potential for off-site migration could increase over time as a result of disturbances by humans and natural processes.

As discussed in Section 1.7 above, the BRA considered potential risks to on-site receptors for industrial land use including adult and adolescent trespassers, construction workers, maintenance workers, and industrial workers. All of these risks would remain in place or possibly increase under Alternative 1.

4.2.1.2 Compliance with ARARs

Alternative 1 does not comply with the ARARs. Because no remedial action would be implemented, current conditions would not change and the media containing contamination above the concentrations specified in the ARARs would not be addressed.

4.2.1.3 Long-Term Effectiveness and Permanence

Alternative 1 would allow contaminated soil, groundwater, and other media to remain on-site. There would be no reduction in the risks associated with the site-related contamination. Future risks would increase since the existing site controls would not be maintained and no additional controls would be implemented. The potential for human exposure to the site contaminants could increase over time due to contaminant migration due to disturbances by humans and other natural processes.

4.2.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

No reduction of contaminant toxicity, mobility, or volume is achieved because no remedial actions are proposed under Alternative 1.

4.2.1.5 Short-Term Effectiveness

There are no short-term risks associated with Alternative 1 beyond the existing baseline conditions. There would be no additional short-term health risks to the community, site workers, or the environment since no remedial actions would be implemented.

4.2.1.6 Implementability

There are no technical implementability concerns associated with Alternative 1 since no construction, operation, or other actions would occur under this alternative.

This alternative would be difficult to implement from an administrative standpoint. It is unlikely that this alternative would be supported by any agencies due to the uncontrolled risks that would remain at the site.

4.2.1.7 Cost

This alternative is the baseline scenario and requires no action. Therefore, the capital, annual O&M and total present value costs of this alternative are all considered to be $0.

4.2.2 Alternative 2 – Complete Removal

Alternative 2 consists of excavating all impacted soil and other media at the site that exceeds the FS PRGs and disposing the materials off-site. This includes the excavation and removal of the ROC/PAH-contaminated soil, VOC plume soil, Building 433, the contaminated building foundations, and the Building 401 foundation and drains. Volatile organic compound plume groundwater in EU4 would be removed via dewatering ancillary to the excavation of the impacted soil from that area of the site. Amendments would be added to the EU4 VOC plume excavation prior to backfilling to enhance degradation of residual, dissolved-phase impacts.

Following the removal of all materials exceeding the FS PRGs, the excavated areas would be backfilled, and the site would be restored to promote ALARA.

4.2.2.1 Overall Protection of Human Health and the Environment

Under Alternative 2, the USACE would excavate and remove from site all soil, groundwater, and media containing contamination above the FS PRGs. Removing the contaminated media would meet all of the RAOs developed for the site and therefore is considered protective of human health and the environment.

4.2.2.2 Compliance with ARARs

Alternative 2 would comply with 10 CFR Part 40, Appendix A, Criterion 6(6) since all impacted soil and building foundations containing contamination above the FS PRGs would be excavated and removed or decontaminated to remove the impacted media from the site.

Alternative 2 would also comply with the 40 CFR 761.61 (TSCA) cleanup level for PCBs, industrial use SCOs in 6 NYCRR Part 375-6.8 for PAHs, as well as site-specific risk-based SCOs for soil and groundwater.

4.2.2.3 Long-Term Effectiveness and Permanence

The excavation and removal of the contaminated soil, groundwater, and other media under Alternative 2 is considered highly effective in the long-term and would permanently reduce on-site exposures. Any residual contaminated soil, groundwater, and other media at the site would be at concentrations below the FS PRGs.

4.2.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 2 does not include any treatment components; all of the contaminated materials would be excavated and removed from the site. However, the excavation plans would be developed with waste minimization procedures such as radiological scanning and soil sorting with the intent to minimize the total volume of waste removed and requiring off-site disposal. Clean overburden and cutback soil would be sampled and stockpiled separately from the soil for disposal.

4.2.2.5 Short-Term Effectiveness

The duration for Alternative 2 is estimated as 28.5 months (24 months for design and plans and 4.5 months for construction). Due to the significant amount of intrusive work associated with complete excavation, handling, and transportation of all contaminated soil, groundwater, and media under Alternative 2, the protection of workers and the community would be of utmost priority with this remedial action. A site operations plan, site-specific health and safety plan, transportation plan, and other documents would be developed to outline procedures for safe completion of the work and for monitoring plans to ensure the safety of remediation workers and the general public. Most of the short-term risks can be addressed through relatively simple means such as dust control and air monitoring. The risks would mainly be present for the duration of the intrusive remedial activities. Once the impacted materials are removed from the site, there would be no further risk.

4.2.2.6 Implementability

No specialized equipment, personnel, or services are required to implement Alternative 2. Soil excavation, transport, and disposal activities use readily available resources and conventional earth-moving equipment. Dewatering and excavation controls are expected to be minimal and fairly simple to implement, if required. No treatment (e.g., stabilization) of soils to reduce moisture content and facilitate shipping is anticipated.

Possible challenges with this alternative could arise with the excavation of the concrete building foundations, including the Building 401 floor drains. These items may require deeper excavation (in the case of the subsurface floor drains). The construction of the foundations is not well known and could present challenges.

No administrative problems are anticipated that would limit the implementability of Alternative 2.

This alternative would require some coordination of remediation activities (e.g., transportation) with the local authorities to minimize health and safety risks to on-site personnel and the community, but it is expected that this would be successfully accomplished.

4.2.2.7 Cost

The estimated cost to implement Alternative 2 is:

Capital Cost:	$23,814,326
O&M Cost:	$ 414,153
Contingency Cost:	$11,440,418
Total Cost:	$35,668,897

The capital costs include preparation of a remedial design work plan, excavation, confirmatory sampling, transport, off-site disposal, site restoration, preparation of a remedial action completion report, and other components. The remedial construction duration for Alternative 2 is estimated as 4.5 months.

The O&M costs include implementing five-year reviews over a 1,000-year duration.

Contingency costs were developed through an abbreviated risk analysis conducted by USACE. The abbreviated risk analysis involves developing a risk register for each remedial alternative, evaluating risk by likelihood and impact, and producing a contingency percentage for the individual alternative cost estimates. A more detailed discussion of the abbreviated risk analysis is included with the detailed cost estimate information provided in **Appendix F**.

4.2.3 Alternative 3 – Removal with Building Decontamination

Alternative 3 consists of excavating all impacted soil at the site that exceeds the FS PRGs and disposing the materials off-site. This includes the excavation and removal of the ROC-, PAH-, and VOC-contaminated soil. VOC-contaminated groundwater would be removed via dewatering ancillary to the excavation of the impacted soil from that area of the site. Following the removal of all soil exceeding the FS PRGs, the excavated areas would be backfilled, and the site would be restored.

The Building 430, 431/432 foundations and Building 433 and its foundation would be left in place but would be decontaminated to remove the risk associated with these media. The Building 401 foundation and drains would be removed.

4.2.3.1 Overall Protection of Human Health and the Environment

Under Alternative 3, soil and groundwater containing contamination above the FS PRGs would be excavated and removed from the site. Additionally, the building foundations would be decontaminated, with the contaminated building foundation surface materials being collected and taken off-site for disposal. Contamination in the Building 401 foundation and drains would be removed and taken off-site for disposal.

Alternative 3 would meet all of the RAOs developed for the site and therefore is considered protective of human health and the environment.

4.2.3.2 Compliance with ARARs

Alternative 3 would comply with 10 CFR Part 40, Appendix A, Criterion 6(6) since all impacted soil and building foundations containing contamination above the PRGs would be excavated and removed or decontaminated to remove the impacted media from the site.

Alternative 3 would also comply with the 40 CFR 761.61 (TSCA) cleanup level for PCBs, industrial use SCOs in 6 NYCRR Part 375-6.8 for PAHs, as well as site-specific risk-based SCOs for soil and groundwater.

4.2.3.3 Long-Term Effectiveness and Permanence

The excavation and removal of all contaminated soil and groundwater, and the majority of the contaminated media under Alternative 3 is considered highly effective in the long-term and would permanently reduce on-site exposures.

4.2.3.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Under Alternative 3, most of the contaminated soil would be excavated and removed from the site. The excavation plans would be developed with waste minimization procedures such as radiological scanning and soil sorting with the intent to minimize the total volume of waste removed and requiring off-site disposal. Clean overburden and cutback soil would be sampled and stockpiled separately from the soil for disposal.

4.2.3.5 Short-Term Effectiveness

The duration for Alternative 3 is estimated as 28.5 months (24 months for design and plans and 4.5 months for construction). Due to the significant amount of intrusive work associated with complete excavation, handling, and transportation of all contaminated soil under Alternative 3, in addition to the concrete scarification, the protection of workers and the community would be of utmost priority with this remedial alternative. A site operations plan, site-specific health and safety plan, transportation plan, and other documents would be developed to outline procedures for safe completion of the work and for monitoring plans to ensure the safety of remediation workers and the general public. Most of the short-term risks can be addressed through relatively simple means such as dust control and air monitoring. The risks would mainly be present for the duration of the intrusive remedial activities. Once the impacted materials are removed from the site, there would be no further risk.

4.2.3.6 Implementability

No specialized equipment, personnel, or services are required to implement Alternative 3. Soil excavation, transport, and disposal activities use readily available resources and conventional earth-moving equipment. Dewatering and excavation controls are expected to be minimal and fairly simple to implement, if required.

Equipment and services required for the concrete scarification are relatively available since the same equipment and services are also used outside of the remediation industry.

No administrative problems are anticipated that would limit the implementability of Alternative 3.

This alternative would require some coordination of remediation activities (e.g., transportation) with the local authorities to minimize health and safety risks to on-site personnel and the community, but it is expected that this would be successfully accomplished.

4.2.3.7 Cost

The estimated cost to implement Alternative 3 is:

Capital Cost:	$17,557,536
O&M Cost:	$ 414,153
Contingency Cost:	$ 6,564,779
Total Cost:	$24,536,468

The capital costs include preparation of a remedial design work plan, excavation, confirmatory sampling, transport, off-site disposal, site restoration, preparation of a remedial action completion report, and other components. The remedial construction duration for Alternative 3 is estimated as 4.5 months.

The O&M costs include implementing five-year reviews over a 1,000-year duration.

Contingency costs were developed through an abbreviated risk analysis conducted by USACE. The abbreviated risk analysis involves developing a risk register for each remedial alternative, evaluating risk by likelihood and impact, and producing a contingency percentage for the individual alternative cost estimates. A more detailed discussion of the abbreviated risk analysis is included with the detailed cost estimate information provided in **Appendix F**.

4.2.4 Alternative 4 – Removal with Building Decontamination and *In Situ* Remediation

Alternative 4 consists of excavating all ROC-, PAH-, and VOC-contaminated soil (excluding the EU4 VOC plume soil) at the site that exceeds the FS PRGs and disposing the materials off-site. Following the removal of all ROC and PAH soil exceeding the FS PRGs, the excavated areas would be backfilled, and the site would be restored. Volatile organic compound plume soil and groundwater would be treated via *in situ* thermal treatment methods. Construction O&M would only be required during active *in situ* remediation to ensure proper operation of the remediation system components.

The Building 430, 431/432 foundations, and Building 433 and its foundation would be left in place but would be decontaminated to remove the risk associated with these media. The Building 401 foundation and drains would be removed.

4.2.4.1 Overall Protection of Human Health and the Environment

Under Alternative 4, all ROC, PAH, and non-EU4 VOC plume soil containing contamination above the FS PRGs would be excavated and removed from the site. Exposure Unit 4 VOC plume soil and groundwater would be treated to reduce contaminant concentrations to below the FS PRGs via *in situ* thermal treatment and site restoration.

Additionally, the building foundations would be decontaminated, with the impacted layer of the concrete being collected and taken off-site for disposal.

Alternative 4 would meet all of the RAOs developed for the site and therefore is considered protective of human health and the environment.

4.2.4.2 Compliance with ARARs

Alternative 4 would comply with 10 CFR Part 40, Appendix A, Criterion 6(6) since all ROC-impacted soil and building foundations containing contamination above the FS PRGs would be excavated and removed or decontaminated to remove the impacted media from the site.

Exposure Unit 4 VOC plume soil and groundwater would be remediated to concentrations below the site-specific risk-based criteria. Soil containing PAHs above the Part 375 criteria would be excavated and removed from the site. Building foundations would be remediated to comply with the 40 CFR 761.61 (TSCA) cleanup level for PCBs.

4.2.4.3 Long-Term Effectiveness and Permanence

The excavation and removal of all ROC, PAH, and EU13 VOC-impacted soil, and the majority of the contaminated media under Alternative 4 is considered highly effective in the long-term and would permanently reduce on-site exposures. With off-site destruction of off-gases, in situ treatment of the EU4 VOC plume soil and groundwater would also be highly effective and permanent in reducing contaminant concentrations. Residual contaminated soil and media at the site would be at concentrations below the FS PRGs.

4.2.4.4 Reduction of Toxicity, Mobility, or Volume through Treatment

In situ thermal treatment of the EU4 VOC plume soil and groundwater would reduce the toxicity to acceptable levels. The volume of soil requiring off-site treatment and disposal would be reduced accordingly.

Under Alternative 4, ROC and PAH, and EU13 VOC-impacted soil would be excavated and removed from the site. The excavation plans would be developed with waste minimization procedures such as radiological scanning and soil sorting with the intent to minimize the total volume of waste removed and requiring off-site disposal. Clean overburden and cutback soil would be sampled and stockpiled separately from the soil for disposal.

4.2.4.5 Short-Term Effectiveness

The duration for Alternative 4 is estimated as 37 months (24 months for design and plans and 13 months for construction). Due to the significant amount of intrusive work associated with excavation, handling, and transportation of all ROC and PAH-contaminated soil under Alternative 4, in addition to the *in situ* thermal treatment of the VOC-contaminated soil and groundwater, and the concrete scarification, the protection of workers and the community would be of utmost priority with this remedial alternative. A site operations plan, site-specific health and safety plan, transportation plan, and other documents would be developed to outline procedures for safe completion of the work and for monitoring plans to ensure the safety of remediation workers and the general public. Most of the short-term risks can be addressed through relatively simple means such as dust control, vapor and emissions controls, and air monitoring. The risks would mainly be present for the duration of the intrusive remedial activities and vapor and emission collection during *in situ* remediation activities. Once the impacted materials are removed from the site, there would be no further risk.

4.2.4.6 Implementability

Implementation of *in situ* thermal treatment should not be difficult but is somewhat limited since only a few vendors perform this type of remedial work and use specialized equipment. In addition, there are high energy demands associated with this alternative.

No specialized equipment, personnel, or services are required to implement soil excavation, transport, and disposal activities for Alternative 4. The required resources are readily available and use conventional earth-moving equipment. Dewatering and excavation controls are expected to be minimal and fairly simple to implement, if required.

Equipment and services required for concrete scarification are relatively available since the same equipment and services are also used outside of the remediation industry.

No administrative problems are anticipated that would limit the implementability of Alternative 4.

This alternative would require some coordination of remediation activities (e.g., transportation) with the local authorities to minimize health and safety risks to on-site personnel and the community, but it is expected that this would be successfully accomplished.

4.2.4.7 Cost

The estimated cost to implement Alternative 4 is:

Capital Cost:	$17,180,164
O&M Cost:	$ 414,153
Contingency Cost:	$ 5,320,836
Total Cost:	$22,915,153

The capital costs include preparation of a remedial design work plan, excavation, confirmatory sampling, transport, off-site disposal, site restoration, preparation of a remedial action completion report, and other components. The remedial construction duration for Alternative 4 is estimated as 13 months.

The O&M costs include implementing five-year reviews over a 1,000-year duration.

Contingency costs were developed through an abbreviated risk analysis conducted by USACE. The abbreviated risk analysis involves developing a risk register for each remedial alternative, evaluating risk by likelihood and impact, and producing a contingency percentage for the individual alternative cost estimates. A more detailed discussion of the abbreviated risk analysis is included with the detailed cost estimate information provided in **Appendix F**.

4.2.5 Alternative 5 – Removal with Building Decontamination and *Ex Situ* Remediation

Alternative 5 consists of excavating all ROC- and PAH-impacted soil and EU13 VOC-impacted soil at the site that exceeds the FS PRGs and disposing the materials off-site. Following the removal of all soil exceeding the FS PRGs, the excavated areas would be backfilled, and the site would be restored. Exposure Unit 4 VOC plume soil and groundwater would be excavated and treated via *ex situ* thermal treatment methods.

The Building 430, 431/432 foundations, and Building 433 and its foundation would be left in place but would be decontaminated to remove the risk associated with these media. The Building 401 foundation and drains would be removed.

4.2.5.1 Overall Protection of Human Health and the Environment

Under Alternative 5, all ROC- and PAH-impacted soil and EU13 VOC-impacted soil containing contamination above the PRGs would be excavated and removed from the site. Exposure Unit 4 VOC plume soil and groundwater would be excavated and treated on-site to reduce contaminant concentrations to below the FS PRGs via *ex situ* thermal treatment.

Additionally, the building foundations would be decontaminated, with the impacted layer of the concrete being collected and taken off-site for disposal.

Alternative 5 would essentially meet all of the RAOs developed for the site and therefore is considered protective of human health and the environment.

4.2.5.2 Compliance with ARARS

Alternative 5 would comply with 10 CFR Part 40, Appendix A, Criterion 6(6) since all FS ROC-impacted soil and building foundations containing contamination above the FS PRGs would be excavated and removed or decontaminated to remove the impacted media from the site.

Exposure Unit 4 VOC plume soil and groundwater and EU13 VOC-impacted soil would be remediated to concentrations below the site-specific risk-based criteria. Soil containing PAHs above Part 375 criteria would be excavated and removed from the site. Building foundations would be remediated to comply with the 40 CFR 761.61 (TSCA) cleanup level for PCBs.

4.2.5.3 Long-Term Effectiveness and Permanence

The excavation and removal of ROC, PAH, and EU13 VOC impacted soil and other impacted media (e.g., foundations), under Alternative 5 is considered highly effective in the long-term and would permanently reduce on-site exposures. *Ex situ* treatment of the EU4 VOC plume soil and groundwater would also be highly effective and permanent in reducing contaminant concentrations.

4.2.5.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Under Alternative 5, the building foundations would be scarified to remove the contaminated surface layer of the concrete. Compared to total foundation removal, scarification could reduce the total volume of contaminated concrete foundation material by more than 95 percent. The remainder of the cleaned concrete foundations would remain on-site.

Excavation and *ex situ* thermal treatment of the EU4 VOC plume soil and groundwater and subsequent destruction of the off-gas contaminants would reduce the contaminant toxicity to acceptable levels and reduce the volume of waste requiring off-site disposal accordingly.

Under Alternative 5, ROC- and PAH-impacted soil and EU13 VOC-impacted soil would be excavated and removed from the site. The excavation plans would be developed with waste minimization procedures such as radiological scanning and soil sorting with the intent to minimize the total volume of waste removed and requiring off-site disposal. Clean overburden and cutback soil would be sampled and stockpiled separately from the soil for disposal.

4.2.5.5 Short-Term Effectiveness

The duration for Alternative 5 is estimated as 37 months (24 months for design and plans and 13 months for construction). Due to the significant amount of intrusive work associated with excavation, handling, and transportation of all contaminated soil under Alternative 5, in addition to the *ex situ* thermal treatment of the EU4 VOC plume soil and groundwater, and the concrete scarification, the protection of workers and the community would be of utmost priority with this remedial alternative. A site operations plan, site-specific health and safety plan, transportation plan, and other documents would be developed to outline procedures for safe completion of the work and for monitoring plans to ensure the safety of remediation workers and the general public. Most of the short-term risks can be addressed through relatively simple means such as dust control, proper use of personal protective equipment, vapor and emissions controls, and air monitoring. The risks would only be present for the duration of active intrusive remedial activities and the *ex situ* soil treatment; appropriate precautions would be implemented by the remediation contractor to minimize potential risks during these activities. Once the impacted materials are removed from the site or treated, there would be no further risk.

4.2.5.6 Implementability

Implementation of *ex situ* thermal treatment should not be difficult but is somewhat limited since only a few vendors perform this type of remedial work. However, there are high energy demands associated with this alternative. *Ex situ* treatment would require excavation of impacted soil for treatment.

No specialized equipment, personnel, or services are required to implement soil excavation, transport, and disposal activities for Alternative 5. The required resources are readily available and use conventional earth-moving equipment. Dewatering and excavation controls are expected to be minimal and fairly simple to implement, if required.

Equipment and services required for the concrete scarification are relatively available since the same equipment and services are also used outside of the remediation industry.

No administrative problems are anticipated that would limit the implementability of Alternative 5.

This alternative would require some coordination of remediation activities (e.g., transportation) with the local authorities to minimize health and safety risks to on-site personnel and the community, but it is expected that this would be successfully accomplished.

4.2.5.7 Cost

The estimated cost to implement Alternative 5 is:

Capital Cost:	$19,784,859
O&M Cost:	$ 414,153
Contingency Cost:	$ 7,066,521
Total Cost:	$27,265,533

The capital costs include preparation of a remedial design work plan, excavation, confirmatory sampling, transport, off-site disposal, site restoration, preparation of a remedial action completion report, and other components. The remedial construction duration for Alternative 5 is estimated as 13 months.

The O&M costs include implementing five-year reviews over a 1,000-year duration.

Contingency costs were developed through an abbreviated risk analysis conducted by USACE. The abbreviated risk analysis involves developing a risk register for each remedial alternative, evaluating risk by likelihood and impact, and producing a contingency percentage for the individual alternative cost estimates. A more detailed discussion of the abbreviated risk analysis is included with the detailed cost estimate information provided in **Appendix F**.

5 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

5.1 Introduction

In this section, the five site-wide alternatives undergo a comparative analysis for the purpose of identifying the relative advantages and disadvantages of each alternative on the basis of the detailed analysis provided in the previous section. The comparative analysis provides a means by which remedial alternatives can be directly compared to one another with respect to common criteria. Overall protection of human health and the environment and compliance with ARARs are threshold criteria that must be met by any alternative for it to be eligible for selection. The other criteria, consisting of long-term effectiveness and permanence; reduction of contaminant toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost; are the primary balancing criteria used to select a preferred remedy among alternatives satisfying the threshold criteria.

5.2 Comparison Using CERCLA Criteria

5.2.1 Overall Protection of Human Health and the Environment

All remedial alternatives, except Alternative 1 – No Action, are considered protective of human health and the environment.

Alternative 1 leaves the site "as is," with no remedial actions for any of the impacted media and no actions taken regarding any controls beyond those already in place. Under this alternative, impacted soil, groundwater, and all other media would remain in place at the current locations. Existing physical controls (i.e., fencing and signs) would be left in place but not maintained. Environmental monitoring would not be performed. In addition, no restrictions on land use would be pursued.

5.2.2 Compliance with ARARs

Alternative 1 – No Action does not comply with the ARARs since no remedial action would be implemented; current conditions would not change; and the media containing contamination above the concentrations specified in the ARARs would not be addressed. However, site maintenance would be performed during federal ownership.

Remedial Alternatives 2 through 5 would comply with 10 CFR Part 40, Appendix A, Criterion 6(6) since all impacted soil and building foundations containing contamination above the PRGs would be excavated and removed or decontaminated to remove the impacted media from the site.

Alternatives 2 through 5 would comply with the 40 CFR 761.61 (TSCA) cleanup level for PCBs, industrial use SCOs in 6 NYCRR Part 375-6.8 for PAHs, as well as site-specific risk-based SCOs for soil and groundwater.

5.2.3 Long-Term Effectiveness and Permanence

Alternative 1 – No Action would not be effective or permanent since it would allow contaminated soil, groundwater, and other media to remain on-site. There would be no reduction in the risks associated with the site-related contamination.

Alternatives 2 through 5 provide long-term effectiveness and permanence since each alternative would permanently reduce on-site exposures. Any residual contaminated soil, groundwater, and media at the site would be at concentrations below the FS PRGs.

None of the alternatives require any O&M to maintain the effectiveness of the alternative, although site maintenance would be performed during federal ownership.

5.2.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 1 – No Action and Alternative 2 – Complete Removal would not incorporate the treatment of soil to reduce contaminant volume, toxicity, or mobility. However, the excavation in Alternatives 2 through 5 would incorporate waste minimization procedures, such as radiological scanning and soil sorting, with the intent to minimize the total volume of waste removed and requiring off-site disposal.

Alternatives 4 and 5 would have the highest reduction in toxicity, mobility, or volume since either *in situ* or *ex situ* thermal treatment of the EU4 VOC plume soil (and groundwater with the *in situ* treatment) would include off-site destruction of off-gas contaminants and result in a significant reduction in contaminant volume.

5.2.5 Short-Term Effectiveness

There are no short-term risks associated with Alternative 1 beyond the existing baseline conditions. There would be no additional short-term health risks to the community, site workers, or the environment since no remedial actions would be implemented.

The lowest level of short-term effectiveness would likely be under Alternative 2 – Complete Removal since complete excavation, handling, and transportation of all contaminated soil and media requires the most intrusive work. The other alternatives would have similar levels of effectiveness and risk since they all include the excavation of a large volume of soil and media. The alternatives to excavation, such as decontamination and the treatment options, also would present a similar level of effectiveness as excavation.

In all cases, the risks are relatively easily controlled. A site operations plan, site-specific health and safety plan, transportation plan, and other documents would be developed to outline procedures for safe completion of the work and for monitoring plans to ensure the safety of remediation workers and the general public. Most of the short-term risks can be addressed through relatively simple means such as dust control and air monitoring. The risks would only be present for the duration of the intrusive remedial activities. Once the material is removed from the site, there is no further risk.

5.2.6 Implementability

There are no technical implementability concerns associated with Alternative 1 since no construction, operation, or other actions would occur under this alternative. This alternative would be difficult to implement from an administrative standpoint. It is unlikely that this alternative would be supported by any agencies due to the uncontrolled risks that would remain at the site.

All of the remaining alternatives have a relatively similar level of implementability. No specialized equipment, personnel, or services are required to implement soil excavation, transport, and disposal activities. The required resources are readily available and use conventional earth-moving equipment. Dewatering and excavation controls are expected to be minimal and fairly simple to implement, if required. Equipment and services required for the concrete scarification are relatively available since the same equipment and services are also used outside of the remediation industry.

Alternatives 4 and 5 would be the most difficult to implement since there are only a few firms that perform either *in situ* or *ex situ* thermal treatment of soil.

5.2.7 Cost

Among the alternatives where action is undertaken, at $22.9 million, Alternative 4 has the lowest total cost. The costs for the remaining alternatives range from approximately $24.5 to $35.7 million.

Five-year reviews would be required for each alternative except Alternative 1. Under Alternatives 2 through 5, the site would be remediated to promulgated and site-specific risk-based industrial use criteria. The duration of five-year reviews is 1,000 years.

5.3 Time to Complete Remediation

Alternative 1 does not include any remediation. The duration for development of designs and plans for Alternatives 2 through 5 are the same, 24 months. Alternatives 2 and 3 would require approximately 4.5 months to complete remedial construction and Alternatives 4 and 5 would require approximately 13 months.

5.4 Summary of Comparative Analysis

The comparative analysis of alternatives based upon the above criteria provides the basis for selection of the preferred alternative. The preferred alternative must meet the CERCLA threshold criteria of overall protection of human health and the environment and compliance with ARARs, but the balancing criteria (long-term effectiveness and permanence; short-term effectiveness; reduction of toxicity, mobility, or volume through treatment; implementability; and cost) and modifying criteria (state and community acceptance) are also considered in the selection process. **Table 5-1** summarizes the comparative analysis of the five remedial alternatives. Community and state acceptance criteria are not assessed in **Table 5-1**,but would be fully addressed after the public comment period following issuance of the proposed plan.

6 REFERENCES

Acres American, Inc. 1981. *Hydrologic and Geologic Characterization of the DOE-Niagara Falls Storage Site.* Prepared for NLO, Inc., September.

Aerospace Corporation, The, 1982. *Background and Resurvey Recommendations for the Atomic Energy Commission Portion of the Lake Ontario Ordnance Works.* Prepared for U.S. DOE, November.

Battelle 1980. *Interim Summary Report on the Comprehensive Radiological Survey of the DOE-Niagara Falls Storage Site.* Prepared by B.S. Ausmus, J.F. Dettorre, and T.L. Anderson for the U.S. DOE Remedial Action Program, August.

Battelle 1981. *Final Report on a Comprehensive Characterization and Hazard Assessment of the DOE-Niagara Falls Storage Site.* Prepared for U.S. DOE, June.

BNI (Bechtel National, Inc.) 1983. Radiological and Non-radiological Contaminant Description for the Niagara Falls Storage Site. June.

BNI 1984. *Niagara Falls Storage Site Construction Reports*. June.

BNI 1985. *Niagara Falls Storage Site Construction Reports*. November.

BNI 1986a. "Internal Memorandum for K-65 Waste Volume", From M.G. Jones to W.C. Borden. April.

BNI 1986b. *Niagara Falls Storage Site Annual Site Environmental Monitoring Report, Lewiston, New York, Calendar Year 1985.* Prepared for U.S. DOE, April.

BNI 1986c. *Closure/Post-Closure Plan for the Interim Waste Containment Facility at the Niagara Falls Storage Site.* Prepared for U.S. DOE-Oak Ridge, May.

BNI 1989. *Post Remedial Action Report, Niagara Falls Storage Site Vicinity Properties – 1985 and 1986, Lewiston, New York.* Prepared by M.E. Kaye and A.M. Feldman for U.S. DOE, January.

BNI 1990. *Preliminary Assessment for Niagara Falls Storage Site, Lewiston, New York.* Prepared by J.F. Gonzales and L.A Martin for U.S. DOE, May.

BNI 1994a. *Failure Analysis Report, Niagara Falls Storage Site, Lewiston, New York.* Prepared for U.S. DOE, Oak Ridge Operations Office, November.

BNI 1994b. *Geologic Report, Niagara Falls Storage Site, Lewiston, New York.* Prepared for U.S. DOE, June.

CCME (Canadian Council of Ministers of the Environment). 2011. *Scientific Criteria Document for the Development of the Canadian Water Quality Guidelines for the Protection of Aquatic Life: Uranium*. PN 1451. Canadian Council of Ministers of the Environment.

EA Engineering, Science, Technology 1998. *History Search Report, Lake Ontario Ordnance Works (LOOW), Niagara County New York,* August.

Grove Software. MicroShield Version 7.02.

Johnson 1964. *Ground Water in the Niagara Falls Area, New York, with emphasis on the water-bearing characteristics of bedrock*. Bulletin GW-53. 1964.

Lewiston Porter Central School District 2016. Available at: <http://www.lew-port.com/Page/1>.

National Academy of Sciences 1999. *Evaluation of Guidelines for Exposures to Technologically Enhanced Naturally Occurring Radioactive Materials*. 1999.

New York State Assembly 1979. *New York Contamination Survey–Final Report, for US Army Toxic and Hazardous Materials Agency, Edgewood Area, Aberdeen Proving Ground, Maryland 21010*. January.

Niagara County Department of Health 2006. *Summary Report for Private Water Well Project, Towns of Lewiston and Porter, Niagara County, New York.* March.

Oak Ridge National Laboratory 1986. *Results of Radiological Measurements Taken in the Niagara Falls, New York Area (NF002)*. J. K. Williams, B. A. Berven., Health and Safety Research Division. Nuclear and Chemical Waste Programs. November.

Suter, G. W. II and C. L. Tsao 1996. *Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Revision*. Prepared for the U. S. Department of Energy Office of Environmental Management

USACE (U.S. Army Corps of Engineers) 1943*. Completion Report, Lake Ontario Ordnance Works, Youngstown, New York*. April.

USACE 2007a. *NFSS Remedial Investigation Report*. Prepared by Science Applications International Corporation, December. Available at: <http://www.lrb.usace.army.mil/Missions/HTRW/FUSRAP/NiagaraFallsStorageSite.aspx>.

USACE 2007b. *Groundwater Flow and Contaminant Transport Modeling, Niagara Falls Storage Site.* Prepared by HydroGeoLogic, Inc., December.

USACE 2007c. *Baseline Risk Assessment Report. Niagara Falls Storage Site. Lewiston, New York.* Revision 3, Vol. 1. Prepared by Science Applications International Corporation, December.

USACE 2011. *NFSS Remedial Investigation Report Addendum for the Niagara Falls Storage Site.* Prepared by Science Applications International Corporation, April. Available at: <https://www.lrb.usace.army.mil/Missions/HTRW/FUSRAP/Niagara-Falls-Storage-Site/>.

USACE 2013. *Final Field Investigation Report, Balance of Plant Operable Unit Field Investigation, Niagara Falls Storage Site, Lewiston, New York.* Prepared by URS Group, Inc., August.

USACE 2014. *Feasibility Study Simulations Report Groundwater Flow and Contaminant Transport Modeling FUSRAP, NFSS, Lewiston, New York. January 2014.*Appendix B in *USACE Final (R3) Feasibility Study Report for the Interim Waste Containment Structure at the Niagara Falls Storage Site, Lewiston, New York*. Prepared by HydroGeoLogic, Inc., December.

USACE 2015a. *Final Field Investigation Report, Balance of Plant Operable Unit Investigation to Refine the Extent of Soil Contamination, Niagara Falls Storage Site, Lewiston, New York.* Prepared by URS Group, Inc., February.

USACE 2015b. *Final (R3) Feasibility Study Report for the Interim Waste Containment Structure at the Niagara Falls Storage Site, Lewiston, New York.* December.

USACE 2016a. *FUSRAP Niagara Falls Storage Site 2014 Environmental Surveillance Technical Memorandum.* January.

USACE 2016b. *FUSRAP Niagara Falls Storage Site 2015 Environmental Surveillance Technical Memorandum.* December.

USACE 2018. *FUSRAP Niagara Falls Storage Site 2017 Environmental Surveillance Technical Memorandum.* November.

U. S. Census Bureau 2010a. *Niagara County, New York, Quick Facts*, available at: <http://factfinder2.census.gov/faces/nav/jsf/pages/community_facts.xhtml>.

U. S. Census Bureau 2010b. *Lewiston Village, New York, 2010 Demographic Profile*, available at: <http://factfinder2.census.gov/faces/nav/jsf/pages/community_facts.xhtml>.

U. S. Census Bureau 2010c. *Porter Town, Niagara County, New York*, 2010 Demographic Profile, available at: <http://factfinder2.census.gov/faces/nav/jsf/pages/community_facts.xhtml>.

U.S. Department of Energy (U.S. DOE) 1991a. *Geotechnical Post-Construction Report for NFSS Contaminated Waste Pile Consolidation.* October 1991.

U.S. DOE 1991b. *Environmental Monitoring Plan, Niagara Falls Storage Site, Lewiston, New York.* November 1991.

U.S. DOE 2002. *A Graded Approach for Evaluating Radiation Doses to Aquatic and Terrestrial Biota,* DOE-STD-1153-2002, July 2002

U.S. Environmental Protection Agency (U.S. EPA) 1986. *Guidelines for Ground-Water Classification under the EPA Ground-Water Protection Strategy,* U.S. EPA/440/6-86-007. December.

U.S. EPA 1988. Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA. Interim Final. U.S. EPA/540/G-89/004. OSWER Directive 9355.3-01. October.

U.S. EPA 1989. *Risk Assessment Guidance for Superfund* (RAGS), EPA/540/1-89/002. December.

U.S. EPA 1997. Exposure Factors Handbook, Final Report, 1997 EPA/600/P-95/002F a-c, 1997.

U.S. EPA 2014. *Human Health Evaluation Manual Supplemental Guidance: Update to Standard Default Exposure Factors,* OSWER Directive 9200.1-120, February.

U.S. EPA 2016. *Update of the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters and the Integrated Exposure Uptake Biokinetic Model's Default Maternal Blood Lead Concentration at Birth Variable,* OSWER 9285.6-55, August.

THIS PAGE INTENTIONALLY LEFT BLANK

Tables

THIS PAGE INTENTIONALLY LEFT BLANK

Table ES-1
Summary of Feasibility Study COCs and ROCs by Media

Parameter Group	Soil (includes road bedding)	Building 433 and Building Foundations	Utility Sediment	Utility Water	Groundwater
ROCs					
	Actinium-227	Actinium-227			
	Protactinium-231	Protactinium-231			
	Lead -210	Lead -210			
	Radium-226	Radium-226			
	Thorium -230	Thorium-230			
	Uranium-234	Uranium-234			
	Uranium-235	Uranium-235			
	Uranium-238	Uranium-238			
COCs					
	Benzo(a)pyrene	Benzo(a)pyrene			
	Benzo(a)anthracene	Benzo(a)anthracene			
	Benzo(b)fluoranthene	Benzo(b)fluoranthene			
	Dibenz(a,h)anthracene	Dibenz(a,h)anthracene			
		Aroclor-1260	Aroclor-1260	Aroclor-1260	
			Aroclor-1254	Aroclor-1254	
	Tetrachloroethene				Tetrachloroethene
	Trichloroethene				Trichloroethene
	Cis-1,2-dichloroethene				Cis-1,2-dichloroethene
	Vinyl chloride				Vinyl chloride

Note:

Based on construction worker receptor

COC - chemical of concern

ROC - radionuclide of concern

The listed ROCs and COCs do not apply to all media (e.g., there are no COCs in road bedding).

Table ES-2
Summary of Preliminary Remediation Goals

Media	Constituent	Units	FS PRG	Basis for FS PRG (ARAR or Risk)	FS PRG Reference
Soil					
	Radium-226	pCi/g	5/15*	ARAR	10 CFR Part 40, Appendix A
	Thorium-230	pCi/g	18/55*	ARAR	10 CFR Part 40, Appendix A
	Uranium-238	pCi/g	115/346*	ARAR	10 CFR Part 40, Appendix A
	Benzo(a)pyrene	mg/kg	1.1	ARAR	6 NYCRR Part 375-6.8(b)
	Benzo(a)anthracene	mg/kg	11	ARAR	6 NYCRR Part 375-6.8(b)
	Benzo(b)fluoranthene	mg/kg	11	ARAR	6 NYCRR Part 375-6.8(b)
	Dibenz(a,h)anthracene	mg/kg	1.1	ARAR	6 NYCRR Part 375-6.8(b)
	Tetrachloroethene	mg/kg	1.53	Risk	BOP & GW OU FS, Appendix E
	Trichloroethene	mg/kg	0.33	Risk	BOP & GW OU FS, Appendix E
	Cis-1,2-dichloroethene	mg/kg	0.75	Risk	BOP & GW OU FS, Appendix E
	Vinyl chloride	mg/kg	0.07	Risk	BOP & GW OU FS, Appendix E
Road Bedding					
	Radium-226	pCi/g	5/15*	ARAR	10 CFR Part 40, Appendix A
	Thorium-230	pCi/g	18/55*	ARAR	10 CFR Part 40, Appendix A
	Uranium-238	pCi/g	115/346*	ARAR	10 CFR Part 40, Appendix A
Building Foundations**					
	Radium-226	pCi/g	5/15*	ARAR	10 CFR Part 40, Appendix A
	Thorium-230	pCi/g	18/55*	ARAR	10 CFR Part 40, Appendix A
	Uranium-238	pCi/g	115/346*	ARAR	10 CFR Part 40, Appendix A
	Benzo(a)pyrene	mg/kg	1.1	ARAR	6 NYCRR Part 375-6.8(b)
	Benzo(a)anthracene	mg/kg	11	ARAR	6 NYCRR Part 375-6.8(b)
	Benzo(b)fluoranthene	mg/kg	11	ARAR	6 NYCRR Part 375-6.8(b)
	Dibenz(a,h)anthracene	mg/kg	1.1	ARAR	6 NYCRR Part 375-6.8(b)
	Aroclor-1254	mg/kg	25	ARAR	40 CFR Part 761.61
	Aroclor-1260	mg/kg	25	ARAR	40 CFR Part 761.61
Utility Sediment***					
	Aroclor-1254	mg/kg	25	ARAR	40 CFR Part 761.61
Utility Water					
	Aroclor-1260	mg/L	0.0001	Risk	USACE 2007
	Aroclor-1254	mg/L	0.0001	Risk	USACE 2007
Groundwater					
	Tetrachloroethene	mg/L	1.5	Risk	BOP & GW OU FS, Appendix E
	Trichloroethene	mg/L	0.33	Risk	BOP & GW OU FS, Appendix E
	Cis-1,2-dichloroethene	mg/L	2.4	Risk	BOP & GW OU FS, Appendix E
	Vinyl chloride	mg/L	0.17	Risk	BOP & GW OU FS, Appendix E

Notes:

* Surface soil (upper 15 centimeters)/subsurface soil averaged over an area of 100 square meters; Ac-227, Pa-231, U-234, and U-235 included under U-238 and Pb-210 included under Ra-226

** Building foundations are assumed to have the same impacts as adjacent soils. However, the identified Aroclor 1254 impact is from a core sample from Bulding 401 and PRGs for Building 433 are only ROCs.

*** Liquid phase Aroclor 1254 detected in utility drains.

ARAR - Applicable or Relevant and Appropriate Requirement

BRA - Baseline Risk Assessment

FS - Feasibility Study

PRG - Preliminary Remediation Goal

mg/kg - milligrams per kilogram

mg/L - milligrams per liter

pCi/g - picoCuries per gram

USACE 2007: Table A 702, Baseline Risk Assessment for the Niagara Falls Storage Site, December 2007

10 CFR Part 40: 10 CFR Part 40, Appendix A, Criterion 6(6)

40 CFR Part 761.61 criteria is for total PCBs

Table ES-3

Estimated In-Situ Volumes Requiring Remediation

Basis	Matrix	Volume (m^3)	Volume (yd^3)
Soil, includes road bedding and EU13 VOC soil, excludes EU4 VOC plume soil	Soil	1,529	2,000
EU4 VOC plume soil	Soil	2,600	3,400
Building 431/432 trench (estimated 1/2 soil)	Soil	382	500
Building 431/432 trench (estimated 1/2 concrete)	Concrete	382	500
Building 401 foundation (including drains)	Concrete	556	727
Building 430 foundation	Concrete	688	900
Building 431/432 foundation	Concrete	414	541
Building 433 foundation, sidewalls, and roof	Concrete	31	41
Total Volume		**6,582**	**8,609**
	Matrix	**Volume (l)**	**Volume (gal)**
EU4 VOC plume (assume 1 gal/yd^3 of EU4 plume soil removed)	Groundwater	12,499	3,302
Total Volume		**12,499**	**3,302**

Notes:

m^3 – cubic meter

l - liter

gal - gallon

yd^3 – cubic yard

EU - exposure unit

VOC - volatile organic compound

Soils beneath the IWCS are not included in this list.

Table ES-4

Comparative Analysis of Alternatives

CERCLA Evaluation Criterion	Alternative 1 – No Action	Alternative 2 – Complete Removal	Alternative 3 – Removal with Building Decontamination	Alternative 4 – Removal with Building Decontamination and *In Situ* Remediation	Alternative 5 – Removal with Building Decontamination and Ex *Situ* Remediation
Overall protection of human health and the environment	No	Yes	Yes	Yes	Yes
Compliance with ARARs	No	Yes	Yes	Yes	Yes
Long-term effectiveness and permanence	Low	High	High	High	High
Reduction of toxicity, mobility, or volume through treatment	Low	Low	Low	Moderate	Moderate
Short-term effectiveness	High	Low	Low	Low	Low
Implementability	Low	High	High	Moderate	Moderate
Cost (capital)	Zero cost	$23,814,326	$17,557,536	$17,180,164	$19,784,859
Cost (O&M discounted)	Zero cost	$414,153	$414,153	$414,153	$414,153
Contingency costs	Zero cost	$11,440,418	$6,564,779	$5,320,836	$7,066,521
Total Cost	Zero cost	$35,668,897	$24,536,468	$22,915,153	$27,265,533

ARAR = applicable or relevant and appropriate requirement
Bldg = building
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
FS = feasibility study
O&M = operation and maintenance
PAH = polycyclic aromatic hydrocarbon
ROC = radionuclide of concern
VOC = volatile organic compound
EU = exposure unit

Table 1-1

Summary of Radioactive Materials Storage Areas Outside IWCS Footprint

Site	LOOW Building Name	Material	Storage Method	Comments	Current Status
Bldg 401	Boiler House	KAPL Waste	55-gal Drums	KAPL drums stored here and then transferred to buildings in the Baker-Smith Area (former Bldgs 443-448) in 1953 in preparation for conversion of Bldg 401 to the Boron-10 Plant	Demolished Foundation present
Bldg 409	Fire Reservoir	Uranium Slag and Scrap	Bulk	Uranium slag and scrap bulk-stored on the ground outside to the south and southeast of former Bldg 409 Stored slurry water from Bldg 434 K-65 transfer to IWCS	Decontaminated and then demolished Buried during IWCS construction Foundation backfilled with the building rubble and fillcrete
Bldg 420	General Storehouse	K-65 Waste Uranium Metal	55-gal Drums Bulk	Temporary storage site in the early 1950s for 2,000 empty, but K-65 contaminated drums Also, used for uranium metal bulk storage	Demolished Foundation present
Bldg 421	Materal Shed	Uranium Rods	Bulk	Uranium rods stored inside on the dirt floor in 1950 The floor was then to be dug up and disposed of	Demolished Foundation piled with debris
Bldg 430	Combined Shops	Uranium Ingots, Metal Scrap, Oxide, Sweepings	Bulk	Uranium ingots, metal scrap, oxide, and sweepings were stored in bulk inside the former Bldg 430 - eventually all apparently shipped off-site	Demolished Foundation present
Bldgs 431/432 (Vaults A/B)	Vaults A and B	Uranium Rods	Bulk	Bulk storage of uranium rods in the early 1950s	Demolished Foundation present, half is piled with debris Building rubble is suspected to be buried in an adjacent trench
Bldg 433 (Radium Vault)	Hose House	Radium Sources	Bulk	Bulk storage of radium sources in 1953	Building still standing
Bldg 434 (Silo and Thawhouse)	Cooling Water Storage Tower	K-65 Waste P-54 Waste P-56 Waste	Bulk 55-gal Drums Barrels	K-65 was transferred from drums to the former Bldg 434 Tower (silo) in the late 1940s/early 1950s Empty K-65 drums were dried in the former Bldg 434 Thawhouse Full K-65 drums were also stored in the Thawhouse All drummed K-65 unable to be bulk-stored in the Tower was eventually transferred off-site to Ohio in late 1952 P-54 drums also were stored at the Thawhouse; not present in 1982 - presumed transferred to Oak Ridge or West Valley P-56 barrels stored either in the former Bldg 434 Thawhouse or former Bldg 410; not present in 1982 - presumed transferred to Oak Ridge or West Valley Onsite K-65 waste placed in IWCS	Demolished No remaining evidence of building
Bldg 443	Welding Shop	L-30 Sludge KAPL Waste K-65 Waste Contaminated Special Equipment	Wood Barrels 55-gal Drums Bulk	Referred to as the Baker-Smith Area L-30 was stored in wood barrels and drums in the mid 1940s, primarily in former Bldgs 443, 444, and 445 When the barrels began to deteriorate some were transferred to New Jersey while the rest, with the drums, were moved to former Bldg 411 for bulk storage KAPL waste was stored in drums in former Bldgs 443-448 The drums were eventually transferred to Oak Ridge K-65 was stored in drums, primarily in Bldg 444 The equipment was eventually transferred off-site in 1951 Cesium and radium have been detected in this area	Demolished No remaining evidence of building
Bldg 444	Storage Building				Demolished No remaining evidence of building
Bldg 445	Pipe Shop				Demolished, about 1/4 of foundation present
Bldg 446	Lord Electric Shop				Demolished No remaining evidence of building
Bldg 447	Tool House				Demolished No remaining evidence of building
Bldg 448	Paint Shop				Demolished No remaining evidence of building
Bldg 7221	Riggers Shop	Uranium Rods	Bulk	Located north of X Street between former Bldgs 428 and 430 Possible uranium rod saw building; rods were sawed down to a smaller size at this location	Demolished Foundation present
Castle Garden Road (East of Bldg 421 along F-Line Railroad)	NA	KAPL Waste K-65 Waste	NA	KAPL may have been incinerated in this area Empty K-65 contaminated drums were dried (turned upside down on tarps and beat on) and redrummed before being shipped off-site	Remediated
Organic Burial Area	NA	Organic wastes	Bulk	Organic materials (trees, brush, etc) generated during DOE remediation activities Some radioactive impacts present	Buried in EU7
New Naval Waste Area (S of north Street, northeast of former Bldg 433 (Radium Vault))	NA	Miscellaneous	Bulk	Received wastes from Navy Mathieson area (on current CWM property) Unclear whether wastes were buried or placed on the ground surface 1979 radiological survey identifed contamination down to 16 ft	Remediated

Notes:

The majority of information presented in this table was taken from *Background and Resurvey Recommendations for the Atomic Energy Commission Portion of the Lake Ontario Ordnance Works* , dated November 1982, prepared by The Aerospace Corporation

KAPL = Knolls Atomic Power Laboratory waste (plutonium and fission products)
K-65 = Belgian Congo Q-11 high-grade pitchblende ore residue
P-54 = lead sulfide cake from processing of L-30 and L-50 ore - contains 1% U_3O_8
P-56 = regenerated lead sulfate cake
L-30 = residue from processing 10% uranium ore
EU = exposure unit
DOE = Department of Energy
NA = not applicable
CWM = CWM Chemical Services, LLC
IWCS = Interim Waste Containment Structure
LOOW = Lake Ontario Ordnance Works
ft = feet
gal = gallon
N = north
NE = northeast
S = south

Table 1-2
Description of Physical Exposure Units

EU	Description	Past Usage
EU1 (Baker-Smith Area and Vicinity)	Located in the northwest corner of the NFSS The WDD flows to the north through EU1	LOOW pipe shop, machine shop, welding shop, and store house Near rail line Knolls Atomic Power Laboratory wastes were stored in buildings in this area The KAPL wastes were later transferred to Oak Ridge National Laboratory and the K-65 wastes were moved to a silo in EU6 The DOE performed remedial actions in the Baker-Smith Area in 1981
EU2 (Baker-Smith Area and Vicinity)	Located along the northern boundary of the NFSS property east of EU1	Includes a small portion of the New Naval Waste Area where construction debris was stored The DOE performed remedial actions in the New Naval Waste Area in 1983
EU3 (Acid Area and Vicinity)	Located along the northern boundary of the NFSS property and is bordered by EU2 on the west and EU4 on the east	The major portion of the New Naval Waste Area, where building debris was stored, was located within EU3 Building 433, also known as the former radium storage vault used to store sealed radium sources, was located in EU3
EU4 (Acid Area and Vicinity)	Located along the northern boundary of the NFSS property Bordered by EU3 on the west and EU5 on the east	LOOW nitric acid and other materials related to the manufacture of TNT During the 1950s, uranium rods were stored in Buildings 431 and 432 These buildings were decontaminated and demolished by the DOE in 1986 Several subsurface pipelines used to transfer acids north to the former TNT production facilities remain in the EU
EU5 (Panhandle Area)	Located in the northeastern portion of the site property along the northern property boundary Bordered by EU4 on the west and EU6 on the east	LOOW ammonia storage facilities were present in EU5 In 1953, an explosion and fire that was not related to the storage or use of ammonia occurred immediately south of the Panhandle Area The cause of the fire is unknown The pipeline that transferred K-65 slurry from EU6 to the IWCS passed through EU5 along O Street
EU6 (Panhandle Area)	Located in the northeastern corner of the site property Bordered by EU5 on the west, CWM to the north and east, and Modern Landfill to the south	Building 434, a LOOW water tower (silo) and later used to store K-65 residues In the 1980s, the K-65 residues were slurry transferred to the IWCS through a temporary transfer pipeline and the water tower was removed
EU7 (IWCS Vicinity)	A large grassy area north of the IWCS (EU10)	During the DOE remedial actions in 1980s, several temporary ponds, principally used for the management and storage of stormwater, were located in this area EU7 is also the location of the former DOE Organic Burial Area where roofing timbers, wooden debris, and organic material from clearing activities were disposed
EU8 (Shops Area)	Located in the east-central portion of the NFSS, north of Building 401 It is bordered to the north by the acid area, to the south by the Building 401 Area, to the east by Modern Landfill, and to the west by Campbell Street	This area contained a LOOW parking garage, equipment maintenance garage, material shed, general storehouse, combined shops, millwright shop, and riggers shop None of these buildings remain although some concrete building foundations are still present Radioactive residues were stored in several of the former buildings and corroded uranium billets were cut into smaller sections in the riggers shop
EU9 (National Grid Property)	Located adjacent to the western boundary of the NFSS	The WDD is the principal site feature of the National Grid property Impacted soils in the WDD were removed during a previous removal action
EU10 (IWCS and Vicinity)	Located along the western border of the NFSS property boundary south of EU7	The predominant feature in EU10 is the IWCS Prior to the construction of the IWCS, the LOOW freshwater treatment plant was located at the southern end of the EU
EU11 (IWCS and Vicinity)	'L' shaped area located east and south of EU10	A LOOW fire house was located in the central portion this EU and a parking lot was located in the southern portion During the remedial actions by the DOE in the 1980s, a water treatment plant and several temporary ponds were used to hold treated slurry water, decontamination water, and stormwater prior to release
EU12	A vacant wooded tract located between south of the shops area	No production or storage activities are known to have occurred in EU12 The Building 401 Ditch flows north through the EU where it joins the South 16 Ditch, which continues to the west joining the Central Ditch in EU10
EU13 (former Building 401 and Vicinity)	Surrounded by EUs 11, 12, and 14	The main feature in EU13 is the former Building 401 foundation Building 401 was the LOOW power house, generating steam for use in the TNT production facilities Later, the building housed a boron-10 (a nonradioactive isotope) separation process The building was used to temporarily store and stage radioactive waste The building was demolished in 2011
EU14	Bounded on two sides by Modern Landfill	A wooded tract with both South 31 Ditch and the Modern Ditch flowing through the area and joining near the northwest corner of the EU No production or storage activities are known to have occurred in EU14

Notes:

CWM = CWM Chemical Services, LLC
DOE = Department of Energy
EU = exposure unit
IWCS = Interim Waste Conatinment Structure
LOOW = Lake Ontario Ordnance Works
TNT = trinitrotoluene
WDD = West Drainage Ditch
NFSS = Niagara Falls Storage Site

Table 1-3

Summary of Human Health Risk Assessment ROCs and COCs

Chemical

COCs contributing 50% or more to risk shown in bold.		COC	Industrial Worker	Maintenance Worker	Construction Worker	Adult Trespasser/Rec. Visitor	Adolescent Trespasser/Rec Visitor
RME Cancer Risk	If total cancer risk exceeds 10^{-4}, constituents exceeding10^{-5} are listed.	Aroclor-1254			**W**		
		Benzo(a)anthracene		S			
		Benzo(a)pyrene	S	S			
		Benzo(b)fluoranthene		S			
		Benzo(K)fluoranthene					
		Dibenz(a,h)anthracene	S	S			
		Trichloroethene			G		
		Vinyl Chloride			G		
		Tetrachloroethene			**G**		
RME Non-Cancer Risk	> HI = 1*	Aroclor-1260	S	S	D W		S
		Aroclor-1254			**D W**		**D**
		Tetrachloroethene			**G**		
		Cis-1,2-dichloroethene			G		
		Trichloroethene			G		
		Vinyl Chloride			G		
		Arsenic			**G**		
		Lead is retained as a COC because the exposure point concentration (EPC) in groundwater and surface water exceed the drinking water action level potentially impacting industrial workers, construction workers, and maintenance workers and adult trespasser/recreational visitor. The EPC for lead in sediment exceeds PRGs for industrial workers, construction workers, and maintenance workers.					

Radiological

ROCs contributing 50% or more to risk or dose are shown in bold.		ROC	Industrial Worker	Maintenance Worker	Construction Worker	Adult Trespasser/Rec. Visitor	Adolescent Trespasser/Rec Visitor
RME Cancer Risk	If total cancer risk exceeds 10^{-4}, constituents exceeding10^{-5} are listed.	Ac-227	S	S	B	S	
		Pa-231	S	S	B		
		Pb-210	S	S	B	S	S
		Ra-226	S	S	**B**	S	S
		Th-230	S	S		S	
		Th-232		S			
		U-234	S	S			
		U-235	S	S	B	S	S
		U-238	S	S	B	S	S
RME Dose	If total dose exceeds 25 mrem/yr, constituents exceeding 2.5 mrem/yr are listed.	Ac-227	S	S	B		
		Pa-231	S	S	B		
		Pb-210	S	S	B		S
		Ra-226	S	S	**B**	S	S
		Th-230		S	B		
		U-234	S	S	B		
		U-235	S	S	B		
		U-238	S	S	B		

*RME total HI exceeds 1.0 for the construction worker soil and sediment pathways but does not exceed 1 for any individual COC.

Notes:
COC = chemical of concern
ROC = radionuclide of concern
B = soil (0-10 ft),
D = sediment,
G = groundwater,
S = soil (0-0.5 ft),
W = utility water
HI = hazard index

Table 2-1
Summary of Feasibility Study COCs and ROCs by Media

Parameter Group	Soil (includes road bedding)	Building 433 and Building Foundations	Utility Sediment	Utility Water	Groundwater
ROCs					
	Ac-227	Ac-227			
	Pa-231	Pa-231			
	Pb-210	Pb-210			
	Ra-226	Ra-226			
	Th-230	Th-230			
	U-234	U-234			
	U-235	U-235			
	U-238	U-238			
COCs					
	Benzo(a)pyrene	Benzo(a)pyrene			
	Benzo(a)anthracene	Benzo(a)anthracene			
	Benzo(b)fluoranthene	Benzo(b)fluoranthene			
	Dibenz(a,h)anthracene	Dibenz(a,h)anthracene			
		Aroclor-1260	Aroclor-1260	Aroclor-1260	
			Aroclor-1254	Aroclor-1254	
	Tetrachloroethene				Tetrachloroethene
	Trichloroethene				Trichloroethene
	Cis-1,2-dichloroethene				Cis-1,2-dichloroethene
	Vinyl chloride				Vinyl chloride

Note:

COC - chemical of concern

ROC - radionuclide of concern

Based on construction worker receptor

The listed ROCs and COCs do apply to all media (e.g., there are no COCs in road bedding)

Table 2-2
Summary of Preliminary Remediation Goals

Media	Constituent	Units	FS PRG	Basis for FS PRG (ARAR or Risk)	FS PRG Reference	Constituent of Concern	
						BRA	FS
Soil							
	Radium-226	pCi/g	5/15*	ARAR	10 CFR Part 40, Appendix A	Yes	Yes
	Thorium-230	pCi/g	18/55*	ARAR	10 CFR Part 40, Appendix A	Yes	Yes
	Uranium-238	pCi/g	115/346*	ARAR	10 CFR Part 40, Appendix A	Yes	Yes
	Benzo(a)pyrene	mg/kg	1 1	ARAR	6 NYCRR Part 375-6 8(b)	Yes	Yes
	Benzo(a)anthracene	mg/kg	11	ARAR	6 NYCRR Part 375-6 8(b)	Yes	Yes
	Benzo(b)fluoranthene	mg/kg	11	ARAR	6 NYCRR Part 375-6 8(b)	Yes	Yes
	Dibenz(a,h)anthracene	mg/kg	1 1	ARAR	6 NYCRR Part 375-6 8(b)	Yes	Yes
	Lead	mg/kg	1,199	Risk	BOP & GW OU FS, Appendix B	Yes	No
	Aroclor-1260	mg/kg	25	ARAR	40 CFR Part 761 61	Yes	No
	Tetrachloroethene	mg/kg	1 53	Risk	BOP & GW OU FS, Appendix E	Yes	Yes
	Trichloroethene	mg/kg	0 33	Risk	BOP & GW OU FS, Appendix E	Yes	Yes
	Cis-1,2-dichloroethene	mg/kg	0 75	Risk	BOP & GW OU FS, Appendix E	Yes	Yes
	Vinyl chloride	mg/kg	0 07	Risk	BOP & GW OU FS, Appendix E	Yes	Yes
Road Bedding							
	Radium-226	pCi/g	5/15*	ARAR	10 CFR Part 40, Appendix A	Yes	Yes
	Thorium-230	pCi/g	18/55*	ARAR	10 CFR Part 40, Appendix A	Yes	Yes
	Uranium-238	pCi/g	115/346*	ARAR	10 CFR Part 40, Appendix A	Yes	Yes
Building Foundations**							
	Radium-226	pCi/g	5/15*	ARAR	10 CFR Part 40, Appendix A	Yes	Yes
	Thorium-230	pCi/g	18/55*	ARAR	10 CFR Part 40, Appendix A	Yes	Yes
	Uranium-238	pCi/g	115/346*	ARAR	10 CFR Part 40, Appendix A	Yes	Yes
	Benzo(a)pyrene	mg/kg	1 1	ARAR	6 NYCRR Part 375-6 8(b)	Yes	Yes
	Benzo(a)anthracene	mg/kg	11	ARAR	6 NYCRR Part 375-6 8(b)	Yes	Yes
	Benzo(b)fluoranthene	mg/kg	11	ARAR	6 NYCRR Part 375-6 8(b)	Yes	Yes
	Dibenz(a,h)anthracene	mg/kg	1 1	ARAR	6 NYCRR Part 375-6 8(b)	Yes	Yes
	Aroclor-1254	mg/kg	25	ARAR	40 CFR Part 761 61	Yes	Yes
	Aroclor-1260	mg/kg	25	ARAR	40 CFR Part 761 61	Yes	Yes
	Lead	mg/kg	1,199	Risk	BOP & GW OU FS, Appendix B	Yes	No
Utility Sediment***							
	Aroclor-1260	mg/kg	25	ARAR	40 CFR Part 761 61	Yes	No
	Aroclor-1254	mg/kg	25	ARAR	40 CFR Part 761 61	Yes	Yes
	Lead	mg/kg	57,640	Risk	BOP & GW OU FS, Appendix B	Yes	No
Utility Water							
	Aroclor-1260	mg/L	0 0001	Risk	USACE 2007	Yes	Yes
	Aroclor-1254	mg/L	0 0001	Risk	USACE 2007	Yes	Yes
	Lead	mg/L	144,099	Risk	BOP & GW OU FS, Appendix B	Yes	No
Groundwater							
	Arsenic	mg/L	1 4	Risk	USACE 2007	Yes	No
	Lead	mg/L	144,099	Risk	BOP & GW OU FS, Appendix B	Yes	No
	Tetrachloroethene	mg/L	1 5	Risk	BOP & GW OU FS, Appendix E	Yes	Yes
	Trichloroethene	mg/L	0 33	Risk	BOP & GW OU FS, Appendix E	Yes	Yes
	Cis-1,2-dichloroethene	mg/L	2 4	Risk	BOP & GW OU FS, Appendix E	Yes	Yes
	Vinyl chloride	mg/L	0 17	Risk	BOP & GW OU FS, Appendix E	Yes	Yes

Notes:

* Surface soil (upper 15 centimeters)/subsurface soil averaged over an area of 100 square meters; Ac-227, Pa-231, U-234, and U-235 included under U-238 and Pb-210 included under Ra-226

** Building foundations are assumed to have the same impacts as adjacent soils However, the identified Aroclor 1254 impact is from a core sample from Bulding 401 and PRGs for Building 433 are only ROCs

*** Liquid phase Aroclor 1254 detected in utility drains

ARAR - Applicable or Relevant and Appropriate Requirement

BRA - Baseline Risk Assessment

FS - Feasibility Study

PRG - Preliminary Remediation Goal

mg/kg - milligrams per kilogram

mg/L - milligrams per liter

pCi/g - picoCuries per gram

USACE 2007: Table A 702, Baseline Risk Assessment for the Niagara Falls Storage Site, December 2007

10 CFR Part 40: 10 CFR Part 40, Appendix A, Criterion 6(6)

40 CFR Part 761 61 criteria is for total PCBs

Table 2-3

Estimated In-Situ Volumes Requiring Remediation

Basis	**Matrix**	**Volume (m^3)**	**Volume (yd^3)**
Soil, includes road bedding and EU13 VOC soil, excludes EU4 VOC plume soil	Soil	1,529	2,000
EU4 VOC plume soil	Soil	2,600	3,400
Building 431/432 trench (estimated 1/2 soil)	Soil	382	500
Building 431/432 trench (estimated 1/2 concrete)	Concrete	382	500
Building 401 foundation (including drains)	Concrete	556	727
Building 430 foundation	Concrete	688	900
Building 431/432 foundation	Concrete	414	541
Building 433 foundation, sidewalls, and roof	Concrete	31	41
Total Volume		**6,582**	**8,609**
	Matrix	**Volume (l)**	**Volume (gal)**
EU4 VOC plume (assume 1 gal/yd^3 of EU4 plume soil removed)	Groundwater	12,499	3,302
Total Volume		**12,499**	**3,302**

Notes:

m^3 – cubic meter

l - liter

gal - gallon

yd^3 – cubic yard

EU - exposure unit

VOC - volatile organic compound

Soils beneath the IWCS are not included in this list.

TABLE 2-4
SUMMARY OF GENERAL RESPONSE ACTIONS, TECHNOLOGY TYPES, AND PROCESS OPTIONS

General Response Action	Technology Type	Process Option
Land-Use Controls	Administrative and Legal Mechanisms	Access Restrictions/Proprietary Controls
		Government Controls
		Enforcement and Permit Tools
		Educational Awareness Program/Informational Tools
		Signage
		Regular Inspections
	Engineering	Fencing
Containment	Capping	Permeable
		Impermeable
		Multilayered
		Evapotranspiration (ET Cover)
	Horizontal Migration Barrier	Slurry Wall
		Sheetpile Wall
		Grout Curtain
		Cryogenic
	Vertical Migration Barrier	Jet Grouting or Horizontal Grout Wells
	Hydraulic Control	Pump and Treat
	Encapsulation	Pozzolonic Encapsulation
		Grouting
		Cryogenic Encapsulation
		Vitrification
Removal	Soil Excavation	Earth Moving Equipment
	Volume Reduction	Scarification
	Dewatering	Pump and Treat
Treatment	Thermal	*In Situ* Thermal Treatment
		Ex Situ Thermal Treatment
	Chemical	*In Situ* Chemical Oxidation
		Ex Situ Chemical Oxidation
	Biological	*In Situ* Bio-stimulation
		In Situ Bio-augmentation
Disposal	On-Site	New Engineered Structure
		Existing Engineered Structure
	Off-Site	New Engineered Facility
		Existing Permitted Facility

TABLE 2-5
INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

General Response Action	Technology Type	Process Option	Description	Screening Comments	ROCs/PAHs/EU13 VOCs		COCs (EU4 VOC Plume and Bldg. 401 Drains)		
					Soils	Foundations	VOC Soils	Bldg. 401 Drains	VOC GW
Land-Use Controls	Administrative and Legal Mechanisms	Access Restrictions/Proprietary Controls	Access restrictions would include documentation and tracking of restrictions by security to prevent or restrict access to the Site or affected areas. Contractual mechanisms based upon private property law (e.g., deed restrictions, covenants, easements) would be placed on the Site to prevent a future landowner from disturbing contaminated soil or coincident groundwater.	***Not Retained*** Site will be remediated to PRGs	X	X	X	X	X
		Government Controls	The use of zoning laws and other local government mechanisms to control potential land use. This could be used as an additional measure to make the LUC more durable or could be used to control installation of drinking water wells in the area.	***Not Retained*** Site will be remediated to PRGs	X	X	X	X	X
		Enforcement and Permit Tools	Administrative orders or consent decrees that can be used to limit the use of land.	***Not Retained*** Site will be remediated to PRGs	X	X	X	X	X
		Signage	Place signs warning potential receptors of dangers and restrictions related to the Site. Periodic inspections and maintenance of engineered controls typically required.	***Not Retained*** Site will be remediated to PRGs	X	X	X	X	X
		Regular Inspections	Inspections and maintenance to ensure proper operation of engineered controls.	***Not Retained*** Site will be remediated to PRGs	X	X	X	X	X
	Engineering	Fencing	Install fencing to prevent unauthorized access to the Site. Periodic inspections and maintenance of engineered controls typically required.	***Not Retained*** Site will be remediated to PRGs	X	X	X	X	X
Containment	Capping	Permeable	The installation of a cap to either minimize/prevent exposure to ROCs or COCs. For the ROCs a permeable cap may be considered to minimize exposure and provide distance and shielding while allowing radioactive daughter products such as radon gas to pass through at low levels. Long-term maintenance and monitoring of the cap to ensure this purpose is being met would be required.	***Retained*** A potential viable option to eliminate risk from exposure.	X		X		X
		Impermeable	The installation of a cap to either minimize/prevent exposure to ROCs or COCs and minimize the effects of infiltration to spread or mobilize the contaminant. For the COCs such as PAHs an impermeable cap would be more applicable to prevent exposure to COCs and prevent mobilization of the COCs from the capped area due to infiltration or surface run-off. Long-term maintenance and monitoring to ensure this purpose is being met would be required. May be required to be used in conjunction with horizontal and/or vertical containment to control contaminant migration.	***Retained*** A potential viable option to eliminate risk from exposure.	X		X		X
		Multilayered	A multilayered cap combining both the impermeable cap with a permeable gas collection layer beneath that can be passively or actively vented for control. This type of cap could be used for both ROCs and COCs.	***Retained*** A potential viable option to eliminate risk from exposure	X		X		X
		Evapotranspiration (ET Cover)	This cap is often used in arid environments as an alternative to clay or synthetic liner single or multilayered caps. The cap is constructed from silty loam materials such as loess and is vegetated for all infiltration to be handled by a combination of evaporation and plant transpiration. The cap is permeable yet controls infiltration.	***Not Retained*** The NFSS is not located in an arid climate due to its proximity to both Lakes Erie and Ontario. The type of soils needed for construction are not readily available in the area	X		X		X

TABLE 2-5
INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

General Response Action	Technology Type	Process Option	Description	Screening Comments	ROCs/PAHs/EU13 VOCs		COCs (EU4 VOC Plume and Bldg. 401 Drains)		
					Soils	Foundations	VOC Soils	Bldg. 401 Drains	VOC GW
Containment (Cont.)	Horizontal Migration Barrier	Slurry Wall	A slurry wall would be installed to prevent lateral migration from a contaminated area with the bottom tied into a competent underlying impermeable layer. This would require prevention/minimization of infiltration by either an impermeable cap and/or a hydraulic control mechanism within the contained area. This technology would require long-term maintenance into the future. This would also require an evaluation of slurry wall materials with the COCs to be sure compatibility for long-term effectiveness. For some COCs identified at the Site, in particular PCE and its daughter products, the tendency of the solvent to dissolve the clay matrices could lead to migration through the underlying confining units by gravity and migrate to underlying more permeable zones in the future. Impermeable barriers could also prevent migration of ROC daughter products such as radon gas which would could lead to future exposure issues.	***Not Retained*** NFSS, with the exception of sand lenses and fractures, is mostly low-permeability soils with lower permeability than a completed wall.	X		X		X
		Sheetpile Wall	Sheetpile wall would be installed to prevent lateral migration from a contaminated area with the bottom tied into a competent underlying impermeable layer. This would require prevention/minimization of infiltration by either an impermeable cap and/or a hydraulic control mechanism within the contained area. This technology would require long-term maintenance into the future. This would also require an evaluation of sheetpile materials with the COCs to be sure compatibility for long-term effectiveness For example, if steel was selected, PCE and daughter products could cause significant corrosion leading to failure. For some COCs identified at the Site, in particular PCE and its daughter products, the tendency of the solvent to dissolve the clay matrices could lead to migration through the underlying confining units by gravity and migrate to underlying more permeable zones in the future. Impermeable barriers could also prevent migration of ROC daughter products such as radon gas which would could lead to future exposure issues.	***Not Retained*** NFSS, with the exception of sand lenses and fractures, is mostly low-permeability soils with lower permeability than a completed wall.	X		X		X
		Grout Curtain	Horizontal barriers could be created by grouting fractures or identified permeable zones to prevent lateral migration of impacted material or daughter products outside of a contained area. This may require prevention/minimization of infiltration by either an impermeable cap and/or a hydraulic control mechanism within the contained area. This technology would require long-term maintenance into the future. This would also require an evaluation of material compatibility with the contaminants of concern to ensure long-term effectiveness.	***Not Retained*** NFSS, with the exception of sand lenses and fractures, is mostly low-permeability soils with lower permeability than a completed grout curtain.	X		X		X
		Cryogenic	A wall of frozen soil would be installed by the application of cryogenic fluids like liquid nitrogen through soil probes to prevent lateral migration from a contaminated area with the bottom tied into a competent underlying impermeable layer. This would require prevention/minimization of infiltration by either an impermeable cap and/or a hydraulic control mechanism within the contained area. This technology would require long-term maintenance into the future.	***Not Retained*** Not applicable. Full scale demonstration of technology is limited and has significant health and safety concerns.	X		X		X
	Vertical Migration Barrier	Jet Grouting or Horizontal Grout Wells	Vertical barriers can be constructed by injecting grout of different materials through fractures or potential permeable zones to limit or prevent vertical migration of contaminants. This may require the combination of hydraulic control and/or capping to ensure an inward gradient is maintained to minimize potential migration. Typically, this would be used to eliminate preferential migration pathways that may exist or be used in conjunction with horizontal barriers and/or capping/hydraulic control. Long-term monitoring and maintenance would be required to ensure the vertical barrier was working as planned.	***Not Retained*** Not applicable. Existing confining layers are sufficient to prevent vertical migration of groundwater contaminants according to modeling performed by others.	X		X		X
	Hydraulic Control	Pump and Treat	Hydraulic control can be used to minimize or prevent migration of contaminants at a site. This could consist of permeable trenches with a pump and treat system to maintain control. The use of hydraulic control in conjunction with other barriers discussed above could also be effective. The use of hydraulic control will require some form of long-term monitoring and maintenance to prove the effectiveness and durability of the technology.	***Not Retained*** Due to the low permeability of the material at the site, pump and treat systems would not be effective for hydraulic control.					X

TABLE 2-5
INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

General Response Action	Technology Type	Process Option	Description	Screening Comments	ROCs/PAHs/EU13 VOCs		COCs (EU4 VOC Plume and Bldg. 401 Drains)		
					Soils	Foundations	VOC Soils	Bldg. 401 Drains	VOC GW
Containment (Cont.)	Encapsulation	Pozzolonic Encapsulation	Encapsulation can consist of any form of matrix entrapment preventing migration of the ROC or COC. This includes stabilization with pozzolonic material such as fly ash, lime or cement to trap the contaminants within the mix matrix. Pozzolonic stabilization would require significant pilot testing to ensure the material would be trapped within the matrix and not readily leached out. However, radioactive materials could still be an exposure pathway and might require that capping or other technologies be combined to prevent risk.	***<u>Retained</u>*** Could be utilized to stabilize soil for transportation if required.	X		X		X
		Grouting	Grouting would consist of injecting grout in building drains or other potential preferential pathways to prevent potential contaminant migration.	***<u>Retained</u>*** Grouting would be a viable option to limit/prevent lateral migration through building drains.				X	
		Cryogenic Encapsulation	Encapsulation can consist of any form of matrix entrapment preventing migration of the ROC or COC. Cryogenic stabilization would freeze the existing soil matrix preventing migration trapping the contaminants. However, radioactive materials could still be an exposure pathway and might require capping or other technologies be combined to prevent risk. Cryogenic stabilization requires substantial maintenance to keep the media in the frozen state. If it is not maintained it would revert back to the initial exposure risk.	***<u>Not Retained</u>*** Not applicable. Full scale demonstration of technology is limited and has significant health and safety concerns.	X	X	X	X	X
		Vitrification	Encapsulation can consist of any form of matrix entrapment preventing migration of the ROC or COC. Vitrification heats the soil to extreme temperatures which melts the matrix into glass trapping the contaminants. Vitrification would require a very costly energy demand to dry and vitrify the site soil matrix. Leachability of the final matrix would need to be evaluated to ensure sustainability.	***<u>Not Retained</u>*** Not applicable since the contamination is spread across the Site and not collocated.	X	X	X	X	X
Removal	Excavation	Earth Moving Equipment	Mechanically/hydraulically operated units such as excavators, front-end loaders, bulldozers and/or hand tools used for surface and subsurface materials removal.	***<u>Retained</u>*** Potentially applicable for excavation and loading contaminated soil. Will be combined with other technologies.	X	X	X	X	X
	Volume Reduction	Scarification	Decontamination of concrete and other site media by transferring the contaminants from the media to another substrate. Scarification physically removes the contaminated surface of the concrete and other media. The extracted media would be managed as a reduced volume waste as applicable.	***<u>Retained</u>*** Potentially applicable for volume reduction of radiologically contaminated materials such as concrete building foundations. Will be combined with other technologies.		X			
	Dewatering	Pump and Treat	Dewatering is not a standalone technology but is a requirement in conjunction with excavation where groundwater or surface runoff water is encountered in the excavated area. Removal technology is applicable to excavation of both ROC and COC impacts, and to all contaminated materials at the Site where excavation is required.	***<u>Retained</u>*** Not suitable for standalone remedy but will likely be used in conjunction with excavation at specific areas of the Site.	X		X		X
Treatment	Thermal	*In Situ* Thermal Treatment	Electrical resistive heating of subsurface soil by inductive heating or similar method. Drives VOC to vapor phase and is collected and quenched above ground on carbon or other off-gas treatment systems. This method works well for PCE in any soil type. Not effective for ROCs	***<u>Retained</u>*** Potentially applicable for PCE and daughter products soil and collocated groundwater.			X		X
		Ex Situ Thermal Treatment	High-or Low-temperature thermal desorption will work to treat VOC-impacted soils. This would include excavation and transportation to the treatment area and processing through the treatment equipment. This may require additional off-gas treatment. Would not provide treatment for the ROCs.	***<u>Retained</u>*** Potentially applicable for PCE and daughter products soil and collocated groundwater.			X		X
	Chemical	*In Situ* Oxidation	Use of injection or in place mixing of an oxidant with the contaminated soils and groundwater to chemically mineralize the COCs through oxidation reactions. This could be performed by direct injection into the subsurface or direct mixing in place with traditional or specialized earth moving equipment. Examples of oxidants for PCE and daughter products would include sodium permanganate, activated persulphate, catalyzed hydrogen peroxide, etc.	***<u>Not Retained</u>*** Due to the fine-grained nature of the Site soil, *in situ* injection technologies are not implementable.			X		X
		Ex Situ Oxidation	Excavation and stockpiling of contaminated media and treatment by mixing an oxidant with the material on a treatment pad. This would work for most COCs	***<u>Retained</u>*** Potentially applicable for PCE and daughter products soil and collocated groundwater			X		X

TABLE 2-5
INITIAL SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

General Response Action	Technology Type	Process Option	Description	Screening Comments	ROCs/PAHs/EU13 VOCs		COCs (EU4 VOC Plume and Bldg. 401 Drains)		
					Soils	Foundations	VOC Soils	Bldg. 401 Drains	VOC GW
Treatment (Cont.)	Biological	*In Situ* Bio-stimulation	Injection or in place mixing of electron acceptor substrate to stimulate reductive dechlorination of contaminants with native bacteria. Has the potential to establish conditions where long term flux of contamination from fine grained soil matrix is readily dechlorinated to non-toxic end products such as ethene. May cause concentration of more toxic daughter products (vinyl chloride) if not properly performed or maintained.	***Not Retained*** Due to the fine-grained nature of the Site soil, viability of long-term biological treatment is unlikely			X		X
		In Situ Bio-augmentation	Injection or in place mixing of non-indigenous bacteria to allow for reductive dechlorination of contaminants. Usually performed in conjunction with bio-stimulation to ensure required conditions are maintained. Has the potential to establish conditions where long-term flux of contamination from fine-grained soil matrix is readily dechlorinated to non-toxic end products such as ethene. May cause concentration of more toxic daughter products (vinyl chloride) if not properly performed or maintained	***Not Retained*** Due to the fine-grained nature of the Site soil, viability of long-term biological treatment is unlikely			X		X
Disposal	On-Site	New Engineered Structure	Permit, design and construct a disposal facility on-site.	***Not Retained*** Not applicable. The IWCS is to be removed per the Proposed Plan for that operable unit. Construction of an additional unit for the BOP operable unit is unlikely.	X	X	X	X	X
		Existing Engineered Structure	Utilize the IWCS for long-term on-site disposal.	***Not Retained*** Not applicable. The IWCS is to be removed by the proposed plan for that operable unit.	X	X	X	X	X
	Off-Site	New Engineered Facility	Permit, design and construct a new disposal facility off-site. Transport treated and/or untreated soils and debris meeting waste acceptance criteria to the new facility.	***Not Retained*** Any new facility would have significant permitting and construction difficulties and community opposition.	X	X	X	X	X
		Existing Permitted Facility	Transport treated and/or untreated soils and debris meeting waste acceptance criteria to a permitted off-site disposal facility.	***Retained*** Requires permitting and long-term maintenance.	X	X	X	X	X

Notes:

Bldg = building
COC = chemical of concern
EU = exposure unit
GW = groundwater
IWCS = interim waste containment structure
LUC = land use control
Shading indicates Process Option not retained

NFSS = Niagara Falls Storage Site
PAH = polycyclic aromatic hydrocarbon
PCE = tetrachloroethylene
PRG = preliminary remediation goal
ROC = radionuclide of concern
USACE = United States Army Corps of Engineers
VOC = volatile organic compound

TABLE 2-6
SUMMARY OF RETAINED TECHNOLOGIES AND PROCESS OPTIONS AFTER INITIAL SCREENING

General Response Action	Technology Type	Process Option	ROCs/PAHs/EU13 VOCs		COCs (EU4 VOC Plume and Bldg. 401 Drains)		
			Soil	Foundations	VOC Soil	Bldg. 401 Drains	VOC GW
Containment	Capping	Permeable	X		X		X
		Impermeable	X		X		X
		Multilayered	X		X		X
	Encapsulation	Pozzolonic Encapsulation	X		X		X
		Grouting				X	
Removal	Excavation	Earth Moving Equipment	X	X	X	X	X
	Dewatering	Pump and Treat	X		X		X
Treatment	Thermal	*In Situ* Thermal Treatment			X		X
		Ex Situ Thermal Treatment			X		X
	Chemical	*Ex Situ* Oxidation			X		X
Disposal	Off-Site	Existing Permitted Facility	X	X	X	X	X

Notes:
Soil includes road bedding
Bldg = building
COC = chemical of concern
EU = exposure unit
GW = groundwater
PAH = polycyclic aromatic hydrocarbon
ROC = radionuclide of concern
VOC = volatile organic compound
Foundations include Bldg 433

TABLE 2-7
EVALUATION OF TECHNOLOGIES AND PROCESS OPTIONS

General Response Action	Remedial Technology	Process Option	Effectiveness	Implementability	Cost	Screening Comments	ROCs/PAHs/EU13 VOCs		COCs (EU4 VOC Plume and Bldg. Drains)		
							Soil	Foundations	VOC Soil	Bldg. 401	VOC GW
Containment	Capping	Permeable	**Medium** Can prevent exposure to ROCs at the site and prevent accumulation of radon gas. Will not protect against COC accumulation or migration.	**Low** Would require caps for ROC areas. Would need to be used in conjunction with LUCs and engineering controls to be effective. Would not be applicable to COCs. Administrative implementability is considered to be low.	**Medium** Capital: Medium LTM: Medium-High	Not Retained.	X		X		X
		Impermeable	**Medium-High** Effective for isolating ROCs and COCs from receptor exposure. Could trap and result in radon exposure in the vicinity.	**Low** Would require caps all across the site for ROC areas. Would need to be used in conjunction with LUCs and engineering controls to be effective. Administrative implementability is considered to be low.	**Medium-High** Capital: Medium LTM: Medium-High	Not Retained.	X		X		X
		Multilayered	**High** Effective for isolating ROCs and COCs and the gas collection system could be configured to ensure controlled release of contaminants below action levels. Would require grading and fill at each location along with protection to ensure it is maintained (fencing, etc.).	**Low** Would require caps all across the site for ROC areas. Would need to be used in conjunction with LUCs and engineering controls to be effective. Administrative implementability is considered to be low.	**Medium-High** Capital: Medium LTM: Medium-High	Not Retained.	X		X		X
	Encapsulation	Pozzolonic Encapsulation	**Low-Medium** Effective in encapsulating material including trapping moisture to meet transportation requirement but likely not required.	**High** Technology to blend with waste soils is readily implementable.	**Medium-Low** Capital: Medium-Low LTM: None	Not Retained.	X		X		X
		Grouting	**Low** Grouting of drains and high-permeability soil, if present, can effectively limit migration of contaminant through these preferential pathways. However, contamination remains in place.	**High** Would prevent migration through preferential media and is readily implementable through construction methods for drain grouting and direct-push injection technology for subsurface soil. Could be used to minimize impacts by migration in identified pathways.	**Low** Capital: Medium LTM: None	Not Retained.				X	
Removal	Excavation	Earth Moving Equipment	**High** The excavation of contaminated material for treatment/volume reduction/disposal is very effective to remove the contaminant causing risk at the site. Property stockpile and management techniques are required to ensure effectiveness and minimize spread of contamination.	**High** Excavation is a standard readily implementable technique for contaminant removal.	**Medium** Capital: Medium LTM: None	Retained.	X	X	X	X	X
	Dewatering	Pump and Treat	**High** Effective for the removal of groundwater in conjunction with excavation.	**High** Readily implementable using readily available equipment.	**Low** Capital: Low LTM: None	Retained for use in conjunction with excavation.	X		X		X
Treatment	Thermal	*In Situ* Thermal Treatment	**High** Highly effective for PCE and daughter products in all soil types. Most vendors offer guarantee for completion. Can be performed at comingled sites, effective for PAHs and VOCs.	**Medium** Readily implementable. Will require power distribution to the treatment area. Can be performed around existing structures.	**High** Capital: High LTM: None	Retained.			X		X
		Ex Situ Thermal Treatment	**High** Requires excavation and staging of the materials for treatment. Effective at removing VOCs and PAHs from all soils.	**Medium** Readily implementable. Requires power or heat source but could be performed in an area where the resources are readily available.	**High** Capital: High LTM: None	Retained.			X		X
	Chemical	*Ex Situ* Chemical Oxidation	**Medium-Low** Requires excavation and staging and handling of the materials for treatment. Effective at removing VOCs from soils. Less effective for PAHs.	**Moderate** Needs to have a treatment pad constructed in area of treatment area to prevent cross contamination of soil/groundwater.	**High** Capital: High LTM: None	Not Retained.			X		X
Disposal	Off-Site	Existing Permitted Facility	**Medium-High** Has been effectively used to dispose of site residues. Has risk of exposure during transportation phase that would be required.	**High** Has been performed before with a durable control of ROC and COC risk for the Site vicinity.	**Medium** Capital: Medium LTM: None	Retained.	X	X	X	X	X

Notes:
Bldg = building
COC = chemical of concern
EU = exposure unit
GW = groundwater
LTM = long-term monitoring
LUC = land-use control
Shading indicates Process Option not retained
NFSS = Niagara Falls Storage Site
PAH = polycyclic aromatic hydrocarbon
PCE = tetrachloroethylene
ROC = radionuclide of concern
VOC = volatile organic compound
Soil includes road bedding
Foundations include Bldg 433

Table 2-8
Summary of Retained General Response Actions, Technology Types, and Process Options

General Response Action	Technology Type	Process Option	ROCs/PAHs/EU13 VOCs		COCs (EU4 VOC Plume and Bldg. 401 Drains)		
			Soil	Foundations	VOC Soil	Bldg. 401	VOC GW
Removal	Excavation	Earth-Moving Equipment	X	X	X	X	X
	Dewatering	Pump and Treat	X		X		X
Treatment	Thermal	*In Situ* Thermal Treatment			X		X
		Ex Situ Thermal Treatment			X		X
Disposal	Off-Site	Existing Permitted Facility	X	X	X	X	X

Notes:
Bldg. = building
COC = chemical of concern
EU = exposure unit
GW = groundwater
PAH - polycyclic aromatic hydrocarbon
ROC = radionuclide of concern
VOC = volatile organic compound
Soil includes road bedding
Foundations include Bldg. 433

Table 3-1
Summary of Remedial Alternatives

Alternatives	Process Options - ROCs/PAHs/EU13 VOCs		Process Options - COCs (EU4 VOC Plume and Bldg 401 Drains)		
	Soil	**Foundations**	**VOC Soil**	**Bldg. 401**	**VOC GW**
Alternative 1 – No Action	No Action		No Action		
Alternative 2 – Complete Removal	Earth Moving	Earth Moving	Earth Moving	Earth Moving	Dewatering
Alternative 3 – Removal with Building Decontamination	Earth Moving	Decontamination	Earth Moving	Earth Moving	Dewatering
Alternative 4 – Removal with Building Decontamination and *In Situ* Remediation	Earth Moving	Decontamination	*In Situ* Treatment	Earth Moving	In-Situ Treatment
Alternative 5 – Removal with Building Decontamination and Ex *Situ* Remediation	Earth Moving	Decontamination	*Ex Situ* Treatment	Earth Moving	Dewatering

Notes:

Soil includes road bedding

Foundations includes Building 433

Building decontamination would consist of scarifying

Dewatering would consist of pumping and on-site or off-site treatment

Bldg = building

COC = chemical of concern

EU = exposure unit

GW = groundwater

PAH = polycyclic aromatic hydrocarbon

ROC = radionuclide of concern

VOC = volatile organic compound

Table 4-1

Summary of Detailed Analysis of Alternatives

CERCLA Evaluation Criterion	Alternative 1 – No Action	Alternative 2 – Complete Removal	Alternative 3 – Removal with Building Decontamination	Alternative 4 – Removal with Building Decontamination and *In Situ* Remediation	Alternative 5 – Removal with Building Decontamination and *Ex Situ* Remediation
Overall Protection of Human Health and the Environment					
Protectiveness of remedy	Not protective	Protective Meets all RAOs developed for the Site	Protective Meets all RAOs developed for the Site	Protective Meets all RAOs developed for the Site	Protective Meets all RAOs developed for the Site
Compliance with ARARs					
Compliance with ARARs	Does not comply with ARARs	Complies with ARARs	Complies with ARARs	Complies with ARARs	Complies with ARARs
Long-Term Effectiveness and Permanence					
Magnitude of risk associated with waste to remain	All impacted materials remain in place resulting in unacceptable risk	All impacted materials above PRGs removed from the Site, permanently reducing the risk of on-site exposure	All ROC-impacted materials and COC-impacted materials above PRGs removed from the Site, permanently reducing risk of on-site exposure	Removal of ROC-impacted soils and foundations and COC-impacted materials, and *in situ* EU4 VOC plume treatment would permanently reduce risk of on-site exposure from material above PRGs	Removal of ROC-impacted soils and foundations and COC-impacted materials, and *ex situ* EU4 VOC plume soils treatment would permanently reduce risk of on-site exposure from material above PRG
Adequacy and reliability of controls	Current site controls cease	Site would be remediated to industrial use PRGs	Site would be remediated to industrial use PRGs	Site would be remediated to industrial use PRGs	Site would be remediated to industrial use PRGs
Summary	Not effective at preventing long-term exposures in the absence of LUC	Effective as all impacted materials above PRGs are removed	Effective as all impacted materials above PRGs are removed	Effective as all impacted materials above PRGs are removed or treated	Effective as all impacted materials above PRGs are removed or treated
Reduction of Toxicity, Mobility, or Volume Through Treatment					
Treatment process used and materials treated	No treatment used	No treatment used	No treatment used	Thermal treatment to reduce toxicity of EU4 VOC plume soil and groundwater	Thermal treatment to reduce toxicity of EU4 VOC plume soil
Amount of impacted materials destroyed or treated	No materials destroyed or treated	No materials destroyed or treated	No materials destroyed or treated	3,302 cu yds of EU4 VOC plume soil and groundwater treated on-site	3,302 cu yds of EU4 VOC plume soil treated on-site Groundwater would be treated off-site
Degree of expected eduction in toxicity, mobility, or volume	No reduction in toxicity, mobility, or volume	No reduction in toxicity, mobility, or volume	No reduction in toxicity, mobility, or volume	Thermal treatment would permanently reduce the toxicity of the EU4 VOC plume soil and groundwater	Thermal treatment would permanently reduce the toxicity of the EU4 VOC plume soil
Type and quantity of esiduals remaining after treatment	No treatment and therefore no residuals	All impacted materials would be taken off-site All residual materials would be below PRGs	All impacted materials would be taken off-site All residual materials would be below PRGs	All impacted materials would be taken off-site except EU4 VOC plume soil which would be treated on-site All residual materials would be below PRGs	All impacted materials would be taken off-site except EU4 VOC plume soil which would be treated on-site All residual materials would be below PRGs

Table 4-1

Summary of Detailed Analysis of Alternatives

CERCLA Evaluation Criterion	Alternative 1 – No Action	Alternative 2 – Complete Removal	Alternative 3 – Removal with Building Decontamination	Alternative 4 – Removal with Building Decontamination and *In Situ* Remediation	Alternative 5 – Removal with Building Decontamination and *Ex Situ* Remediation
Short-Term Effectiveness					
Protection of community during remedial actions	No short-term impacts to community	Increased potential for community exposure due to excavation and trucking, but controls would be used	Increased potential for community exposure due to excavation and trucking, but controls would be used	Increased potential for community exposure due to excavation and trucking, but controls would be used	Increased potential for community exposure due to excavation and trucking, but controls would be used
Protection of workers during emedial actions	No short-term impacts to workers	Low potential for exposure to workers when complying with radiation worker protection requirements and VOC protection requirements	Low potential for exposure to workers when complying with radiation worker protection requirements and VOC protection requirements	Low potential for exposure to workers when complying with radiation worker protection requirements and VOC protection requirements	Low potential for exposure to workers when complying with radiation worker protection requirements and VOC protection requirements
Environmental impacts	No short-term impacts to the environment	Controls in place to prevent environmental impacts	Controls in place to prevent environmental impacts	Controls in place to prevent environmental impacts	Controls in place to prevent environmental impacts
Time until remedial action objectives are achieved	RAOs would not be achieved	28 5 months (24 months design and plans, 4 5 months construction)	28 5 months (24 months design and plans, 4 5 months construction)	37 months (24 months design and plans, 13 months construction) EU4 VOC treatment requires extended treatment time	37 months (24 months design and plans, 13 months construction) EU4 VOC treatment requires extended treatment time
Summary	No short-term impacts	All short-term impacts can be addressed by work controls	All short-term impacts can be addressed by work controls	All short-term impacts can be addressed by work controls	All short-term impacts can be addressed by work controls
Implementability					
Ability to construct and operate the technology	No action proposed	Proven technologies	Proven technologies for removal and foundation decontamination	Proven technologies for removal and foundation decontamination Limited vendors for VOC *in situ* treatment Power demand for VOC treatment would be high	Proven technologies for removal and foundation decontamination Limited vendors for VOC *ex situ* treatment Power demand for VOC treatment would be high
Reliability of the technology	NA	Alternative incorporates reliable excavation, loading, and transport approaches	Alternative incorporates reliable excavation, loading, and transport approaches Foundation decontamination requires specialized, but reliable, equipment	Alternative incorporates reliable excavation, loading, and transport approaches Foundation decontamination requires specialized, but reliable, equipment *In situ* EU4 VOC treatment is reliable but has a high power	Alternative incorporates reliable excavation, loading, and transport approaches Foundation decontamination requires specialized, but reliable, equipment *Ex situ* EU4 VOC treatment is reliable but has a high power
Ease of undertaking additional remedial actions, f necessary	Additional action could be implemented	Additional action could be implemented	Additional action could be implemented	Additional action could be implemented	Additional action could be implemented
Ability to monitor the effectiveness of the remedy	Monitoring would not be conducted	Confirmation samples would be collected from the end-points of the excavation areas	Confirmation samples would be collected from the end-points of the excavation areas and following decontamination procedures	Confirmation samples would be collected from the end-points of the excavation areas Confirmation sampling of *in situ* EU4 VOC treatment would also be required and following decontamination	Confirmation samples would be collected from the end-points of the excavation areas Confirmation sampling of *ex situ* EU4 VOC treatment would also be required and following decontamination

Table 4-1

Summary of Detailed Analysis of Alternatives

CERCLA Evaluation Criterion	Alternative 1 – No Action	Alternative 2 – Complete Removal	Alternative 3 – Removal with Building Decontamination	Alternative 4 – Removal with Building Decontamination and *In Situ* Remediation	Alternative 5 – Removal with Building Decontamination and *Ex Situ* Remediation
Implementability (continued)					
Administrative Feasibility	Unlikely to be supported by regulatory agencies due to the uncontrolled risks that would	Likely to be supported by regulatory agencies since all risks are addressed	Likely to be supported by regulatory agencies since all risks are addressed	Likely to be supported by regulatory agencies since all risks are addressed	Likely to be supported by regulatory agencies since all risks are addressed
Availability of off-site treatment, storage, and disposal services and capacity	NA	Few facilities can accept ROC-impacted materials VOC soil may require thermal treatment which is available at some off-site disposal facilities	Few facilities can accept ROC-impacted materials VOC soil may require thermal treatment which is available at some off-site disposal facilities	Few facilities can accept ROC-impacted materials EU13 VOC soil may require thermal treatment which is available at some off-site disposal facilities Off-site EU4 VOC soil and groundwater disposal would not be needed	Few facilities can accept ROC-impacted materials EU13 VOC soil may require thermal treatment which is available at some off-site disposal facilities Off-site EU4 VOC soil disposal would not be needed EU4 groundwater would require off-site treatment which is
Availability of necessary equipment and specialists	NA	Readily available	Readily available	Readily available	Readily available
Summary	NA	Implementable	Implementable	Implementable Power demand for EU4 VOC treatment would be high	Implementable Power demand for EU4 VOC treatment would be high
Cost					
Capital costs	$0	$23,814,326	$17,557,536	$17,180,164	$19,784,859
Present worth O&M costs (discounted)	$0	$414,153	$414,153	$414,153	$414,153
Contingency costs	$0	$11,440,418	$6,564,779	$5,320,836	$7,066,521
Total Cost	$0	$35,668,897	$24,536,468	$22,915,153	$27,265,533

Notes:

ARAR = applicable or relevant and appropriate requirement
Bldg = building
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
COC = chemical of concern
cu yds = cubic yards
Decon = decontamination
EU = exposure unit
GW = groundwater
LUC = land-use control
NA = not applicable
O&M = operation and maintenance
PAH - polycyclic aromatic hydrocarbon
PRG = potential remediation goal
RAO = remedial action objective
ROC = radionuclide of concern
VOC = volatile organic compound

Table 5-1

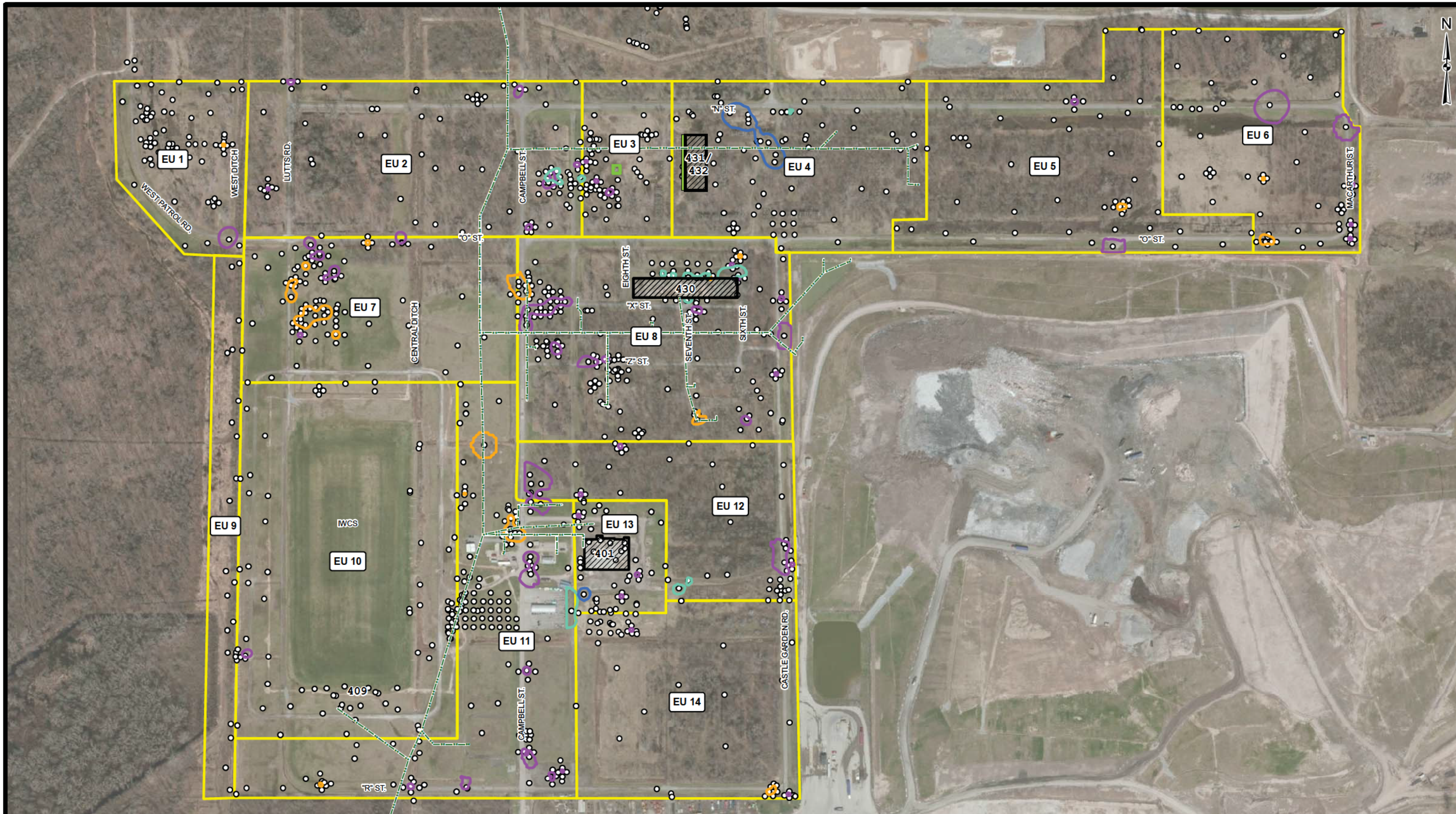
Comparative Analysis of Alternatives

CERCLA Evaluation Criterion	Alternative 1 – No Action	Alternative 2 – Complete Removal	Alternative 3 – Removal with Building Decontamination	Alternative 4 – Removal with Building Decontamination and *In Situ* Remediation	Alternative 5 – Removal with Building Decontamination and Ex *Situ* Remediation
Overall protection of human health and the environment	No	Yes	Yes	Yes	Yes
Compliance with ARARs	No	Yes	Yes	Yes	Yes
Long-term effectiveness and permanence	Low	High	High	High	High
Reduction of toxicity, mobility, or volume through treatment	Low	Low	Low	Moderate	Moderate
Short-term effectiveness	High	Low	Low	Low	Low
Implementability	Low	High	High	Moderate	Moderate
Cost (capital)	Zero cost	$23,814,326	$17,557,536	$17,180,164	$19,784,859
Cost (O&M discounted)	Zero cost	$414,153	$414,153	$414,153	$414,153
Contingency costs	Zero cost	$11,440,418	$6,564,779	$5,320,836	$7,066,521
Total Cost	Zero cost	$35,668,897	$24,536,468	$22,915,153	$27,265,533

ARAR = applicable or relevant and appropriate requirement
Bldg = building
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
FS = feasibility study
O&M = operation and maintenance
PAH = polycyclic aromatic hydrocarbor
ROC = radionuclide of concern
VOC = volatile organic compound
EU = exposure unit

Figures

THIS PAGE INTENTIONALLY LEFT BLANK



Legend

- Soil Sample Location
- Modeled Extent of Organic Contamination
- Extent of VOC Contaminated Soils
- Modeled Extent of Surface Radiological Contamination
- Modeled Extent of Subsurface Radiological Contamination
- Foundation to be Remediated
- Former Building 431/432 Trench
- Building to be Removed
- Sanitary Sewer

0 175 350 700 Feet

US Army Corps of Engineers
Buffalo District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

ESTIMATED EXTENT OF AREAS REQUIRING REMEDIATION

Document Name: 160926_AllRAD.mxd
Drawn By: H5TDESPM
Date Saved: 26 Sep 2016
Time Saved: 9:41:58 AM

NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK

FIGURE ES-1

Figure 1-1. Location of the NFSS, Lewiston, New York

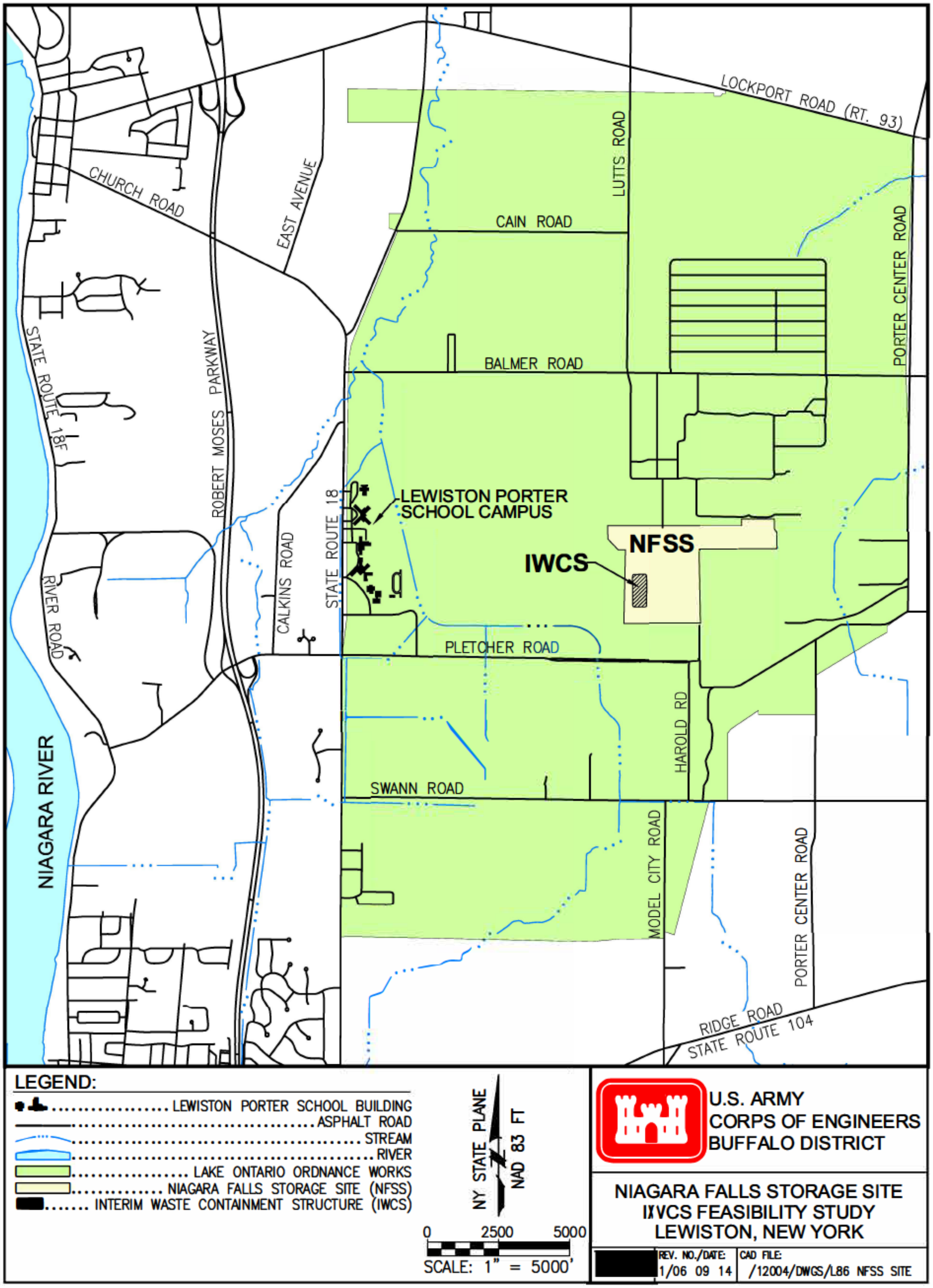
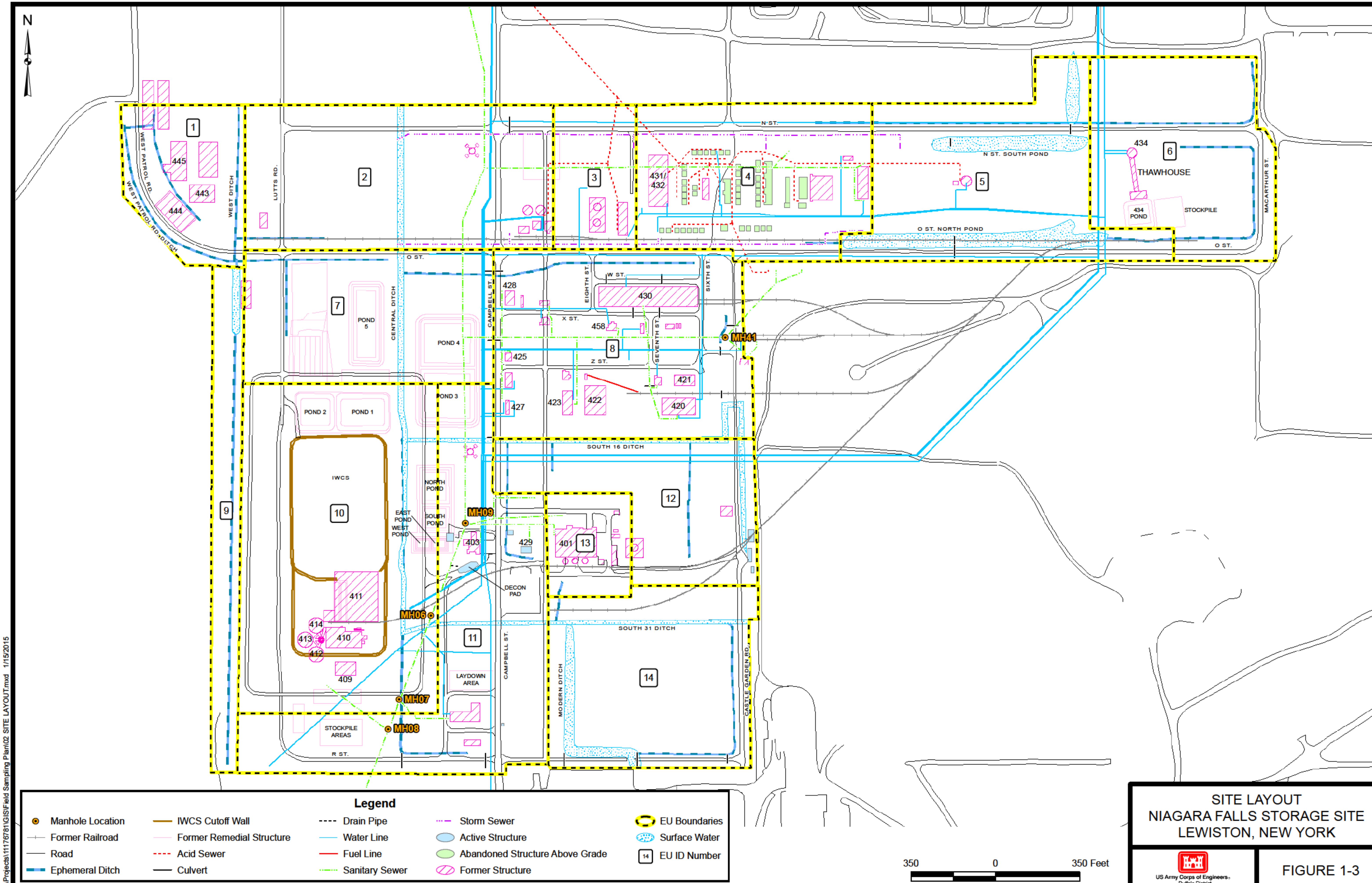


Figure 1-2. Relationship of the LOOW and the NFSS



J:\Projects\11176781\GIS\Field Sampling Plan\02 SITE LAYOUT.mxd 1/15/2015

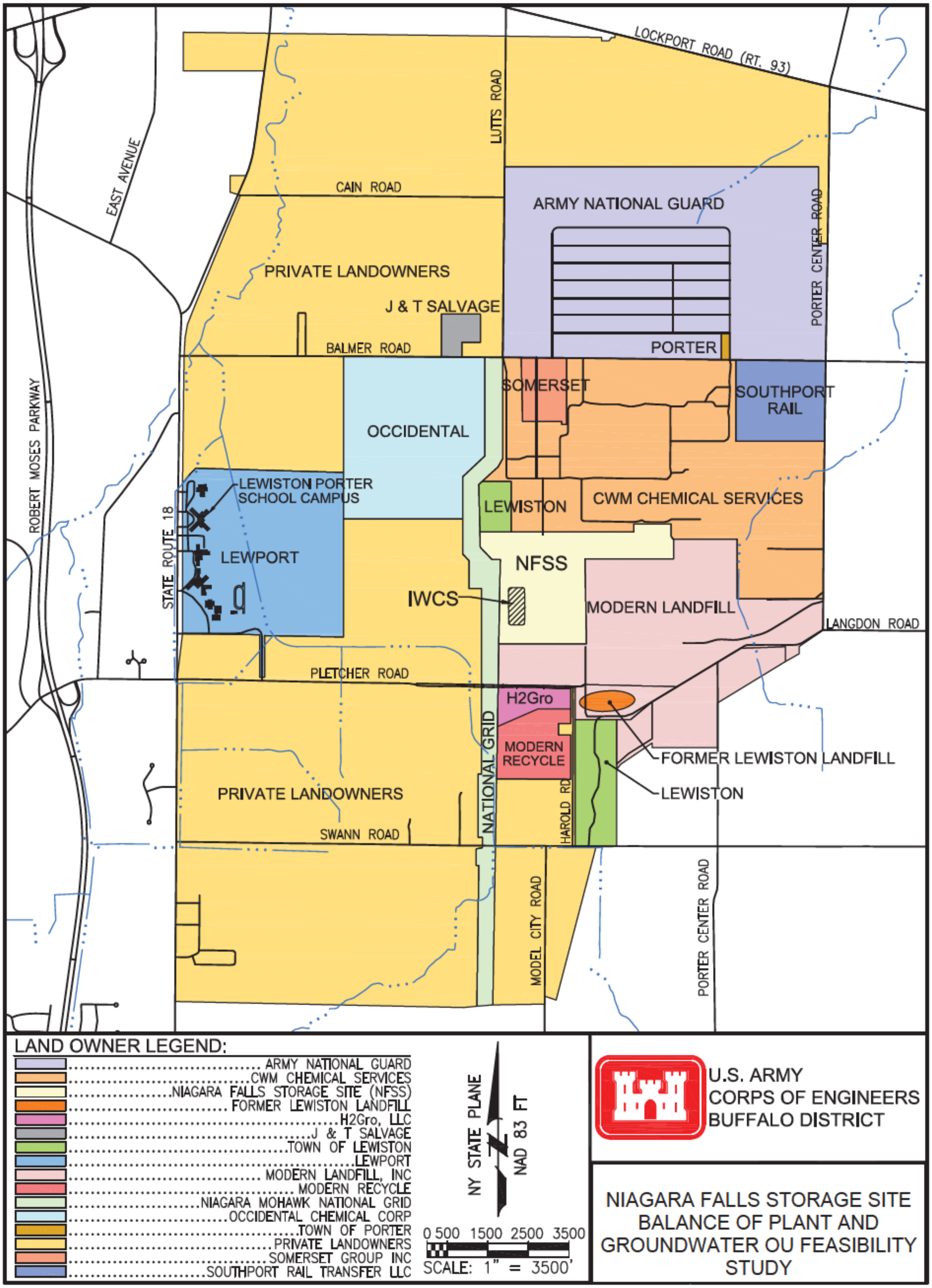
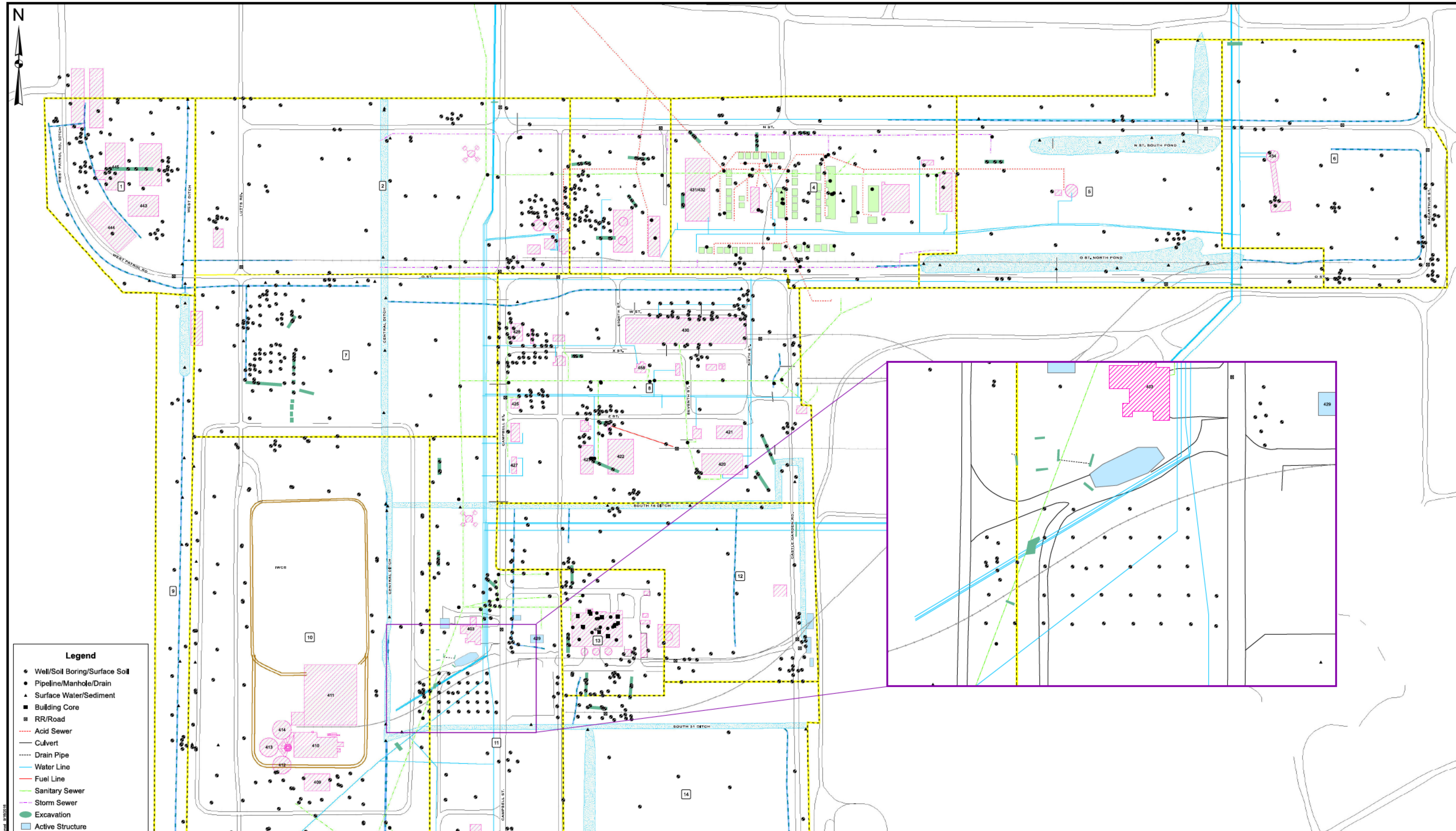
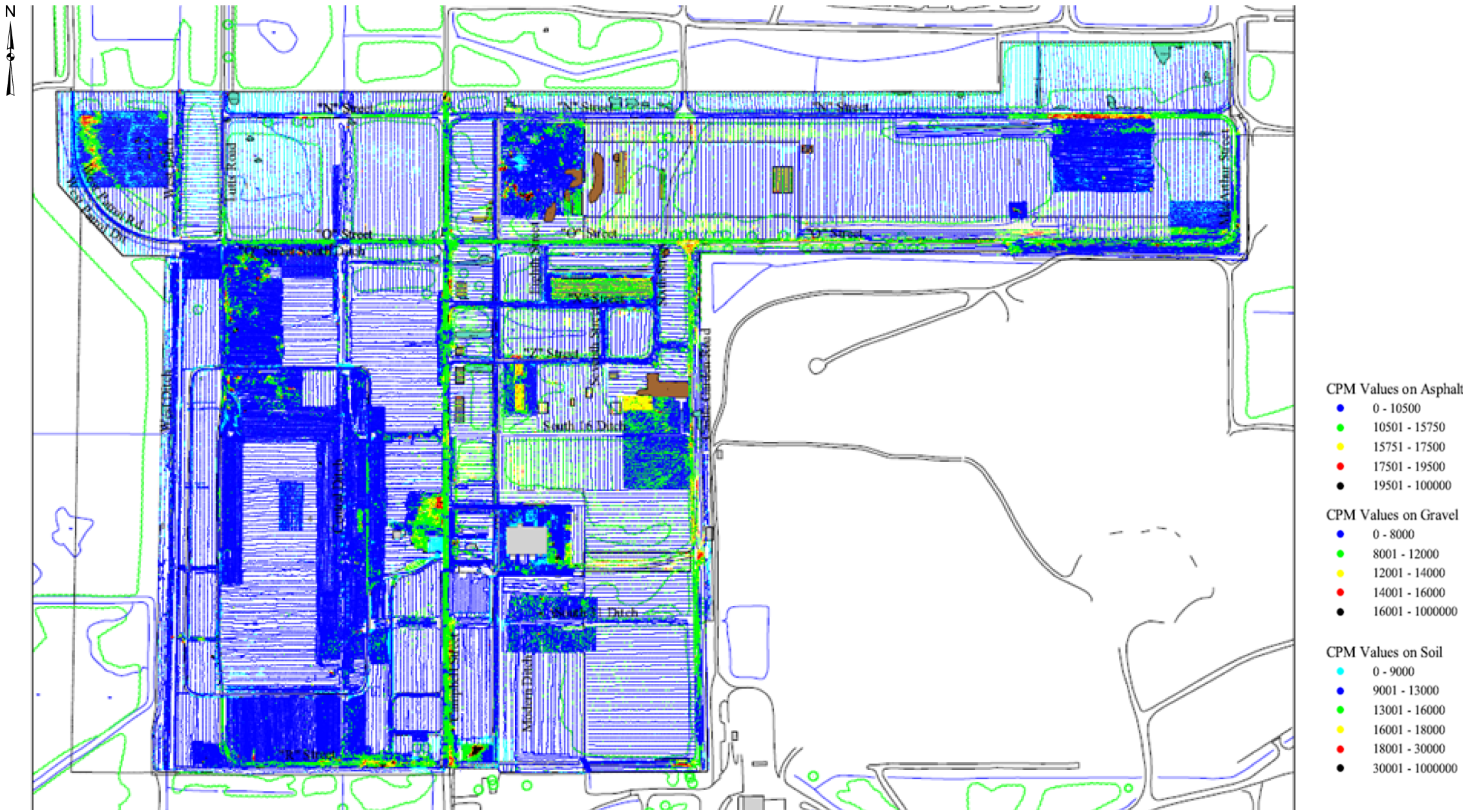


Figure 1-4. Land Use in the Vicinity of the NFSS



INVESTIGATION LOCATION MAP
NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK

FIGURE 1-5



Notes:
Source: 2007 Remedial Investigation, Appendix B
Additional Gamma Walkover Surveys were performed at locations across the site during the BOP investigations in 2013 and 2015

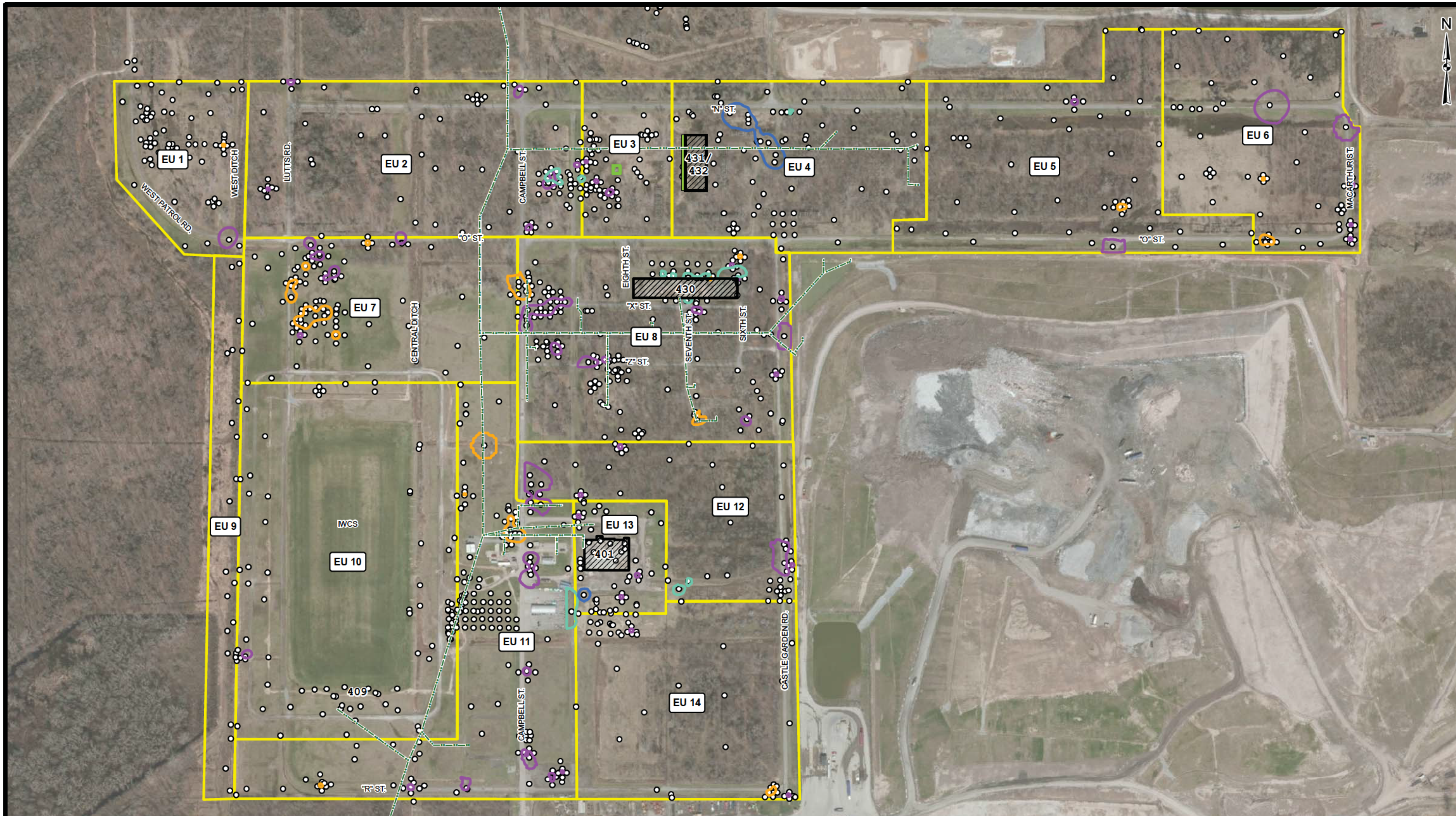
2007 GAMMA WALKOVER SURVEY
NFSS, LEWISTON, NEW YORK

US Army Corps of Engineers, Buffalo District

FIGURE 1-6

AG21110-60440939-092016-GCM

FIGURE 1-7



Legend

- Soil Sample Location
- Modeled Extent of Organic Contamination
- Extent of VOC Contaminated Soils
- Modeled Extent of Surface Radiological Contamination
- Modeled Extent of Subsurface Radiological Contamination
- Foundation to be Remediated
- Former Building 431/432 Trench
- Building to be Removed
- Sanitary Sewer

0 175 350 700 Feet

US Army Corps of Engineers Buffalo District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

ESTIMATED EXTENT OF AREAS REQUIRING REMEDIATION

Document Name: 160926_AllRAD.mxd
Drawn By: H5TDESPM
Date Saved: 26 Sep 2016
Time Saved: 9:41:58 AM

NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK

FIGURE 2-1

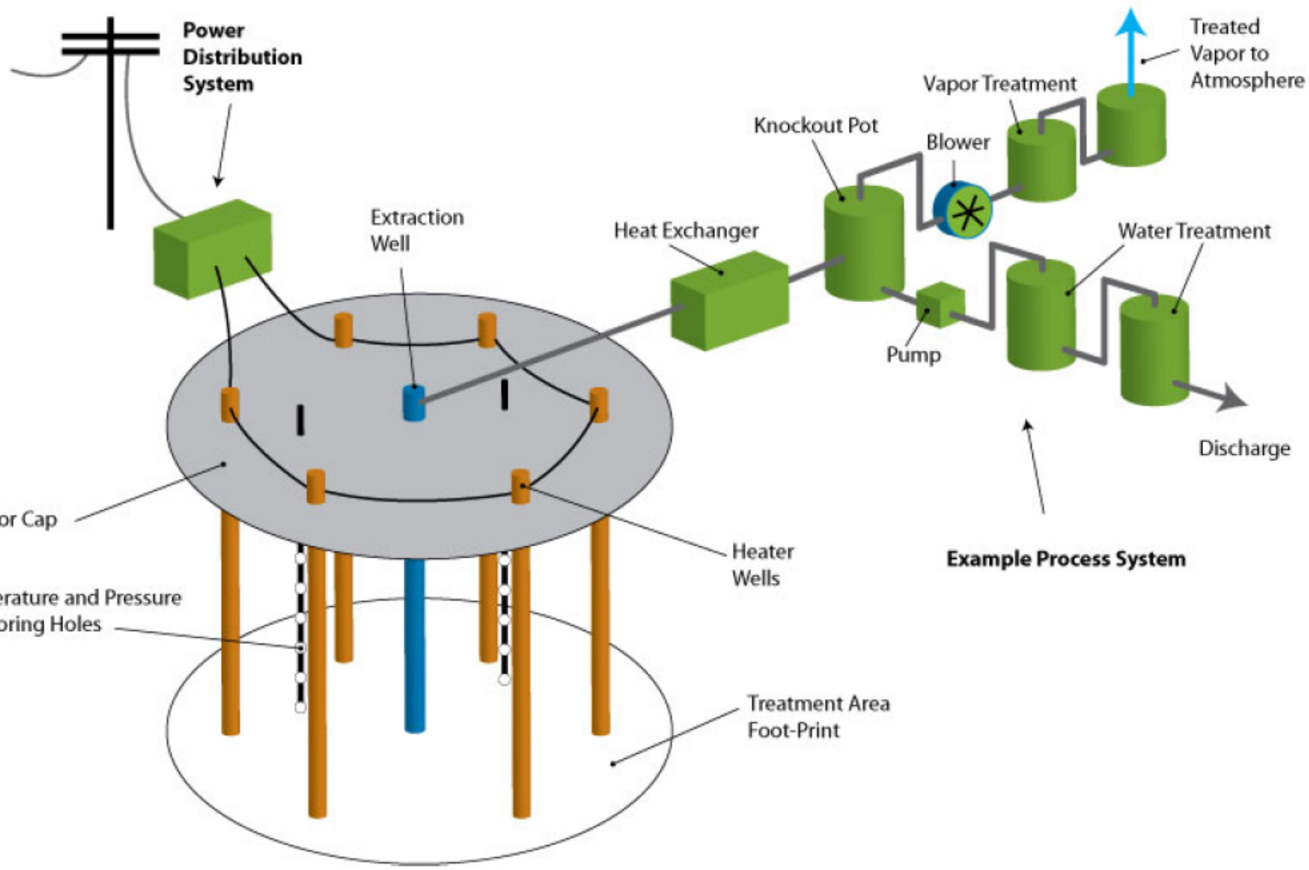
AG21110-60440939-092016-GCM

U.S. Army
Corps of Engineers
Buffalo District

NIAGARA FALLS STORAGE SITE
CONCRETE SCARIFYING EQUIPMENT

FIGURE 3-1

AG21110-60440939-092016-GCM

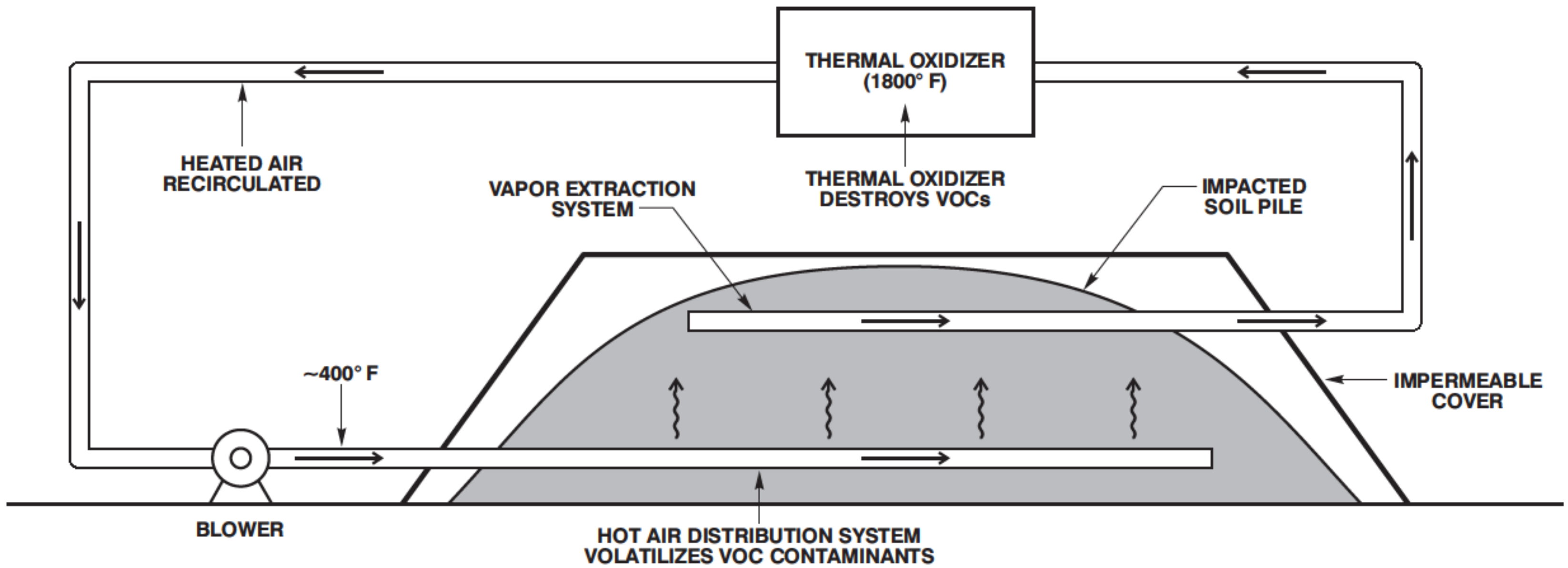


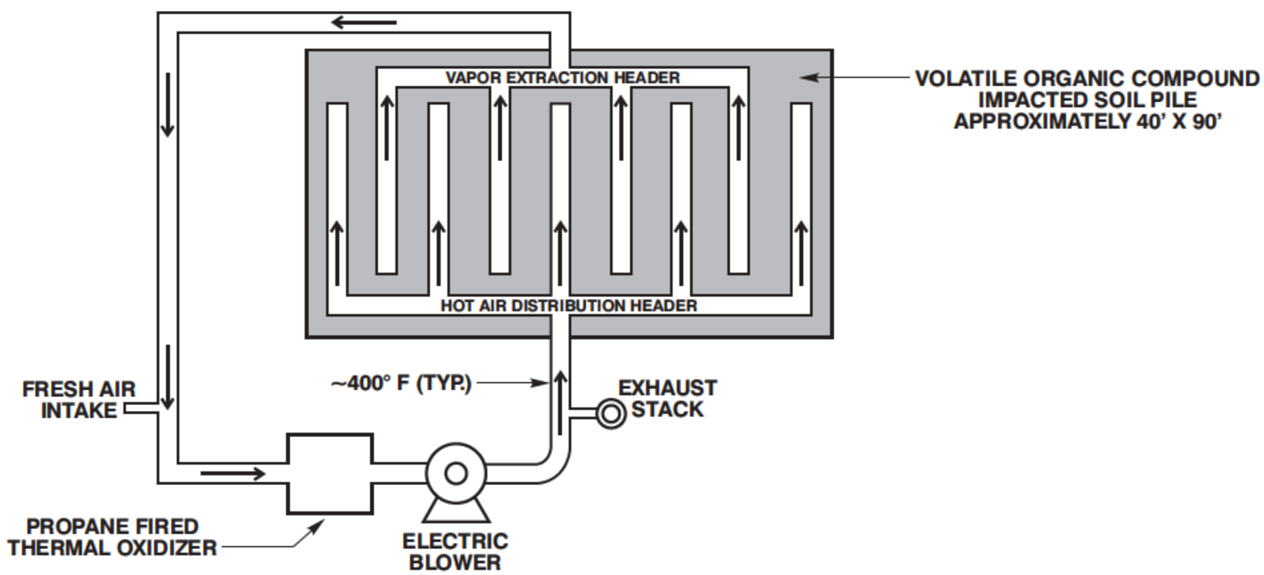
U.S. Army
Corps of Engineers
Buffalo District

NIAGARA FALLS STORAGE SITE
IN-SITU THERMAL DESORPTION

FIGURE 3-2

AG21110-60440939-092016-GCM





U.S. Army
Corps of Engineers
Buffalo District

NIAGARA FALLS STORAGE SITE
EX-SITU THERMAL TREATMENT

FIGURE 3-3

APPENDIX A

CALCULATIONS

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A-1

TECHNICAL MEMORANDUM –EVALUATION OF GROUNDWATER – SURFACE WATER INTERACION

THIS PAGE INTENTIONALLY LEFT BLANK

TECHNICAL MEMORANDUM
EVALUATION OF GROUNDWATER – SURFACE WATER INTERACTION
NIAGARA FALLS STORAGE SITE, LEWISTON, NEW YORK

1.0 INTRODUCTION

HydroGeologic, Inc. (HGL) completed a study to evaluate the potential impact of uranium in groundwater underlying the Niagara Falls Storage Site (NFSS) on surface water within the site drainage ditches. The study was completed in three phases. The phases were completed in succession and included:

- Phase 1 – Screening-Level Evaluation: Simple partitioning calculations were performed to determine whether uranium concentrations in soil could lead to an exceedance of surface water criteria in the NFSS drainage ditches. This analysis is considered a screening level assessment and several conservative assumptions were applied in the analysis. The areas identified in Phase 1 as having the potential to negatively affect surface water were carried forward into Phase 2.
- Phase 2 – One-Dimensional (1D) Column Modeling: One-dimensional transport modeling was conducted to determine whether uranium in soil could potentially leach to groundwater and ultimately result in exceedances of surface water criteria.
- Phase 3 – Three-Dimensional (3D) Modeling: The NFSS regional groundwater model was used to assess whether uranium in groundwater could potentially result in exceedances of surface water criteria.

The objective, methodology, and conclusions are documented for each phase of the evaluation. Overall conclusions and recommendations are included in Section 5.

2.0 PHASE 1: SCREENING-LEVEL EVALUATION

2.1 PHASE 1 OBJECTIVE

HGL completed a screening-level evaluation of soil data to identify areas within NFSS where uranium in soil could potentially result in elevated uranium concentrations in surface water. Conservative assumptions were made during this evaluation to overestimate the uranium concentrations in water. Although the analysis is conservative, the results provide a defensible framework to identify areas where more detailed analysis should be performed to assess future impacts more accurately. Conversely, the results also identify areas where uranium in soil is not expected to negatively impact surface water.

2.2 METHODOLOGY

HGL used soil sampling results provided by the U.S. Army Corps of Engineers (USACE) – Buffalo District to complete the analysis. For soil samples where uranium was detected, HGL calculated the uranium concentration that would be expected in the pore water within the sample.

Based on this pore water concentration, HGL applied a dilution attenuation factor (DAF) to estimate the uranium concentration in the underlying, saturated groundwater. HGL then assumed that the calculated concentration in groundwater would be the same as the concentration that would be expected in nearby surface water. This assumption is conservative. It does not account for the attenuation of uranium within the saturated zone. It also does not account for dilution/mixing within the surface water in the drainage ditches. Nonetheless, this approach provides a screening method to identify areas where uranium in soil will not negatively impact surface water. Perhaps more importantly, the screening evaluation identifies areas that require more scrutiny.

Three screening levels were used to evaluate whether the uranium detected in soil may negatively impact surface water. These include the following.

- The calculated uranium concentrations in pore water and saturated groundwater were compared to the maximum concentration limit (MCL) for total uranium of 30 micrograms/liter (µg/L).
- The calculated uranium concentrations were compared to the annual limit on the intake of total isotopic uranium in effluent discharged from uncontrolled site drainage, which is 300 picocuries (pCi)/L (10 Code of Federal Regulations [CFR] 20, Appendix B).
- The calculated uranium concentrations were compared to the Canadian Water Quality Guideline for the protection of aquatic life from long-term exposure to uranium of 15 µg/L.

The USACE notes that these screening levels are not applicable guidelines per Section 2.2.2.2 of the FS, but only comparative values that exemplify the protectiveness of site conditions.

The locations where the calculated uranium concentration exceeded the three screening levels are identified on Figures 1 and 2. The NFSS 3D groundwater model was then used to determine the locations that were close enough to the drainage ditches, where the uranium in soil could potentially leach to groundwater and reach the drainage ditch within a 1,000-year time period. These locations are identified on Figure 3. Uranium in soil outside the 1,000-year flow path boundaries have a very low probability of negatively impacting surface water.

Soil sampling data collected during the NFSS Remedial Investigation (RI) and Supplemental RI were used to perform the analysis. These data were provided by USACE in a Microsoft Access database. The USACE database contains 3,416 soil sampling results collected from 1999 to 2015. Both surface and subsurface sampling results are contained in the database, and the subsurface soil samples were collected from multiple depth intervals. The database contains laboratory analysis results for both isotopic uranium and total uranium. However, not all samples were analyzed for both isotopic uranium and total uranium. Results for the isotopic analysis of uranium-238 (U-238) are the most prevalent uranium analyses in the database, with 2,457 soil samples analyzed for U-238. A total of 959 samples were analyzed for total uranium.

For most samples in which total uranium results were reported, U-238 results were also reported. The U-238 isotope represents approximately 99.7% of the total uranium mass; consequently, HGL used the U-238 isotopic analysis to approximate the total uranium concentration in cases where a sample was not analyzed for total uranium. To confirm the validity of this approximation, HGL conducted a statistical comparison between 928 samples that were analyzed for both U-238 and total uranium.

For the comparison, HGL converted the U-238 isotopic concentrations in soil to mass concentrations (i.e., units of mg/kg). The U-238 specific activity of 3.4×10^{-7} Ci/g was used to perform this conversion. The statistical analysis, performed using a parametric t-test, demonstrated that the two data sets are similar; therefore, U-238 concentrations in soil were used in the subsequent analysis to approximate total uranium concentrations, in cases where a soil sample was not analyzed for total uranium.

If a duplicate sample analysis was provided in the database, the average of the parent and duplicate results was calculated and used. If a soil at a given location was sampled from multiple depth intervals and these depth intervals overlap, the measurement with the highest uranium concentration for a specific depth interval was used. Overall, the available data were grouped into surface locations (0 to 0.5 feet below ground surface [ft bgs]) and subsurface locations (below 0.5 ft bgs).

The total uranium concentrations in soil were used estimate the total uranium that would be expected in pore water within the individual samples. This was accomplished using the following formula for linear partitioning:

Cpw = Cs/Kd

where, Cpw = total uranium concentration in pore water (µg/L);
Cs = total uranium concentration in soil (µg/kg); and
Kd = distribution coefficient (L/kg)

A Kd of 122 L/kg was used to perform these calculations. This Kd value was calculated by SAIC as part of the NFSS RI.

The calculated total uranium concentrations in pore water represent the expected concentration in water within the unsaturated zone. The pore water that infiltrates vertically to the water table is diluted as it mixes with clean groundwater flowing within the saturated zone. This dilution process can be approximated using a DAF. A DAF of 20 was used to approximate the total uranium in groundwater directly beneath individual soil samples. This value is the default value used by the U.S. Environmental Protection Agency (USEPA) to develop soil screening criteria, and is thought to be a conservative estimate. Using the default DAF, the expected total uranium concentration in groundwater was calculated using the following formula:

Cgw = Cpw/DAF

where: Cgw = concentration in groundwater (µg/L).

The calculated total uranium concentrations in pore water and groundwater (see Table 1) were compared against three screening levels to determine whether uranium concentrations in soil could potentially have a negative impact on surface water. Two of the screening levels are based on mass concentrations (e.g., the MCL of 30 µg/L and Canadian screening level of 15 µg/L), whereas the annual limit on the intake of uranium in effluent discharge of 300 pCi/L (10 CFR 20, Appendix B) is activity based. To facilitate comparison to the calculated concentrations in pore water and saturated groundwater, the activity-based concentration was converted to a mass-based concentration. To perform this conversion, it was assumed that the uranium isotopes in soil reflect the isotopic ratios associated with natural uranium. The conversion resulted in an equivalent screening level of 439 µg/L.

It should be noted the total uranium concentrations that were calculated for vadose zone pore water and groundwater are higher than the concentrations that would be expected in surface water. The uranium in groundwater would likely be attenuated through dispersion and chemical adsorption as the groundwater flows towards the drainage ditches. In addition, the uranium would also be diluted by cleaner water within the NFSS drainage ditches.

As a final step in the analysis, the NFSS groundwater flow model (USACE 2011b), baseline conditions were used to determine areas where uranium in soil could potentially leach into groundwater and travel to one of the drainage ditches within a 1,000-year time period. To complete this analysis, reverse particle tracking was used to predict groundwater travel times to surface water. Particles were placed in the drain cells representing the primary drainage ditches in the model. These drain cells represent locations where groundwater discharge to surface water is anticipated. Particle tracking was not performed from the smaller on-site drainage ditches because groundwater discharge to surface water is not anticipated at these locations.

Two particle tracking simulations were performed. The initial simulation was performed to evaluate the distance that a conservative tracer would move in groundwater over a 1,000-year period. This simulation reflects the distance that uranium could migrate if chemical adsorption was not a factor; therefore, uranium migration is assumed to occur at the same velocity as the groundwater flow. In practice, uranium moves much slower than groundwater, because uranium migration is retarded by geochemical processes in groundwater systems (e.g., adsorption). To evaluate the impact of uranium adsorption, a retardation factor was calculated for uranium, and this retardation factor was incorporated into the particle tracking analysis. The retardation factor accounts for the chemical adsorption that occurs for reactive chemical species such as uranium.

The retardation factor for uranium was calculated using the following formula:
$Rf = 1 + K_d * (\rho/\varphi)$

where: Rf = retardation factor (unitless);
ρ = bulk density (kg/L)
φ = porosity (unitless)

To calculate the retardation factor, the site-specific Kd of 122 L/Kg was used. In addition, a bulk density of 1.3 g/cm^3 to 1.7 g/cm^3 (USACE, 2011a) and a total porosity of 45% were used to calculate the retardation factor. A total porosity of 45% is consistent with glacial tills. When a retardation factor was applied in the particle tracking analysis, the results indicated that uranium in groundwater near the drainage ditches would not migrate more than 100 feet within a 1,000-year period.

To ensure that the analysis is conservative, only the particle tracking simulations representing a conservative (non-reactive) tracer are presented in the results section of this technical memorandum (Section 3.0). Soil that is not located within the 1,000-year pathlines for the conservative tracer would have a very low probability of impacting surface water.

2.3 PHASE I RESULTS SUMMARY AND CONCLUSIONS

The calculated uranium concentrations in pore water and in groundwater are summarized in Table 1. The table identifies the soil samples that would result in a surface water screening level exceedance. Maps illustrating the screening level exceedances are provided in Figures 1 and 2.

Figure 1 illustrates the calculated screening level exceedances in the unsaturated zone pore water. The figure shows that there are wide spread exceedances of the Canadian screening level and the MCL. However, the site-specific U-238 soil background values (surface soils = 1.36 pCi/g and subsurface soils =1.34 pCi/g) lead to a slight exceedance of the MCL when a Kd of 122 L/kg is used in the calculations. Given the conservative nature of the calculations, the exceedances of the uranium MCL and Canadian screening level in pore water are not considered to represent a realistic threat to surface water. There are eight areas within the NFSS where there are exceedances of the 300 pCi/L (439 μg/L) screening level. These areas are identified on Figure 1 and represent regions that may require additional evaluation.

Figure 2 illustrates the calculated screening level exceedances in the saturated groundwater. Of the eight areas that were identified based on screening-level exceedances in unsaturated zone pore water, eight of the areas have one or more exceedances of the aquatic screening level; seven of the areas have one or more exceedances of the MCL screening level; and only two of the areas have exceedances of the effluent discharge screening level. In all but one case, the exceedances are very limited, and the soil samples that are associated with the screening level exceedance are surrounded by soil samples that are below the screening criteria. The exception to this is Area 6 where there are several exceedances of the Canadian Water Quality Guideline.

The results of the reverse particle tracking analysis are shown on Figure 3. The red polygons surrounding the particle tracks represent the area in which shallow groundwater could travel to one of the drainage ditches within 1,000 years. As discussed in Section 2.0, the particle tracking results presented on this figure assume that chemical adsorption is not attenuating uranium migration. This is not the case at NFSS; therefore, the results are conservative. The eight areas with elevated uranium concentrations in soil are also shown on Figure 3. Of these areas, only Areas 4 and 6 are primarily within the 1,000-year groundwater pathlines. Groundwater within the other areas is not expected to reach the drainage ditches within 1,000 years.

A summary of the analysis is provided in Table 2. Of the two areas that are within the 1,000-year groundwater pathlines, both have potential exceedances of the Canadian Water Quality Guideline and MCL screening criteria. However, neither area includes soil samples that would result in an exceedance of the effluent discharge screening level and there are only three isolated exceedances of the MCL screening level within Areas 4 and 6.

Based on the screening-level analysis that was conducted, there is a low probability that uranium in NFSS soil will impact surface water quality in the drainage ditches. There are few soil samples that would result in a screening level exceedance in groundwater. Furthermore, only two of eight areas associated with screening level exceedances in pore water are within the 1,000-year capture zone associated with the major drainage ditches.

3.0 PHASE 2: ONE-DIMENSIONAL TRANSPORT MODELING

3.1 PHASE 2 OBJECTIVE

HGL completed 1D groundwater flow and transport modeling to assess the potential for uranium in soil to impact groundwater quality. The modeling focuses on the eight areas identified in Phase 1 where uranium in soil could potentially result in elevated uranium concentrations in surface water. MODHMS (HGL, 2006) was selected to perform 1D transport simulations to predict the transport of uranium through unsaturated soils to the water table. The 1D transport simulations provide predicted time-varying mass flux of uranium to the water table and uranium concentrations in the Upper Water Bearing Zone (UWBZ) groundwater.

3.2 METHODOLOGY

MODHMS was used to develop 1D flow and transport models representing the eight areas identified in Phase 1 that contain elevated uranium concentrations in soil. MODHMS is capable of simulating groundwater flow and solute transport under saturated and unsaturated conditions (HGL, 2006). The vadose zone underlying the NFSS consists primarily of glacial till with discontinuous sand lenses. For each of the eight areas, a 1D column model was developed to represent the glacial till, which consists primarily of clay with fine sand. Details of the model development, including input parameters, is summarized below.

3.2.1 Model Discretization

The column models were established using 16 model layers, each with a uniform thickness of 0.5 ft. Simulations were performed to provide transport predictions for up to 10,000 years. Time was discretized into 120 steady-state stress periods. A stress period is pre-determined length of time during which prescribed model stresses are held constant. For 0 to 5,000 years, all stress periods were assigned to be 50 years in duration. For simulation times from 5,000 to 10,000 years, a larger stress period of 250 years was used.

3.2.2 Hydraulic Properties

The hydraulic conductivity values for the glacial till was derived from previous groundwater flow modeling efforts. A hydraulic conductivity of 9.2×10^{-3} ft/day (3.3×10^{-6} cm/s) was assigned in the model to represent glacial till. This hydraulic conductivity was assigned to represent the Upper Clay Till in the calibrated NFSS groundwater model (USACE, 2011b). This value was calculated as the geometric mean of 326 field measurements of hydraulic conductivity.

Unsaturated flow parameters (i.e., van Genuchten parameters) were derived from the literature (Carsel and Parrish, 1988) for the column models. Published values for the sandy clay texture were utilized to represent glacial till.

3.2.3 Precipitation Recharge

Precipitation recharge represents the primary transport mechanism for the migration of uranium through the soil column. One recharge rate was assigned in the 1D soil column models (5.2×10^{-3} in/yr). This recharge rate was obtained from the NFSS groundwater flow model (USACE, 2011b), and it represents the maximum precipitation recharge rate that was assigned in the calibrated 3D model.

3.2.4 Depth to Water

The depth to water represents the transport distance for uranium migration to the water table. Given the long-term nature of the simulations, average depths to groundwater were used in the model. Where possible, these average depths were determined for each of the eight identified areas using historical data from wells installed within each respective area. Of the eight areas of interest, only Areas 3, 6, and 7 contain wells that could be used to determine the average depth to the water table.

Monitoring wells are not present in Areas 1, 2, 4, 5, and 8. In these areas, data from all NFSS monitoring wells completed within the UWBZ were used to calculate the average depth to the water table. An average depth to water table of 5.2 ft was calculated using these data and assigned in the 1D models for these five areas. Table 3 illustrates the average depth to the water table for each of the areas of interest.

3.2.5 Uranium Source Term

The uranium in soil was represented in each 1D column model by assigning an initial pore water concentration in the model. The pore water concentrations in each area were calculated using the same approach that was used during the Phase 1 evaluation described in Section 2.2. The total uranium concentrations in soil were used to estimate the total uranium that would be expected in pore water within the individual samples using the linear partitioning formula. A distribution coefficient (Kd) of 122 L/kg was used to perform these calculations. This Kd value was calculated by SAIC as part of the NFSS RI.

For each of the eight areas, the maximum uranium concentration detected for individual depth interval was assigned as the initial concentration in each model layer. The top and bottom elevations of the soil sampling intervals were used to determine the model layer that corresponds to the same depth interval. In cases where soil samples were not collected for specific depth intervals, the maximum concentration from adjacent sampling intervals was assigned in the model. The initial concentrations applied in the 1D column models for each of the eight areas are listed in Table 4.

3.2.6 Transport Parameters

Transport parameters consisting of effective porosity, dispersivity, and Kd were assigned in each of the column models. Radioactive decay was not simulated. The value for effective porosity was derived from previous modeling (USACE 2011b). An effective porosity of 8% was assigned in the model to represent clay, which is the dominant lithology associated with the glacial till that comprises the UWBZ.

Vertical dispersivity assigned in the 1D transport model is 3.28 ft (1 meter), a reasonable (and conservative) value for the model scale based on the values reported in Gelhar et al. (1992). A Kd value of 122 L/Kg was assigned in the model to represent partitioning in the glacial till.

3.3 PHASE 2 RESULTS SUMMARY AND CONCLUSIONS

The 1D column models used to predict time-varying uranium concentrations beneath each area of interest is presented in Figure 4. These concentrations reflect the uranium concentrations in pore water directly above the water table. The models were used to simulate a period of 1,000 years. Table 5 presents the maximum predicted concentration over the 1,000-year period.

Figure 4 illustrates that the uranium concentrations do not change significantly over the 1,000-year simulation period. This is due to the low rate of precipitation recharge and the relatively high chemical adsorption associated with uranium in NFSS soils. The predicted uranium concentration in the unsaturated zone water directly above the water table reflects the uranium concentration in soil at the same interval.

As shown in Figure 4 and Table 5, the highest predicted uranium concentrations are associated with Areas 6 and 7. Of the eight areas of interest, these two areas contain the highest uranium concentrations directly above the water table (Table 4). Areas 2, 5, and 8, contain higher uranium concentrations in soil; however, the high uranium concentrations exist much closer to land surface, and the uranium in shallow soil does not migrate to the water table within the 1,000-year simulation period.

The uranium concentrations that were calculated using the 1D column models represent uranium in unsaturated zone groundwater. The uranium concentrations in the UWBZ saturated zone are expected to be much lower due to dilution. Using the approach that was applied in Phase 1, a DAF was used to estimate the uranium concentration in saturated groundwater directly beneath each area of interest. A DAF of 20 was applied to estimate the uranium concentration that would be expected in saturated zone groundwater. The predicted uranium concentrations are provided in Table 5. Except for Areas 6 and 7, the uranium concentrations in saturated groundwater are predicted to be much lower than the MCL (30 µg/L) and Canadian screening level (15 µg/L). As shown in Table 6, the predicted concentrations for Areas 6 and 7 are 21.3 and 28.4 µg/L, respectively. These concentrations are higher than the Canadian screening level, but lower than the MCL.

The uranium concentrations that have been detected in groundwater in Area 6 and 7 monitoring wells are significantly higher than concentrations predicted by the model using the DAF. This suggests that: 1) current groundwater concentrations still reflect past impacts from historic residue storage in these areas; 2) saturated groundwater is in direct contact with soils containing elevated uranium concentrations; and 3) the DAF of 20 is a high estimate for these areas. The mechanism that resulted in deep soil contamination in Areas 6 and 7 is currently unknown. It is possible that uranium contaminated soils were introduced to the subsurface during historical construction and earthmoving activities at the NFSS. It is also possible that soils containing elevated uranium are only saturated during the wet season, when the water table is seasonally elevated, which has been observed in seasonal sampling data.

Given the slow rate of uranium migration in the unsaturated zone (i.e., driven by seasonal matric potentials), it is unlikely that uranium migration vertically through unsaturated zone soils has resulted in the elevated uranium in saturated UWBZ groundwater. In addition, based on the modeling results, it is unlikely that uranium in unsaturated soils will lead to exceedances of the MCL and/or Canadian screening level in the future. Based on this conclusion, uranium in unsaturated soils was not further evaluated in Phase 3 of the modeling study, which focused on existing plume transport to surface water conveyances.

4.0 PHASE 3 THREE-DIMENSIONAL GROUNDWATER FLOW MODELING

4.1 PHASE 3 OBJECTIVE

The objective of Phase 3 was to predict whether uranium observed in UWBZ groundwater could impact surface water in the on-site drainage ditches. To complete this analysis, the 3D groundwater flow and transport model (USACE, 2011b) was used to predict the transport of uranium in groundwater and uranium mass loading rates to surface water. The model was also used to predict average baseflow within the drainage ditches. Using the predicted mass-loading rates and baseflow estimates, HGL was able to predict future uranium concentrations in surface water derived from baseflow (sans surface water dilution) and to conservatively compare these predicted uranium concentrations to surface water screening criteria.

4.2 METHODOLOGY

To complete this assessment, the observed uranium distribution (Figure 5) in groundwater was input into the existing groundwater flow and transport model (USACE, 2011b). The hydrogeologic units represented by this 3D model, from top to bottom, include the following: Upper Clay Till (model layer 1), Glacio-Lacustrine Clay (model layer 2), Alluvial Sand and Gravel (model layer 3), and Fractured Upper Queenston Formation (layer 4). The UWBZ occurs within the Upper Clay Till (model layer 1). Model simulations were performed to provide transport predictions for up to 1,000 years. The hydraulic properties and transport parameters that are assigned in the calibrated NFSS model were previously documented (USACE, 2011b) and are not presented in this technical memorandum.

The NFSS is drained by man-made ditches flowing east-west and north-south. The Central Drainage Ditch originates near the southern NFSS boundary, and flows northward dividing NFSS. The South 31 Drainage Ditch and the South 16 Drainage Ditch flow westward and empty into the Central Drainage Ditch. The West Drainage Ditch originates a few hundred yards south of NFSS and flows northward along the western NFSS boundary. Groundwater and uranium discharge to surface water bodies (ditches) is simulated in the model. Drain cells are used to represent the on-site ditches. The drain cells remove water and contaminant mass from the model when predicted water levels are above the bottom elevation of the drain cell.

The observed uranium distribution in the UWBZ was provided by USACE and is shown on Figure 5. This spatial distribution of uranium was assigned as an initial condition in model layer 1. Background uranium concentrations were assigned in the model in areas where elevated uranium is not observed. In these areas, an average background concentration of 5.24 µg/L was assigned in the model.

The groundwater flow and transport model was used to predict uranium concentrations in groundwater over a 1,000-year period. It was also used to calculate uranium mass loading rates to the model drain cells that represent the drainage ditches. Finally, the model was used to predict the average baseflow for drainage ditches. Using the model-predicted uranium mass-loading rates and baseflow, HGL calculated the expected uranium concentration in surface water in discrete sections (or reaches) of the drainage ditches.

As with all models, there are limitations and assumptions associated with the modeling effort that should be considered when evaluating the results. Several key limitations and assumptions associated with the groundwater flow model include the following:

- The model was designed to simulate local- and regional-scale groundwater flow and solute transport. It was not specifically designed to simulate surface water. There will be some inaccuracies associated with the scale of the model cells relative to the small scale of the drainage ditches (e.g., the ditch invert may undulate, but was modeled as a smooth surface).
- The groundwater flow model does not simulate all aspects of the surface water system. The model can be used to estimate baseflow, but other contributions to surface water flows are not simulated. For example, the model does not simulate storm water runoff, overland flow, or interflow; therefore, the model will underestimate the volume of actual surface water flow observed in the drainage ditches. This could result in overestimating uranium concentrations in surface water, since baseflow is only one component of total flow in the ditches.
- The results do not reflect influence of parameter uncertainty on predicted results.

4.3 PHASE 3 RESULTS SUMMARY AND CONCLUSIONS

The predicted uranium extent in the UWBZ (layer 1) after 1,000 years is presented in Figure 6. Comparison of the initial uranium concentrations in groundwater (Figure 5) and the predicted concentrations after 1,000 years (Figure 6) indicates that uranium is expected to migrate very slowly within the 1,000-year simulation period. This is due to the following: 1) very low hydraulic conductivity and gradients associated with the glacial tills that underlie the site; 2) low precipitation recharge rates; and 3) attenuation of uranium due to chemical adsorption.

As described in Section 4.2, HGL used the model to predict the uranium mass flux to the ditches and the groundwater baseflow component of surface water flow. Groundwater flow is simulated under steady state conditions to represent long-term average conditions. As a result, the model-predicted baseflow estimates for the ditches does not vary over time. The model-predicted uranium transport to the ditches does change over time, but as noted above, very little transport occurs within the 1,000-year simulation period. Consequently, the uranium mass-loading rates to the ditches do not vary significantly with time.

The modeling results indicate six drainage ditch segments or reaches where the predicted uranium concentration in groundwater discharging to the ditch is in excess of the 30 µg/L MCL (Figure 7 and Table 6). Drainage ditch reaches WDD-1, WDD-2, and WDD-3 are located within the West Drainage Ditch, and reach CDD-1 is located within the Central Drainage Ditch. Drainage ditch reaches S16DD-1 and S31DD-1 are located on South 16 and South 31 Drainage Ditches, respectively. As illustrated in Figure 7, each of these reaches represents a small area within the drainage ditches. These drainage ditch reaches are located in areas where elevated uranium concentrations are currently observed in groundwater. Uranium mass flux to the ditches is nearly constant over the 1,000-year simulation period.

Predicted groundwater discharge rates and uranium concentrations in groundwater discharging to the six reaches are summarized in Table 6. The maximum concentration of groundwater discharging to the ditches is 85.7 µg/L and occurs at S31DD-1 on the South 31 Drainage Ditch. It should be noted that this reflects plume-based baseflow to the ditch, but not the uranium concentrations within surface water. Dilution within the drainage ditches will result in lower concentrations in surface water.

The groundwater discharge (i.e., baseflow) and uranium mass-loading rates were calculated for discrete reaches within the drainage ditches. Reach segments were defined as groups of drain cells as depicted on Figure 8. For example, the West Drainage Ditch was divided up into six separate reaches. Reach 1 represents the group of drain cells upgradient of WDD-1. Reach 2 is the group of cells in WDD-1. Reach 3 is the next downstream grouping of drain cells between WDD-1 and WDD-2, and so forth. Therefore, on the West Drainage Ditch, water flows through Reaches 1, 2, 3, 4, 5, and 6. Starting from the southern segment (Reach 1), mixing calculations were conducted as the ditch flows downstream for each reach on the West Drainage Ditch. Both individual and cumulative discharge rates and concentrations are summarized for West Drainage Ditch in Table 7. The cumulative concentration was calculated by mixing the current reach with all upstream reaches.

For the West Drainage Ditch, the groundwater model predicts a long-term cumulative baseflow of 2.84 ft^3/d for the entire drainage ditch. Simulation results show generally increasing uranium concentrations from south to north (upstream to downstream). The predicted cumulative concentration derived from baseflow at the northern end of the drainage ditch is 17.9 µg/L.

This same approach was used for the Central Drainage Ditch and the two smaller tributaries. Eleven reach segments were defined, five on the Central Drainage Ditch and three each on the two tributaries (Figure 8).

Both individual and cumulative discharge rates and concentrations are summarized for the Central Drainage Ditch and the two tributaries in Table 8. On the South 31 Drainage Ditch, water flows through Reaches 11, 12, and 13. On the South 16 Drainage Ditch, water flows through Reaches 15, 16, and 17. On the Central Drainage Ditch, water flows through Reaches 8, 9, 10 and mixes with South 31 Drainage Ditch. It then flows through Reach 14 and mixes with South 16 Drainage Ditch, and then exits NFSS at Reach 18.

For the Central Drainage Ditch and the South 31 and South 16 Drainage Ditches, the groundwater model predicts a long-term cumulative baseflow of 8.87 ft^3/d for the entire drainage ditch length simulated in the model. Unlike the West Drainage Ditch, the simulation does not show generally increasing uranium concentrations from south to north (upstream to downstream) along the Central Drainage Ditch due to several low-concentration reaches that dilute baseflow (e.g., reaches 14 and 18). The predicted cumulative concentration at the northern end (downstream end) of the Central Drainage Ditch is 16.3 µg/L.

The modeling analysis predicts that localized groundwater discharge to on-site ditches (baseflow) will exceed the Canadian Water Quality Guideline of 15 µg/L in many of the reaches within the West Drainage Ditch, the Central Drainage Ditch, South 16 Drainage Ditch, and South 31 Drainage Ditch. Localized groundwater discharge to on-site ditches also exceeds the uranium MCL of 30 µg/L in six reaches, including three on the West Drainage Ditch and one each on the Central Drainage Ditch, South 16 Drainage Ditch, and South 31 Drainage Ditch. These six areas are associated with elevated uranium concentrations in groundwater. None of the localized groundwater discharge to the ditches exceeds the annual limit of 300 pCi/L (439 µg/L) specified in 10CFR20, Appendix B. As discussed above, the uranium concentrations in groundwater discharge do not reflect the observed uranium concentration in the surface water, since dilution with surface water will lower uranium concentrations in surface water.

As was done for the West Drainage Ditch, mixing calculations were performed to predict the uranium concentration at the downgradient extent of each drainage ditch reach. Based on this analysis, the uranium concentration is expected to exceed the Canadian Water Quality Guideline of 15 µg/L in the northern two reaches of the West Drainage Ditch and all but three reaches of the Central, South 16, and South 31 Drainage Ditches. The uranium concentration is not expected to exceed the MCL of 30 µg/L in any of the reaches.

5.0 CONCLUSIONS AND RECOMMENDATIONS - PHASES 1 THROUGH 3

HGL completed a three-phase study to evaluate the potential impact of uranium in soil and groundwater underlying the NFSS on surface water within the site drainage ditches. In Phase 1, simple partitioning calculations were performed to determine whether uranium concentrations in soil could lead to an exceedance of surface water criteria in the NFSS drainage ditches. The partitioning evaluation identified eight areas where further evaluation was warranted. Phase 1 also included modeling (particle tracking) to identify areas of shallow groundwater that could migrate to the ditches within 1,000 years. Only two of the eight areas overlie shallow groundwater that could migrate to the ditches within 1,000 years. Phase 1 results indicate there is a low probability that uranium in NFSS soil will impact surface water quality in the drainage ditches. There are few soil samples that would result in a screening level exceedance in groundwater.

In Phase 2, 1D transport modeling was conducted to further evaluate whether uranium in soil could potentially lead to exceedances of surface water criteria for the eight areas identified in Phase 1. The approach that was used in Phase 2 is considered more robust and less conservative than the approach that was applied in Phase 1. During Phase 2, simulations were completed for each of the eight areas. Results from the simulations predict that there will be little uranium migration through the vadose zone. Phase 2 results also suggest that the elevated uranium in groundwater may be derived from legacy concentrations caused by historic sources and/or direct contact of saturated groundwater with soils containing elevated uranium, which may occur seasonally via fluctuating water levels.

In Phase 3, the distribution of uranium in groundwater from the balance of plant investigation was input to the existing 3D groundwater flow and solute transport model and the model was used to predict potential groundwater discharge and uranium migration to on-site surface water ditches. Six localized areas of groundwater discharge to the ditches were identified where uranium levels exceeded 30 µg/L, but cumulative uranium concentrations in surface water are not expected to exceed the MCL of 30 µg/L.

Recommendations are included here to further substantiate the results of the groundwater-surface water interactions and include the following:

- Implement a rigorous sensitivity/uncertainty analysis to better quantify the likely range in uranium migration from groundwater to surface water and demonstrate understanding and assessment of plausible range of input parameters on model results.
- Quantify surface-water flows in the drainage ditches through direct field measurement to more accurately identify surface water/groundwater dilution factors and to evaluate the accuracy of baseflow estimates derived from the 3D model.
- Develop a fully integrated groundwater/surface water model that incorporates all aspects of the hydrologic cycle (e.g., storm flow, overland flow, interflow, etc.), if more accurate predictions of surface water behavior are required to satisfy stakeholder concerns.

6.0 REFERENCES

Carsel, R.F. and R.S. Parrish, 1988. Developing Joint Probability Distributions of Soil Water Retention Characteristics. Water Resources Research 1988; 24(5): pgs. 755-769.

Gelhar, Lynn W., Claire Welty and Kenneth R. Rehfeldt, 1992. A critical review of data on field scale dispersion in aquifers. Water Resources Research 28(7), pp. 1955-1974.

HydroGeoLogic, Inc. (HGL), 2002. *Draft Groundwater Flow Model Calibration Technical Memorandum, Niagara Falls Storage Site, Lewiston, New York*. Prepared for the U.S. Army Corps of Engineers, Buffalo District. April.

HGL, 2006. MODHMS Software, Version 2.2. Overview: Installation, Registration and Simulation Procedures. Copyright 2002.

HGL, 2016. *Technical Memorandum: Potential Impact of Elevated Uranium in Soil on Surface Water Quality, Niagara Falls Storage Site, Lewiston, New York*. Prepared for the U.S. Army Corps of Engineers, Buffalo District. September.

U.S. Army Corps of Engineers (USACE), 2011a. *NFSS Remedial Investigation Report Addendum, Niagara Falls Storage Site, Lewiston, New York*. Prepared by Science Applications International Corporation for the U.S. Army Corps of Engineers, Buffalo District.

USACE, 2011b. *Updated Model Results Groundwater Flow and Contaminant Transport Modeling, Niagara Falls Storage Site, Lewiston, New York*. Prepared by HydroGeoLogic, Inc. for the U.S. Army Corps of Engineers, Buffalo District.

FIGURES

THIS PAGE INTENTIONALLY LEFT BLANK

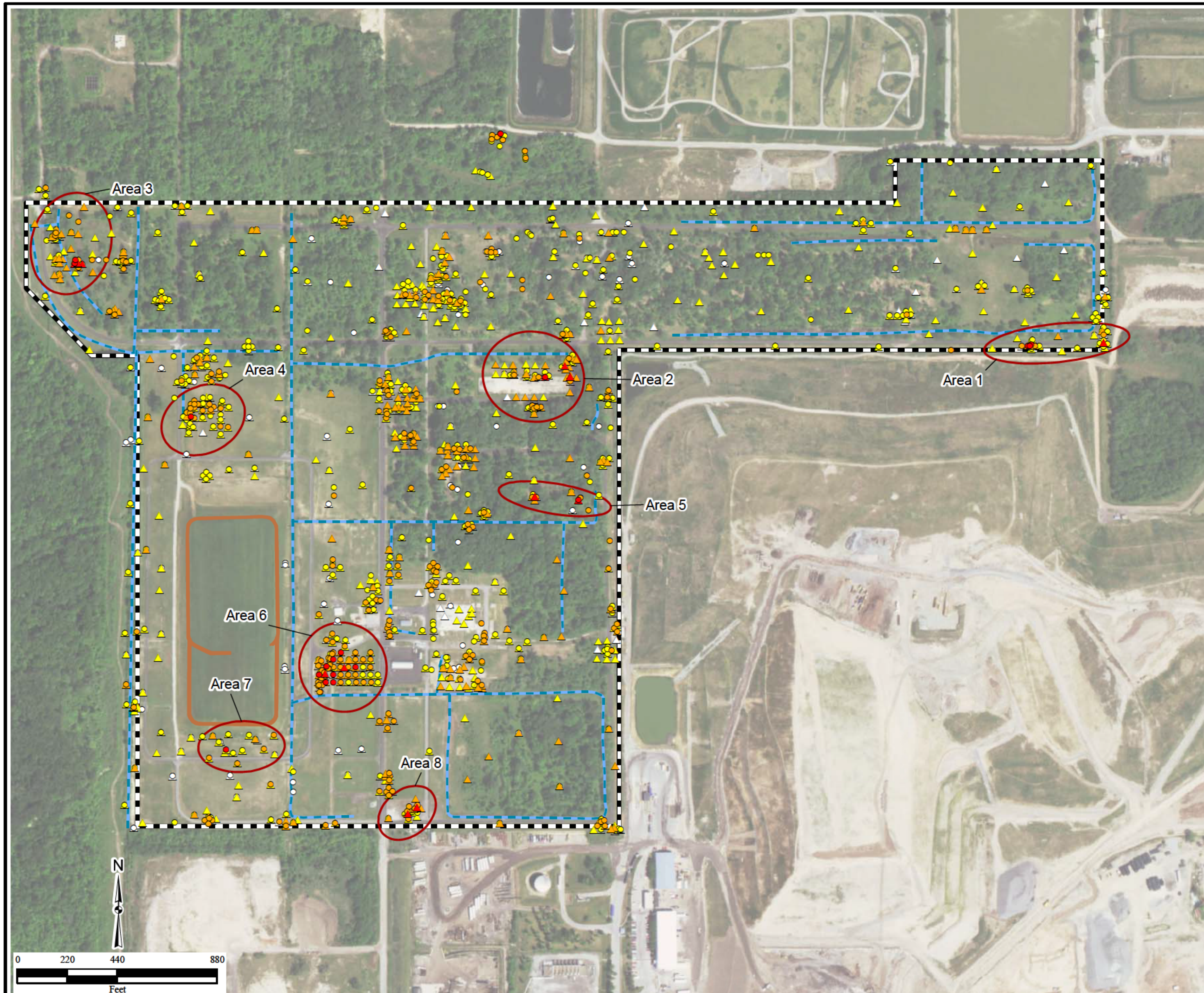


Figure 1
Calculated Total Uranium Concentration in Unsaturated Zone Pore Water

Legend

Predicted Total Uranium in Unsaturated Zone Pore Water:

- ▲ Utotal >439 µg/L, soil 0–0.5 ft bgs
- ▲ Utotal >30–439 µg/L, soil 0–0.5 ft bgs
- ▲ Utotal >15–30 µg/L, soil 0–0.5 ft bgs
- △ Utotal ≤ 15 µg/L, soil 0–0.5 ft bgs
- ● Utotal > 439 µg/L, soil below 0.5 ft bgs
- ● Utotal >30–439 µg/L, soil below 0.5 ft bgs
- ● Utotal >15–30 µg/L, soil below 0.5 ft bgs
- ○ Utotal ≤ 15 µg/L, soil below 0.5 ft bgs
- IWCS Cutoff Wall
- Ditch
- Areas
- NFSS

Notes:
Calculated water concentrations assume equilibrium partitioning with soil using Kd of 122 mL/g and represent screening-level calculations only. The values depicted on this map do not represent measured water concentrations on the NFSS.

ft bgs=feet below ground surface
IWCS=Interim Waste Containment Structure
mL/g=milliliters per gram
µg/L=micrograms per liter
NFSS=Niagara Falls Storage Site

\\Gst-srv-01\hglgis\NFSS_MSIW\GW_SW_Tech_Memo\(1)Calculated_UTotal.mxd
9/13/2016 ARW
Source: HGL, SAIC, URS
ArcGIS Online Imagery

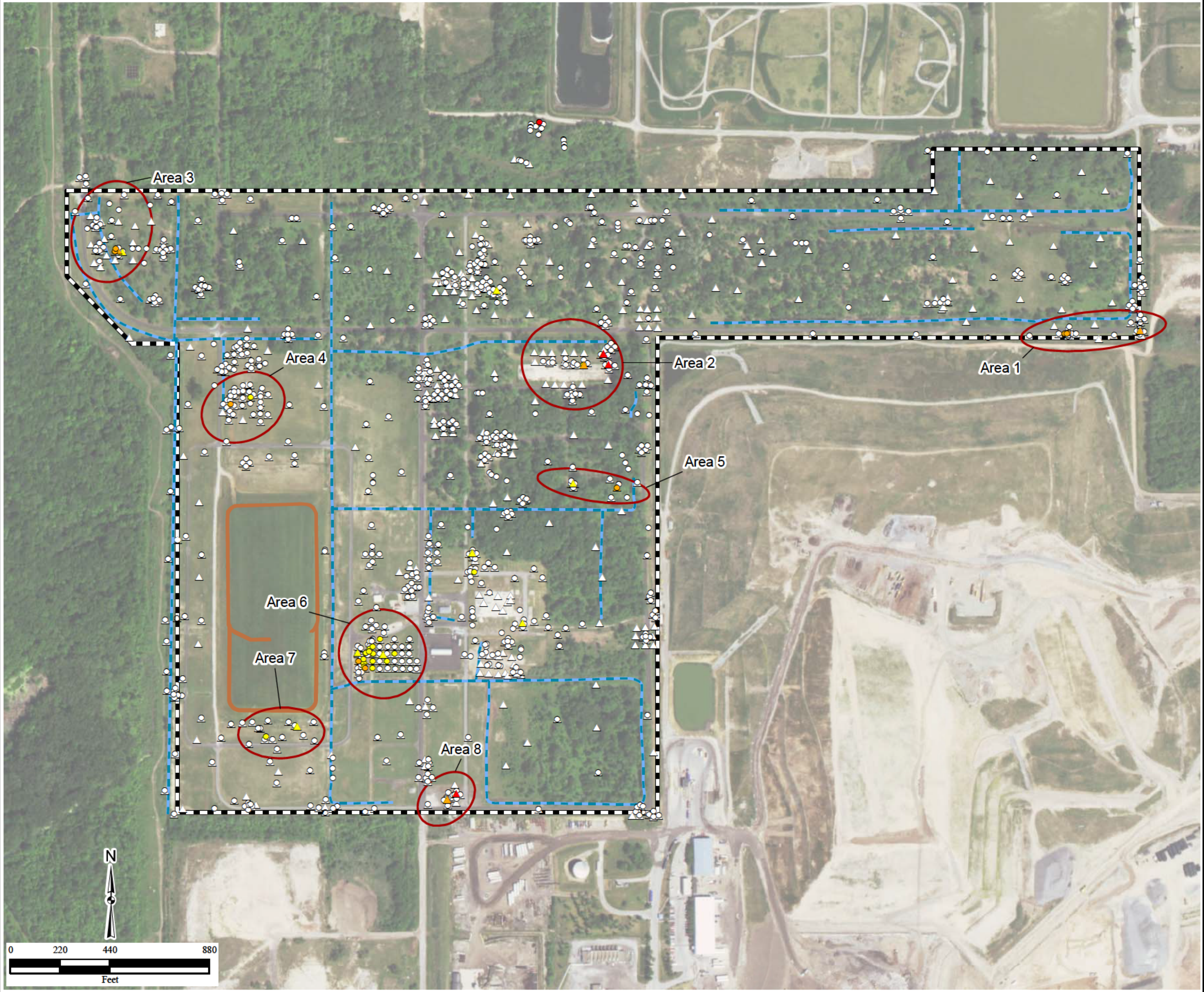


Figure 2
Calculated Total Uranium Concentration in Saturated Groundwater

Legend

Total Uranium in Saturated Groundwater:

- ▲ Utotal >439 µg/L, soil 0–0.5 ft bgs
- ▲ Utotal >30–439 µg/L, soil 0–0.5 ft bgs
- ▲ Utotal >15–30 µg/L, soil 0–0.5 ft bgs
- △ Utotal ≤ 15 µg/L, soil 0–0.5 ft bgs
- ● Utotal > 439 µg/L, soil below 0.5 ft bgs
- ● Utotal >30–439 µg/L, soil below 0.5 ft bgs
- ● Utotal >15–30 µg/L, soil below 0.5 ft bgs
- ○ Utotal ≤ 15 µg/L, soil below 0.5 ft bgs

IWCS Cutoff Wall

Ditch

Areas

NFSS

Notes:

Calculated water concentrations assume equilibrium partitioning with soil using Kd of 122 mL/g and represent screening-level calculations only. The values depicted on this map do not represent measured water concentrations on the NFSS.

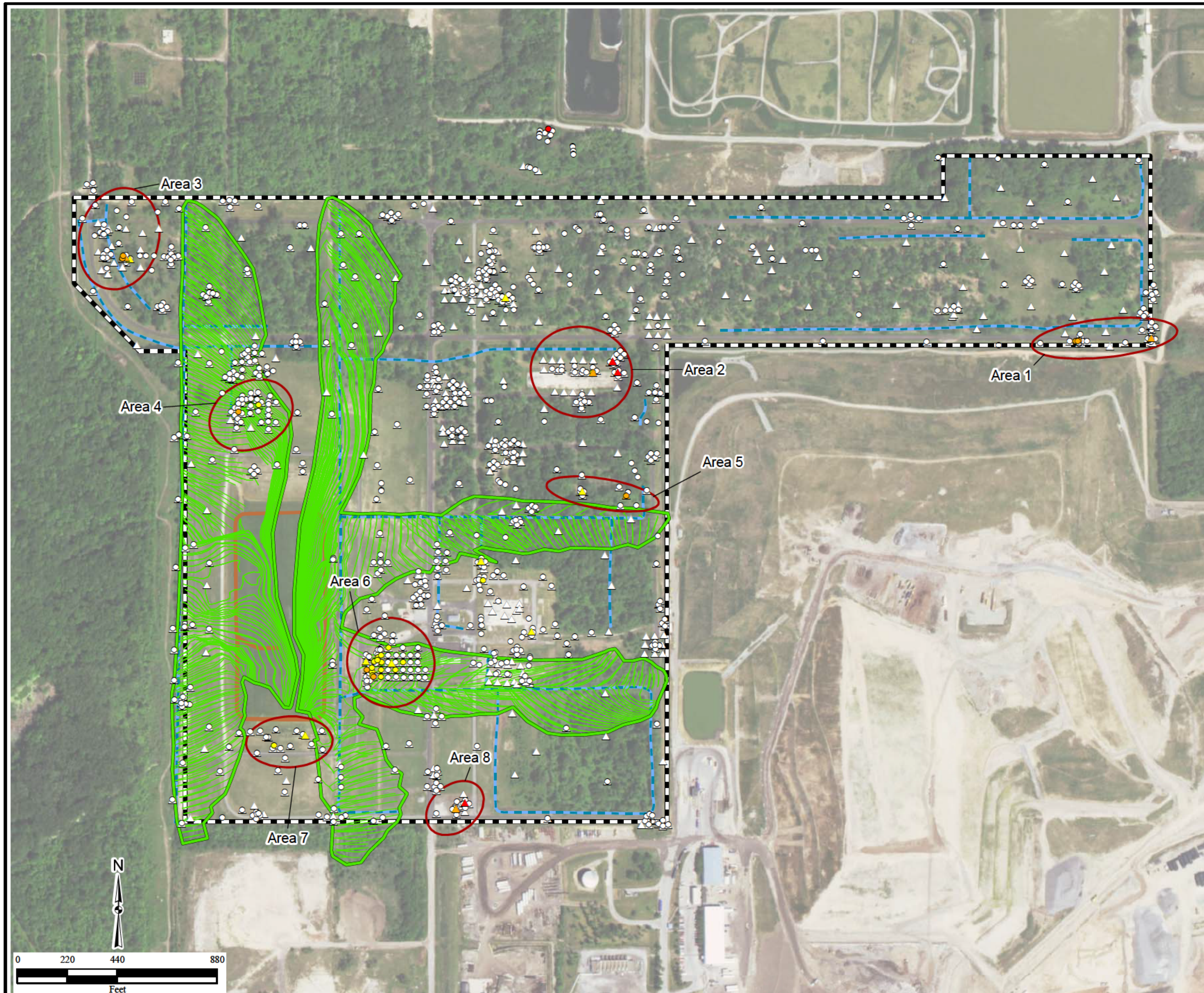
DAF of 20 from USEPA Soil Screening Guidance: User's Guide, Publication 9355.4-23 July 1996.

ft bgs=feet below ground surface
IWCS=Interim Waste Containment Structure
mL/g=milliliters per gram
µg/L=micrograms per liter
NFSS=Niagara Falls Storage Site

\\Gst-srv-01\hglgis\NFSS_MSIW\GW_SW_Tech_Memo\(2)Calculated_UTotal_20x.mxd
9/13/2016 ARW
Source: HGL, SAIC, URS
ArcGIS Online Imagery

HGL HydroGeoLogic, Inc

Figure 3
Reverse Particle Tracking Analysis



Legend

Predicted Total Uranium in Saturated Groundwater:

- Utotal >439 μg/L, soil 0–0.5 ft bgs
- Utotal >30–439 μg/L, soil 0–0.5 ft bgs
- Utotal >15–30 μg/L, soil 0–0.5 ft bgs
- Utotal ≤ 15 μg/L, soil 0–0.5 ft bgs
- Utotal > 439 μg/L, soil below 0.5 ft bgs
- Utotal >30–439 μg/L, soil below 0.5 ft bgs
- Utotal >15–30 μg/L, soil below 0.5 ft bgs
- Utotal ≤ 15 μg/L, soil below 0.5 ft bgs
- 1,000-Year Path Line
- IWCS Cutoff Wall
- Ditch
- 1,000-Year Path Line Boundary
- Areas with Elevated Uranium Concentrations
- NFSS

Notes:
Calculated water concentrations assume equilibrium partitioning with soil using Kd of 122 mL/g and represent screening-level calculations only. The values depicted on this map do not represent measured water concentrations on the NFSS.

ft bgs=feet below ground surface
IWCS=Interim Waste Containment Structure
mL/g=milliliters per gram
μg/L=micrograms per liter
NFSS=Niagara Falls Storage Site

\\Gst-srv-01\hglgis\NFSS_MSIW\GW_SW_Tech_Memo\(3)ReverseParticleTracking_1000yr.mxd
9/13/2016 ARW
Source: HGL, SAIC, URS
ArcGIS Online Imagery

HGL HydroGeoLogic, Inc

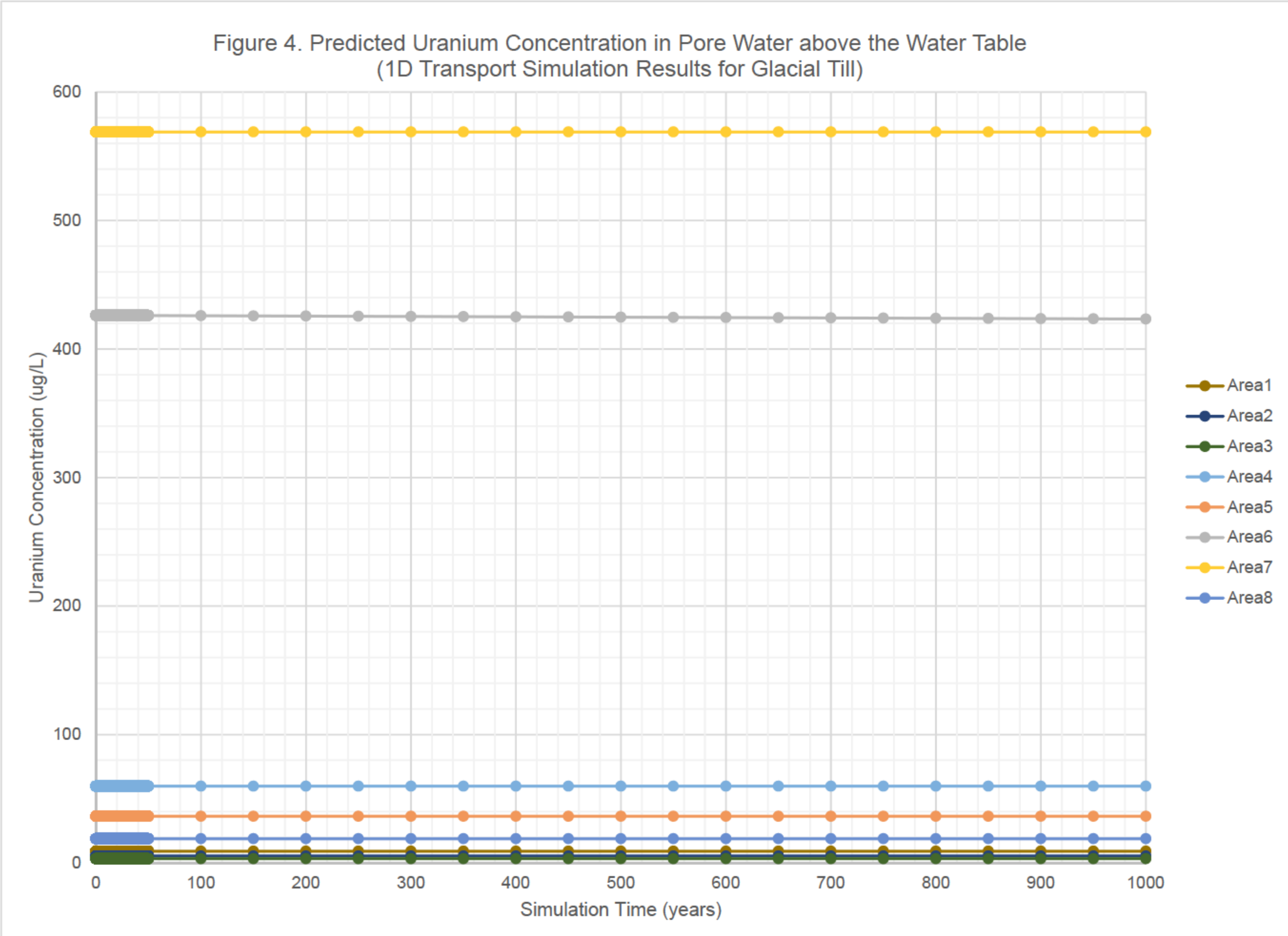


Figure 4. Predicted Uranium Concentration in Pore Water above the Water Table
(1D Transport Simulation Results for Glacial Till)
Uranium Concentration (ug/L)
600
500
400
300
200
100
0
0
100
200
300
400
500
600
700
800
900
1000
Simulation Time (years)
Area1
Area2
Area3
Area4
Area5
Area6
Area7
Area8

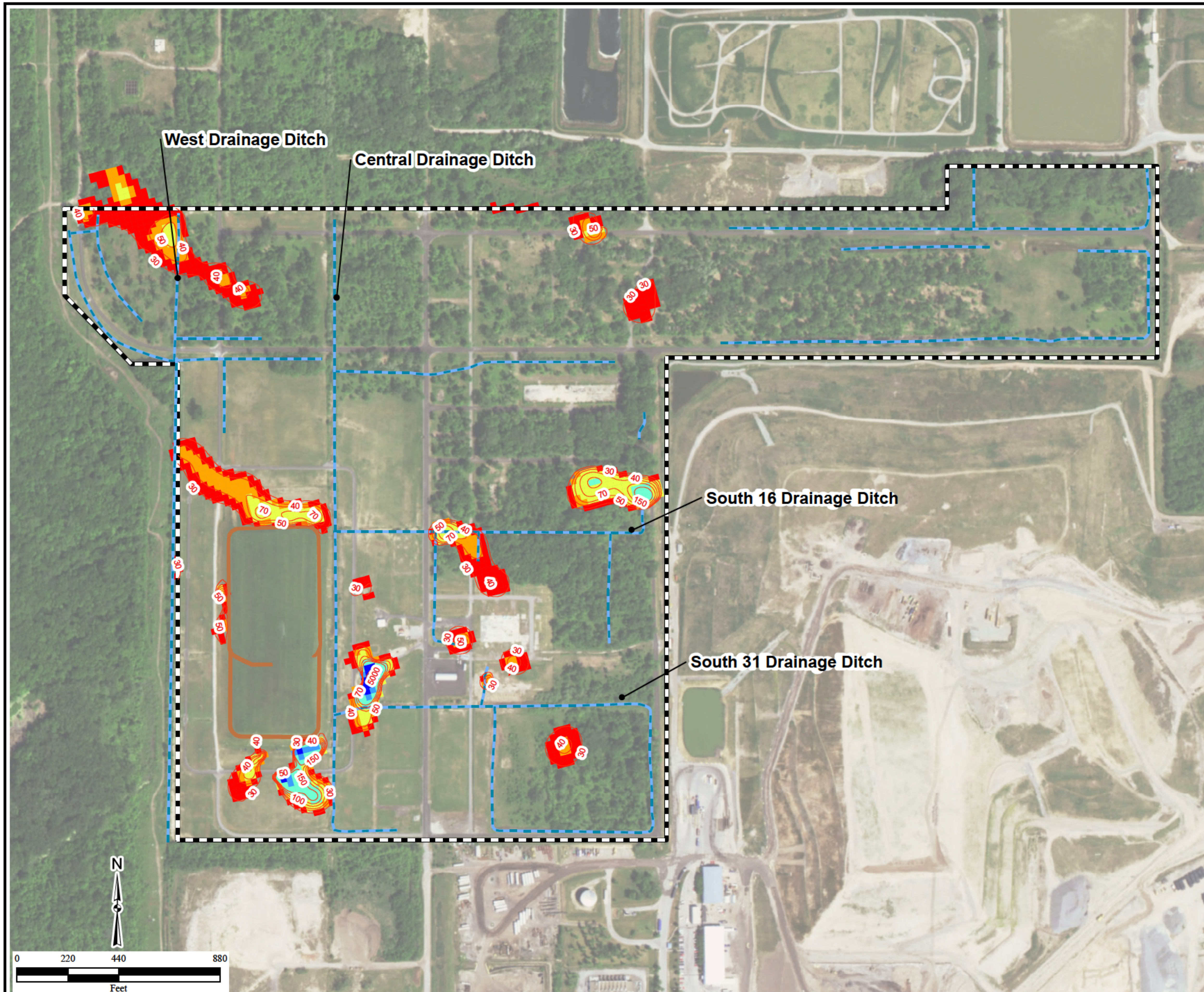


Figure 5
Uranium distribution in the UWBZ

Legend

UTotal Isoconcentration Contour Based on Antilog of Isocon Raster

IWCS Cutoff Wall

Ditch

NFSS

Notes:
Square points represent local minima or maxima from the isocon raster.
Red labels indicate values of possible missing sample locaitons, derived from local minima and maxima of the isocon raster.

IWCS=Interim Waste Containment Structure
g/L=micrograms per liter
NFSS=Niagara Falls Storage Site

Concentration(ug/L)

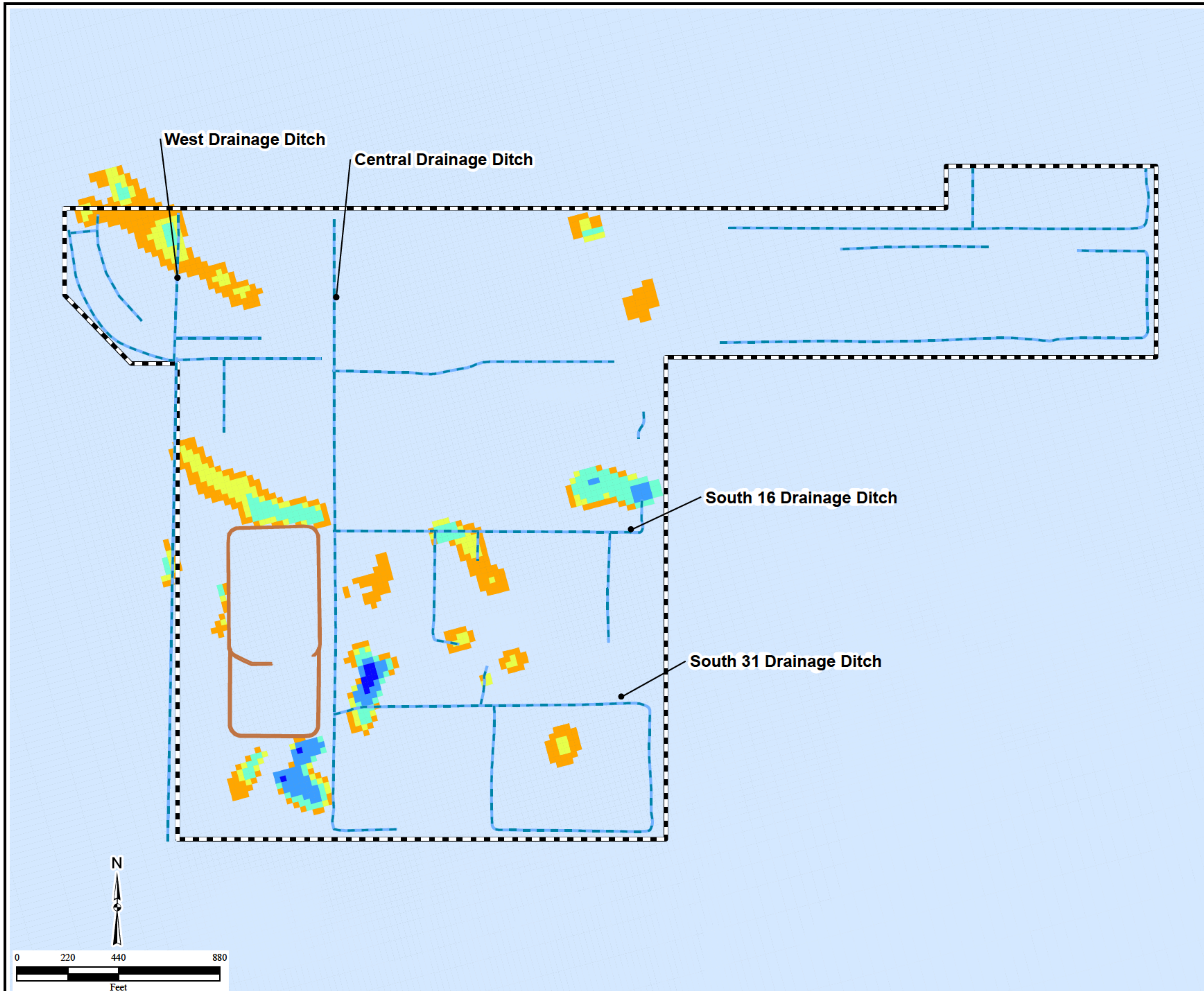
30.0 - 40.0
40.0 - 50.0
50.0 - 100.0
100.0 - 500.0
500.0 - 1000.0
>1000.0

P:\BU4001\201610_NFSS\Report\3D_v2\Figure6_Uranium_Distribution.mxd
3/29/2017 ARW
Source: HGL, SAIC, URS
ArcGIS Online Imagery

HGL HydroGeoLogic, Inc

HGL—Niagara Falls Storage Site, Lewiston, NY

Figure 6
Predicted Uranium distribution at T=1,000 years



Legend

- IWCS Cutoff Wall
- Ditch
- NFSS

Concentration (ug/L)

- 2.72 - 30.0
- 30.1 - 40.0
- 40.1 - 50.0
- 50.1 - 100.0
- 100.1 - 1000.0
- 1000.1 - 5157.4

Notes:
Square points represent local minima or maxima from the isocon raster.
Red labels indicate values of possible missing sample locaitons, derived from local minima and maxima of the isocon raster.

IWCS=Interim Waste Containment Structure
g/L=micrograms per liter
NFSS=Niagara Falls Storage Site

P:\BU4001\201610_NFSS\Report\3D_v2
Figure7_Predicted_Uranium_Distribution.mxd
3/29/2017 ARW
Source: HGL, SAIC, URS
ArcGIS Online Imagery

HGL HydroGeoLogic, Inc

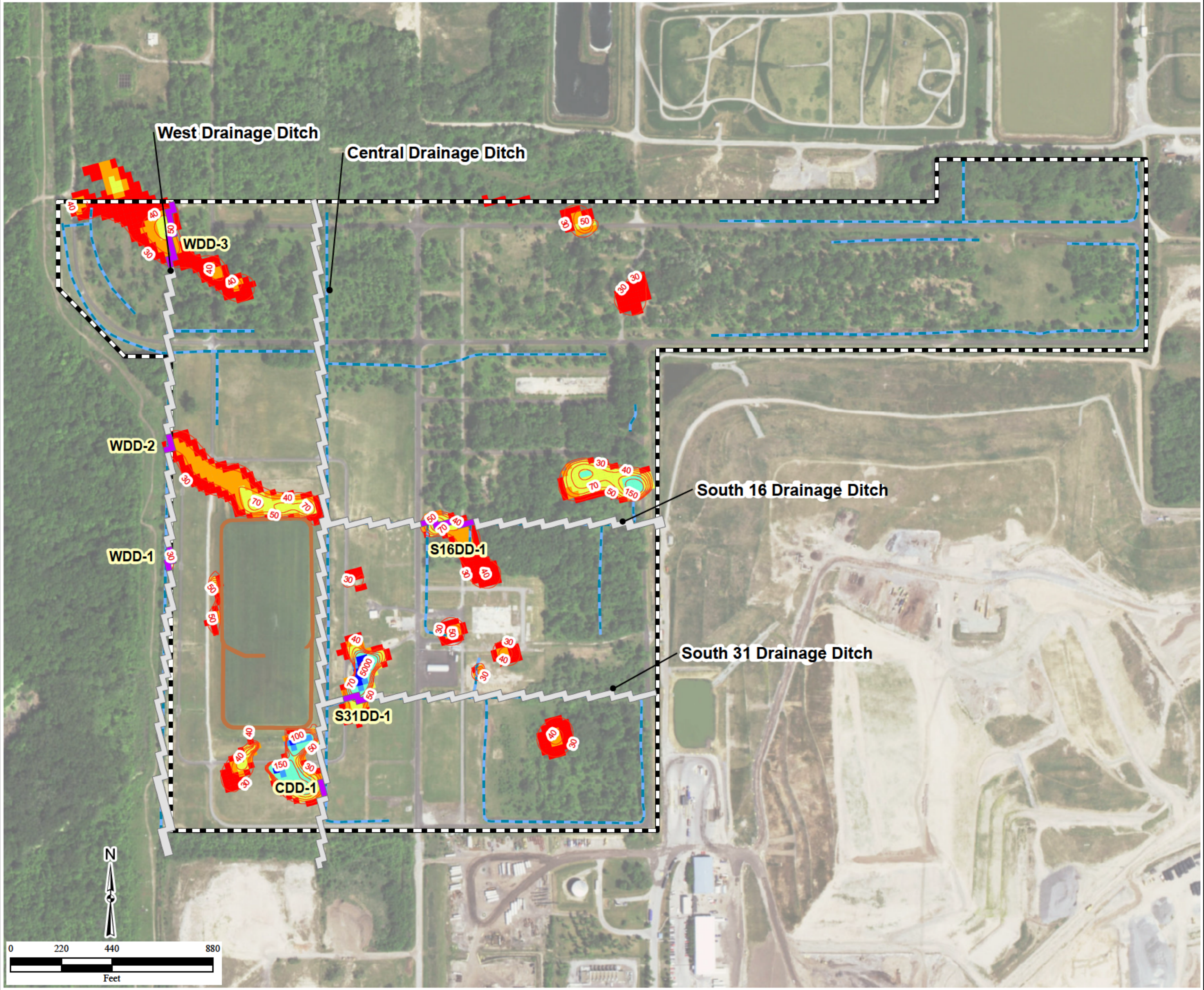


Figure 7
Locations where groundwater discharge to the ditches exceeded 30 ug/L

Legend

- UTotal Isoconcentration Contour Based on Antilog of Isocon Raster
- IWCS Cutoff Wall
- Ditch
- NFSS
- Drain cells >= 30ug/L
- Drain cells < 30ug/L

Notes:

IWCS=Interim Waste Containment Structure

NFSS=Niagara Falls Storage Site

Concentration(ug/L)

- 30.0 - 40.0
- 40.0 - 50.0
- 50.0 - 100.0
- 100.0 - 500.0
- 500.0 - 1000.0
- >1000.0

P:\BU4001\201610_NFSS\Report\3D_v2\Figure8_DDLocation.mxd
1/4/2017 ARW
Source: HGL, SAIC, URS
ArcGIS Online Imagery

HGL HydroGeoLogic, Inc

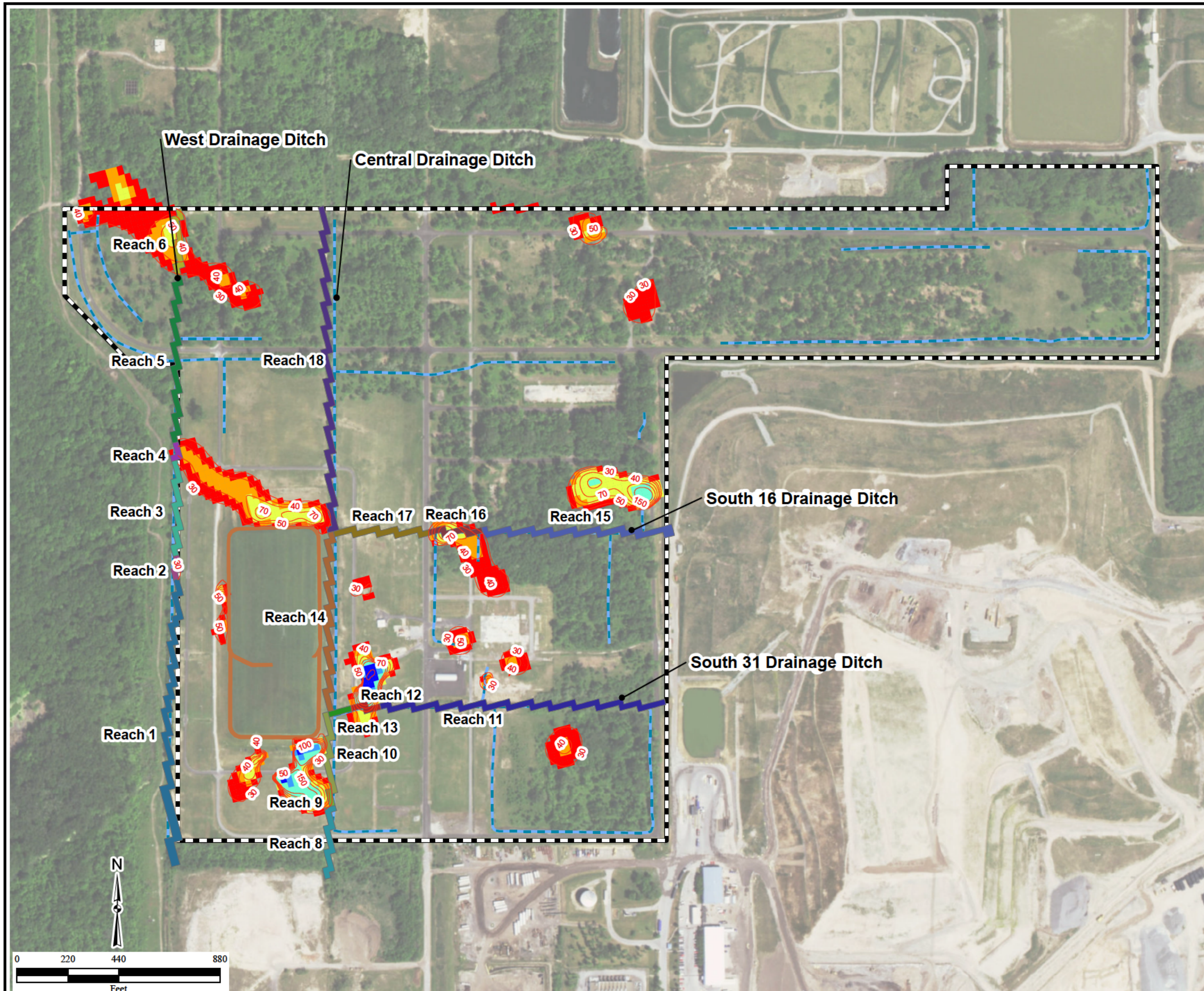


Figure 8
Reaches along Drainage Ditches on NFSS

Legend

- UTotal Isoconcentration Contour Based on Antilog of Isocon Raster
- IWCS Cutoff Wall
- Ditch
- NFSS

Notes:
Square points represent local minima or maxima from the isocon raster.
Red labels indicate values of possible missing sample locaitons, derived from local minima and maxima of the isocon raster.

IWCS=Interim Waste Containment Structure
g/L=micrograms per liter
NFSS=Niagara Falls Storage Site

Concentration(ug/L)

- 30.0 - 40.0
- 40.0 - 50.0
- 50.0 - 100.0
- 100.0 - 500.0
- 500.0 - 1000.0
- >1000.0

P:\BU4001\201610_NFSS\Report\3D_v2\Figure9_ReachLocation.mxd
1/4/2017 ARW
Source: HGL, SAIC, URS
ArcGIS Online Imagery

HGL HydroGeoLogic, Inc

TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
101	10	10.5	9/8/2000	1.67	MG/KG	13.689	0.68
101	0	0.5	9/8/2000	3.64	MG/KG	29.836	1.49
102	9	9.5	9/8/2000	2.3	MG/KG	18.852	0.94
102	0	0.5	9/8/2000	2.5	MG/KG	20.492	1.02
103	10	10.5	9/8/2000	2.3	MG/KG	18.852	0.94
103	0	0.5	9/8/2000	3.9	MG/KG	31.967	1.60
201	9.5	10	11/18/1999	1.94	MG/KG	15.902	0.80
201	0	0.5	11/18/1999	3.39	MG/KG	27.787	1.39
202	9.5	10	11/22/1999	2.6	MG/KG	21.311	1.07
202	0	0.5	11/22/1999	6.34	MG/KG	51.967	2.60
203	11.5	12	11/19/1999	2.99	MG/KG	24.508	1.23
203	0	0.5	11/19/1999	5.06	MG/KG	41.475	2.07
204	8.5	9	11/19/1999	2.44	MG/KG	20.000	1.00
204	0	0.5	11/19/1999	2.92	MG/KG	23.934	1.20
205	12	12.5	11/17/1999	2.03	MG/KG	16.639	0.83
205	0	0.5	11/17/1999	0.763	PCI/G	18.405	0.92
206	8.5	9	11/17/1999	4.77	MG/KG	39.098	1.95
206	0	0.5	11/17/1999	0.796	PCI/G	19.201	0.96
207	13.5	14	11/21/1999	1.6	MG/KG	13.115	0.66
207	0	0.5	11/21/1999	3.96	MG/KG	32.459	1.62
208	11.5	12	11/21/1999	2.81	MG/KG	23.033	1.15
208	0	0.5	11/21/1999	3.61	MG/KG	29.590	1.48
209	9.5	10	11/21/1999	2.58	MG/KG	21.148	1.06
209	0	0.5	11/21/1999	2.45	MG/KG	20.082	1.00
210	12.5	13	11/21/1999	1.76	MG/KG	14.426	0.72
210	0	0.5	11/21/1999	0.65	PCI/G	15.679	0.78
211	10.5	11	11/21/1999	2.56	MG/KG	20.984	1.05
211	0	0.5	11/21/1999	3.03	MG/KG	24.836	1.24
212	12	12.5	11/18/1999	2.53	MG/KG	20.738	1.04
212	0	0.5	11/18/1999	2.73	MG/KG	22.377	1.12
213	12	12.5	11/18/1999	2.68	MG/KG	21.967	1.10
213	0	0.5	11/18/1999	3.05	MG/KG	25.000	1.25
214	14.5	15	11/18/1999	2.28	MG/KG	18.689	0.93
214	0	0.5	11/18/1999	2.39	MG/KG	19.590	0.98
215	7	7.5	12/1/1999	3.61	MG/KG	29.590	1.48
215	0	0.5	12/1/1999	3.2	MG/KG	26.230	1.31
216	10	10.5	11/18/1999	2.69	MG/KG	22.049	1.10
216	0	0.5	11/18/1999	2.66	MG/KG	21.803	1.09
217	12.5	13	11/19/1999	2.4	MG/KG	19.672	0.98
217	0	0.5	11/19/1999	2.54	MG/KG	20.820	1.04
218	1.5	2	9/10/2000	2.74	MG/KG	22.459	1.12
218	15	15	9/30/2003	1.225	PCI/G	29.550	1.48
218	0	0.5	9/10/2000	49.4	MG/KG	404.918	20.25
219	1.5	2	9/15/2000	3.91	MG/KG	32.049	1.60
219	6	6	10/3/2003	1.995	PCI/G	48.124	2.41
219	0	0.5	9/15/2000	20.9	MG/KG	171.311	8.57
220	20	20	9/30/2003	2.05	MG/KG	16.803	0.84
220	0	0.5	9/13/2000	21.1	MG/KG	172.951	8.65
221	1.5	2	9/10/2000	4.48	MG/KG	36.721	1.84
221	0	0.5	9/10/2000	44.8	MG/KG	367.213	18.36
222	6	6	10/3/2003	1.93	MG/KG	15.820	0.79

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
223	3	3	10/2/2003	3.49	MG/KG	28.607	1.43
224	10	10	10/4/2003	1.89	MG/KG	15.492	0.77
225	10	10	10/3/2003	1.65	MG/KG	13.525	0.68
226	12	12	10/3/2003	1.96	MG/KG	16.066	0.80
227	15	15	10/4/2003	1.77	MG/KG	14.508	0.73
301	9.5	10	12/1/1999	2.4	MG/KG	19.672	0.98
301	0	0.5	12/1/1999	3.1	MG/KG	25.410	1.27
302	10.5	11	11/18/1999	1.85	MG/KG	15.164	0.76
302	0	0.5	11/18/1999	0.658	PCI/G	15.872	0.79
303	7.5	8	12/1/1999	2	MG/KG	16.393	0.82
303	0	0.5	12/1/1999	4.81	MG/KG	39.426	1.97
304	8.5	9	12/1/1999	2.43	MG/KG	19.918	1.00
304	0	0.5	12/1/1999	2.55	MG/KG	20.902	1.05
305	12	12.5	12/2/1999	2.02	MG/KG	16.557	0.83
305	0	0.5	12/2/1999	2.92	MG/KG	23.934	1.20
306	12	12.5	12/2/1999	2.02	MG/KG	16.557	0.83
306	0	0.5	12/2/1999	4.2	MG/KG	34.426	1.72
307	9.5	10	12/2/1999	1.96	MG/KG	16.066	0.80
307	0	0.5	12/2/1999	2.53	MG/KG	20.738	1.04
308	18.5	19	11/17/1999	2.09	MG/KG	17.131	0.86
308	0	0.5	11/17/1999	10.4	MG/KG	85.246	4.26
309	18.5	19	11/17/1999	1.56	MG/KG	12.787	0.64
309	0	0.5	11/17/1999	3.09	MG/KG	25.328	1.27
310	8	8.5	12/2/1999	1.8	MG/KG	14.754	0.74
310	0	0.5	12/2/1999	1.98	MG/KG	16.230	0.81
311	12.5	13	11/18/1999	2.25	MG/KG	18.443	0.92
311	0	0.5	11/18/1999	5.33	MG/KG	43.689	2.18
312	14.5	15	11/18/1999	2.07	MG/KG	16.967	0.85
312	0	0.5	11/18/1999	2.09	PCI/G	50.415	2.52
313	13	13.5	9/15/2000	2.38	MG/KG	19.508	0.98
313	0	0.5	9/15/2000	3.23	MG/KG	26.475	1.32
314	1	1.5	9/14/2000	3.2	MG/KG	26.230	1.31
314	0	0.5	9/14/2000	5.77	MG/KG	47.295	2.36
401	19.5	20	11/16/1999	2.32	MG/KG	19.016	0.95
401	0	0.5	11/16/1999	0.724	PCI/G	17.464	0.87
402	22.5	23	11/8/1999	1.76	MG/KG	14.426	0.72
402	0	0.5	11/8/1999	33.1	MG/KG	271.311	13.57
403	17.5	18	11/8/1999	1.7	MG/KG	13.934	0.70
403	0	0.5	11/7/1999	2.6	MG/KG	21.311	1.07
404	24.5	25	11/7/1999	1.43	MG/KG	11.721	0.59
404	0	0.5	11/7/1999	3	MG/KG	24.590	1.23
405	24.5	25	11/8/1999	1.62	MG/KG	13.279	0.66
405	0	0.5	11/8/1999	1.86	MG/KG	15.246	0.76
406	17.5	18	11/16/1999	2.12	MG/KG	17.377	0.87
406	0	0.5	11/16/1999	1.12	PCI/G	27.017	1.35
407	19.5	20	11/8/1999	1.3	MG/KG	10.656	0.53
407	0	0.5	11/8/1999	3.69	MG/KG	30.246	1.51
408	19.5	20	11/17/1999	1.57	MG/KG	12.869	0.64
408	0	0.5	11/17/1999	2.24	MG/KG	18.361	0.92
409	0	0.5	11/30/1999	2.96	MG/KG	24.262	1.21
410	10.5	11	11/30/1999	1.97	MG/KG	16.148	0.81

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
410	0	0.5	11/30/1999		MG/KG	0.000	0.00
411	19.5	20	11/16/1999	1.83	MG/KG	15.000	0.75
411	0	0.5	11/16/1999	2.71	MG/KG	22.213	1.11
412	14.5	15	11/22/1999	1.7	MG/KG	13.934	0.70
412	0	0.5	11/22/1999	2.18	MG/KG	17.869	0.89
413	18.5	19	11/22/1999	2.61	MG/KG	21.393	1.07
413	0	0.5	11/22/1999	2.72	MG/KG	22.295	1.11
414	20.5	21	12/2/1999	3.15	MG/KG	25.820	1.29
414	5	5	10/1/2003	0.8355	PCI/G	20.154	1.01
414	0	0.5	12/2/1999	1	MG/KG	8.197	0.41
415	13.5	14	11/30/1999	1.63	MG/KG	13.361	0.67
415	0	0.5	11/30/1999	1.8	MG/KG	14.754	0.74
416	20.5	21	12/3/1999	1.67	MG/KG	13.689	0.68
416	0	0.5	12/3/1999	1.68	MG/KG	13.770	0.69
417	8.4	8.9	11/30/1999	2.14	MG/KG	17.541	0.88
417	0	0.5	11/30/1999	2.39	MG/KG	19.590	0.98
418	18.5	19	12/1/1999	1.69	MG/KG	13.852	0.69
418	0	0.5	12/1/1999	1.8	MG/KG	14.754	0.74
419	16.5	17	12/1/1999	1.75	MG/KG	14.344	0.72
419	0	0.5	12/1/1999	1.9	MG/KG	15.574	0.78
420	6.5	7	11/17/1999	2	MG/KG	16.393	0.82
420	0	0.5	11/17/1999	0.955	PCI/G	23.037	1.15
421	15.5	16	12/1/1999	2.04	MG/KG	16.721	0.84
421	0	0.5	12/1/1999	2	MG/KG	16.393	0.82
422	10	10.5	9/10/2000	2.28	MG/KG	18.689	0.93
422	0	0.5	9/9/2000	2.29	MG/KG	18.770	0.94
423	9.5	10	9/12/2000	2.06	MG/KG	16.885	0.84
423	0	0.5	9/12/2000	3.13	MG/KG	25.656	1.28
424	15.5	16	9/10/2000	1.79	MG/KG	14.672	0.73
424	0	0.5	9/9/2000	2.36	MG/KG	19.344	0.97
425	10	10.5	9/11/2000	2.45	MG/KG	20.082	1.00
425	0	0.5	9/11/2000	2.46	MG/KG	20.164	1.01
501	11.5	12	11/7/1999	2.3	MG/KG	18.852	0.94
501	0	0.5	11/7/1999	2.43	MG/KG	19.918	1.00
502	12.5	13	11/17/1999	2.52	MG/KG	20.656	1.03
502	0	0.5	11/16/1999	27.1	MG/KG	222.131	11.11
503	12.5	13	11/7/1999	1.92	MG/KG	15.738	0.79
503	0	0.5	11/7/1999	366	MG/KG	3000.000	150.00
504	13.5	14	9/9/2000	2.75	MG/KG	22.541	1.13
504	0	0.5	9/9/2000	27.7	MG/KG	227.049	11.35
505	16.5	17	8/26/2000	2.08	MG/KG	17.049	0.85
505	0	0.5	8/26/2000	3.58	MG/KG	29.344	1.47
506	12.5	13	9/9/2000	2.77	MG/KG	22.705	1.14
506	0	0.5	9/9/2000	2.55	MG/KG	20.902	1.05
601	12.5	13	12/2/1999	2.05	MG/KG	16.803	0.84
601	0	0.5	12/2/1999	1.68	MG/KG	13.770	0.69
602	14.5	15	11/16/1999	1.98	MG/KG	16.230	0.81
602	0	0.5	11/16/1999	0.605	PCI/G	14.594	0.73
603	0	0.5	11/16/1999	0.838	PCI/G	20.214	1.01
604	14.5	15	11/7/1999	1.83	MG/KG	15.000	0.75
604	0	0.5	11/7/1999	2.28	MG/KG	18.689	0.93

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
605	16	16.5	9/11/2000	1.7	MG/KG	13.934	0.70
605	0	0.5	9/11/2000	2.96	MG/KG	24.262	1.21
606	17.5	18	8/25/2000	0.907	PCI/G	21.879	1.09
606	0	0.5	8/25/2000	287	MG/KG	2352.459	117.62
607	16.5	17	9/11/2000	1.96	MG/KG	16.066	0.80
607	0	0.5	9/11/2000	2.48	MG/KG	20.328	1.02
801	17.5	18	11/6/1999	2.01	MG/KG	16.475	0.82
801	0	0.5	11/6/1999	3.79	MG/KG	31.066	1.55
802	16.5	17	11/6/1999	1.71	MG/KG	14.016	0.70
802	0	0.5	11/6/1999	2.22	MG/KG	18.197	0.91
803	7	7.5	11/17/1999	2.97	MG/KG	24.344	1.22
803	0	0.5	11/17/1999	3.31	MG/KG	27.131	1.36
804	7	7.5	12/2/1999	2.12	MG/KG	17.377	0.87
804	0	0.5	12/2/1999	4.41	MG/KG	36.148	1.81
805	7	7.5	11/7/1999	2.1	MG/KG	17.213	0.86
805	0	0.5	11/7/1999	3.29	MG/KG	26.967	1.35
806	18.4	18.9	11/6/1999	1.63	MG/KG	13.361	0.67
806	0	0.5	11/6/1999	3.71	MG/KG	30.410	1.52
807	17.7	18.2	11/6/1999	2.19	MG/KG	17.951	0.90
807	0	0.5	11/6/1999	2.57	MG/KG	21.066	1.05
808	14.5	15	11/8/1999	1.57	MG/KG	12.869	0.64
808	0	0.5	11/8/1999	2.48	MG/KG	20.328	1.02
809	17.5	18	11/16/1999	1.19	MG/KG	9.754	0.49
809	0	0.5	11/16/1999	0.795	PCI/G	19.177	0.96
810	11.5	12	11/30/1999	0.879	MG/KG	7.205	0.36
810	0	0.5	11/30/1999	1.81	MG/KG	14.836	0.74
811	22.5	23	12/2/1999	2.11	MG/KG	17.295	0.86
811	0	0.5	12/2/1999	1.74	MG/KG	14.262	0.71
812	9.5	10	11/8/1999	2.09	MG/KG	17.131	0.86
812	0	0.5	11/8/1999	1.92	MG/KG	15.738	0.79
813	10	10.5	9/9/2000	2.12	MG/KG	17.377	0.87
813	0	0.5	9/9/2000	3.65	MG/KG	29.918	1.50
814	18.5	19	8/30/2000	2.49	MG/KG	20.410	1.02
814	0	0.5	8/30/2000	9.52	MG/KG	78.033	3.90
815	10.5	11	9/10/2000	2.38	MG/KG	19.508	0.98
815	0	0.5	9/10/2000	9.23	MG/KG	75.656	3.78
816	11.5	12	8/25/2000	1.065	PCI/G	25.690	1.28
816	0	0.5	8/25/2000	8.94	MG/KG	73.279	3.66
817	9.5	10	9/9/2000	2.67	MG/KG	21.885	1.09
817	0	0.5	9/9/2000	4.79	MG/KG	39.262	1.96
818	10	10.5	9/12/2000	1.63	MG/KG	13.361	0.67
818	0	0.5	9/12/2000	5.52	MG/KG	45.246	2.26
819	8.5	9	9/11/2000	2.69	MG/KG	22.049	1.10
819	0	0.5	9/11/2000	55.8	MG/KG	457.377	22.87
820	18	18.5	9/8/2000	1.85	MG/KG	15.164	0.76
820	0	0.5	9/8/2000	3.94	MG/KG	32.295	1.61
821	11.5	12	9/9/2000	2.75	MG/KG	22.541	1.13
821	0	0.5	9/8/2000	3.7	MG/KG	30.328	1.52
822	10.5	11	9/8/2000	2.41	MG/KG	19.754	0.99
822	0	0.5	9/8/2000	3.14	MG/KG	25.738	1.29
823	13	13.5	9/11/2000	2.23	MG/KG	18.279	0.91

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
823	0	0.5	9/11/2000	2.17	MG/KG	17.787	0.89
824	12.5	13	9/11/2000	1.69	MG/KG	13.852	0.69
824	0	0.5	9/11/2000	2.49	MG/KG	20.410	1.02
825	9	9.5	9/11/2000	2.52	MG/KG	20.656	1.03
825	0	0.5	9/11/2000	2.17	MG/KG	17.787	0.89
826	0	0.5	9/14/2000	9.87	MG/KG	80.902	4.05
827	1.5	2	9/13/2000	6.51	MG/KG	53.361	2.67
827	0	0.5	9/13/2000	8.35	MG/KG	68.443	3.42
828	0	0.5	8/31/2000	9.08	MG/KG	74.426	3.72
829	0	0.5	9/15/2000	3.06	MG/KG	25.082	1.25
830	1.5	2	9/10/2000	30.1	MG/KG	246.721	12.34
830	0	0.5	9/10/2000	884	MG/KG	7245.902	362.30
831	15	15	10/2/2003	1.66	MG/KG	13.607	0.68
831	0	0.5	10/2/2003	2.77	MG/KG	22.705	1.14
832	12	12	10/2/2003	2.25	MG/KG	18.443	0.92
832	0	0.5	10/2/2003	3.42	MG/KG	28.033	1.40
833	10	10	10/2/2003	2.95	MG/KG	24.180	1.21
833	0	0.5	10/2/2003	40.2	MG/KG	329.508	16.48
834	14	14	10/3/2003	2.11	MG/KG	17.295	0.86
834	0	0.5	10/2/2003	2.65	MG/KG	21.721	1.09
835	15	15	9/20/2003	1	MG/KG	8.197	0.41
835	0	0.5	9/20/2003	0.596	MG/KG	4.885	0.24
836	15	15	9/21/2003	0.938	MG/KG	7.689	0.38
836	0	0.5	9/21/2003	1.02	MG/KG	8.361	0.42
837	19	19	9/21/2003	0.833	MG/KG	6.828	0.34
837	0	0.5	9/21/2003	1.18	MG/KG	9.672	0.48
838	14	14	9/30/2003	2.22	MG/KG	18.197	0.91
838	0	0.5	9/30/2003	1.5	MG/KG	12.295	0.61
839	14	14	9/30/2003	1.59	MG/KG	13.033	0.65
839	0	0.5	9/30/2003	1.86	MG/KG	15.246	0.76
840	12	12	9/18/2003	0.981	MG/KG	8.041	0.40
840	0	0.5	9/18/2003	1.05	MG/KG	8.607	0.43
841	10	10	9/18/2003	0.656	MG/KG	5.377	0.27
841	0	0.5	9/18/2003	2.27	MG/KG	18.607	0.93
842	10	10	9/18/2003	1.05	MG/KG	8.607	0.43
842	0	0.5	9/19/2003	1.22	MG/KG	10.000	0.50
843	10	10	9/19/2003	1	MG/KG	8.197	0.41
843	0	0.5	9/19/2003	1.53	MG/KG	12.541	0.63
844	11	11	9/19/2003	0.767	MG/KG	6.287	0.31
844	0	0.5	9/19/2003	1.52	MG/KG	12.459	0.62
845	13	13	9/19/2003	0.548	MG/KG	4.492	0.22
845	0	0.5	9/19/2003	1.61	MG/KG	13.197	0.66
846	16	16	9/19/2003	1.25	MG/KG	10.246	0.51
846	0	0.5	9/19/2003	1.54	MG/KG	12.623	0.63
847	10	10	9/19/2003	1.19	MG/KG	9.754	0.49
847	0	0.5	9/19/2003	1.65	MG/KG	13.525	0.68
848	11	11	9/21/2003	1.07	MG/KG	8.770	0.44
848	0	0.5	9/21/2003	2.04	MG/KG	16.721	0.84
849	11	11	9/21/2003	0.993	MG/KG	8.139	0.41
849	0	0.5	9/21/2003	2.21	MG/KG	18.115	0.91
850	17	17	9/21/2003	0.891	MG/KG	7.303	0.37

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
850	0	0.5	9/21/2003	1.33	MG/KG	10.902	0.55
851	18	18	9/21/2003	0.938	MG/KG	7.689	0.38
851	0	0.5	9/21/2003	1.29	MG/KG	10.574	0.53
852	15	15	9/30/2003	1.2	MG/KG	9.836	0.49
852	0	0.5	9/30/2003	2.91	MG/KG	23.852	1.19
853	16.5	16.5	9/30/2003	2.02	MG/KG	16.557	0.83
853	0	0.5	9/30/2003	2.46	MG/KG	20.164	1.01
854	13	13	9/30/2003	1.24	MG/KG	10.164	0.51
854	0	0.5	9/30/2003	3.29	MG/KG	26.967	1.35
855	15	15	9/30/2003	1.52	MG/KG	12.459	0.62
855	0	0.5	9/30/2003	2.76	MG/KG	22.623	1.13
856	11	11	10/2/2003	1.24	MG/KG	10.164	0.51
856	0	0.5	10/2/2003	2.33	MG/KG	19.098	0.95
857	11	11	10/2/2003	1.11	MG/KG	9.098	0.45
857	0	0.5	10/2/2003	24.3	MG/KG	199.180	9.96
858	16	16	10/2/2003	2.25	MG/KG	18.443	0.92
858	0	0.5	10/2/2003	2.9	MG/KG	23.770	1.19
859	18	18	10/2/2003	1.86	MG/KG	15.246	0.76
859	0	0.5	10/2/2003	2.61	MG/KG	21.393	1.07
860	15	15	9/21/2003	0.979	MG/KG	8.025	0.40
861	34.5	34.5	9/20/2003	0.906	MG/KG	7.426	0.37
861	38	38	9/20/2003	0.691	MG/KG	5.664	0.28
861	0	0.5	9/20/2003	1.08	MG/KG	8.852	0.44
864	10	10	10/2/2003	1.77	MG/KG	14.508	0.73
901	1.5	2	11/15/2001	0.576	MG/KG	4.721	0.24
901	0	0.5	11/15/2001	0.878	MG/KG	7.197	0.36
902	1.5	2	11/15/2001	1.84	MG/KG	15.082	0.75
902	0	0.5	11/15/2001	1.96	MG/KG	16.066	0.80
903	1.5	2	11/18/2001	3.09	MG/KG	25.328	1.27
903	0	0.5	11/18/2001	4.01	MG/KG	32.869	1.64
904	2.5	3	11/18/2001	2.24	MG/KG	18.361	0.92
904	0	0.5	11/18/2001	2.36	MG/KG	19.344	0.97
905	1.5	2	11/18/2001	12.2	MG/KG	100.000	5.00
905	0	0.5	11/18/2001	13.5	MG/KG	110.656	5.53
906	2.5	3	11/18/2001	1.92	MG/KG	15.738	0.79
906	0	0.5	11/18/2001	2.32	MG/KG	19.016	0.95
907	2	2.5	11/15/2001	2.01	MG/KG	16.475	0.82
907	0	0.5	11/15/2001	1.87	MG/KG	15.328	0.77
908	2	2.5	11/18/2001	2.87	MG/KG	23.525	1.18
908	0	0.5	11/18/2001	2.19	MG/KG	17.951	0.90
909	1.5	2	11/14/2001	1.17	MG/KG	9.590	0.48
909	0	0.5	11/14/2001	1.38	MG/KG	11.311	0.57
910	1.5	2	11/14/2001	1.92	MG/KG	15.738	0.79
910	0	0.5	11/14/2001	1.49	MG/KG	12.213	0.61
913	1	1.5	11/15/2001	3.67	MG/KG	30.082	1.50
913	0	0.5	11/15/2001	4.07	MG/KG	33.361	1.67
1A001	0	0.5	9/7/2001	3.33	MG/KG	27.295	1.36
1A002	0	0.5	9/7/2001	2.85	MG/KG	23.361	1.17
1B001	0	0.5	9/7/2001	2.3	MG/KG	18.852	0.94
1B002	0	0.5	9/7/2001	2.8	MG/KG	22.951	1.15
203-1	0.5	2	12/4/2013	0.999	PCI/G	24.098	1.20

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
203-1	2	3	12/4/2013	1.97	PCI/G	47.521	2.38
203-1	0	0.5	12/4/2013	1.23	PCI/G	29.670	1.48
203-2	0.5	2	12/4/2013	0.849	PCI/G	20.480	1.02
203-2	2	3	12/4/2013	0.793	PCI/G	19.129	0.96
203-2	0	0.5	12/4/2013	1.07	PCI/G	25.811	1.29
203-3	0.5	2	12/4/2013	0.813	PCI/G	19.611	0.98
203-3	2	3	12/4/2013	1.44	PCI/G	34.736	1.74
203-3	0	0.5	12/4/2013	1.43	PCI/G	34.495	1.72
203-4	0.5	2	12/4/2013	1.3	PCI/G	31.359	1.57
203-4	2	3	12/4/2013	2.25	PCI/G	54.275	2.71
203-4	0	0.5	12/4/2013	1.36	PCI/G	32.806	1.64
205-1	0.5	2	12/16/2013	0.858	PCI/G	20.697	1.03
205-1	2	3	12/16/2013	0.712	PCI/G	17.175	0.86
205-1	0	0.5	12/16/2013	0.976	PCI/G	23.543	1.18
205-2	0.5	2	12/16/2013	1	PCI/G	24.122	1.21
205-2	2	3	12/16/2013	0.504	PCI/G	12.158	0.61
205-2	0	0.5	12/16/2013	0.926	PCI/G	22.337	1.12
205-3	0.5	2	12/16/2013	2.95	PCI/G	71.160	3.56
205-3	2	3	12/16/2013	1.11	PCI/G	26.776	1.34
205-3	0	0.5	12/16/2013	0.762	PCI/G	18.381	0.92
205-4	0.5	2	12/16/2013	0.961	PCI/G	23.181	1.16
205-4	0	0.5	12/16/2013	1.07	PCI/G	25.811	1.29
218-1	0.5	2	12/3/2013	1.36	PCI/G	32.806	1.64
218-1	2	3	12/3/2013	1.34	PCI/G	32.324	1.62
218-1	0	0.5	12/3/2013	0.982	PCI/G	23.688	1.18
218-2	0.5	2	12/3/2013	1.6	PCI/G	38.596	1.93
218-2	2	3	12/3/2013	0.771	PCI/G	18.598	0.93
218-2	0	0.5	12/3/2013	0.819	PCI/G	19.756	0.99
218-3	0.5	2	12/3/2013	1.03	PCI/G	24.846	1.24
218-3	2	3	12/3/2013	1.32	PCI/G	31.841	1.59
218-3	0	0.5	12/3/2013	1.07	PCI/G	25.811	1.29
218-4	0.5	2	12/3/2013	1.66	PCI/G	40.043	2.00
218-4	2	3	12/3/2013	1	PCI/G	24.122	1.21
218-4	0	0.5	12/3/2013	1.22	PCI/G	29.429	1.47
219-1	0.5	2	12/13/2013	0.762	PCI/G	18.381	0.92
219-1	2	3	12/13/2013	0.996	PCI/G	24.026	1.20
219-1	0	0.5	12/13/2013	0.828	PCI/G	19.973	1.00
219-2	0.5	2	12/13/2013	0.853	PCI/G	20.576	1.03
219-2	2	3	12/13/2013	0.912	PCI/G	21.999	1.10
219-2	0	0.5	12/13/2013	0.993	PCI/G	23.953	1.20
219-3	0.5	2	12/13/2013	0.804	PCI/G	19.394	0.97
219-3	2	3	12/13/2013	1.25	PCI/G	30.153	1.51
219-3	0	0.5	12/13/2013	0.857	PCI/G	20.673	1.03
219-4	0.5	2	12/13/2013	0.572	PCI/G	13.798	0.69
219-4	2	3	12/13/2013	1.38	PCI/G	33.289	1.66
219-4	0	0.5	12/13/2013	1.06	PCI/G	25.570	1.28
220-1	0.5	2	12/3/2013	1.09	PCI/G	26.293	1.31
220-1	2	3	12/3/2013	1.37	PCI/G	33.047	1.65
220-1	0	0.5	12/3/2013	1	PCI/G	24.122	1.21
220-2	0.5	2	12/3/2013	0.842	PCI/G	20.311	1.02
220-2	2	3	12/3/2013	1.18	PCI/G	28.464	1.42

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
220-2	0	0.5	12/3/2013	0.648	PCI/G	15.631	0.78
220-3	0.5	2	12/3/2013	16.5	PCI/G	398.016	19.90
220-3	2	3	12/3/2013	3.44	PCI/G	82.980	4.15
220-3	0	0.5	12/3/2013	0.707	PCI/G	17.054	0.85
220-4	0.5	2	12/3/2013	1.53	PCI/G	36.907	1.85
220-4	2	3	12/3/2013	1.19	PCI/G	28.705	1.44
221-1	0.5	2	12/3/2013	0.592	PCI/G	14.280	0.71
221-1	2	3	12/3/2013	0.735	PCI/G	17.730	0.89
221-1	0	0.5	12/3/2013	0.655	PCI/G	15.800	0.79
221-2	0.5	2	12/3/2013	0.599	PCI/G	14.449	0.72
221-2	2	3	12/3/2013	2.58	PCI/G	62.235	3.11
221-3	0.5	2	12/3/2013	2.23	PCI/G	53.792	2.69
221-3	2	3	12/3/2013	2.65	PCI/G	63.924	3.20
221-4	0.5	2	12/3/2013	3.2	PCI/G	77.191	3.86
221-4	2	3	12/3/2013	0.888	PCI/G	21.421	1.07
221-4	0	0.5	12/3/2013	2.09	PCI/G	50.415	2.52
221A	15	15	9/30/2003	1.5	MG/KG	12.295	0.61
2A001	10.5	11	9/11/2000	2.14	MG/KG	17.541	0.88
2A002	10.5	11	9/12/2000	2.56	MG/KG	20.984	1.05
2A002	0	0.5	9/12/2000	2.22	MG/KG	18.197	0.91
2A003	11	11.5	9/12/2000	2.58	MG/KG	21.148	1.06
2A003	0	0.5	9/12/2000	1.88	MG/KG	15.410	0.77
2A004	0	0.5	9/10/2001	3.51	MG/KG	28.770	1.44
2A005	1.53	1.7	9/8/2001	2.34	MG/KG	19.180	0.96
2A005	0	0.5	9/8/2001	2.77	MG/KG	22.705	1.14
2A006	0	0.5	11/17/2001	3.12	MG/KG	25.574	1.28
2A006-1	0.5	2	11/13/2013	1.17	PCI/G	28.223	1.41
2A006-1	2	3	11/13/2013	1.86	PCI/G	44.867	2.24
2A006-1	0	0.5	11/13/2013	0.967	PCI/G	23.326	1.17
2A006-2	0.5	2	11/13/2013	1.14	PCI/G	27.499	1.37
2A006-2	2	3	11/13/2013	1.25	PCI/G	30.153	1.51
2A006-2	0	0.5	11/13/2013	1.41	PCI/G	34.012	1.70
2A006-3	0.5	2	11/13/2013	0.815	PCI/G	19.660	0.98
2A006-3	2	3	11/13/2013	0.921	PCI/G	22.217	1.11
2A006-3	0	0.5	11/13/2013	0.764	PCI/G	18.429	0.92
2A006-4	0.5	2	11/13/2013	1.28	PCI/G	30.876	1.54
2A006-4	2	3	11/13/2013	1.95	PCI/G	47.038	2.35
2A006-4	0	0.5	11/13/2013	1.12	PCI/G	27.017	1.35
2A006-5	0.5	2	6/17/2014	1.3	PCI/G	31.359	1.57
2A006-5	2	3	6/17/2014	1.12	PCI/G	27.017	1.35
2A006-5	0	0.5	6/17/2014	1.82	PCI/G	43.902	2.20
2A006-6	0.5	2	6/17/2014	2.99	PCI/G	72.125	3.61
2A006-6	2	3	6/17/2014	1.45	PCI/G	34.977	1.75
2A006-6	0	0.5	6/17/2014	6.24	PCI/G	150.522	7.53
2A007	0	0.5	11/17/2001	2.42	MG/KG	19.836	0.99
2A008	0	0.5	11/17/2001	2.91	MG/KG	23.852	1.19
2A008-1	0.5	2	12/3/2013	1.24	PCI/G	29.912	1.50
2A008-1	2	3	12/3/2013	0.786	PCI/G	18.960	0.95
2A008-1	0	0.5	12/3/2013	0.889	PCI/G	21.445	1.07
2A008-2	0.5	2	12/3/2013	0.767	PCI/G	18.502	0.93
2A008-2	0	0.5	12/3/2013	1.14	PCI/G	27.499	1.37

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
2A008-3	0.5	2	12/3/2013	1.33	PCI/G	32.083	1.60
2A008-3	2	3	12/3/2013	1.1	PCI/G	26.534	1.33
2A008-3	3	4	12/3/2013	0.884	PCI/G	21.324	1.07
2A008-3	0	0.5	12/3/2013	1.11	PCI/G	26.776	1.34
2A008-4	0.5	2	12/3/2013	1.02	PCI/G	24.605	1.23
2A008-4	2	3	12/3/2013	0.622	PCI/G	15.004	0.75
2A008-4	0	0.5	12/3/2013	1.43	PCI/G	34.495	1.72
2A008-5	0.5	2	6/18/2014	1.57	PCI/G	37.872	1.89
2A008-5	2	3	6/18/2014	1.02	PCI/G	24.605	1.23
2A008-5	0	0.5	6/18/2014	1.07	PCI/G	25.811	1.29
2A008-6	0.5	2	6/18/2014	1.21	PCI/G	29.188	1.46
2A008-6	2	3	6/18/2014	0.985	PCI/G	23.760	1.19
2A008-6	0	0.5	6/18/2014	1.59	PCI/G	38.354	1.92
2A008-7	0.5	2	6/18/2014	1.18	PCI/G	28.464	1.42
2A008-7	2	3	6/18/2014	1.2	PCI/G	28.947	1.45
2A008-7	0	0.5	6/18/2014	1.43	PCI/G	34.495	1.72
2A008-8	0.5	2	6/18/2014	1.48	PCI/G	35.701	1.79
2A008-8	2	3	6/18/2014	1.15	PCI/G	27.741	1.39
2A008-8	0	0.5	6/18/2014	1.11	PCI/G	26.776	1.34
2A009	0	0.5	11/17/2001	0.846	MG/KG	6.934	0.35
2B001	15.5	16	8/30/2000	2.35	MG/KG	19.262	0.96
2B001	0	0.5	8/26/2000	2.68	MG/KG	21.967	1.10
2B002	9	9.5	8/30/2000	2.72	MG/KG	22.295	1.11
2B002	0	0.5	8/26/2000	3.65	MG/KG	29.918	1.50
2B003	7.5	8	9/12/2000	1.86	MG/KG	15.246	0.76
2B003	0	0.5	8/26/2000	9.59	MG/KG	78.607	3.93
2B004	0	0.5	8/26/2000	9.69	MG/KG	79.426	3.97
2B005	0	0.5	8/26/2000	2.51	MG/KG	20.574	1.03
2B006	12.5	13	9/15/2000	2.35	MG/KG	19.262	0.96
2B006	0	0.5	8/26/2000	6.21	MG/KG	50.902	2.55
2B007	0	0.5	8/26/2000	4.44	MG/KG	36.393	1.82
2B008	0	0.5	8/26/2000	5.62	MG/KG	46.066	2.30
2B009	0	0.5	8/26/2000	3.05	MG/KG	25.000	1.25
2B010	0	0.5	8/26/2000	3.32	MG/KG	27.213	1.36
2B011	0	0.5	8/26/2000	3.89	MG/KG	31.885	1.59
2B012	0	0.5	8/26/2000	2.6	MG/KG	21.311	1.07
2B013	0	0.5	8/26/2000	2.12	MG/KG	17.377	0.87
2B014	2	2	11/17/2001	3.55	MG/KG	29.098	1.45
2B014	0	0.5	11/17/2001	9.96	MG/KG	81.639	4.08
2B014-1	0.5	2	12/18/2013	0.829	PCI/G	19.997	1.00
2B014-1	0	0.5	12/18/2013	0.887	PCI/G	21.396	1.07
2B014-2	0.5	2	12/18/2013	1.02	PCI/G	24.605	1.23
2B014-2	2	3	12/18/2013	1.28	PCI/G	30.876	1.54
2B014-2	0	0.5	12/18/2013	0.766	PCI/G	18.478	0.92
2B014-3	0.5	2	12/18/2013	1.54	PCI/G	37.148	1.86
2B014-3	2	3	12/18/2013	0.707	PCI/G	17.054	0.85
2B014-3	0	0.5	12/18/2013	1.79	PCI/G	43.179	2.16
2B014-4	0	0.5	12/18/2013	2.75	PCI/G	66.336	3.32
2B015	0	0.5	11/17/2001	3.93	MG/KG	32.213	1.61
2B016	0	0.5	11/17/2001	4.01	MG/KG	32.869	1.64
2B017	0	0.5	11/17/2001	3.22	MG/KG	26.393	1.32

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
2B018	0	0.5	11/17/2001	2.78	MG/KG	22.787	1.14
2C001	16.5	17	9/12/2000	1.6	MG/KG	13.115	0.66
2C002	0	0.5	11/17/2001	2.5	MG/KG	20.492	1.02
2D001	0	0.5	8/27/2000	1.99	MG/KG	16.311	0.82
2D002	0	0.5	8/27/2000	3.11	MG/KG	25.492	1.27
2D003	0	0.5	8/27/2000	1.8	MG/KG	14.754	0.74
2D004	0	0.5	8/27/2000	0.111	MG/KG	0.910	0.05
2D005	0	0.5	8/27/2000	2.05	MG/KG	16.803	0.84
2D006	0	0.5	8/27/2000	2.78	MG/KG	22.787	1.14
2D007	0	0.5	8/27/2000	2.67	MG/KG	21.885	1.09
2D008	0	0.5	8/27/2000	2.07	MG/KG	16.967	0.85
2D009	0	0.5	11/17/2001	5.57	MG/KG	45.656	2.28
2D010	0	0.5	11/19/2001	4.6	MG/KG	37.705	1.89
2D011	0	0.5	11/17/2001	7.71	MG/KG	63.197	3.16
2D012	0	0.5	11/17/2001	2.42	MG/KG	19.836	0.99
2D012-1	0.5	2	12/17/2013	1.01	PCI/G	24.363	1.22
2D012-1	2	3	12/17/2013	1.67	PCI/G	40.284	2.01
2D012-1	0	0.5	12/17/2013	0.988	PCI/G	23.833	1.19
2D012-2	0.5	2	12/17/2013	1.92	PCI/G	46.315	2.32
2D012-2	2	3	12/17/2013	0.851	PCI/G	20.528	1.03
2D012-2	0	0.5	12/17/2013	1.07	PCI/G	25.811	1.29
2D012-4	0.5	2	12/17/2013	1.95	PCI/G	47.038	2.35
2D012-4	2	3	12/17/2013	2.07	PCI/G	49.933	2.50
2D012-4	2	3	12/17/2013	1.67	PCI/G	40.284	2.01
2D012-4	0	0.5	12/17/2013	2.15	PCI/G	51.863	2.59
2D013	0	0.5	11/17/2001	3.41	MG/KG	27.951	1.40
2D013-1	0.5	2	12/17/2013	4.04	PCI/G	97.454	4.87
2D013-1	0	0.5	12/17/2013	3.33	PCI/G	80.327	4.02
2D013-2	0.5	2	12/17/2013	0.805	PCI/G	19.418	0.97
2D013-2	2	3	12/17/2013	0.703	PCI/G	16.958	0.85
2D013-2	0	0.5	12/17/2013	0.752	PCI/G	18.140	0.91
2D013-4	0.5	2	12/17/2013	1.04	PCI/G	25.087	1.25
2D013-4	2	3	12/17/2013	0.886	PCI/G	21.372	1.07
2D013-4	0	0.5	12/17/2013	1.13	PCI/G	27.258	1.36
308-1	0.5	2	12/10/2013	1.13	PCI/G	27.258	1.36
308-1	2	3	12/10/2013	0.802	PCI/G	19.346	0.97
308-1	0	0.5	12/10/2013	0.929	PCI/G	22.410	1.12
308-2	0.5	2	12/10/2013	1.4	PCI/G	33.771	1.69
308-2	2	3	12/10/2013	1.31	PCI/G	31.600	1.58
308-2	0	0.5	12/10/2013	2.11	PCI/G	50.898	2.54
312-1	0.5	2	12/2/2013	0.69	PCI/G	16.644	0.83
312-1	2	3	12/2/2013	0.638	PCI/G	15.390	0.77
312-1	0	0.5	12/2/2013	0.767	PCI/G	18.502	0.93
312-2	0.5	2	12/2/2013	0.984	PCI/G	23.736	1.19
312-2	2	3	12/2/2013	1.26	PCI/G	30.394	1.52
312-2	0	0.5	12/2/2013	1.02	PCI/G	24.605	1.23
312-3	0.5	2	12/2/2013	0.892	PCI/G	21.517	1.08
312-3	2	3	12/2/2013	0.715	PCI/G	17.247	0.86
312-3	0	0.5	12/2/2013	1.16	PCI/G	27.982	1.40
312-4	0.5	2	6/20/2014	1.55	PCI/G	37.389	1.87
312-4	2	3	6/20/2014	0.73	PCI/G	17.609	0.88

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
312-4	0	0.5	6/20/2014	1.76	PCI/G	42.455	2.12
312-5	0.5	2	6/20/2014	1.34	PCI/G	32.324	1.62
312-5	2	3	6/20/2014	1.3	PCI/G	31.359	1.57
312-5	0	0.5	6/20/2014	1.81	PCI/G	43.661	2.18
314-1	0.5	2	12/9/2013	1.57	PCI/G	37.872	1.89
314-1	2	3	12/9/2013	1.1	PCI/G	26.534	1.33
314-1	0	0.5	12/9/2013	1.19	PCI/G	28.705	1.44
314-2	2	3	12/9/2013	0.773	PCI/G	18.646	0.93
314-2	0	0.5	12/9/2013	0.75	PCI/G	18.092	0.90
314-3	0.5	2	12/9/2013	0.721	PCI/G	17.392	0.87
314-3	2	3	12/9/2013	0.703	PCI/G	16.958	0.85
314-3	0	0.5	12/9/2013	1.32	PCI/G	31.841	1.59
314-4	2	3	12/9/2013	0.705	PCI/G	17.006	0.85
314-4	0	0.5	12/9/2013	1.07	PCI/G	25.811	1.29
3A001	0	0.5	8/25/2000	2.07	MG/KG	16.967	0.85
3A002	0	0.5	8/25/2000	3.94	MG/KG	32.295	1.61
3A002-1	2	3	11/22/2013	1.01	PCI/G	24.363	1.22
3A002-1	0	0.5	11/22/2013	0.545	PCI/G	13.147	0.66
3A002-1	0.5	2	11/22/2013	0.609	PCI/G	14.690	0.73
3A002-2	0.5	2	11/22/2013	0.857	PCI/G	20.673	1.03
3A002-2	2	3	11/22/2013	0.879	PCI/G	21.203	1.06
3A002-2	0	0.5	11/22/2013	0.98	PCI/G	23.640	1.18
3A002-3	0.5	2	11/22/2013	1.07	PCI/G	25.811	1.29
3A002-3	2	3	11/22/2013	0.796	PCI/G	19.201	0.96
3A002-3	0	0.5	11/22/2013	0.936	PCI/G	22.578	1.13
3A002-4	0.5	2	11/22/2013	0.874	PCI/G	21.083	1.05
3A002-4	2	3	11/22/2013	1.1	PCI/G	26.534	1.33
3A002-4	0	0.5	11/22/2013	0.898	PCI/G	21.662	1.08
3A003	0	0.5	8/25/2000	4.24	MG/KG	34.754	1.74
3A004	0	0.5	8/25/2000	12.1	MG/KG	99.180	4.96
3A005	0	0.5	8/25/2000	9.12	MG/KG	74.754	3.74
3A005-1	0.5	2	11/22/2013	1.22	PCI/G	29.429	1.47
3A005-1	2	3	11/22/2013	0.836	PCI/G	20.166	1.01
3A005-1	0	0.5	11/22/2013	2.96	PCI/G	71.402	3.57
3A005-2	0.5	2	11/22/2013	1.52	PCI/G	36.666	1.83
3A005-2	2	3	11/22/2013	0.91	PCI/G	21.951	1.10
3A005-2	0	0.5	11/22/2013	1.62	PCI/G	39.078	1.95
3A005-3	0.5	2	11/22/2013	1.19	PCI/G	28.705	1.44
3A005-3	2	3	11/22/2013	0.964	PCI/G	23.254	1.16
3A005-3	0	0.5	11/22/2013	3.77	PCI/G	90.941	4.55
3A005-4	2	3	11/21/2013	0.939	PCI/G	22.651	1.13
3A006	0	0.5	8/25/2000	3.92	MG/KG	32.131	1.61
3A006-1	0.5	2	11/21/2013	1.1	PCI/G	26.534	1.33
3A006-1	2	3	11/21/2013	1.06	PCI/G	25.570	1.28
3A006-1	0	0.5	11/21/2013	1.49	PCI/G	35.942	1.80
3A006-2	0.5	2	11/21/2013	0.88	PCI/G	21.228	1.06
3A006-2	2	3	11/21/2013	0.528	PCI/G	12.737	0.64
3A006-2	0	0.5	11/21/2013	1.13	PCI/G	27.258	1.36
3A006-3	0.5	2	11/21/2013	0.838	PCI/G	20.214	1.01
3A006-3	2	3	11/21/2013	0.871	PCI/G	21.010	1.05
3A006-3	0	0.5	11/21/2013	1.27	PCI/G	30.635	1.53

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
3A006-4	0.5	2	11/21/2013	0.841	PCI/G	20.287	1.01
3A006-4	2	3	11/21/2013	1.12	PCI/G	27.017	1.35
3A006-4	0	0.5	11/21/2013	0.977	PCI/G	23.567	1.18
3A007	0	0.5	8/25/2000	4.26	MG/KG	34.918	1.75
3A007-1	0.5	2	11/21/2013	0.627	PCI/G	15.125	0.76
3A007-1	0	0.5	11/21/2013	1.67	PCI/G	40.284	2.01
3A007-2	0	0.5	11/21/2013	1.23	PCI/G	29.670	1.48
3A007-2	0.5	2	11/21/2013	1.01	PCI/G	24.363	1.22
3A007-2	2	3	11/21/2013	0.583	PCI/G	14.063	0.70
3A007-3	0.5	2	11/21/2013	0.858	PCI/G	20.697	1.03
3A007-3	2	3	11/21/2013	0.697	PCI/G	16.813	0.84
3A007-3	0	0.5	11/21/2013	1.28	PCI/G	30.876	1.54
3A008	0	0.5	8/25/2000	3.33	MG/KG	27.295	1.36
3A009	0	0.5	8/25/2000	2.78	MG/KG	22.787	1.14
3A010	0	0.5	8/25/2000	3.37	MG/KG	27.623	1.38
3A011	0	0.5	8/25/2000	3.06	MG/KG	25.082	1.25
3A012	0	0.5	8/25/2000	4.26	MG/KG	34.918	1.75
3A013	0	0.5	8/25/2000	3.95	MG/KG	32.377	1.62
3A013-1	0.5	2	12/2/2013	1	PCI/G	24.122	1.21
3A013-1	2	3	12/2/2013	0.848	PCI/G	20.456	1.02
3A013-1	0	0.5	12/2/2013	1.28	PCI/G	30.876	1.54
3A013-2	0.5	2	12/2/2013	0.705	PCI/G	17.006	0.85
3A013-2	0	0.5	12/2/2013	1.4	PCI/G	33.771	1.69
3A014	0	0.5	8/25/2000	2.95	MG/KG	24.180	1.21
3A015	0	0.5	8/25/2000	4.6	MG/KG	37.705	1.89
3A016	0	0.5	8/25/2000	5.36	MG/KG	43.934	2.20
3A017	5	5	9/17/2003	1.15	MG/KG	9.426	0.47
3A017	0	0.5	9/8/2001	3.45	MG/KG	28.279	1.41
3A017-1	0.5	2	11/21/2013	0.662	PCI/G	15.969	0.80
3A017-1	2	3	11/21/2013	0.728	PCI/G	17.561	0.88
3A017-1	0	0.5	11/21/2013	0.603	PCI/G	14.546	0.73
3A017-2	0.5	2	11/21/2013	1.25	PCI/G	30.153	1.51
3A017-2	2	3	11/21/2013	1.13	PCI/G	27.258	1.36
3A017-2	0	0.5	11/21/2013	0.84	PCI/G	20.263	1.01
3A017-3	0.5	2	11/21/2013	1.88	PCI/G	45.350	2.27
3A017-3	2	3	11/21/2013	0.872	PCI/G	21.035	1.05
3A017-3	0	0.5	11/21/2013	1.09	PCI/G	26.293	1.31
3A017-4	0.5	2	11/21/2013	1.11	PCI/G	26.776	1.34
3A017-4	2	3	11/21/2013	0.801	PCI/G	19.322	0.97
3A017-4	0	0.5	11/21/2013	0.886	PCI/G	21.372	1.07
3A017-5	0.5	2	6/20/2014	2.11	PCI/G	50.898	2.54
3A017-5	2	3	6/20/2014	1.12	PCI/G	27.017	1.35
3A017-5	0	0.5	6/20/2014	0.881	PCI/G	21.252	1.06
3A017-6	0.5	2	6/20/2014	0.975	PCI/G	23.519	1.18
3A017-6	2	3	6/20/2014	0.682	PCI/G	16.451	0.82
3A017-6	0	0.5	6/20/2014	0.976	PCI/G	23.543	1.18
3A017-7	0.5	2	6/20/2014	1.89	PCI/G	45.591	2.28
3A017-7	2	3	6/20/2014	1.25	PCI/G	30.153	1.51
3A017-7	0	0.5	6/20/2014	1.39	PCI/G	33.530	1.68
3A020	2	2	11/16/2001	4.13	MG/KG	33.852	1.69
3A020	5	5	9/22/2003	0.6745	PCI/G	16.270	0.81

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
3A020	0	0.5	11/16/2001	3.41	MG/KG	27.951	1.40
3A020-1	0.5	2	11/20/2013	0.792	PCI/G	19.105	0.96
3A020-1	2	3	11/20/2013	1.85	PCI/G	44.626	2.23
3A020-1	0	0.5	11/20/2013	0.742	PCI/G	17.899	0.89
3A020-3	0.5	2	11/21/2013	0.942	PCI/G	22.723	1.14
3A020-3	2	3	11/21/2013	1.13	PCI/G	27.258	1.36
3A020-3	0	0.5	11/21/2013	1.15	PCI/G	27.741	1.39
3A020-4	0.5	2	11/21/2013	2.85	PCI/G	68.748	3.44
3A020-4	2	3	11/21/2013	0.647	PCI/G	15.607	0.78
3A020-4	0	0.5	11/21/2013	0.951	PCI/G	22.940	1.15
3A020-5	0.5	2	6/20/2014	2.15	PCI/G	51.863	2.59
3A020-5	2	3	6/20/2014	0.724	PCI/G	17.464	0.87
3A020-5	0	0.5	6/20/2014	1.02	PCI/G	24.605	1.23
3A021	0	0.5	11/16/2001	4.8	MG/KG	39.344	1.97
3A022	0	0.5	11/17/2001	3.44	MG/KG	28.197	1.41
3A023	0	0.5	11/16/2001	3.73	MG/KG	30.574	1.53
3A023-1	0.5	2	11/21/2013	1.1	PCI/G	26.534	1.33
3A023-1	2	3	11/21/2013	0.638	PCI/G	15.390	0.77
3A023-1	0	0.5	11/21/2013	1.32	PCI/G	31.841	1.59
3A023-2	0.5	2	11/21/2013	0.635	PCI/G	15.318	0.77
3A023-2	2	3	11/21/2013	0.627	PCI/G	15.125	0.76
3A023-2	0	0.5	11/21/2013	0.652	PCI/G	15.728	0.79
3A023-3	0.5	2	11/21/2013	0.764	PCI/G	18.429	0.92
3A023-3	2	3	11/21/2013	0.718	PCI/G	17.320	0.87
3A023-3	0	0.5	11/21/2013	0.753	PCI/G	18.164	0.91
3A024	0	0.5	11/16/2001	4.63	MG/KG	37.951	1.90
3A025	0	0.5	11/16/2001	2.4	MG/KG	19.672	0.98
3B001	0	0.5	8/26/2000	4.77	MG/KG	39.098	1.95
3B002	0	0.5	8/26/2000	2.6	MG/KG	21.311	1.07
3B003	0	0.5	8/27/2000	6.25	MG/KG	51.230	2.56
3B003-1	0.5	2	12/12/2013	0.696	PCI/G	16.789	0.84
3B003-1	2	3	12/12/2013	0.634	PCI/G	15.293	0.76
3B003-1	0	0.5	12/12/2013	1.16	PCI/G	27.982	1.40
3B003-2	0.5	2	12/12/2013	1.44	PCI/G	34.736	1.74
3B003-2	2	3	12/12/2013	0.772	PCI/G	18.622	0.93
3B003-2	0	0.5	12/12/2013	1.74	PCI/G	41.973	2.10
3B003-3	0.5	2	6/23/2014	1.38	PCI/G	33.289	1.66
3B003-3	2	3	6/23/2014	1	PCI/G	24.122	1.21
3B003-3	0	0.5	6/23/2014	1.83	PCI/G	44.144	2.21
3B003-4	0.5	2	6/23/2014	0.719	PCI/G	17.344	0.87
3B003-4	0	0.5	6/23/2014	2.1	PCI/G	50.657	2.53
3B004	0	0.5	8/27/2000	5.39	MG/KG	44.180	2.21
3B004-1	0.5	2	12/11/2013	1.16	PCI/G	27.982	1.40
3B004-1	2	3	12/11/2013	0.808	PCI/G	19.491	0.97
3B004-1	0	0.5	12/11/2013	1.22	PCI/G	29.429	1.47
3B004-2	0.5	2	12/11/2013	0.946	PCI/G	22.820	1.14
3B004-2	2	3	12/11/2013	1.04	PCI/G	25.087	1.25
3B004-2	0	0.5	12/11/2013	0.805	PCI/G	19.418	0.97
3B004-3	0.5	2	12/11/2013	1.25	PCI/G	30.153	1.51
3B004-3	2	3	12/11/2013	1.62	PCI/G	39.078	1.95
3B004-3	0	0.5	12/11/2013	1.36	PCI/G	32.806	1.64

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
3B005	0	0.5	8/27/2000	5.44	MG/KG	44.590	2.23
3B006	0	0.5	8/27/2000	2.75	MG/KG	22.541	1.13
3B007	0	0.5	8/27/2000	7.17	MG/KG	58.770	2.94
3B008	0	0.5	8/27/2000	3.89	MG/KG	31.885	1.59
3B009	0	0.5	8/27/2000	3.5	MG/KG	28.689	1.43
3B010	0	0.5	8/27/2000	5.62	MG/KG	46.066	2.30
3B011	1.5	2	11/15/2001	2.82	MG/KG	23.115	1.16
3B011	0	0.5	11/15/2001	5.51	MG/KG	45.164	2.26
3B011-1	0.5	2	12/12/2013	0.704	PCI/G	16.982	0.85
3B011-1	0	0.5	12/12/2013	2.32	PCI/G	55.963	2.80
3B011-2	0.5	2	12/12/2013	1.05	PCI/G	25.328	1.27
3B011-2	2	3	12/12/2013	0.601	PCI/G	14.497	0.72
3B011-2	0	0.5	12/12/2013	1.25	PCI/G	30.153	1.51
3B011-3	0.5	2	6/20/2014	0.952	PCI/G	22.964	1.15
3B011-3	2	3	6/20/2014	0.684	PCI/G	16.500	0.82
3B011-3	0	0.5	6/20/2014	1.58	PCI/G	38.113	1.91
3B011-4	0.5	2	6/20/2014	0.705	PCI/G	17.006	0.85
3B011-4	2	3	6/20/2014	0.633	PCI/G	15.269	0.76
3B011-4	0	0.5	6/20/2014	4.44	PCI/G	107.103	5.36
3B012	0	0.5	11/15/2001	2.13	MG/KG	17.459	0.87
3B013	1.5	2	11/15/2001	2.8	MG/KG	22.951	1.15
3B013	0	0.5	11/15/2001	2.15	MG/KG	17.623	0.88
3B013-1	0.5	2	12/12/2013	1.28	PCI/G	30.876	1.54
3B013-1	0	0.5	12/12/2013	0.856	PCI/G	20.649	1.03
3B013-2	0.5	2	12/12/2013	1.08	PCI/G	26.052	1.30
3B013-2	2	3	12/12/2013	1.26	PCI/G	30.394	1.52
3B013-2	0	0.5	12/12/2013	1.3	PCI/G	31.359	1.57
3B013-3	0.5	2	12/12/2013	0.84	PCI/G	20.263	1.01
3B013-3	2	3	12/12/2013	0.581	PCI/G	14.015	0.70
3B013-3	0	0.5	12/12/2013	3.26	PCI/G	78.638	3.93
3B013-4	0.5	2	12/12/2013	0.975	PCI/G	23.519	1.18
3B013-4	0	0.5	12/12/2013	1.69	PCI/G	40.767	2.04
3B014	0	0.5	11/15/2001	4.4	MG/KG	36.066	1.80
3B015	1	1.25	11/15/2001	24.4	MG/KG	200.000	10.00
3B015	5	5	9/17/2003	1.176	PCI/G	28.368	1.42
3B015	0	0.5	11/15/2001	16.9	MG/KG	138.525	6.93
3B015-1	0.5	2	12/13/2013	0.834	PCI/G	20.118	1.01
3B015-1	2	3	12/13/2013	0.782	PCI/G	18.864	0.94
3B015-1	0	0.5	12/13/2013	1.19	PCI/G	28.705	1.44
3B015-2	0.5	2	12/13/2013	1.13	PCI/G	27.258	1.36
3B015-2	2	3	12/13/2013	0.781	PCI/G	18.839	0.94
3B015-2	0	0.5	12/13/2013	1.15	PCI/G	27.741	1.39
3B015-3	0.5	2	12/13/2013	0.635	PCI/G	15.318	0.77
3B015-3	2	3	12/13/2013	0.718	PCI/G	17.320	0.87
3B015-3	0	0.5	12/13/2013	2.18	PCI/G	52.586	2.63
3B015-4	0.5	2	12/13/2013	0.831	PCI/G	20.046	1.00
3B015-4	2	3	12/13/2013	0.647	PCI/G	15.607	0.78
3B015-4	0	0.5	12/13/2013	0.971	PCI/G	23.423	1.17
3B016	0	0.5	11/15/2001	4.07	MG/KG	33.361	1.67
3B017	0	0.5	11/15/2001	2.65	MG/KG	21.721	1.09
3B018	0	0.5	11/15/2001	2.05	MG/KG	16.803	0.84

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
3B019	0	0.5	11/15/2001	2.05	MG/KG	16.803	0.84
3C001	0	0.5	8/26/2000	2.74	MG/KG	22.459	1.12
3C002	0	0.5	8/26/2000	4.19	MG/KG	34.344	1.72
3C003	0	0.5	8/26/2000	2.32	MG/KG	19.016	0.95
3C004	0	0.5	8/26/2000	3.34	MG/KG	27.377	1.37
3C005	0	0.5	8/26/2000	12.4	MG/KG	101.639	5.08
3C006	0	0.5	8/26/2000	5.71	MG/KG	46.803	2.34
3C006-1	0.5	2	12/10/2013	0.767	PCI/G	18.502	0.93
3C006-1	2	3	12/10/2013	0.835	PCI/G	20.142	1.01
3C006-1	0	0.5	12/10/2013	0.877	PCI/G	21.155	1.06
3C006-2	0.5	2	12/10/2013	0.651	PCI/G	15.704	0.79
3C006-2	2	3	12/10/2013	0.755	PCI/G	18.212	0.91
3C006-2	0	0.5	12/10/2013	1.87	PCI/G	45.109	2.26
3C006-3	0.5	2	12/10/2013	1.48	PCI/G	35.701	1.79
3C006-3	2	3	12/10/2013	1	PCI/G	24.122	1.21
3C006-3	0	0.5	12/10/2013	0.601	PCI/G	14.497	0.72
3C007	0	0.5	8/26/2000	9.41	MG/KG	77.131	3.86
3C007-1	0.5	2	12/10/2013	0.676	PCI/G	16.307	0.82
3C007-1	2	3	12/10/2013	1.2	PCI/G	28.947	1.45
3C007-1	0	0.5	12/10/2013	0.581	PCI/G	14.015	0.70
3C007-2	0.5	2	12/10/2013	0.901	PCI/G	21.734	1.09
3C007-2	2	3	12/10/2013	0.769	PCI/G	18.550	0.93
3C007-2	0	0.5	12/10/2013	0.833	PCI/G	20.094	1.00
3C008	0	0.5	8/26/2000	3.56	MG/KG	29.180	1.46
3C008-1	0.5	2	12/10/2013	0.784	PCI/G	18.912	0.95
3C008-1	2	3	12/10/2013	0.901	PCI/G	21.734	1.09
3C008-1	0	0.5	12/10/2013	0.629	PCI/G	15.173	0.76
3C008-2	0.5	2	12/10/2013	1.01	PCI/G	24.363	1.22
3C008-2	2	3	12/10/2013	0.819	PCI/G	19.756	0.99
3C008-2	0	0.5	12/10/2013	0.97	PCI/G	23.399	1.17
3C008-3	0.5	2	12/10/2013	5.57	PCI/G	134.361	6.72
3C008-3	2	3	12/10/2013	2.74	PCI/G	66.095	3.30
3C008-3	0	0.5	12/10/2013	7.78	PCI/G	187.671	9.38
3C009	0	0.5	8/26/2000	1.77	MG/KG	14.508	0.73
3C010	0	0.5	8/26/2000	20.9	MG/KG	171.311	8.57
3C011	0	0.5	8/26/2000	6.46	MG/KG	52.951	2.65
3C012	0	0.5	8/26/2000	3.81	MG/KG	31.230	1.56
3C013	0	0.5	8/26/2000	3.24	MG/KG	26.557	1.33
3C014	1.5	2	11/16/2001	7.19	MG/KG	58.934	2.95
3C014	5	5	9/17/2003	0.581	PCI/G	14.015	0.70
3C014	0	0.5	11/16/2001	15.4	MG/KG	126.230	6.31
3C014-1	0.5	2	12/11/2013	0.61	PCI/G	14.715	0.74
3C014-1	2	3	12/11/2013	0.848	PCI/G	20.456	1.02
3C014-1	0	0.5	12/11/2013	1.22	PCI/G	29.429	1.47
3C014-2	0.5	2	12/11/2013	0.784	PCI/G	18.912	0.95
3C014-2	2	3	12/11/2013	0.881	PCI/G	21.252	1.06
3C014-2	0	0.5	12/11/2013	1.91	PCI/G	46.073	2.30
3C014-3	0.5	2	12/11/2013	2.6	PCI/G	62.718	3.14
3C014-3	2	3	12/11/2013	1.19	PCI/G	28.705	1.44
3C014-3	0	0.5	12/11/2013	4.03	PCI/G	97.212	4.86
3C014-4	0.5	2	12/11/2013	0.993	PCI/G	23.953	1.20

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
3C014-4	2	3	12/11/2013	0.805	PCI/G	19.418	0.97
3C014-4	0	0.5	12/11/2013	1.41	PCI/G	34.012	1.70
3C014-5	0.5	2	6/23/2014	1.37	PCI/G	33.047	1.65
3C014-5	2	3	6/23/2014	0.958	PCI/G	23.109	1.16
3C014-5	0	0.5	6/23/2014	1.08	PCI/G	26.052	1.30
3C014-6	0.5	2	6/23/2014	3.67	PCI/G	88.528	4.43
3C014-6	2	3	6/23/2014	2.26	PCI/G	54.516	2.73
3C014-6	0	0.5	6/23/2014	4.04	PCI/G	97.454	4.87
3C015	1	1.5	11/16/2001	54.8	MG/KG	449.180	22.46
3C015	5	5	9/17/2003	1.558	PCI/G	37.582	1.88
3C015	0	0.5	11/16/2001	330	MG/KG	2704.918	135.25
3C016	0	0.5	11/17/2001	3.6	MG/KG	29.508	1.48
3D001	1	1	11/16/2001	3.24	MG/KG	26.557	1.33
3D001	5	5	10/1/2003	0.899	PCI/G	21.686	1.08
3D001	0	0.5	11/16/2001	6.02	MG/KG	49.344	2.47
3D001-1	0.5	2	12/17/2013	0.846	PCI/G	20.407	1.02
3D001-1	2	3	12/17/2013	0.698	PCI/G	16.837	0.84
3D001-1	0	0.5	12/17/2013	1.31	PCI/G	31.600	1.58
3D001-2	0.5	2	12/17/2013	0.703	PCI/G	16.958	0.85
3D001-2	2	3	12/17/2013	0.695	PCI/G	16.765	0.84
3D001-2	0	0.5	12/17/2013	1.06	PCI/G	25.570	1.28
3D001-3	0.5	2	12/17/2013	0.64	PCI/G	15.438	0.77
3D001-3	2	3	12/17/2013	0.79	PCI/G	19.057	0.95
3D001-3	0	0.5	12/17/2013	2.35	PCI/G	56.687	2.83
3D001-4	0.5	2	12/17/2013	0.962	PCI/G	23.206	1.16
3D001-4	2	3	12/17/2013	0.691	PCI/G	16.668	0.83
3D001-4	0	0.5	12/17/2013	0.828	PCI/G	19.973	1.00
3D002	5	5	9/22/2003	1.89	MG/KG	15.492	0.77
3D002	0	0.5	11/16/2001	3.61	MG/KG	29.590	1.48
3D003	1.5	2	11/17/2001	2.17	MG/KG	17.787	0.89
3D004	0	0.5	11/17/2001	4.31	MG/KG	35.328	1.77
3D004-1	0.5	2	12/17/2013	0.793	PCI/G	19.129	0.96
3D004-1	2	3	12/17/2013	1.22	PCI/G	29.429	1.47
3D004-1	0	0.5	12/17/2013	1.13	PCI/G	27.258	1.36
3D004-2	0.5	2	12/17/2013	3.22	PCI/G	77.673	3.88
3D004-2	2	3	12/17/2013	1.06	PCI/G	25.570	1.28
3D004-2	0	0.5	12/17/2013	4.77	PCI/G	115.063	5.75
3D004-3	0.5	2	12/17/2013	0.897	PCI/G	21.638	1.08
3D004-3	2	3	12/17/2013	1.02	PCI/G	24.605	1.23
3D004-3	0	0.5	12/17/2013	1.07	PCI/G	25.811	1.29
3D004-4	0.5	2	12/17/2013	0.738	PCI/G	17.802	0.89
3D004-4	0	0.5	12/17/2013	0.696	PCI/G	16.789	0.84
3D004-5	0.5	2	6/23/2014	1.25	PCI/G	30.153	1.51
3D004-5	2	3	6/23/2014	1.17	PCI/G	28.223	1.41
3D004-5	0	0.5	6/23/2014	1	PCI/G	24.122	1.21
3D005	0	0.5	11/16/2001	6.72	MG/KG	55.082	2.75
3D006	5	5	9/22/2003	0.672	MG/KG	5.508	0.28
3D006	0	0.5	11/17/2001	1270	MG/KG	10409.836	520.49
3D006-1	0.5	2	12/11/2013	0.999	PCI/G	24.098	1.20
3D006-1	2	3	12/11/2013	0.933	PCI/G	22.506	1.13
3D006-1	0	0.5	12/11/2013	1.43	PCI/G	34.495	1.72

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
3D006-2	0.5	2	12/11/2013	0.689	PCI/G	16.620	0.83
3D006-2	2	3	12/11/2013	0.735	PCI/G	17.730	0.89
3D006-2	0	0.5	12/11/2013	1.7	PCI/G	41.008	2.05
3D006-3	0.5	2	12/11/2013	0.924	PCI/G	22.289	1.11
3D006-3	2	3	12/11/2013	0.773	PCI/G	18.646	0.93
3D006-3	0	0.5	12/11/2013	2.24	PCI/G	54.034	2.70
3D006-4	0.5	2	12/11/2013	3.01	PCI/G	72.608	3.63
3D006-4	2	3	12/11/2013	0.558	PCI/G	13.460	0.67
3D006-4	0	0.5	12/11/2013	6.86	PCI/G	165.478	8.27
3D007	0	0.5	11/17/2001	5630	MG/KG	46147.541	2307.38
3D007-1	0.5	2	12/10/2013	0.918	PCI/G	22.144	1.11
3D007-1	2	3	12/10/2013	1.1	PCI/G	26.534	1.33
3D007-1	0	0.5	12/10/2013	1.1	PCI/G	26.534	1.33
3D007-2	0.5	2	12/10/2013	1.01	PCI/G	24.363	1.22
3D007-2	2	3	12/10/2013	0.727	PCI/G	17.537	0.88
3D007-2	0	0.5	12/10/2013	1.58	PCI/G	38.113	1.91
3D007-3	0.5	2	12/10/2013	0.858	PCI/G	20.697	1.03
3D007-3	2	3	12/10/2013	0.828	PCI/G	19.973	1.00
3D007-3	0	0.5	12/10/2013	1.42	PCI/G	34.254	1.71
3D008	0	0.5	11/16/2001	15	MG/KG	122.951	6.15
3D009	0	0.5	11/16/2001	20.2	MG/KG	165.574	8.28
404-1	0.5	2	11/25/2013	0.776	PCI/G	18.719	0.94
404-1	2	3	11/25/2013	1.53	PCI/G	36.907	1.85
404-1	0	0.5	11/25/2013	1	PCI/G	24.122	1.21
404-2	0.5	2	11/25/2013	1.24	PCI/G	29.912	1.50
404-2	2	3	11/25/2013	4.55	PCI/G	109.756	5.49
404-2	0	0.5	11/25/2013	1.14	PCI/G	27.499	1.37
404-3	0.5	2	11/25/2013	3.5	PCI/G	84.428	4.22
404-3	2	3	11/25/2013	1.19	PCI/G	28.705	1.44
404-3	0	0.5	11/25/2013	0.933	PCI/G	22.506	1.13
4A001	0	0.5	8/28/2000	3.34	MG/KG	27.377	1.37
4A002	0	0.5	8/28/2000	2.04	MG/KG	16.721	0.84
4A003	0	0.5	8/28/2000	2.48	MG/KG	20.328	1.02
4A003-1	0.5	2	11/26/2013	0.693	PCI/G	16.717	0.84
4A003-1	2	3	11/26/2013	0.933	PCI/G	22.506	1.13
4A003-1	0	0.5	11/26/2013	0.691	PCI/G	16.668	0.83
4A003-2	0.5	2	11/26/2013	0.634	PCI/G	15.293	0.76
4A003-2	2	3	11/26/2013	0.606	PCI/G	14.618	0.73
4A003-2	0	0.5	11/26/2013	0.709	PCI/G	17.103	0.86
4A003-3	0.5	2	6/26/2014	0.622	PCI/G	15.004	0.75
4A003-3	2	3	6/26/2014	0.702	PCI/G	16.934	0.85
4A003-3	0	0.5	6/26/2014	0.73	PCI/G	17.609	0.88
4A004	0	0.5	8/28/2000	2.57	MG/KG	21.066	1.05
4A005	0	0.5	8/28/2000	3.32	MG/KG	27.213	1.36
4A006	0	0.5	8/28/2000	3.49	MG/KG	28.607	1.43
4A007	0	0.5	8/28/2000	6.11	MG/KG	50.082	2.50
4A007-1	0.5	2	11/25/2013	0.632	PCI/G	15.245	0.76
4A007-1	2	3	11/25/2013	0.644	PCI/G	15.535	0.78
4A007-1	0	0.5	11/25/2013	0.74	PCI/G	17.850	0.89
4A007-2	0.5	2	11/25/2013	2.55	PCI/G	61.512	3.08
4A007-2	2	3	11/25/2013	3.42	PCI/G	82.498	4.12

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
4A007-2	0	0.5	11/25/2013	0.78	PCI/G	18.815	0.94
4A008	0	0.5	8/28/2000	2.16	MG/KG	17.705	0.89
4A009	0	0.5	8/28/2000	1.97	MG/KG	16.148	0.81
4A010	0	0.5	8/28/2000	2.58	MG/KG	21.148	1.06
4A011	0	0.5	8/28/2000	3.6	MG/KG	29.508	1.48
4A012	0	0.5	8/28/2000	8.69	MG/KG	71.230	3.56
4A013	1	1.5	10/5/2001	4.55	MG/KG	37.295	1.86
4A013	1.5	2	10/5/2001	5.05	MG/KG	41.393	2.07
4A013	0	0.5	10/5/2001	4.05	MG/KG	33.197	1.66
4A013-1	0.5	2	12/2/2013	3.57	PCI/G	86.116	4.31
4A013-1	2	3	12/2/2013	4.47	PCI/G	107.826	5.39
4A013-1	0	0.5	12/2/2013	3.27	PCI/G	78.880	3.94
4A013-2	2	3	12/2/2013	0.963	PCI/G	23.230	1.16
4A013-2	0	0.5	12/2/2013	0.721	PCI/G	17.392	0.87
4A013-3	0.5	2	12/2/2013	0.854	PCI/G	20.600	1.03
4A013-3	2	3	12/2/2013	0.769	PCI/G	18.550	0.93
4A013-3	0	0.5	12/2/2013	0.709	PCI/G	17.103	0.86
4A013-4	0.5	2	12/2/2013	0.756	PCI/G	18.236	0.91
4A013-4	2	3	12/2/2013	1.58	PCI/G	38.113	1.91
4A013-4	0	0.5	12/2/2013	0.727	PCI/G	17.537	0.88
4A013-5	0.5	2	6/27/2014	0.696	PCI/G	16.789	0.84
4A013-5	2	3	6/27/2014	1.07	PCI/G	25.811	1.29
4A013-5	0	0.5	6/27/2014	0.94	PCI/G	22.675	1.13
4A013-6	0.5	2	6/27/2014	1.03	PCI/G	24.846	1.24
4A013-6	2	3	6/27/2014	1.45	PCI/G	34.977	1.75
4A013-6	0	0.5	6/27/2014	1.36	PCI/G	32.806	1.64
4A014	0	0.5	10/5/2001	11.4	MG/KG	93.443	4.67
4A014-1	0	0.5	11/26/2013	0.952	PCI/G	22.964	1.15
4A015	0	0.5	10/5/2001	10.5	MG/KG	86.066	4.30
4A016	0	0.5	10/5/2001	1.77	MG/KG	14.508	0.73
4A017	0	0.5	10/6/2001	2.2	MG/KG	18.033	0.90
4A018	0	0.5	10/6/2001	1.84	MG/KG	15.082	0.75
4A019	0	0.5	11/17/2001	1.41	MG/KG	11.557	0.58
4A020	0	0.5	11/13/2001	1.54	MG/KG	12.623	0.63
4B001	0	0.5	8/28/2000	8.97	MG/KG	73.525	3.68
4B002	0	0.5	8/28/2000	5.07	MG/KG	41.557	2.08
4B003	0	0.5	8/28/2000	2.55	MG/KG	20.902	1.05
4B004	0	0.5	8/28/2000	2.65	MG/KG	21.721	1.09
4B005	0	0.5	8/28/2000	2.14	MG/KG	17.541	0.88
4B006	0	0.5	8/28/2000	2.04	MG/KG	16.721	0.84
4B007	0	0.5	10/4/2001	1.88	MG/KG	15.410	0.77
4B008	0	0.5	10/4/2001	2.22	MG/KG	18.197	0.91
4B009	1.5	2	10/4/2001	4.39	MG/KG	35.984	1.80
4B009	0	0.5	10/4/2001	34.3	MG/KG	281.148	14.06
4B009-1	0.5	2	11/27/2013	1.12	PCI/G	27.017	1.35
4B009-1	2	3	11/27/2013	1.07	PCI/G	25.811	1.29
4B009-1	0	0.5	11/27/2013	12.5	PCI/G	301.527	15.08
4B009-2	0.5	2	11/27/2013	1.06	PCI/G	25.570	1.28
4B009-2	2	3	11/27/2013	0.698	PCI/G	16.837	0.84
4B009-2	0	0.5	11/27/2013	0.795	PCI/G	19.177	0.96
4B009-3	0.5	2	11/27/2013	0.623	PCI/G	15.028	0.75

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
4B009-3	2	3	11/27/2013	0.722	PCI/G	17.416	0.87
4B009-3	0	0.5	11/27/2013	0.684	PCI/G	16.500	0.82
4B009-4	0.5	2	12/2/2013	0.525	PCI/G	12.664	0.63
4B009-4	2	3	12/2/2013	0.789	PCI/G	19.032	0.95
4B009-4	0	0.5	12/2/2013	0.692	PCI/G	16.693	0.83
4B010	0	0.5	10/4/2001	6.6	MG/KG	54.098	2.70
4B010-1	0.5	2	11/27/2013	2.32	PCI/G	55.963	2.80
4B010-1	2	3	11/27/2013	2.09	PCI/G	50.415	2.52
4B010-1	0	0.5	11/27/2013	5.63	PCI/G	135.808	6.79
4B010-2	0.5	2	11/27/2013	0.654	PCI/G	15.776	0.79
4B010-2	2	3	11/27/2013	0.606	PCI/G	14.618	0.73
4B010-2	0	0.5	11/27/2013	0.601	PCI/G	14.497	0.72
4B010-3	0.5	2	11/27/2013	0.838	PCI/G	20.214	1.01
4B010-3	2	3	11/27/2013	0.737	PCI/G	17.778	0.89
4B010-3	0	0.5	11/27/2013	0.872	PCI/G	21.035	1.05
4B010-4	0.5	2	6/30/2014	0.805	PCI/G	19.418	0.97
4B010-4	2	3	6/30/2014	0.636	PCI/G	15.342	0.77
4B010-4	0	0.5	6/30/2014	0.755	PCI/G	18.212	0.91
4B011	1.5	2	10/5/2001	2.1	MG/KG	17.213	0.86
4B012	0	0.5	10/4/2001	2.65	MG/KG	21.721	1.09
4B013	1.5	2	10/4/2001	2.02	MG/KG	16.557	0.83
4B013	0	0.5	10/4/2001	1.96	MG/KG	16.066	0.80
4B014	1	1.5	10/4/2001	2.11	MG/KG	17.295	0.86
4B014	0	0.5	10/4/2001	4.28	MG/KG	35.082	1.75
4B014-1	0.5	2	11/26/2013	0.81	PCI/G	19.539	0.98
4B014-1	2	3	11/26/2013	0.928	PCI/G	22.385	1.12
4B014-1	0	0.5	11/26/2013	0.868	PCI/G	20.938	1.05
4B014-2	0.5	2	11/26/2013	0.93	PCI/G	22.434	1.12
4B014-2	2	3	11/26/2013	0.908	PCI/G	21.903	1.10
4B014-2	0	0.5	11/26/2013	0.819	PCI/G	19.756	0.99
4B014-3	0.5	2	11/27/2013	3.27	PCI/G	78.880	3.94
4B014-3	2	3	11/27/2013	0.638	PCI/G	15.390	0.77
4B014-3	0	0.5	11/27/2013	0.814	PCI/G	19.635	0.98
4B014-4	0.5	2	11/26/2013	0.609	PCI/G	14.690	0.73
4B014-4	2	3	11/26/2013	0.613	PCI/G	14.787	0.74
4B014-4	0	0.5	11/26/2013	0.584	PCI/G	14.087	0.70
4B014-5	0.5	2	6/27/2014	0.827	PCI/G	19.949	1.00
4B014-5	2	3	6/27/2014	0.817	PCI/G	19.708	0.99
4B014-5	0	0.5	6/27/2014	0.819	PCI/G	19.756	0.99
4B014-6	0.5	2	6/27/2014	0.933	PCI/G	22.506	1.13
4B014-6	2	3	6/27/2014	1.19	PCI/G	28.705	1.44
4B014-6	0	0.5	6/27/2014	1.9	PCI/G	45.832	2.29
4B014-7	0.5	2	6/27/2014	0.811	PCI/G	19.563	0.98
4B014-7	2	3	6/27/2014	0.816	PCI/G	19.684	0.98
4B014-7	0	0.5	6/27/2014	1.57	PCI/G	37.872	1.89
4B014-8	0.5	2	6/30/2014	0.707	PCI/G	17.054	0.85
4B014-8	2	3	6/30/2014	0.852	PCI/G	20.552	1.03
4B014-8	0	0.5	6/30/2014	0.557	PCI/G	13.436	0.67
4B015	0	0.5	10/7/2001	3.88	MG/KG	31.803	1.59
4B016	0	0.5	10/4/2001	7.76	MG/KG	63.607	3.18
4B017	0	0.5	10/4/2001	2.47	MG/KG	20.246	1.01

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
4B017-1	0.5	2	11/26/2013	0.821	PCI/G	19.804	0.99
4B017-1	2	3	11/26/2013	0.894	PCI/G	21.565	1.08
4B017-1	0	0.5	11/26/2013	0.866	PCI/G	20.890	1.04
4B017-2	0.5	2	11/26/2013	1.13	PCI/G	27.258	1.36
4B017-2	2	3	11/26/2013	0.718	PCI/G	17.320	0.87
4B017-2	0	0.5	11/26/2013	1.35	PCI/G	32.565	1.63
4B018	1.5	2	10/4/2001	2.21	MG/KG	18.115	0.91
4B019	0	0.5	10/4/2001	3.27	MG/KG	26.803	1.34
4B020	0	0.5	10/4/2001	2.43	MG/KG	19.918	1.00
4B021	1.5	2	10/4/2001	2.75	MG/KG	22.541	1.13
4B021	0	0.5	10/4/2001	3.91	MG/KG	32.049	1.60
4B021-1	0.5	2	11/27/2013	0.835	PCI/G	20.142	1.01
4B021-1	2	3	11/27/2013	0.524	PCI/G	12.640	0.63
4B021-1	0	0.5	11/27/2013	0.677	PCI/G	16.331	0.82
4B021-2	0.5	2	11/27/2013	0.607	PCI/G	14.642	0.73
4B021-2	2	3	11/27/2013	0.618	PCI/G	14.908	0.75
4B021-2	0	0.5	11/27/2013	0.552	PCI/G	13.315	0.67
4B021-3	0.5	2	11/27/2013	0.695	PCI/G	16.765	0.84
4B021-3	2	3	11/27/2013	0.738	PCI/G	17.802	0.89
4B021-3	0	0.5	11/27/2013	0.703	PCI/G	16.958	0.85
4B021-4	0.5	2	11/27/2013	0.634	PCI/G	15.293	0.76
4B021-4	2	3	11/27/2013	0.553	PCI/G	13.340	0.67
4B021-4	0	0.5	11/27/2013	0.941	PCI/G	22.699	1.13
4C001	0	0.5	8/29/2000	2.07	MG/KG	16.967	0.85
4C002	0	0.5	10/5/2001	7.43	MG/KG	60.902	3.05
4C002-1	0.5	2	12/9/2013	1.62	PCI/G	39.078	1.95
4C002-1	2	3	12/9/2013	0.598	PCI/G	14.425	0.72
4C002-1	0	0.5	12/9/2013	3.08	PCI/G	74.296	3.71
4C002-2	0.5	2	12/9/2013	0.687	PCI/G	16.572	0.83
4C002-2	2	3	12/9/2013	0.666	PCI/G	16.065	0.80
4C002-2	0	0.5	12/9/2013	1.2	PCI/G	28.947	1.45
4C002-3	0.5	2	12/9/2013	1.23	PCI/G	29.670	1.48
4C002-3	2	3	12/9/2013	0.605	PCI/G	14.594	0.73
4C002-3	0	0.5	12/9/2013	3.67	PCI/G	88.528	4.43
4C002-4	0.5	2	12/9/2013	0.567	PCI/G	13.677	0.68
4C002-4	2	3	12/9/2013	0.701	PCI/G	16.910	0.85
4C002-4	0	0.5	12/9/2013	0.881	PCI/G	21.252	1.06
4C003	0	0.5	10/5/2001	5.19	MG/KG	42.541	2.13
4C004	0	0.5	10/5/2001	4.15	MG/KG	34.016	1.70
4C005	0	0.5	10/5/2001	2.02	MG/KG	16.557	0.83
4C006	0	0.5	10/5/2001	2.42	MG/KG	19.836	0.99
4D001	14	14.5	9/12/2000	2.08	MG/KG	17.049	0.85
4D002	11.5	12	9/14/2000	1.96	MG/KG	16.066	0.80
4D003	14	14.5	9/13/2000	2.24	MG/KG	18.361	0.92
4D004	14	14.5	9/14/2000	2.54	MG/KG	20.820	1.04
4D005	15	15.5	9/13/2000	2.31	MG/KG	18.934	0.95
4D005	0	0.5	9/13/2000	2.12	MG/KG	17.377	0.87
4D006	14.5	15	9/14/2000	2.09	MG/KG	17.131	0.86
4D006	0	0.5	9/14/2000	2.17	MG/KG	17.787	0.89
4D007	0	0.5	8/28/2000	1.79	MG/KG	14.672	0.73
4D008	0	0.5	8/28/2000	2.4	MG/KG	19.672	0.98

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
4D009	0	0.5	8/28/2000	2.24	MG/KG	18.361	0.92
4D010	0	0.5	8/28/2000	2.56	MG/KG	20.984	1.05
4D011	0	0.5	8/28/2000	3.68	MG/KG	30.164	1.51
4D012	0	0.5	8/28/2000	2.92	MG/KG	23.934	1.20
4D013	0	0.5	8/28/2000	2.93	MG/KG	24.016	1.20
4D014	0	0.5	8/28/2000	2.9	MG/KG	23.770	1.19
4D015	0	0.5	8/28/2000	2	MG/KG	16.393	0.82
4D017	0	0.5	10/5/2001	3.97	MG/KG	32.541	1.63
4D018	0	0.5	10/5/2001	1.5	MG/KG	12.295	0.61
4D019	0	0.5	10/5/2001	2.4	MG/KG	19.672	0.98
4D020	0	0.5	10/5/2001	1.67	MG/KG	13.689	0.68
4F001	0	0.5	8/27/2000	2.03	MG/KG	16.639	0.83
4F002	0	0.5	8/27/2000	2.21	MG/KG	18.115	0.91
4F003	0	0.5	8/27/2000	2.14	MG/KG	17.541	0.88
4F004	0	0.5	8/27/2000	2.01	MG/KG	16.475	0.82
4F005	0	0.5	10/6/2001	2.38	MG/KG	19.508	0.98
4F006	0	0.5	10/6/2001	2.16	MG/KG	17.705	0.89
4F007	0	0.5	10/6/2001	1.99	MG/KG	16.311	0.82
4F008	0	0.5	10/6/2001	2.05	MG/KG	16.803	0.84
4F009	0	0.5	10/6/2001	1.87	MG/KG	15.328	0.77
4F010	0	0.5	11/14/2001	1.99	MG/KG	16.311	0.82
4F011	0	0.5	11/14/2001	2.22	MG/KG	18.197	0.91
4G001	0	0.5	10/6/2001	2.1	MG/KG	17.213	0.86
4G002	1	1.5	10/7/2001	1.91	MG/KG	15.656	0.78
4G002	1.5	2	10/7/2001	1.76	MG/KG	14.426	0.72
4G002	0	0.5	10/7/2001	4.09	MG/KG	33.525	1.68
4G002-1	0.5	2	11/8/2013	0.879	PCI/G	21.203	1.06
4G002-1	2	3	11/8/2013	0.587	PCI/G	14.160	0.71
4G002-1	0	0.5	11/8/2013	0.788	PCI/G	19.008	0.95
4G002-2	0.5	2	11/8/2013	0.855	PCI/G	20.624	1.03
4G002-2	2	3	11/8/2013	0.592	PCI/G	14.280	0.71
4G002-2	0	0.5	11/8/2013	0.774	PCI/G	18.671	0.93
4G002-3	0.5	2	11/8/2013	1.01	PCI/G	24.363	1.22
4G002-3	2	3	11/8/2013	0.704	PCI/G	16.982	0.85
4G002-3	0	0.5	11/8/2013	0.765	PCI/G	18.453	0.92
4G002-4	0.5	2	11/8/2013	0.734	PCI/G	17.706	0.89
4G002-4	1	2	11/8/2013	0.691	PCI/G	16.668	0.83
4G002-4	0	0.5	11/8/2013	0.914	PCI/G	22.048	1.10
503-1	0.5	2	11/20/2013	38.3	PCI/G	923.880	46.19
503-1	2	3	11/20/2013	11	PCI/G	265.344	13.27
503-1	0	0.5	11/20/2013	33.5	PCI/G	808.093	40.40
503-2	0.5	2	11/20/2013	7.18	PCI/G	173.197	8.66
503-2	2	3	11/20/2013	3.78	PCI/G	91.182	4.56
503-2	0	0.5	11/20/2013	6.04	PCI/G	145.698	7.28
503-3	0.5	2	11/20/2013	5.57	PCI/G	134.361	6.72
503-3	2	3	11/20/2013	1.68	PCI/G	40.525	2.03
503-3	0	0.5	11/20/2013	21	PCI/G	506.566	25.33
503-4	0.5	2	11/20/2013	4.86	PCI/G	117.234	5.86
503-4	2	3	11/20/2013	2.73	PCI/G	65.854	3.29
503-4	0	0.5	11/20/2013	4.05	PCI/G	97.695	4.88
504-1	0.5	2	11/19/2013	1.98	PCI/G	47.762	2.39

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
504-1	2	3	11/19/2013	0.978	PCI/G	23.592	1.18
504-1	0	0.5	11/19/2013	1.47	PCI/G	35.460	1.77
504-2	0.5	2	11/19/2013	1.21	PCI/G	29.188	1.46
504-2	2	3	11/19/2013	0.829	PCI/G	19.997	1.00
504-2	0	0.5	11/19/2013	1.52	PCI/G	36.666	1.83
504-3	0.5	2	11/19/2013	1.19	PCI/G	28.705	1.44
504-3	2	3	11/19/2013	0.829	PCI/G	19.997	1.00
504-3	0	0.5	11/19/2013	1.56	PCI/G	37.631	1.88
504-4	0.5	2	11/19/2013	1.37	PCI/G	33.047	1.65
504-4	2	3	11/19/2013	1.11	PCI/G	26.776	1.34
504-4	0	0.5	11/19/2013	1.67	PCI/G	40.284	2.01
5A001	0	0.5	8/29/2000	8.97	MG/KG	73.525	3.68
5A002	0	0.5	8/29/2000	8.01	MG/KG	65.656	3.28
5A003	0	0.5	8/29/2000	3.07	MG/KG	25.164	1.26
5A004	0	0.5	8/29/2000	3.14	MG/KG	25.738	1.29
5A005	0	0.5	8/29/2000	3.17	MG/KG	25.984	1.30
5A006	0	0.5	8/29/2000	7.6	MG/KG	62.295	3.11
5A007	0	0.5	8/29/2000	2.96	MG/KG	24.262	1.21
5A008	0	0.5	8/29/2000	3.67	MG/KG	30.082	1.50
5A009	0	0.5	9/9/2001	3.5	MG/KG	28.689	1.43
5A010	1.5	2	9/10/2001	2.55	MG/KG	20.902	1.05
5A010	5	5	9/18/2003	1.458	PCI/G	35.170	1.76
5A010	0	0.5	9/10/2001	7.63	MG/KG	62.541	3.13
5A010-1	0.5	2	11/20/2013	1.24	PCI/G	29.912	1.50
5A010-1	2	3	11/20/2013	0.77	PCI/G	18.574	0.93
5A010-1	0	0.5	11/20/2013	3.3	PCI/G	79.603	3.98
5A010-2	1	2	11/20/2013	1.51	PCI/G	36.425	1.82
5A010-2	0.5	2	11/20/2013	1.93	PCI/G	46.556	2.33
5A010-2	2	3	11/20/2013	1.16	PCI/G	27.982	1.40
5A010-2	0	0.5	11/20/2013	3.59	PCI/G	86.599	4.33
5A010-3	0.5	2	11/20/2013	0.743	PCI/G	17.923	0.90
5A010-3	2	3	11/20/2013	0.702	PCI/G	16.934	0.85
5A010-3	0	0.5	11/20/2013	1.14	PCI/G	27.499	1.37
5A010-4	0.5	2	6/24/2014	1.12	PCI/G	27.017	1.35
5A010-4	2	3	6/24/2014	1.07	PCI/G	25.811	1.29
5A010-4	0	0.5	6/24/2014	1.97	PCI/G	47.521	2.38
5A010-5	0.5	2	6/24/2014	0.955	PCI/G	23.037	1.15
5A010-5	2	3	6/24/2014	0.861	PCI/G	20.769	1.04
5A010-5	0	0.5	6/24/2014	1.23	PCI/G	29.670	1.48
5A011	0	0.5	9/9/2001	3.25	MG/KG	26.639	1.33
5A012	0	0.5	9/10/2001	6	MG/KG	49.180	2.46
5A013	1.5	2	9/10/2001	2.98	MG/KG	24.426	1.22
5A013	5	5	9/18/2003	1.07	MG/KG	8.770	0.44
5A013	0	0.5	9/10/2001	6.73	MG/KG	55.164	2.76
5A014	0	0.5	9/9/2001	6.81	MG/KG	55.820	2.79
5A015	0	0.5	9/9/2001	2.73	MG/KG	22.377	1.12
5A016	1	1.5	9/9/2001	13.6	MG/KG	111.475	5.57
5A016	1.53	1.7	9/9/2001	10	MG/KG	81.967	4.10
5A016	5	5	9/22/2003	2.31	MG/KG	18.934	0.95
5A016	0	0.5	9/9/2001	4.43	MG/KG	36.311	1.82
5A016-1	1	2	11/19/2013	0.955	PCI/G	23.037	1.15

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
5A016-1	0.5	2	11/19/2013	0.969	PCI/G	23.374	1.17
5A016-1	2	3	11/19/2013	0.872	PCI/G	21.035	1.05
5A016-1	0	0.5	11/19/2013	0.695	PCI/G	16.765	0.84
5A016-2	0.5	2	11/19/2013	1.06	PCI/G	25.570	1.28
5A016-2	2	3	11/19/2013	0.686	PCI/G	16.548	0.83
5A016-2	0	0.5	11/19/2013	1.48	PCI/G	35.701	1.79
5A016-3	0.5	2	11/19/2013	1.06	PCI/G	25.570	1.28
5A016-3	2	3	11/19/2013	0.938	PCI/G	22.627	1.13
5A016-3	0	0.5	11/19/2013	1.14	PCI/G	27.499	1.37
5A016-4	0.5	2	11/19/2013	1.95	PCI/G	47.038	2.35
5A016-4	2	3	11/19/2013	0.528	PCI/G	12.737	0.64
5A016-4	0	0.5	11/19/2013	0.938	PCI/G	22.627	1.13
5A016-5	0.5	2	6/23/2014	0.599	PCI/G	14.449	0.72
5A016-5	2	3	6/23/2014	0.906	PCI/G	21.855	1.09
5A016-5	0	0.5	6/23/2014	0.961	PCI/G	23.181	1.16
5A016-6	0.5	2	6/24/2014	0.823	PCI/G	19.853	0.99
5A016-6	2	3	6/24/2014	0.905	PCI/G	21.831	1.09
5A016-6	0	0.5	6/24/2014	1.06	PCI/G	25.570	1.28
5A016-7	0.5	2	6/23/2014	2.2	PCI/G	53.069	2.65
5A016-7	2	3	6/23/2014	0.963	PCI/G	23.230	1.16
5A016-7	0	0.5	6/23/2014	2.22	PCI/G	53.551	2.68
5A016-8	0.5	2	6/23/2014	0.669	PCI/G	16.138	0.81
5A016-8	2	3	6/23/2014	0.829	PCI/G	19.997	1.00
5A016-8	0	0.5	6/23/2014	1.02	PCI/G	24.605	1.23
5A016-9	0.5	2	6/24/2014	0.691	PCI/G	16.668	0.83
5A016-9	2	3	6/24/2014	0.689	PCI/G	16.620	0.83
5A016-9	0	0.5	6/24/2014	2.07	PCI/G	49.933	2.50
5A017	0	0.5	9/9/2001	2.68	MG/KG	21.967	1.10
5A018	1.5	2	9/9/2001	2.54	MG/KG	20.820	1.04
5A018	5	5	9/18/2003	1.35	MG/KG	11.066	0.55
5A019	1.5	1.75	9/9/2001	4.12	MG/KG	33.770	1.69
5A020	1.5	2	9/9/2001	2.43	MG/KG	19.918	1.00
5A020	5	5	9/22/2003	0.914	MG/KG	7.492	0.37
5A021	0	0.5	9/9/2001	10	MG/KG	81.967	4.10
5A021-1	0.5	2	11/20/2013	1.06	PCI/G	25.570	1.28
5A021-1	2	3	11/20/2013	0.807	PCI/G	19.467	0.97
5A021-1	0	0.5	11/20/2013	4.28	PCI/G	103.243	5.16
5A021-2	0.5	2	11/20/2013	1.11	PCI/G	26.776	1.34
5A021-2	2	3	11/20/2013	0.708	PCI/G	17.079	0.85
5A021-2	0	0.5	11/20/2013	1.06	PCI/G	25.570	1.28
5A021-3	1	2	11/20/2013	1.05	PCI/G	25.328	1.27
5A021-3	0.5	2	11/20/2013	1.05	PCI/G	25.328	1.27
5A021-3	2	3	11/20/2013	0.881	PCI/G	21.252	1.06
5A021-3	0	0.5	11/20/2013	1.72	PCI/G	41.490	2.07
5A021-4	0.5	2	11/20/2013	0.803	PCI/G	19.370	0.97
5A021-4	2	3	11/20/2013	0.749	PCI/G	18.068	0.90
5A021-4	0	0.5	11/20/2013	1.48	PCI/G	35.701	1.79
5A021-5	0.5	2	6/24/2014	0.815	PCI/G	19.660	0.98
5A021-5	2	3	6/24/2014	0.676	PCI/G	16.307	0.82
5A021-5	0	0.5	6/24/2014	0.93	PCI/G	22.434	1.12
606-1	0.5	2	11/7/2013	0.774	PCI/G	18.671	0.93

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
606-1	2	3	11/7/2013	0.669	PCI/G	16.138	0.81
606-1	0	0.5	11/7/2013	0.877	PCI/G	21.155	1.06
606-2	0.5	2	11/7/2013	0.674	PCI/G	16.258	0.81
606-2	2	3	11/7/2013	0.933	PCI/G	22.506	1.13
606-2	0	0.5	11/7/2013	0.677	PCI/G	16.331	0.82
606-3	0.5	2	11/5/2013	0.554	PCI/G	13.364	0.67
606-3	2	3	11/5/2013	0.708	PCI/G	17.079	0.85
606-3	0	0.5	11/5/2013	0.632	PCI/G	15.245	0.76
606-4	0.5	2	11/7/2013	0.687	PCI/G	16.572	0.83
606-4	2	3	11/7/2013	0.57	PCI/G	13.750	0.69
606-4	0	0.5	11/7/2013	0.756	PCI/G	18.236	0.91
6A001	1.5	2	10/7/2001	2.04	MG/KG	16.721	0.84
6A001	1	1.5	10/7/2001	4.46	MG/KG	36.557	1.83
6A001	0	0.5	10/7/2001	3.58	MG/KG	29.344	1.47
6A001-1	0.5	2	11/7/2013	0.7915	PCI/G	19.093	0.95
6A001-1	2	3	11/7/2013	0.722	PCI/G	17.416	0.87
6A001-1	0	0.5	11/7/2013	1.21	PCI/G	29.188	1.46
6A001-2	0.5	2	11/7/2013	0.64	PCI/G	15.438	0.77
6A001-2	0	0.5	11/7/2013	0.537	PCI/G	12.954	0.65
6A001-3	0.5	2	11/7/2013	0.654	PCI/G	15.776	0.79
6A001-3	2	3	11/7/2013	0.681	PCI/G	16.427	0.82
6A001-3	0	0.5	11/7/2013	0.54	PCI/G	13.026	0.65
6A001-4	0	0.5	11/7/2013	0.661	PCI/G	15.945	0.80
6A001-5	0.5	2	6/30/2014	0.716	PCI/G	17.271	0.86
6A001-5	2	3	6/30/2014	0.806	PCI/G	19.442	0.97
6A001-5	0	0.5	6/30/2014	0.735	PCI/G	17.730	0.89
6A001-6	0.5	2	6/30/2014	0.686	PCI/G	16.548	0.83
6A001-6	2	3	6/30/2014	0.569	PCI/G	13.726	0.69
6A001-6	0	0.5	6/30/2014	0.843	PCI/G	20.335	1.02
6A002	0	0.5	10/7/2001	1.72	MG/KG	14.098	0.70
6A003	0	0.5	10/7/2001	2.27	MG/KG	18.607	0.93
6A004	0	0.5	10/7/2001	1.35	MG/KG	11.066	0.55
6A005	0	0.5	10/7/2001	2.57	MG/KG	21.066	1.05
6A006	1.5	2	10/7/2001	2.71	MG/KG	22.213	1.11
6A006	0	0.5	10/7/2001	1.93	MG/KG	15.820	0.79
6A007	0	0.5	10/7/2001	1.65	MG/KG	13.525	0.68
6A008	0	0.5	10/7/2001	1.53	MG/KG	12.541	0.63
6A009	0	0.5	10/7/2001	2.2	MG/KG	18.033	0.90
6A010	0	0.5	10/7/2001	3.06	MG/KG	25.082	1.25
6B001	0	0.5	10/7/2001	2.99	MG/KG	24.508	1.23
6B002	0	0.5	10/7/2001	1.5	MG/KG	12.295	0.61
6B003	0	0.5	10/7/2001	2.2	MG/KG	18.033	0.90
6B004	0	0.5	10/7/2001	2.63	MG/KG	21.557	1.08
6B005	1	1.5	10/6/2001	79.2	MG/KG	649.180	32.46
6B005	1.5	2	10/6/2001	27.7	MG/KG	227.049	11.35
6B005	0	0.5	10/6/2001	6.55	MG/KG	53.689	2.68
6B005-1	0.5	2	11/7/2013	33.5	PCI/G	808.093	40.40
6B005-1	2	3	11/7/2013	2.94	PCI/G	70.919	3.55
6B005-1	0	0.5	11/7/2013	1.85	PCI/G	44.626	2.23
6B005-2	0.5	2	11/7/2013	0.975	PCI/G	23.519	1.18
6B005-2	2	3	11/7/2013	1.06	PCI/G	25.570	1.28

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
6B005-2	0	0.5	11/7/2013	0.946	PCI/G	22.820	1.14
6B005-3	0.5	2	11/7/2013	1.81	PCI/G	43.661	2.18
6B005-3	2	3	11/7/2013	1.29	PCI/G	31.118	1.56
6B005-3	0	0.5	11/7/2013	1.36	PCI/G	32.806	1.64
6B005-4	0.5	2	11/7/2013	1.11	PCI/G	26.776	1.34
6B005-4	2	3	11/7/2013	0.868	PCI/G	20.938	1.05
6B005-4	0	0.5	11/7/2013	1.03	PCI/G	24.846	1.24
6B005-5	0.5	2	7/1/2014	1.82	PCI/G	43.902	2.20
6B005-5	2	3	7/1/2014	1.27	PCI/G	30.635	1.53
6B005-5	0	0.5	7/1/2014	0.882	PCI/G	21.276	1.06
6B005-6	0.5	2	7/1/2014	0.897	PCI/G	21.638	1.08
6B005-6	2	3	7/1/2014	0.681	PCI/G	16.427	0.82
6B005-6	0	0.5	7/1/2014	0.655	PCI/G	15.800	0.79
6B005-7	0.5	2	7/1/2014	0.729	PCI/G	17.585	0.88
6B005-7	2	3	7/1/2014	1.21	PCI/G	29.188	1.46
6B005-7	0	0.5	7/1/2014	0.887	PCI/G	21.396	1.07
6B006	0	0.5	10/6/2001	2.11	MG/KG	17.295	0.86
6C001	0	0.5	10/6/2001	1.48	MG/KG	12.131	0.61
6C002	0	0.5	10/6/2001	2.02	MG/KG	16.557	0.83
6C003	0	0.5	10/6/2001	3.44	MG/KG	28.197	1.41
6C004	0	0.5	10/6/2001	2.32	MG/KG	19.016	0.95
6C005	0	0.5	10/6/2001	2.97	MG/KG	24.344	1.22
6C006	0	0.5	10/6/2001	3.69	MG/KG	30.246	1.51
816-1	0.5	2	12/16/2013	0.977	PCI/G	23.567	1.18
816-1	2	3	12/16/2013	0.58	PCI/G	13.991	0.70
816-1	0	0.5	12/16/2013	1.79	PCI/G	43.179	2.16
816-2	0.5	2	12/16/2013	0.781	PCI/G	18.839	0.94
816-2	0	0.5	12/16/2013	0.836	PCI/G	20.166	1.01
816-3	0.5	2	12/16/2013	0.707	PCI/G	17.054	0.85
816-3	2	3	12/16/2013	0.926	PCI/G	22.337	1.12
816-3	0	0.5	12/16/2013	0.654	PCI/G	15.776	0.79
816-4	0.5	2	12/16/2013	0.584	PCI/G	14.087	0.70
816-4	2	3	12/16/2013	0.975	PCI/G	23.519	1.18
816-4	0	0.5	12/16/2013	0.744	PCI/G	17.947	0.90
826-1	0.5	2	12/6/2013	1.34	PCI/G	32.324	1.62
826-1	2	3	12/6/2013	1.04	PCI/G	25.087	1.25
826-1	0	0.5	12/6/2013	0.515	PCI/G	12.423	0.62
826-2	0.5	2	12/6/2013	0.786	PCI/G	18.960	0.95
826-2	2	3	12/6/2013	0.809	PCI/G	19.515	0.98
826-2	0	0.5	12/6/2013	0.797	PCI/G	19.225	0.96
826-3	0.5	2	12/6/2013	1.13	PCI/G	27.258	1.36
826-3	2	3	12/6/2013	0.753	PCI/G	18.164	0.91
826-3	0	0.5	12/6/2013	1.28	PCI/G	30.876	1.54
826-4	0.5	2	12/6/2013	1.58	PCI/G	38.113	1.91
826-4	2	3	12/6/2013	1.1	PCI/G	26.534	1.33
826-4	0	0.5	12/6/2013	1.27	PCI/G	30.635	1.53
827-1	0.5	2	12/5/2013	5.84	PCI/G	140.874	7.04
827-1	0	0.5	12/5/2013	1.27	PCI/G	30.635	1.53
827-2	0.5	2	12/4/2013	1.5	PCI/G	36.183	1.81
827-2	2	3	12/4/2013	1.07	PCI/G	25.811	1.29
827-2	0	0.5	12/4/2013	0.981	PCI/G	23.664	1.18

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
827-3	0.5	2	12/5/2013	1.41	PCI/G	34.012	1.70
827-3	2	3	12/5/2013	1.26	PCI/G	30.394	1.52
827-3	0	0.5	12/5/2013	1.63	PCI/G	39.319	1.97
827-4	0.5	2	12/5/2013	1.26	PCI/G	30.394	1.52
827-4	2	3	12/5/2013	1.72	PCI/G	41.490	2.07
827-4	0	0.5	12/5/2013	1.22	PCI/G	29.429	1.47
827-5	0.5	2	12/5/2013	3.12	PCI/G	75.261	3.76
827-5	2	3	12/5/2013	1.46	PCI/G	35.218	1.76
827-5	0	0.5	12/5/2013	1.08	PCI/G	26.052	1.30
828-1	0.5	2	11/7/2013	0.649	PCI/G	15.655	0.78
828-1	2	3	11/7/2013	0.714	PCI/G	17.223	0.86
828-1	0	0.5	11/7/2013	0.545	PCI/G	13.147	0.66
828-2	0.5	2	11/5/2013	0.527	PCI/G	12.712	0.64
828-2	2	3	11/5/2013	0.601	PCI/G	14.497	0.72
828-2	0	0.5	11/5/2013	0.611	PCI/G	14.739	0.74
828-3	0.5	2	11/5/2013	0.6475	PCI/G	15.619	0.78
828-3	0	0.5	11/5/2013	0.633	PCI/G	15.269	0.76
828-4	2	3	11/5/2013	0.764	PCI/G	18.429	0.92
828-4	0	0.5	11/5/2013	0.622	PCI/G	15.004	0.75
828-5	0.5	2	7/2/2014	0.609	PCI/G	14.690	0.73
828-5	2	3	7/2/2014	0.755	PCI/G	18.212	0.91
828-5	0	0.5	7/2/2014	0.698	PCI/G	16.837	0.84
829-1	0.5	2	11/7/2013	0.992	PCI/G	23.929	1.20
829-1	2	3	11/7/2013	0.715	PCI/G	17.247	0.86
829-1	0	0.5	11/7/2013	1.28	PCI/G	30.876	1.54
829-2	0.5	2	11/7/2013	0.924	PCI/G	22.289	1.11
829-2	2	3	11/7/2013	0.818	PCI/G	19.732	0.99
829-2	0	0.5	11/7/2013	0.755	PCI/G	18.212	0.91
829-3	0.5	2	11/5/2013	0.719	PCI/G	17.344	0.87
829-3	2	3	11/5/2013	0.563	PCI/G	13.581	0.68
829-3	0	0.5	11/5/2013	0.854	PCI/G	20.600	1.03
829-4	0.5	2	11/7/2013	0.558	PCI/G	13.460	0.67
829-4	2	3	11/7/2013	2.92	PCI/G	70.437	3.52
829-4	0	0.5	11/7/2013	0.542	PCI/G	13.074	0.65
830-1	0.5	2	12/5/2013	1.11	PCI/G	26.776	1.34
830-1	2	3	12/5/2013	1.67	PCI/G	40.284	2.01
830-1	0	0.5	12/5/2013	0.712	PCI/G	17.175	0.86
830-2	0.5	2	12/5/2013	1	PCI/G	24.122	1.21
830-2	2	3	12/5/2013	0.847	PCI/G	20.431	1.02
830-2	0	0.5	12/5/2013	0.625	PCI/G	15.076	0.75
8A001	1.5	2	9/8/2001	3.54	MG/KG	29.016	1.45
8A002	0	0.5	9/8/2001	3.12	MG/KG	25.574	1.28
8A003	1.5	2	9/8/2001	3.06	MG/KG	25.082	1.25
8A003	0	0.5	9/8/2001	5.86	MG/KG	48.033	2.40
8A004	0	0.5	9/8/2001	3.65	MG/KG	29.918	1.50
8A004-1	0.5	2	11/13/2013	0.942	PCI/G	22.723	1.14
8A004-1	2	3	11/13/2013	0.935	PCI/G	22.554	1.13
8A004-1	0	0.5	11/13/2013	1	PCI/G	24.122	1.21
8A004-2	0.5	2	11/13/2013	0.989	PCI/G	23.857	1.19
8A004-2	2	3	11/13/2013	1.03	PCI/G	24.846	1.24
8A004-2	0	0.5	11/13/2013	0.922	PCI/G	22.241	1.11

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
8A004-3	0.5	2	11/13/2013	1.58	PCI/G	38.113	1.91
8A004-3	2	3	11/13/2013	2.14	PCI/G	51.621	2.58
8A004-3	0	0.5	11/13/2013	1.17	PCI/G	28.223	1.41
8A004-4	0.5	2	11/13/2013	1.09	PCI/G	26.293	1.31
8A004-4	2	3	11/13/2013	0.96	PCI/G	23.157	1.16
8A004-4	0	0.5	11/13/2013	1.19	PCI/G	28.705	1.44
8A004-5	0.5	2	6/18/2014	1.16	PCI/G	27.982	1.40
8A004-5	2	3	6/18/2014	1.19	PCI/G	28.705	1.44
8A004-5	0	0.5	6/18/2014	0.884	PCI/G	21.324	1.07
8A004-6	0.5	2	6/18/2014	1.32	PCI/G	31.841	1.59
8A004-6	2	3	6/18/2014	1.26	PCI/G	30.394	1.52
8A004-6	0	0.5	6/18/2014	0.903	PCI/G	21.782	1.09
8A004-7	0.5	2	6/18/2014	0.883	PCI/G	21.300	1.06
8A004-7	2	3	6/18/2014	1.26	PCI/G	30.394	1.52
8A004-7	0	0.5	6/18/2014	0.74	PCI/G	17.850	0.89
8A005	0	0.5	9/8/2001	2.63	MG/KG	21.557	1.08
8A006	0	0.5	9/8/2001	3.61	MG/KG	29.590	1.48
8A007	0	0.5	9/7/2001	2.34	MG/KG	19.180	0.96
8A008	0	0.5	9/7/2001	2.63	MG/KG	21.557	1.08
8A009	2	2	9/7/2001	3.77	MG/KG	30.902	1.55
8A009	0	0.5	9/7/2001	4.98	MG/KG	40.820	2.04
8A009-1	0.5	2	12/6/2013	2.03	PCI/G	48.968	2.45
8A009-1	2	3	12/6/2013	1.22	PCI/G	29.429	1.47
8A009-1	0	0.5	12/6/2013	1.96	PCI/G	47.279	2.36
8A009-2	0.5	2	12/6/2013	1.15	PCI/G	27.741	1.39
8A009-2	0	0.5	12/6/2013	1.28	PCI/G	30.876	1.54
8A009-3	0.5	2	12/6/2013	2.18	PCI/G	52.586	2.63
8A009-3	2	3	12/6/2013	0.813	PCI/G	19.611	0.98
8A009-3	0	0.5	12/6/2013	2.44	PCI/G	58.858	2.94
8A009-4	0.5	2	12/6/2013	2.72	PCI/G	65.612	3.28
8A009-4	2	3	12/6/2013	1.15	PCI/G	27.741	1.39
8A010	0	0.5	9/8/2001	3.47	MG/KG	28.443	1.42
8A011	2	2	9/10/2001	2.84	MG/KG	23.279	1.16
8B001	0	0.5	11/19/2001	3.07	MG/KG	25.164	1.26
8B001-1	0.5	2	12/16/2013	1.25	PCI/G	30.153	1.51
8B001-1	2	3	12/16/2013	1.18	PCI/G	28.464	1.42
8B001-1	0	0.5	12/16/2013	0.8	PCI/G	19.298	0.96
8B001-2	0.5	2	12/16/2013	2.57	PCI/G	61.994	3.10
8B001-2	2	3	12/16/2013	0.79	PCI/G	19.057	0.95
8B001-2	0	0.5	12/16/2013	2.11	PCI/G	50.898	2.54
8B001-3	0.5	2	12/16/2013	0.973	PCI/G	23.471	1.17
8B001-3	2	3	12/16/2013	2.5	PCI/G	60.305	3.02
8B001-3	0	0.5	12/16/2013	1.49	PCI/G	35.942	1.80
8B001-4	0.5	2	12/16/2013	1.1	PCI/G	26.534	1.33
8B001-4	2	3	12/16/2013	0.957	PCI/G	23.085	1.15
8B001-4	0	0.5	12/16/2013	0.974	PCI/G	23.495	1.17
8B001-5	0.5	2	6/19/2014	0.994	PCI/G	23.977	1.20
8B001-5	2	3	6/19/2014	0.827	PCI/G	19.949	1.00
8B001-5	3	4	6/19/2014	0.671	PCI/G	16.186	0.81
8B001-5	4	5	6/19/2014	0.724	PCI/G	17.464	0.87
8B001-5	0	0.5	6/19/2014	1.42	PCI/G	34.254	1.71

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
8B001-6	0.5	2	6/19/2014	0.945	PCI/G	22.795	1.14
8B001-6	2	3	6/19/2014	1.01	PCI/G	24.363	1.22
8B001-6	3	4	6/19/2014	0.923	PCI/G	22.265	1.11
8B001-6	4	5	6/19/2014	0.786	PCI/G	18.960	0.95
8B001-6	0	0.5	6/19/2014	0.883	PCI/G	21.300	1.06
8B001-7	0.5	2	6/19/2014	0.759	PCI/G	18.309	0.92
8B001-7	2	3	6/19/2014	4.63	PCI/G	111.686	5.58
8B001-7	3	4	6/19/2014	4.72	PCI/G	113.857	5.69
8B001-7	4	5	6/19/2014	3.64	PCI/G	87.805	4.39
8B001-7	0	0.5	6/19/2014	0.796	PCI/G	19.201	0.96
8B002	2	2	11/17/2001	3.22	MG/KG	26.393	1.32
8B002	0	0.5	11/17/2001	1.86	MG/KG	15.246	0.76
8B003	0	0.5	11/17/2001	2.68	MG/KG	21.967	1.10
8B004	0	0.5	11/18/2001	3.42	MG/KG	28.033	1.40
8B005	0	0.5	11/18/2001	4.07	MG/KG	33.361	1.67
8B006	0	0.5	11/18/2001	3.28	MG/KG	26.885	1.34
8B007	0	0.5	11/18/2001	9.69	MG/KG	79.426	3.97
8B008	2	2	11/18/2001	4.47	MG/KG	36.639	1.83
8B008	0	0.5	11/18/2001	15.5	MG/KG	127.049	6.35
8B009	0	0.5	11/18/2001	2.85	MG/KG	23.361	1.17
8B010	0	0.5	11/18/2001	8.09	MG/KG	66.311	3.32
8C001	0	0.5	9/6/2001	2.89	MG/KG	23.689	1.18
8C002	0	0.5	9/6/2001	0.57	MG/KG	4.672	0.23
8C003	0	0.5	9/7/2001	3.21	MG/KG	26.311	1.32
8C004	0	0.5	9/6/2001	2.68	MG/KG	21.967	1.10
8D001	0	0.5	9/6/2001	3.56	MG/KG	29.180	1.46
8D002	0	0.5	9/7/2001	5.61	MG/KG	45.984	2.30
8D003	4.5	4.5	9/22/2003	0.858	MG/KG	7.033	0.35
8D003	0	0.5	9/5/2001	5.71	MG/KG	46.803	2.34
8D003-1	0.5	2	11/15/2013	1.11	PCI/G	26.776	1.34
8D003-1	2	3	11/15/2013	0.765	PCI/G	18.453	0.92
8D003-1	0	0.5	11/15/2013	1.08	PCI/G	26.052	1.30
8D003-2	0.5	2	11/15/2013	0.875	PCI/G	21.107	1.06
8D003-2	2	3	11/15/2013	0.764	PCI/G	18.429	0.92
8D003-2	0	0.5	11/15/2013	1.09	PCI/G	26.293	1.31
8D003-3	0.5	2	11/15/2013	0.754	PCI/G	18.188	0.91
8D003-3	2	3	11/15/2013	0.642	PCI/G	15.486	0.77
8D003-3	0	0.5	11/15/2013	0.92	PCI/G	22.192	1.11
8D003-4	0.5	2	11/15/2013	1.06	PCI/G	25.570	1.28
8D003-4	2	3	11/15/2013	0.725	PCI/G	17.489	0.87
8D003-4	0	0.5	11/15/2013	1.31	PCI/G	31.600	1.58
8D004	1.47	1.8	9/5/2001	2.69	MG/KG	22.049	1.10
8D004	0	0.5	9/5/2001	5.42	MG/KG	44.426	2.22
8D004-1	0.5	2	11/18/2013	0.813	PCI/G	19.611	0.98
8D004-1	2	3	11/18/2013	0.689	PCI/G	16.620	0.83
8D004-1	0	0.5	11/18/2013	1.47	PCI/G	35.460	1.77
8D004-2	0.5	2	11/18/2013	0.754	PCI/G	18.188	0.91
8D004-2	2	3	11/18/2013	0.698	PCI/G	16.837	0.84
8D004-2	0	0.5	11/18/2013	0.79	PCI/G	19.057	0.95
8D004-3	0.5	2	11/18/2013	0.677	PCI/G	16.331	0.82
8D004-3	2	3	11/18/2013	0.757	PCI/G	18.261	0.91

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
8D004-3	0	0.5	11/18/2013	0.969	PCI/G	23.374	1.17
8D004-4	0.5	2	11/18/2013	1.02	PCI/G	24.605	1.23
8D004-4	2	3	11/18/2013	1.22	PCI/G	29.429	1.47
8D004-4	0	0.5	11/18/2013	0.944	PCI/G	22.771	1.14
8D004-5	0.5	2	6/25/2014	1.13	PCI/G	27.258	1.36
8D004-5	2	3	6/25/2014	0.794	PCI/G	19.153	0.96
8D004-5	0	0.5	6/25/2014	3.25	PCI/G	78.397	3.92
8D004-6	0.5	2	6/25/2014	1.32	PCI/G	31.841	1.59
8D004-6	2	3	6/25/2014	0.822	PCI/G	19.828	0.99
8D004-6	0	0.5	6/25/2014	0.616	PCI/G	14.859	0.74
8D004-7	0.5	2	6/25/2014	1.08	PCI/G	26.052	1.30
8D004-7	2	3	6/25/2014	0.739	PCI/G	17.826	0.89
8D004-7	0	0.5	6/25/2014	0.828	PCI/G	19.973	1.00
8D005	0	0.5	9/5/2001	2.67	MG/KG	21.885	1.09
8D006	1.17	1.5	9/6/2001	3.56	MG/KG	29.180	1.46
8D006	1.5	2	9/6/2001	2.63	MG/KG	21.557	1.08
8D006	2	2.5	9/22/2003	1.16	MG/KG	9.508	0.48
8D006	0	0.5	9/5/2001	2.77	MG/KG	22.705	1.14
8D006-1	0.5	2	11/18/2013	0.809	PCI/G	19.515	0.98
8D006-1	2	3	11/18/2013	1.32	PCI/G	31.841	1.59
8D006-1	0	0.5	11/18/2013	0.878	PCI/G	21.179	1.06
8D006-2	0.5	2	11/15/2013	1.19	PCI/G	28.705	1.44
8D006-2	2	3	11/15/2013	0.645	PCI/G	15.559	0.78
8D006-2	0	0.5	11/15/2013	1.03	PCI/G	24.846	1.24
8D006-3	0.5	2	11/15/2013	0.597	PCI/G	14.401	0.72
8D006-3	2	3	11/15/2013	0.645	PCI/G	15.559	0.78
8D006-3	0	0.5	11/15/2013	1.13	PCI/G	27.258	1.36
8D006-4	0.5	2	11/15/2013	0.735	PCI/G	17.730	0.89
8D006-4	2	3	11/15/2013	0.573	PCI/G	13.822	0.69
8D006-4	0	0.5	11/15/2013	0.745	PCI/G	17.971	0.90
8D006-5	0.5	2	6/24/2014	0.896	PCI/G	21.613	1.08
8D006-5	2	3	6/24/2014	0.674	PCI/G	16.258	0.81
8D006-5	0	0.5	6/24/2014	1.22	PCI/G	29.429	1.47
8D006-6	0.5	2	6/24/2014	0.944	PCI/G	22.771	1.14
8D006-6	2	3	6/24/2014	1.02	PCI/G	24.605	1.23
8D006-6	0	0.5	6/24/2014	0.713	PCI/G	17.199	0.86
8D006-7	0.5	2	6/24/2014	0.86	PCI/G	20.745	1.04
8D006-7	2	3	6/24/2014	0.621	PCI/G	14.980	0.75
8D006-7	0	0.5	6/24/2014	0.726	PCI/G	17.513	0.88
8D007	1.47	1.8	9/5/2001	3.26	MG/KG	26.721	1.34
8D007	0	0.5	9/5/2001	10.9	MG/KG	89.344	4.47
8D007-1	0.5	2	11/18/2013	0.89	PCI/G	21.469	1.07
8D007-1	2	3	11/18/2013	0.719	PCI/G	17.344	0.87
8D007-1	0	0.5	11/18/2013	1.09	PCI/G	26.293	1.31
8D007-2	0.5	2	11/18/2013	1.8	PCI/G	43.420	2.17
8D007-2	2	3	11/18/2013	1.9	PCI/G	45.832	2.29
8D007-2	0	0.5	11/18/2013	1.26	PCI/G	30.394	1.52
8D007-3	1	2	11/18/2013	0.756	PCI/G	18.236	0.91
8D007-3	0.5	2	11/18/2013	0.905	PCI/G	21.831	1.09
8D007-3	2	3	11/18/2013	0.59	PCI/G	14.232	0.71
8D007-3	0	0.5	11/18/2013	1.88	PCI/G	45.350	2.27

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
8D007-4	0.5	2	11/18/2013	1.31	PCI/G	31.600	1.58
8D007-4	2	3	11/18/2013	0.594	PCI/G	14.329	0.72
8D007-4	0	0.5	11/18/2013	1	PCI/G	24.122	1.21
8D007-5	0.5	2	6/25/2014	2.16	PCI/G	52.104	2.61
8D007-5	2	3	6/25/2014	0.598	PCI/G	14.425	0.72
8D007-5	0	0.5	6/25/2014	0.672	PCI/G	16.210	0.81
8D008	0	0.5	9/5/2001	3.21	MG/KG	26.311	1.32
8D009	1.5	2	9/5/2001	2.55	MG/KG	20.902	1.05
8D009	2	2.5	9/22/2003	0.839	MG/KG	6.877	0.34
8D009	0	0.5	9/10/2001	19	MG/KG	155.738	7.79
8D009-1	0.5	2	11/14/2013	0.842	PCI/G	20.311	1.02
8D009-1	2	3	11/14/2013	0.824	PCI/G	19.877	0.99
8D009-1	0	0.5	11/14/2013	0.882	PCI/G	21.276	1.06
8D009-2	0.5	2	11/14/2013	1.58	PCI/G	38.113	1.91
8D009-2	2	3	11/14/2013	0.865	PCI/G	20.866	1.04
8D009-2	0	0.5	11/14/2013	1.11	PCI/G	26.776	1.34
8D009-3	0.5	2	11/14/2013	0.7875	PCI/G	18.996	0.95
8D009-3	2	3	11/14/2013	3.67	PCI/G	88.528	4.43
8D009-3	3	4	11/14/2013	30.8	PCI/G	742.964	37.15
8D009-3	4	5	11/14/2013	5.21	PCI/G	125.677	6.28
8D009-3	0	0.5	11/14/2013	0.69	PCI/G	16.644	0.83
8D009-4	0.5	2	11/14/2013	0.7	PCI/G	16.886	0.84
8D009-4	2	3	11/14/2013	0.558	PCI/G	13.460	0.67
8D009-4	0	0.5	11/14/2013	0.756	PCI/G	18.236	0.91
8D009-5	0.5	2	6/25/2014	0.963	PCI/G	23.230	1.16
8D009-5	2	3	6/25/2014	2.14	PCI/G	51.621	2.58
8D009-5	3	5	6/25/2014	3.09	PCI/G	74.538	3.73
8D009-5	5	7	6/25/2014	0.942	PCI/G	22.723	1.14
8D009-5	0	0.5	6/25/2014	0.633	PCI/G	15.269	0.76
8D009-6	0.5	2	6/25/2014	0.909	PCI/G	21.927	1.10
8D009-6	2	3	6/25/2014	0.923	PCI/G	22.265	1.11
8D009-6	3	5	6/25/2014	2.06	PCI/G	49.692	2.48
8D009-6	5	7	6/25/2014	3.14	PCI/G	75.744	3.79
8D009-6	0	0.5	6/25/2014	0.803	PCI/G	19.370	0.97
8D009-7	0.5	2	6/25/2014	0.801	PCI/G	19.322	0.97
8D009-7	2	3	6/25/2014	0.747	PCI/G	18.019	0.90
8D009-7	3	5	6/25/2014	0.686	PCI/G	16.548	0.83
8D009-7	5	7	6/25/2014	0.544	PCI/G	13.122	0.66
8D009-7	0	0.5	6/25/2014	0.648	PCI/G	15.631	0.78
8D011	1.5	2	9/6/2001	1.89	MG/KG	15.492	0.77
8D012	1.5	2	9/5/2001	1.86	MG/KG	15.246	0.76
8D013	1.53	1.7	9/7/2001	2.56	MG/KG	20.984	1.05
8D014	1.5	2	9/7/2001	2.22	MG/KG	18.197	0.91
8D015	1.5	2	9/5/2001	1.57	MG/KG	12.869	0.64
8D016	1.5	2	9/6/2001	12.6	MG/KG	103.279	5.16
8D016	3	3.5	9/22/2003	0.637	MG/KG	5.221	0.26
8D016-1	0.5	2	11/15/2013	0.729	PCI/G	17.585	0.88
8D016-1	2	3	11/15/2013	2.62	PCI/G	63.200	3.16
8D016-1	0	0.5	11/15/2013	0.724	PCI/G	17.464	0.87
8D016-2	0.5	2	11/15/2013	1.16	PCI/G	27.982	1.40
8D016-2	2	3	11/15/2013	2.62	PCI/G	63.200	3.16

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
8D016-2	0	0.5	11/15/2013	1.06	PCI/G	25.570	1.28
8D016-3	0.5	2	11/15/2013	0.7805	PCI/G	18.827	0.94
8D016-3	2	3	11/15/2013	4.3	PCI/G	103.725	5.19
8D016-3	3	4	11/15/2013	9.73	PCI/G	234.709	11.74
8D016-3	4	5	11/15/2013	2.55	PCI/G	61.512	3.08
8D016-3	0	0.5	11/15/2013	0.989	PCI/G	23.857	1.19
8D016-4	0.5	2	11/15/2013	2.62	PCI/G	63.200	3.16
8D016-4	2	3	11/15/2013	8.13	PCI/G	196.113	9.81
8D016-4	3	4	11/15/2013	4.64	PCI/G	111.927	5.60
8D016-4	4	5	11/15/2013	4.82	PCI/G	116.269	5.81
8D016-4	0	0.5	11/15/2013	1	PCI/G	24.122	1.21
8D016-5	0.5	2	6/26/2014	1.98	PCI/G	47.762	2.39
8D016-5	2	3	6/26/2014	1.75	PCI/G	42.214	2.11
8D016-5	3	5	6/26/2014	1.25	PCI/G	30.153	1.51
8D016-5	5	7	6/26/2014	0.814	PCI/G	19.635	0.98
8D016-5	0	0.5	6/26/2014	1.29	PCI/G	31.118	1.56
8D016-6	0.5	2	6/26/2014	1.03	PCI/G	24.846	1.24
8D016-6	2	3	6/26/2014	1.09	PCI/G	26.293	1.31
8D016-6	3	5	6/26/2014	0.924	PCI/G	22.289	1.11
8D016-6	5	7	6/26/2014	0.848	PCI/G	20.456	1.02
8D016-6	0	0.5	6/26/2014	0.84	PCI/G	20.263	1.01
8D016-7	0.5	2	6/26/2014	1.58	PCI/G	38.113	1.91
8D016-7	2	3	6/26/2014	5.13	PCI/G	123.747	6.19
8D016-7	3	5	6/26/2014	10.3	PCI/G	248.459	12.42
8D016-7	5	7	6/26/2014	5.99	PCI/G	144.492	7.22
8D016-7	0	0.5	6/26/2014	1.04	PCI/G	25.087	1.25
8D016-8	0.5	2	7/2/2014	0.907	PCI/G	21.879	1.09
8D016-8	2	3	7/2/2014	0.952	PCI/G	22.964	1.15
8D016-8	3	5	7/2/2014	0.794	PCI/G	19.153	0.96
8D016-8	5	7	7/2/2014	0.716	PCI/G	17.271	0.86
8D016-8	0	0.5	7/2/2014	0.897	PCI/G	21.638	1.08
8D016-9	0.5	2	7/2/2014	1.24	PCI/G	29.912	1.50
8D016-9	2	3	7/2/2014	0.88	PCI/G	21.228	1.06
8D016-9	3	5	7/2/2014	0.749	PCI/G	18.068	0.90
8D016-9	5	7	7/2/2014	0.676	PCI/G	16.307	0.82
8D016-9	0	0.5	7/2/2014	1.15	PCI/G	27.741	1.39
8E001	0	0.5	9/6/2001	2.85	MG/KG	23.361	1.17
8E002	0	0.5	9/8/2001	2.92	MG/KG	23.934	1.20
8E003	1	1.5	37140	3.36	MG/KG	27.541	1.38
8E003	5	5	10/2/2003	0.7635	PCI/G	18.417	0.92
8E003	0	0.5	9/9/2001	2.32	MG/KG	19.016	0.95
8E003-1	0.5	2	11/19/2013	0.93	PCI/G	22.434	1.12
8E003-1	2	3	11/19/2013	0.77	PCI/G	18.574	0.93
8E003-1	0	0.5	11/19/2013	0.853	PCI/G	20.576	1.03
8E003-2	0.5	2	11/19/2013	0.752	PCI/G	18.140	0.91
8E003-2	2	3	11/19/2013	0.703	PCI/G	16.958	0.85
8E003-2	0	0.5	11/19/2013	0.737	PCI/G	17.778	0.89
8E003-3	0.5	2	11/19/2013	0.645	PCI/G	15.559	0.78
8E003-3	0	0.5	11/19/2013	0.927	PCI/G	22.361	1.12
8E003-4	0.5	2	11/18/2013	0.8525	PCI/G	20.564	1.03
8E003-4	2	3	11/18/2013	0.676	PCI/G	16.307	0.82

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
8E003-4	0	0.5	11/18/2013	0.672	PCI/G	16.210	0.81
8F001	1	1.5	9/9/2001	2.71	MG/KG	22.213	1.11
8F001	0	0.5	9/9/2001	4.32	MG/KG	35.410	1.77
8F001-1	0.5	2	11/22/2013	0.805	PCI/G	19.418	0.97
8F001-1	2	3	11/22/2013	0.703	PCI/G	16.958	0.85
8F001-1	0	0.5	11/22/2013	0.575	PCI/G	13.870	0.69
8F001-2	1	2	11/22/2013	0.601	PCI/G	14.497	0.72
8F001-2	0.5	2	11/22/2013	0.687	PCI/G	16.572	0.83
8F001-2	2	3	11/22/2013	0.785	PCI/G	18.936	0.95
8F001-2	0	0.5	11/22/2013	0.684	PCI/G	16.500	0.82
8F001-3	0.5	2	11/22/2013	0.857	PCI/G	20.673	1.03
8F001-3	2	3	11/22/2013	0.711	PCI/G	17.151	0.86
8F001-3	0	0.5	11/22/2013	0.71	PCI/G	17.127	0.86
8F002	0	0.5	9/9/2001	2.99	MG/KG	24.508	1.23
8F003	0	0.5	9/5/2001	4.83	MG/KG	39.590	1.98
8F003-1	0.5	2	11/19/2013	0.679	PCI/G	16.379	0.82
8F003-1	2	3	11/19/2013	0.678	PCI/G	16.355	0.82
8F003-1	0	0.5	11/19/2013	0.749	PCI/G	18.068	0.90
8F003-2	0.5	2	11/19/2013	0.994	PCI/G	23.977	1.20
8F003-2	2	3	11/19/2013	0.738	PCI/G	17.802	0.89
8F003-2	0	0.5	11/19/2013	0.942	PCI/G	22.723	1.14
8F003-3	0.5	2	11/19/2013	0.777	PCI/G	18.743	0.94
8F003-3	2	3	11/19/2013	0.713	PCI/G	17.199	0.86
8F003-3	0	0.5	11/19/2013	0.705	PCI/G	17.006	0.85
8F003-4	0.5	2	11/19/2013	0.892	PCI/G	21.517	1.08
8F003-4	2	3	11/19/2013	0.67	PCI/G	16.162	0.81
8F003-4	0	0.5	11/19/2013	0.723	PCI/G	17.440	0.87
8F003-5	0.5	2	6/24/2014	0.931	PCI/G	22.458	1.12
8F003-5	2	3	6/24/2014	1.02	PCI/G	24.605	1.23
8F003-5	0	0.5	6/24/2014	0.862	PCI/G	20.793	1.04
8F003-6	0.5	2	6/24/2014	0.859	PCI/G	20.721	1.04
8F003-6	2	3	6/24/2014	0.714	PCI/G	17.223	0.86
8F003-6	0	0.5	6/24/2014	0.743	PCI/G	17.923	0.90
8F003-7	0.5	2	6/24/2014	0.778	PCI/G	18.767	0.94
8F003-7	2	3	6/24/2014	0.587	PCI/G	14.160	0.71
8F003-7	0	0.5	6/24/2014	0.873	PCI/G	21.059	1.05
8F003-8	0.5	2	6/24/2014	0.678	PCI/G	16.355	0.82
8F003-8	2	3	6/24/2014	0.815	PCI/G	19.660	0.98
8F003-8	0	0.5	6/24/2014	0.585	PCI/G	14.111	0.71
8F004	0	0.5	9/8/2001	2.13	MG/KG	17.459	0.87
8F005	1	1.5	9/8/2001	2.09	MG/KG	17.131	0.86
8F005	0	0.5	9/8/2001	4.33	MG/KG	35.492	1.77
8F006	1	1.5	9/9/2001	2.73	MG/KG	22.377	1.12
8F006	0	0.5	9/8/2001	6.63	MG/KG	54.344	2.72
8F006-1	0.5	2	11/25/2013	0.881	PCI/G	21.252	1.06
8F006-1	2	3	11/25/2013	0.811	PCI/G	19.563	0.98
8F006-1	0	0.5	11/25/2013	1.07	PCI/G	25.811	1.29
8F006-2	0.5	2	11/25/2013	0.839	PCI/G	20.239	1.01
8F006-2	2	3	11/25/2013	0.744	PCI/G	17.947	0.90
8F006-2	0	0.5	11/25/2013	1.36	PCI/G	32.806	1.64
8F006-3	1	2	11/25/2013	1	PCI/G	24.122	1.21

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
8F006-3	0.5	2	11/25/2013	1.19	PCI/G	28.705	1.44
8F006-3	2	3	11/25/2013	0.925	PCI/G	22.313	1.12
8F006-3	0	0.5	11/25/2013	0.811	PCI/G	19.563	0.98
8F006-4	0.5	2	11/25/2013	0.817	PCI/G	19.708	0.99
8F006-4	2	3	11/25/2013	0.865	PCI/G	20.866	1.04
8F006-4	0	0.5	11/25/2013	0.73	PCI/G	17.609	0.88
8F006-5	0.5	2	12/9/2013	1.1	PCI/G	26.534	1.33
8F006-5	2	3	12/9/2013	0.627	PCI/G	15.125	0.76
8F006-5	0	0.5	12/9/2013	0.715	PCI/G	17.247	0.86
8F006-6	0.5	2	12/9/2013	1.12	PCI/G	27.017	1.35
8F006-6	2	3	12/9/2013	0.903	PCI/G	21.782	1.09
8F006-6	0	0.5	12/9/2013	2.04	PCI/G	49.209	2.46
8F007	0	0.5	9/8/2001	1.92	MG/KG	15.738	0.79
8G001	0	0.5	10/6/2001	1.84	MG/KG	15.082	0.75
8G002	0	0.5	10/6/2001	1.73	MG/KG	14.180	0.71
8G003	0	0.5	10/6/2001	1.86	MG/KG	15.246	0.76
8G004	0	0.5	10/6/2001	2.07	MG/KG	16.967	0.85
8G005	0	0.5	10/6/2001	2.54	MG/KG	20.820	1.04
8H001	0	0.5	11/18/2001	10.4	MG/KG	85.246	4.26
8H001-1	0.5	2	12/4/2013	0.936	PCI/G	22.578	1.13
8H001-1	2	3	12/4/2013	0.906	PCI/G	21.855	1.09
8H001-1	0	0.5	12/4/2013	1.16	PCI/G	27.982	1.40
8H001-2	0	0.5	12/5/2013	1.78	PCI/G	42.938	2.15
8H001-3	0.5	2	12/4/2013	1.14	PCI/G	27.499	1.37
8H001-3	2	3	12/4/2013	1.25	PCI/G	30.153	1.51
8H001-3	0	0.5	12/4/2013	1.23	PCI/G	29.670	1.48
8H001-4	0	0.5	12/5/2013	1.13	PCI/G	27.258	1.36
8H001-5	0.5	2	12/5/2013	1.46	PCI/G	35.218	1.76
8H001-5	2	3	12/5/2013	0.535	PCI/G	12.905	0.65
8H001-5	0	0.5	12/5/2013	1.5	PCI/G	36.183	1.81
8H001-6	0.5	2	12/5/2013	1.36	PCI/G	32.806	1.64
8H001-6	2	3	12/5/2013	1.22	PCI/G	29.429	1.47
8H001-6	0	0.5	12/5/2013	1.36	PCI/G	32.806	1.64
8H002	0	0.5	11/18/2001	11.3	MG/KG	92.623	4.63
8H002-1	0.5	2	12/4/2013	1.13	PCI/G	27.258	1.36
8H002-1	2	3	12/4/2013	1.98	PCI/G	47.762	2.39
8H002-1	0	0.5	12/4/2013	1.77	PCI/G	42.696	2.13
8H002-2	0.5	2	12/4/2013	2.16	PCI/G	52.104	2.61
8H002-2	2	3	12/4/2013	1.59	PCI/G	38.354	1.92
8H002-2	0	0.5	12/4/2013	2.34	PCI/G	56.446	2.82
8H002-3	0.5	2	12/4/2013	1.64	PCI/G	39.560	1.98
8H002-3	2	3	12/4/2013	0.942	PCI/G	22.723	1.14
8H002-3	0	0.5	12/4/2013	1.35	PCI/G	32.565	1.63
8H002-4	0.5	2	12/4/2013	1.94	PCI/G	46.797	2.34
8H002-4	2	3	12/4/2013	0.963	PCI/G	23.230	1.16
8H002-4	0	0.5	12/4/2013	1.69	PCI/G	40.767	2.04
913-1	0.5	2	11/18/2013	0.698	PCI/G	16.837	0.84
913-1	2	3	11/18/2013	0.637	PCI/G	15.366	0.77
913-1	0	0.5	11/18/2013	0.79	PCI/G	19.057	0.95
913-2	0.5	2	11/18/2013	0.818	PCI/G	19.732	0.99
913-2	2	3	11/18/2013	0.62	PCI/G	14.956	0.75

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
913-2	0	0.5	11/18/2013	0.854	PCI/G	20.600	1.03
913-3	0.5	2	11/18/2013	0.536	PCI/G	12.929	0.65
913-3	0	0.5	11/18/2013	0.671	PCI/G	16.186	0.81
CORE01	0.5	0.5	10/5/2003	2.53	MG/KG	20.738	1.04
CORE02	0.5	0.5	10/5/2003	0.724	MG/KG	5.934	0.30
CORE03	1.5	1.5	10/5/2003	1.61	MG/KG	13.197	0.66
CORE04	0.5	0.5	10/5/2003	2.77	MG/KG	22.705	1.14
CORE05	0.5	0.5	10/6/2003	1.31	MG/KG	10.738	0.54
CORE06	0.5	0.5	10/5/2003	2.55	MG/KG	20.902	1.05
CORE07	0.5	0.5	10/7/2003	1.52	MG/KG	12.459	0.62
CORE08	0.5	0.5	10/5/2003	1.93	MG/KG	15.820	0.79
CORE09	0.5	0.5	10/6/2003	1.88	MG/KG	15.410	0.77
CORE10	0.5	0.5	10/5/2003	2.01	MG/KG	16.475	0.82
EU011	2	2	7/8/2003	1.71	MG/KG	14.470	0.72
EU011	0	0.5	7/8/2003	1.85	MG/KG	15.164	0.76
EU012	1	1	7/8/2003	1.93	MG/KG	15.820	0.79
EU013	1	1	7/8/2003	2.04	MG/KG	16.721	0.84
EU014	1	1	7/8/2003	3.95	MG/KG	32.377	1.62
EU021	1	1	7/9/2003	2.13	MG/KG	17.459	0.87
EU021	0	0.5	7/9/2003	1.98	MG/KG	16.230	0.81
EU022	2	2	7/9/2003	1.91	MG/KG	15.656	0.78
EU022	0	0.5	7/9/2003	1.61	MG/KG	13.197	0.66
EU023	2	2	7/9/2003	1.25	MG/KG	10.246	0.51
EU031	2	2	7/9/2003	0.566	MG/KG	4.639	0.23
EU031	0	0.5	7/9/2003	1.61	MG/KG	13.197	0.66
EU032	1	1	7/9/2003	2.1	MG/KG	17.213	0.86
EU032	0	0.5	7/9/2003	2.29	MG/KG	18.770	0.94
EU041	1	1	7/10/2003	1.96	MG/KG	16.066	0.80
EU042	1	1	7/10/2003	0.702	MG/KG	5.754	0.29
EU051	1	1	7/10/2003	2.41	MG/KG	19.754	0.99
EU051	0	0.5	7/10/2003	5	MG/KG	40.984	2.05
EU052	1.5	1.5	7/10/2003	2.52	MG/KG	20.656	1.03
EU061	2	2	7/10/2003	0.828	MG/KG	6.787	0.34
EU061	0	0.5	7/10/2003	1.64	MG/KG	13.443	0.67
EU061-1	0.5	2	11/7/2013	1.03	PCI/G	24.846	1.24
EU061-1	2	3	11/7/2013	1.1	PCI/G	26.534	1.33
EU061-1	0	0.5	11/7/2013	1.24	PCI/G	29.912	1.50
EU061-2	0.5	2	11/7/2013	0.903	PCI/G	21.782	1.09
EU061-2	2	3	11/7/2013	0.774	PCI/G	18.671	0.93
EU061-2	0	0.5	11/7/2013	0.692	PCI/G	16.693	0.83
EU061-3	0.5	2	11/7/2013	0.888	PCI/G	21.421	1.07
EU061-3	2	3	11/7/2013	0.619	PCI/G	14.932	0.75
EU061-3	0	0.5	11/7/2013	0.658	PCI/G	15.872	0.79
EU061-4	0.5	2	11/7/2013	0.945	PCI/G	22.795	1.14
EU061-4	2	3	11/7/2013	0.989	PCI/G	23.857	1.19
EU061-4	0	0.5	11/7/2013	0.66	PCI/G	15.921	0.80
EU062	2	2	7/10/2003	1.12	MG/KG	9.180	0.46
EU062	0	0.5	7/10/2003	2.24	MG/KG	18.361	0.92
EU071	2	2	7/10/2003	2.54	MG/KG	20.820	1.04
EU071	0	0.5	7/10/2003	3.24	MG/KG	26.557	1.33
EU072	1.5	1.5	7/10/2003	1.92	MG/KG	15.738	0.79

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
EU072	0	0.5	7/10/2003	2.53	MG/KG	20.738	1.04
EU081	1.5	1.5	7/11/2003	5.32	MG/KG	43.607	2.18
EU081	0	0.5	7/11/2003	3	MG/KG	24.590	1.23
EU082	1.5	1.5	7/11/2003	4.18	MG/KG	34.262	1.71
EU091	2	2	7/11/2003	1.58	MG/KG	12.951	0.65
EU091	0	0.5	7/11/2003	1.41	MG/KG	11.557	0.58
EU092	2	2	7/11/2003	1.69	MG/KG	13.852	0.69
EU092	0	0.5	7/11/2003	2.55	MG/KG	20.902	1.05
EU093	2	2	7/11/2003	3.1	MG/KG	25.410	1.27
EU093	0	0.5	7/11/2003	2.93	MG/KG	24.016	1.20
EU101	1	1	7/11/2003	3.33	MG/KG	27.295	1.36
EU101	0	0.5	7/11/2003	2.92	MG/KG	23.934	1.20
EU102	2	2	7/11/2003	69.4	MG/KG	568.852	28.44
EU102	0	0.5	7/11/2003	3.48	MG/KG	28.525	1.43
EU103	1	1	7/11/2003	4.33	MG/KG	35.492	1.77
EU103	0	0.5	7/11/2003	2.32	MG/KG	19.016	0.95
EU111	1.5	1.5	7/12/2003	3.08	MG/KG	25.246	1.26
EU111	0	0.5	7/12/2003	4.14	MG/KG	33.934	1.70
EU113	0	0.5	7/12/2003	2.03	MG/KG	16.639	0.83
EU121	0	0.5	7/12/2003	15.4	MG/KG	126.230	6.31
EU122	0	0.5	7/12/2003	3.11	MG/KG	25.492	1.27
EU123	0	0.5	7/12/2003	3.64	MG/KG	29.836	1.49
EU141	0	0.5	7/12/2003	5.73	MG/KG	46.967	2.35
GWS-02	0.5	2	11/25/2013	0.865	PCI/G	20.866	1.04
GWS-02	2	3	11/25/2013	1	PCI/G	24.122	1.21
GWS-02	0	0.5	11/25/2013	3.1	PCI/G	74.779	3.74
GWS-03	0.5	2	11/25/2013	0.812	PCI/G	19.587	0.98
GWS-03	1	2	11/25/2013	0.793	PCI/G	19.129	0.96
GWS-03	2	3	11/25/2013	0.677	PCI/G	16.331	0.82
GWS-03	0	0.5	11/25/2013	2.63	PCI/G	63.441	3.17
GWS-04	0.5	2	11/19/2013	0.724	PCI/G	17.464	0.87
GWS-04	2	3	11/19/2013	0.794	PCI/G	19.153	0.96
GWS-04	0	0.5	11/19/2013	0.795	PCI/G	19.177	0.96
GWS-05	0.5	2	11/25/2013	0.707	PCI/G	17.054	0.85
GWS-05	2	3	11/25/2013	0.782	PCI/G	18.864	0.94
GWS-05	0	0.5	11/25/2013	0.591	PCI/G	14.256	0.71
GWS-06	0.5	2	11/14/2013	0.8545	PCI/G	20.612	1.03
GWS-06	0	0.5	11/14/2013	1.23	PCI/G	29.670	1.48
GWS-06-1	0.5	2	6/25/2014	0.721	PCI/G	17.392	0.87
GWS-06-1	2	3	6/25/2014	0.725	PCI/G	17.489	0.87
GWS-06-1	0	0.5	6/25/2014	0.691	PCI/G	16.668	0.83
GWS-06-2	0.5	2	6/25/2014	0.882	PCI/G	21.276	1.06
GWS-06-2	2	3	6/25/2014	0.872	PCI/G	21.035	1.05
GWS-06-2	0	0.5	6/25/2014	0.888	PCI/G	21.421	1.07
GWS-06-3	0.5	2	6/25/2014	0.977	PCI/G	23.567	1.18
GWS-06-3	2	3	6/25/2014	0.596	PCI/G	14.377	0.72
GWS-06-3	0	0.5	6/25/2014	0.805	PCI/G	19.418	0.97
GWS-07	0.5	2	11/14/2013	0.567	PCI/G	13.677	0.68
GWS-07	2	3	11/14/2013	0.78	PCI/G	18.815	0.94
GWS-07	0	0.5	11/14/2013	0.767	PCI/G	18.502	0.93
GWS-08	0.5	2	11/26/2013	0.92	PCI/G	22.192	1.11

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
GWS-08	2	3	11/26/2013	0.727	PCI/G	17.537	0.88
GWS-08	0	0.5	11/26/2013	1.47	PCI/G	35.460	1.77
GWS-09	0.5	2	11/27/2013	9.75	PCI/G	235.191	11.76
GWS-09	2	3	11/27/2013	0.832	PCI/G	20.070	1.00
GWS-09	0	0.5	11/27/2013	3.1	PCI/G	74.779	3.74
GWS-09-1	0.5	2	6/30/2014	0.767	PCI/G	18.502	0.93
GWS-09-1	2	3	6/30/2014	0.732	PCI/G	17.657	0.88
GWS-09-1	0	0.5	6/30/2014	0.73	PCI/G	17.609	0.88
GWS-09-2	0.5	2	6/30/2014	1.09	PCI/G	26.293	1.31
GWS-09-2	2	3	6/30/2014	0.813	PCI/G	19.611	0.98
GWS-09-2	0	0.5	6/30/2014	0.713	PCI/G	17.199	0.86
GWS-09-3	0.5	2	6/30/2014	0.573	PCI/G	13.822	0.69
GWS-09-3	2	3	6/30/2014	0.784	PCI/G	18.912	0.95
GWS-09-3	0	0.5	6/30/2014	0.735	PCI/G	17.730	0.89
GWS-11	0.5	2	12/5/2013	0.995	PCI/G	24.002	1.20
GWS-11	2	3	12/5/2013	1.45	PCI/G	34.977	1.75
GWS-11	0	0.5	12/5/2013	2.03	PCI/G	48.968	2.45
GWS-11-1	0.5	2	6/19/2014	1.53	PCI/G	36.907	1.85
GWS-11-1	2	3	6/19/2014	1.17	PCI/G	28.223	1.41
GWS-11-1	0	0.5	6/19/2014	1.94	PCI/G	46.797	2.34
GWS-12	0.5	2	12/5/2013	1.41	PCI/G	34.012	1.70
GWS-12	2	3	12/5/2013	0.825	PCI/G	19.901	1.00
GWS-12	0	0.5	12/5/2013	1.53	PCI/G	36.907	1.85
GWS-13	0.5	2	12/5/2013	1.58	PCI/G	38.113	1.91
GWS-13	2	3	12/5/2013	0.888	PCI/G	21.421	1.07
GWS-13	0	0.5	12/5/2013	0.668	PCI/G	16.114	0.81
GWS-14	0.5	2	12/3/2013	1.14	PCI/G	27.499	1.37
GWS-14	2	3	12/3/2013	1.52	PCI/G	36.666	1.83
GWS-15	0.5	2	12/13/2013	1.1	PCI/G	26.534	1.33
GWS-15	2	3	12/13/2013	0.777	PCI/G	18.743	0.94
GWS-15	0	0.5	12/13/2013	1.64	PCI/G	39.560	1.98
GWS-18	2	3	11/7/2013	0.605	PCI/G	14.594	0.73
GWS-18	0	0.5	11/7/2013	0.914	PCI/G	22.048	1.10
GWS-18-1	0.5	2	6/30/2014	0.959	PCI/G	23.133	1.16
GWS-18-1	2	3	6/30/2014	0.758	PCI/G	18.285	0.91
GWS-18-1	0	0.5	6/30/2014	1.26	PCI/G	30.394	1.52
GWS-18-2	0.5	2	6/30/2014	0.648	PCI/G	15.631	0.78
GWS-18-2	2	3	6/30/2014	0.828	PCI/G	19.973	1.00
GWS-18-2	0	0.5	6/30/2014	0.694	PCI/G	16.741	0.84
GWS-18-3	0.5	2	6/30/2014	0.558	PCI/G	13.460	0.67
GWS-18-3	0	0.5	6/30/2014	1.16	PCI/G	27.982	1.40
GWS-18-4	0.5	2	6/30/2014	0.776	PCI/G	18.719	0.94
GWS-18-4	2	3	6/30/2014	0.616	PCI/G	14.859	0.74
GWS-18-4	0	0.5	6/30/2014	1.17	PCI/G	28.223	1.41
GWS-19	1	2	11/7/2013	1.28	PCI/G	30.876	1.54
GWS-19	0.5	2	11/7/2013	1.4835	PCI/G	35.785	1.79
GWS-19	2	3	11/7/2013	0.558	PCI/G	13.460	0.67
GWS-19	3	4	11/7/2013	0.588	PCI/G	14.184	0.71
GWS-19	4	5	11/7/2013	0.578	PCI/G	13.943	0.70
GWS-19	0	0.5	11/7/2013	0.826	PCI/G	19.925	1.00
GWS-19-1	0.5	2	7/1/2014	0.96	PCI/G	23.157	1.16

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
GWS-19-1	2	3	7/1/2014	0.657	PCI/G	15.848	0.79
GWS-19-1	0	0.5	7/1/2014	0.938	PCI/G	22.627	1.13
GWS-19-2	0.5	2	7/1/2014	0.883	PCI/G	21.300	1.06
GWS-19-2	2	3	7/1/2014	0.656	PCI/G	15.824	0.79
GWS-19-2	0	0.5	7/1/2014	0.765	PCI/G	18.453	0.92
GWS-19-3	0.5	2	7/1/2014	0.797	PCI/G	19.225	0.96
GWS-19-3	2	3	7/1/2014	0.664	PCI/G	16.017	0.80
GWS-19-3	0	0.5	7/1/2014	0.71	PCI/G	17.127	0.86
GWS-19-4	0.5	2	7/1/2014	0.548	PCI/G	13.219	0.66
GWS-19-4	2	3	7/1/2014	0.666	PCI/G	16.065	0.80
GWS-19-4	2	3	7/1/2014	0.586	PCI/G	14.136	0.71
GWS-19-4	0	0.5	7/1/2014	0.806	PCI/G	19.442	0.97
GWS-20	0.5	2	11/7/2013	0.665	PCI/G	16.041	0.80
GWS-20	2	3	11/7/2013	0.872	PCI/G	21.035	1.05
GWS-20	0	0.5	11/7/2013	1.01	PCI/G	24.363	1.22
GWS-21	0.5	2	11/7/2013	0.851	PCI/G	20.528	1.03
GWS-21	2	3	11/7/2013	0.898	PCI/G	21.662	1.08
GWS-21	0	0.5	11/7/2013	4.45	PCI/G	107.344	5.37
GWS-22	0.5	2	11/7/2013	0.812	PCI/G	19.587	0.98
GWS-22	0	0.5	11/7/2013	3.61	PCI/G	87.081	4.35
GWS-23	0.5	2	11/7/2013	0.807	PCI/G	19.467	0.97
GWS-23	2	3	11/7/2013	0.589	PCI/G	14.208	0.71
GWS-23	0	0.5	11/7/2013	4.25	PCI/G	102.519	5.13
GWS-24	2	3	11/7/2013	0.69	PCI/G	16.644	0.83
GWS-24	0	0.5	11/7/2013	1.72	PCI/G	41.490	2.07
GWS-26	0.5	2	6/20/2014	143	PCI/G	3449.474	172.47
GWS-26	2	3	6/20/2014	1.82	PCI/G	43.902	2.20
GWS-26	0	0.5	6/20/2014	358	PCI/G	8635.745	431.79
GWS-27	0.5	2	6/18/2014	1.08	PCI/G	26.052	1.30
GWS-27	2	3	6/18/2014	1.11	PCI/G	26.776	1.34
GWS-27	0	0.5	6/18/2014	1.32	PCI/G	31.841	1.59
IE01	0	0.5	12/5/2012	2.74	MG/KG	22.459	1.12
IE01	6	7.5	12/5/2012	2.23	MG/KG	18.279	0.91
IE01	3	3.5	12/5/2012	4.75	MG/KG	38.934	1.95
IE01	9.5	10	12/5/2012	2.37	MG/KG	19.426	0.97
IE02	0	0.5	12/5/2012	3	MG/KG	24.590	1.23
IE02	4	4.5	12/5/2012	1.63	MG/KG	13.361	0.67
IE02	3.5	4	12/5/2012	2.56	MG/KG	20.984	1.05
IE02	9	9.5	12/5/2012	2.76	MG/KG	22.623	1.13
IE02	4	4	12/5/2012	0.683	PCI/G	16.475	0.82
IE03	0	0.5	11/30/2012	2.38	MG/KG	19.508	0.98
IE03	3.2	3.6	12/3/2012	3.82	MG/KG	31.311	1.57
IE03	3.2	3.6	12/3/2012	4.55	MG/KG	37.295	1.86
IE03	10.2	10.6	12/3/2012	2.34	MG/KG	19.180	0.96
IE04	0	0.5	12/3/2012	1.24	MG/KG	10.164	0.51
IE04	3.5	4	12/3/2012	3.97	MG/KG	32.541	1.63
IE04	2.8	3.2	12/3/2012	1.54	MG/KG	12.623	0.63
IE04	10	10.5	12/3/2012	2.77	MG/KG	22.705	1.14
IE05	0	0.5	12/6/2012	3.11	MG/KG	25.492	1.27
IE05	2.7	3.2	12/6/2012	1.18	MG/KG	9.672	0.48
IE05	2	2.4	12/6/2012	3.05	MG/KG	25.000	1.25

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
IE05	11	11.5	12/6/2012	1.62	MG/KG	13.279	0.66
IE06	0	0.5	12/6/2012	3.01	MG/KG	24.672	1.23
IE06	2.5	3	12/6/2012	25.4	MG/KG	208.197	10.41
IE06	6	8	12/6/2012	2.76	MG/KG	22.623	1.13
IE06	11.5	12	12/6/2012	3.23	MG/KG	26.475	1.32
IE06	2.5	3	12/6/2012	6.78	PCI/G	163.548	8.18
IE07	0	0.5	11/30/2012	6.15	MG/KG	50.410	2.52
IE07	4.5	5	12/4/2012	45.6	MG/KG	373.770	18.69
IE07	7.5	8	12/4/2012	8.67	MG/KG	71.066	3.55
IE07	9	9.5	12/4/2012	32.2	MG/KG	263.934	13.20
IE07	9	9.5	12/4/2012	41.8	MG/KG	342.623	17.13
IE07	1.2	2.5	12/4/2012	4.93	PCI/G	118.922	5.95
IE07	9	9.5	12/4/2012	6.6	PCI/G	159.206	7.96
IE07	6	6	12/4/2012	12.9	PCI/G	311.176	15.56
IE07	4.5	4.5	12/4/2012	11.2	PCI/G	270.169	13.51
IE07	4	4	12/4/2012	13.9	PCI/G	335.298	16.76
IE07	4.5	5	12/4/2012	12.1	PCI/G	291.879	14.59
IE08	0	0.5	11/30/2012	11.8	MG/KG	96.721	4.84
IE08	3	3.5	12/4/2012	45.9	MG/KG	376.230	18.81
IE08	6.5	7	12/4/2012	12.6	MG/KG	103.279	5.16
IE08	8	9	12/4/2012	6.05	MG/KG	49.590	2.48
IE08	6.5	7	12/4/2012	3.11	PCI/G	75.020	3.75
IE09	8	8	11/25/2013	4.79	PCI/G	115.545	5.78
IE09-1	0	0.5	11/25/2013	11.6	MG/KG	95.082	4.75
IE09-2	3.5	4	11/25/2013	49.5	MG/KG	405.738	20.29
IE09-3	6	6.5	11/25/2013	6.84	MG/KG	56.066	2.80
IE09-4	10	10.5	11/25/2013	3.74	MG/KG	30.656	1.53
IE10-1	0	0.5	12/2/2013	53.7	MG/KG	440.164	22.01
IE10-2	3	4	12/2/2013	23.5	MG/KG	192.623	9.63
IE10-3	3	4	12/2/2013	37.2	MG/KG	304.918	15.25
IE10-4	10	10.5	12/2/2013	2.75	MG/KG	22.541	1.13
IE11-1	0	0.5	12/3/2013	18.9	MG/KG	154.918	7.75
IE11-2	3	4	12/3/2013	52	MG/KG	426.230	21.31
IE11-3	1	2	12/3/2013	26.3	MG/KG	215.574	10.78
IE11-4	10	10.5	12/3/2013	5.51	MG/KG	45.164	2.26
IE12-1	0	0.5	12/4/2013	4.33	MG/KG	35.492	1.77
IE12-2	0	0.5	12/4/2013	4.48	MG/KG	36.721	1.84
IE12-3	3	4	12/4/2013	16.6	MG/KG	136.066	6.80
IE12-4	6	7	12/4/2013	4.54	MG/KG	37.213	1.86
IE12-5	5	6	12/4/2013	9.42	MG/KG	77.213	3.86
IE12-6	6	7	12/4/2013	32.5	MG/KG	266.393	13.32
IE12-7	11	11.5	12/4/2013	3.64	MG/KG	29.836	1.49
IE12-8	11	11.5	12/4/2013	21.5	MG/KG	176.230	8.81
IEMH06-1	0	0.5	11/22/2013	8.04	MG/KG	65.902	3.30
IEMH06-2	3	3.5	11/26/2013	12.6	MG/KG	103.279	5.16
IEMH06-3	2	3	11/26/2013	4.32	MG/KG	35.410	1.77
IEMH06-4	6.5	7	11/26/2013	9.69	MG/KG	79.426	3.97
MH06-01	0.5	2	11/11/2013	4.09	PCI/G	98.660	4.93
MH06-01	2	3	11/11/2013	5.24	PCI/G	126.400	6.32
MH06-01	0	0.5	11/11/2013	3.8	PCI/G	91.664	4.58
MH06-02	0.5	2	11/11/2013	25.25	PCI/G	609.085	30.45

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
MH06-02	2	3	11/11/2013	27	PCI/G	651.299	32.56
MH06-02	3	4	11/11/2013	24.5	PCI/G	590.994	29.55
MH06-02	4	5	11/11/2013	19.5	PCI/G	470.383	23.52
MH06-02	0	0.5	11/11/2013	6.69	PCI/G	161.377	8.07
MH06-03	0.5	2	11/11/2013	0.936	PCI/G	22.578	1.13
MH06-03	2	3	11/11/2013	0.832	PCI/G	20.070	1.00
MH06-03	3	4	11/11/2013	23.3	PCI/G	562.047	28.10
MH06-03	4	5	11/11/2013	5.28	PCI/G	127.365	6.37
MH06-04	0.5	2	11/11/2013	5.12	PCI/G	123.506	6.18
MH06-04	2	3	11/11/2013	2.52	PCI/G	60.788	3.04
MH06-04	0	0.5	11/11/2013	5.89	PCI/G	142.080	7.10
MH06-05	0.5	2	11/11/2013	0.977	PCI/G	23.567	1.18
MH06-05	2	3	11/11/2013	1.03	PCI/G	24.846	1.24
MH06-05	0	0.5	11/11/2013	0.957	PCI/G	23.085	1.15
MH06-06	0.5	2	11/11/2013	1.67	PCI/G	40.284	2.01
MH06-06	2	3	11/11/2013	1.265	PCI/G	30.515	1.53
MH06-06	0	0.5	11/11/2013	1.31	PCI/G	31.600	1.58
MH06-07	0.5	2	11/11/2013	1.16	PCI/G	27.982	1.40
MH06-07	2	3	11/11/2013	1.28	PCI/G	30.876	1.54
MH06-07	0	0.5	11/11/2013	1.01	PCI/G	24.363	1.22
MH06-08	0.5	2	11/11/2013	1.45	PCI/G	34.977	1.75
MH06-08	2	3	11/11/2013	0.973	PCI/G	23.471	1.17
MH06-08	0	0.5	11/11/2013	1.03	PCI/G	24.846	1.24
MH06-09	0.5	2	11/11/2013	0.771	PCI/G	18.598	0.93
MH06-09	2	3	11/11/2013	1.12	PCI/G	27.017	1.35
MH06-09	0	0.5	11/11/2013	0.821	PCI/G	19.804	0.99
MH06-10	0.5	2	11/11/2013	23.2	PCI/G	559.635	27.98
MH06-10	2	3	11/11/2013	30.6	PCI/G	738.139	36.91
MH06-10	2	3	11/11/2013	20.6	PCI/G	496.917	24.85
MH06-10	3	4	11/11/2013	23.7	PCI/G	571.696	28.58
MH06-10	4	5	11/11/2013	6.86	PCI/G	165.478	8.27
MH06-10	0	0.5	11/11/2013	10.3	PCI/G	248.459	12.42
MH06-11	2	3	11/11/2013	2.78	PCI/G	67.060	3.35
MH06-11	3	4	11/11/2013	20.7	PCI/G	499.329	24.97
MH06-11	4	5	11/11/2013	15.2	PCI/G	366.657	18.33
MH06-11	0	0.5	11/11/2013	0.597	PCI/G	14.401	0.72
MH06-12	0.5	2	11/12/2013	5.94	PCI/G	143.286	7.16
MH06-12	2	3	11/12/2013	4.18	PCI/G	100.831	5.04
MH06-12	0	0.5	11/12/2013	4.66	PCI/G	112.409	5.62
MH06-13	0.5	2	11/12/2013	7.64	PCI/G	184.294	9.21
MH06-13	2	3	11/12/2013	12.9	PCI/G	311.176	15.56
MH06-13	0	0.5	11/12/2013	3.46	PCI/G	83.463	4.17
MH06-14	0.5	2	11/12/2013	1.56	PCI/G	37.631	1.88
MH06-14	2	3	11/12/2013	1.5	PCI/G	36.183	1.81
MH06-14	0	0.5	11/12/2013	1.69	PCI/G	40.767	2.04
MH06-15	0.5	2	11/12/2013	0.789	PCI/G	19.032	0.95
MH06-15	2	3	11/12/2013	0.57	PCI/G	13.750	0.69
MH06-15	0	0.5	11/12/2013	0.753	PCI/G	18.164	0.91
MH06-16	0.5	2	11/12/2013	1.09	PCI/G	26.293	1.31
MH06-16	2	3	11/12/2013	0.595	PCI/G	14.353	0.72
MH06-16	0	0.5	11/12/2013	0.847	PCI/G	20.431	1.02

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
MH06-17	0.5	2	11/12/2013	1.24	PCI/G	29.912	1.50
MH06-17	2	3	11/12/2013	1.013	PCI/G	24.436	1.22
MH06-17	0	0.5	11/12/2013	0.865	PCI/G	20.866	1.04
MH06-18	0.5	2	11/12/2013	7.3	PCI/G	176.092	8.80
MH06-18	1	2	11/12/2013	3.6845	PCI/G	88.878	4.44
MH06-18	2	3	11/12/2013	4.03	PCI/G	97.212	4.86
MH06-18	0	0.5	11/12/2013	5.51	PCI/G	132.913	6.65
MH06-19	0.5	2	11/12/2013	3.545	PCI/G	85.513	4.28
MH06-19	2	3	11/12/2013	17.2	PCI/G	414.902	20.75
MH06-19	0	0.5	11/12/2013	1.01	PCI/G	24.363	1.22
MH06-20	0.5	2	11/12/2013	3.6	PCI/G	86.840	4.34
MH06-20	2	3	11/12/2013	3.46	PCI/G	83.463	4.17
MH06-20	0	0.5	11/12/2013	1.7	PCI/G	41.008	2.05
MH06-21	0.5	2	11/12/2013	9.38	PCI/G	226.266	11.31
MH06-21	2	3	11/12/2013	6.14	PCI/G	148.110	7.41
MH06-21	0	0.5	11/12/2013	3.91	PCI/G	94.318	4.72
MH06-22	0.5	2	11/12/2013	20.6	PCI/G	496.917	24.85
MH06-22	2	3	11/12/2013	6.38	PCI/G	153.900	7.69
MH06-22	0	0.5	11/12/2013	7.16	PCI/G	172.715	8.64
MH06-23	0.5	2	11/12/2013	2.53	PCI/G	61.029	3.05
MH06-23	2	3	11/12/2013	2.16	PCI/G	52.104	2.61
MH06-23	0	0.5	11/12/2013	1.82	PCI/G	43.902	2.20
MH06-24	0.5	2	11/12/2013	1.195	PCI/G	28.826	1.44
MH06-24	2	3	11/12/2013	0.845	PCI/G	20.383	1.02
MH06-24	0	0.5	11/12/2013	0.896	PCI/G	21.613	1.08
MH06-25	0.5	2	11/12/2013	1.11	PCI/G	26.776	1.34
MH06-25	2	3	11/12/2013	0.913	PCI/G	22.024	1.10
MH06-25	0	0.5	11/12/2013	3.9	PCI/G	94.077	4.70
MH06-26	0.5	2	11/12/2013	0.69	PCI/G	16.644	0.83
MH06-26	2	3	11/12/2013	0.746	PCI/G	17.995	0.90
MH06-26	3	4	11/12/2013	19.4	PCI/G	467.971	23.40
MH06-27	0.5	2	11/12/2013	2.73	PCI/G	65.854	3.29
MH06-27	2	3	11/12/2013	1.82	PCI/G	43.902	2.20
MH06-27	0	0.5	11/12/2013	6.95	PCI/G	167.649	8.38
MH06-28	0.5	2	11/12/2013	0.906	PCI/G	21.855	1.09
MH06-28	2	3	11/12/2013	0.854	PCI/G	20.600	1.03
MH06-28	0	0.5	11/12/2013	3.17	PCI/G	76.467	3.82
MH06-29	0.5	2	11/12/2013	8.35	PCI/G	201.420	10.07
MH06-29	2	3	11/12/2013	11.4	PCI/G	274.993	13.75
MH06-29	0	0.5	11/12/2013	6.06	PCI/G	146.180	7.31
MH06-30	0.5	2	11/12/2013	8.13	PCI/G	196.113	9.81
MH06-30	2	3	11/12/2013	2.54	PCI/G	61.270	3.06
MH06-30	3	4	11/12/2013	1.36	PCI/G	32.806	1.64
MH06-30	0	0.5	11/12/2013	3.89	PCI/G	93.835	4.69
MH06-31	0.5	2	11/13/2013	1.94	PCI/G	46.797	2.34
MH06-31	2	3	11/13/2013	1.45	PCI/G	34.977	1.75
MH06-31	0	0.5	11/13/2013	0.951	PCI/G	22.940	1.15
MH06-32	0.5	2	11/13/2013	1.81	PCI/G	43.661	2.18
MH06-32	2	3	11/13/2013	6.09	PCI/G	146.904	7.35
MH06-32	0	0.5	11/13/2013	1.77	PCI/G	42.696	2.13
MH06-33	0.5	2	11/13/2013	24	PCI/G	578.933	28.95

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
MH06-33	2	3	11/13/2013	4.82	PCI/G	116.269	5.81
MH06-33	0	0.5	11/13/2013	9.81	PCI/G	236.639	11.83
MH06-34	0.5	2	11/13/2013	3.53	PCI/G	85.151	4.26
MH06-34	2	3	11/13/2013	2.06	PCI/G	49.692	2.48
MH06-34	0	0.5	11/13/2013	6.23	PCI/G	150.281	7.51
MH06-35	0.5	2	11/13/2013	3.2	PCI/G	77.191	3.86
MH06-35	2	3	11/13/2013	3.88	PCI/G	93.594	4.68
MH06-35	0	0.5	11/13/2013	1.09	PCI/G	26.293	1.31
MH06-SEEP	9	9	11/21/2013	7.29	PCI/G	175.851	8.79
MW228	11	11	9/19/2003	1.16	MG/KG	9.508	0.48
MW229	11	11	9/18/2003	1.14	MG/KG	9.344	0.47
MW229	28.5	28.5	9/18/2003	0.605	MG/KG	4.959	0.25
MW229	0	0.5	9/18/2003	1.2	MG/KG	9.836	0.49
MW313	11	11	9/17/2003	0.943	MG/KG	7.730	0.39
MW313	0	0.5	9/17/2003	2.4	MG/KG	19.672	0.98
MW314	15	15	9/17/2003	0.586	MG/KG	4.803	0.24
MW314	0	0.5	9/17/2003	1.39	MG/KG	11.393	0.57
MW422	15	15	9/17/2003	0.791	MG/KG	6.484	0.32
MW422	0	0.5	9/17/2003	0.874	MG/KG	7.164	0.36
MW423	15	15	9/16/2003	1.02	MG/KG	8.361	0.42
MW423	0	0.5	9/16/2003	0.905	MG/KG	7.418	0.37
MW424	14	14	9/22/2003	0.666	MG/KG	5.459	0.27
MW424	0	0.5	9/22/2003	1.01	MG/KG	8.279	0.41
MW862	11.5	11.5	9/20/2003	0.652	MG/KG	5.344	0.27
MW862	0	0.5	9/20/2003	1.1	MG/KG	9.016	0.45
MW863	32	32	9/20/2003	0.719	MG/KG	5.893	0.29
MW863	0	0.5	9/20/2003	1.14	MG/KG	9.344	0.47
MW944	10	11	11/18/2012	1.89	MG/KG	15.492	0.77
MW944	13	13.5	11/18/2012	2.5	MG/KG	20.492	1.02
MW944	2	2.5	11/18/2012	3	MG/KG	24.590	1.23
MW944	0	0.5	11/18/2012	2.14	MG/KG	17.541	0.88
MW945	12.5	13	11/18/2012	2.05	MG/KG	16.803	0.84
MW945	12.5	13	11/18/2012	1.97	MG/KG	16.148	0.81
MW945	3.5	4	11/18/2012	3.2	MG/KG	26.230	1.31
MW945	9.5	10	11/18/2012	2.11	MG/KG	17.295	0.86
MW945	0	0.5	11/18/2012	2.35	MG/KG	19.262	0.96
MW945	3.5	4	11/18/2012	2.12	PCI/G	51.139	2.56
MW946	12	12.5	11/14/2012	2.56	MG/KG	20.984	1.05
MW946	6	6.5	11/14/2012	2.64	MG/KG	21.639	1.08
MW946	8	8.5	11/14/2012	1.83	MG/KG	15.000	0.75
MW946	0	0.5	11/13/2012	2.44	MG/KG	20.000	1.00
MW946	12	12.5	11/14/2012	0.652	PCI/G	15.728	0.79
MW947	14	14.5	11/14/2012	1.8	MG/KG	14.754	0.74
MW947	18	18.5	11/14/2012	3.01	MG/KG	24.672	1.23
MW947	2	2.5	11/14/2012	2.79	MG/KG	22.869	1.14
MW947	0	0.5	11/14/2012	2.65	MG/KG	21.721	1.09
MW947	18	18.5	11/14/2012	0.934	PCI/G	22.530	1.13
MW948	10	10.5	11/16/2012	2.52	MG/KG	20.656	1.03
MW948	13	13.5	11/16/2012	2.27	MG/KG	18.607	0.93
MW948	13	13.5	11/16/2012	2.32	MG/KG	19.016	0.95
MW948	5.5	6	11/16/2012	2.55	MG/KG	20.902	1.05

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
MW948	0	0.5	11/16/2012	2.7	MG/KG	22.131	1.11
MW948	5.5	6	11/16/2012	0.671	PCI/G	16.186	0.81
MW949	16	16.5	11/17/2012	2.56	MG/KG	20.984	1.05
MW949	29.5	30	11/17/2012	2.95	MG/KG	24.180	1.21
MW949	34.5	35	11/17/2012	2.05	MG/KG	16.803	0.84
MW949	0	0.5	11/15/2012	2.62	MG/KG	21.475	1.07
MW949	29.5	30	11/17/2012	0.694	PCI/G	16.741	0.84
MW950	10.5	11	11/11/2012	2.16	MG/KG	17.705	0.89
MW950	10.5	11	11/11/2012	2.46	MG/KG	20.164	1.01
MW950	15	15.5	11/11/2012	2.55	MG/KG	20.902	1.05
MW950	2	2.5	11/11/2012	3.58	MG/KG	29.344	1.47
MW950	0	0.5	11/11/2012	3.24	MG/KG	26.557	1.33
MW950	2	2.5	11/11/2012	1.12	PCI/G	27.017	1.35
MW951	15	15.5	11/10/2012	2.02	MG/KG	16.557	0.83
MW951	12.5	18	11/10/2012	2.57	MG/KG	21.066	1.05
MW951	18.5	19	11/10/2012	2.18	MG/KG	17.869	0.89
MW951	0	0.5	11/10/2012	4.21	MG/KG	34.508	1.73
MW951	17.5	18	11/10/2012	0.885	PCI/G	21.348	1.07
MW952	4	4.5	11/19/2012	3.99	MG/KG	32.705	1.64
MW952	6	6.5	11/19/2012	3.08	MG/KG	25.246	1.26
MW952	6.5	7	11/19/2012	2.6	MG/KG	21.311	1.07
MW952	6.5	7	11/19/2012	2.64	MG/KG	21.639	1.08
MW952	0	0.5	11/19/2012	15.9	MG/KG	130.328	6.52
MW952	6	6.5	11/19/2012	1.08	PCI/G	26.052	1.30
MW953	1	2	11/19/2012	45.3	MG/KG	371.311	18.57
MW953	4	4.5	11/19/2012	54.4	MG/KG	445.902	22.30
MW953	6	6.5	11/20/2012	31.4	MG/KG	257.377	12.87
MW953	0	0.5	11/19/2012	18.5	MG/KG	151.639	7.58
MW953	1	2	11/19/2012	14.1	PCI/G	340.123	17.01
MW954	2	2.5	11/20/2012	17.4	MG/KG	142.623	7.13
MW954	5.5	6	11/20/2012	4.95	MG/KG	40.574	2.03
MW954	8.5	9	11/20/2012	2.13	MG/KG	17.459	0.87
MW954	8.5	9	11/20/2012	2.24	MG/KG	18.361	0.92
MW954	0	0.5	11/20/2012	12.2	MG/KG	100.000	5.00
MW955	2.5	3	11/20/2012	23.1	MG/KG	189.344	9.47
MW955	7	8	11/20/2012	1.64	MG/KG	13.443	0.67
MW955	0	0.5	11/20/2012	51.4	MG/KG	421.311	21.07
MW955	2.5	3	11/20/2012	4.775	PCI/G	115.183	5.76
MW956	15.5	16	11/12/2012	5.01	MG/KG	41.066	2.05
MW956	15.5	16	11/12/2012	2.25	MG/KG	18.443	0.92
MW956	16.5	17	11/12/2012	2.31	MG/KG	18.934	0.95
MW956	2.5	3	11/12/2012	2.52	MG/KG	20.656	1.03
MW956	0	0.5	11/12/2012	2.98	MG/KG	24.426	1.22
MW957	2	2.5	11/13/2012	3.12	MG/KG	25.574	1.28
MW957	4	4.5	11/13/2012	30.6	MG/KG	250.820	12.54
MW957	7	7.5	11/13/2012	4.66	MG/KG	38.197	1.91
MW957	0	0.5	11/13/2012	2.79	MG/KG	22.869	1.14
MW957	2	2.5	11/13/2012	1.07	PCI/G	25.811	1.29
MW958	4.5	5	11/13/2012	4.77	MG/KG	39.098	1.95
MW958	7.5	8	11/13/2012	3.31	MG/KG	27.131	1.36
MW958	7.5	8	11/13/2012	3.18	MG/KG	26.066	1.30

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
MW958	8.5	9	11/13/2012	3.2	MG/KG	26.230	1.31
MW958	0	0.5	11/13/2012	3.07	MG/KG	25.164	1.26
MW958	7.5	8	11/13/2012	0.983	PCI/G	23.712	1.19
MW959	13	13.5	11/12/2012	4.33	MG/KG	35.492	1.77
MW959	14	14.5	11/12/2012	2.61	MG/KG	21.393	1.07
MW959	8	8.5	11/12/2012	3.53	MG/KG	28.934	1.45
MW959	0	0.5	11/12/2012	2.26	MG/KG	18.525	0.93
MW959	8	8.5	11/12/2012	0.723	PCI/G	17.440	0.87
MW960	12	12.5	11/11/2012	2.51	MG/KG	20.574	1.03
MW960	2	3	11/11/2012	29.1	MG/KG	238.525	11.93
MW960	9.5	10	11/11/2012	2.86	MG/KG	23.443	1.17
MW960	0	0.5	11/11/2012	2.97	MG/KG	24.344	1.22
MW960	2	3	11/11/2012	9.3	PCI/G	224.336	11.22
OTFL11	13	13	10/1/2003	2.5	MG/KG	20.492	1.02
OTFL12	13.5	13.5	10/1/2003	1.7	MG/KG	13.934	0.70
PE1	15	15.5	11/28/2012	2.9	MG/KG	23.770	1.19
PE2	9	9.5	11/20/2012	0.694	PCI/G	16.741	0.84
PE2	9	9.5	11/20/2012	2.31	MG/KG	18.934	0.95
PE2	9	9.5	11/20/2012	2.09	MG/KG	17.131	0.86
PE2	9	9.5	11/20/2012	2.58	MG/KG	21.148	1.06
PE3	8	8.5	11/13/2012	5.26	MG/KG	43.115	2.16
PE3	8	8.5	11/13/2012	4.26	MG/KG	34.918	1.75
PE3	8	8.5	11/13/2012	3.75	MG/KG	30.738	1.54
PE3	8	8.5	11/13/2012	3.08	MG/KG	25.246	1.26
PE3	10	11	11/15/2012	4.24	MG/KG	34.754	1.74
PE4	7	7.5	12/11/2012	0.779	PCI/G	18.791	0.94
PE4	7.5	8	12/11/2012	0.629	PCI/G	15.173	0.76
PE4	7.1	7.6	12/12/2012	3.73	MG/KG	30.574	1.53
PE4	7	7.5	12/11/2012	2.55	MG/KG	20.902	1.05
PE4	7.5	8	12/11/2012	2.3	MG/KG	18.852	0.94
PE4	7.5	8	12/11/2012	1.95	MG/KG	15.984	0.80
PE5	6.1	6.5	12/14/2012	2.06	MG/KG	16.885	0.84
PE5	6	6.5	12/14/2012	1.67	MG/KG	13.689	0.68
PE5	6	6.5	12/14/2012	1.91	MG/KG	15.656	0.78
PE5	7.1	7.6	12/13/2012	2.02	MG/KG	16.557	0.83
PE6	5	5.5	12/10/2012	2.7	MG/KG	22.131	1.11
PE6	5	5.5	12/10/2012	2.76	MG/KG	22.623	1.13
PIPE74	7	7	10/3/2003	1.78	MG/KG	14.590	0.73
S31D-NS-SEWER-B	10	10	11/21/2013	2.35	PCI/G	56.687	2.83
S31D-NS-SEWER-E	8	8	11/21/2013	7.46	PCI/G	179.952	9.00
S31D-NS-SEWER-W	8	8	11/21/2013	2.95	PCI/G	71.160	3.56
SB-MH06A	8.5	8.5	10/1/2003	2.85	MG/KG	23.361	1.17
SB-MH07	11	11	9/30/2003	2.1	MG/KG	17.213	0.86
SB-MH07/08	11	11	10/1/2003	1.72	MG/KG	14.098	0.70
SB-MH08	11	11	10/1/2003	1.55	MG/KG	12.705	0.64
SB-MH41	8	8	10/1/2003	1.63	MG/KG	13.361	0.67
SB-MH43	9	9	10/1/2003	1.67	MG/KG	13.689	0.68
SB-MH45	9	9	10/1/2003	1.14	MG/KG	9.344	0.47
SP-01	0.5	2	11/8/2013	74.4	PCI/G	1794.691	89.73
SP-01	2	3	11/8/2013	20.9	PCI/G	504.154	25.21
SP-01	3	4	11/8/2013	6.62	PCI/G	159.689	7.98

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
SP-01	0	0.5	11/8/2013	2.83	PCI/G	68.266	3.41
SP-09	1.5	2	11/13/2013	2.59	PCI/G	62.476	3.12
SP-13	1	2	11/20/2013	38.1	PCI/G	919.056	45.95
SP-13	0.5	2	11/20/2013	44	PCI/G	1061.377	53.07
SP-13	2	3	11/20/2013	2.92	PCI/G	70.437	3.52
SP-13	0	0.5	11/20/2013	71.4	PCI/G	1722.325	86.12
SP-14	0.5	2	11/26/2013	0.83	PCI/G	20.021	1.00
SP-14	2	3	11/26/2013	1.15	PCI/G	27.741	1.39
SP-14	0	0.5	11/26/2013	5.64	PCI/G	136.049	6.80
SP-14-1	2	3	6/27/2014	0.834	PCI/G	20.118	1.01
SP-14-1	0	0.5	6/27/2014	0.763	PCI/G	18.405	0.92
SP-15	0.5	2	11/27/2013	0.843	PCI/G	20.335	1.02
SP-15	2	3	11/27/2013	0.899	PCI/G	21.686	1.08
SP-15	0	0.5	11/27/2013	7.11	PCI/G	171.509	8.58
SP-16	0.5	2	11/25/2013	3.06	PCI/G	73.814	3.69
SP-16	2	3	11/25/2013	0.645	PCI/G	15.559	0.78
SP-16	0	0.5	11/25/2013	4.55	PCI/G	109.756	5.49
SP-17	0.5	2	12/5/2013	1.35	PCI/G	32.565	1.63
SP-17	2	3	12/5/2013	0.926	PCI/G	22.337	1.12
SP-17	0	0.5	12/5/2013	0.647	PCI/G	15.607	0.78
SP-18	1	2	12/13/2013	1.73	PCI/G	41.731	2.09
SP-18	0.5	2	12/13/2013	4.11	PCI/G	99.142	4.96
SP-18	2	3	12/13/2013	1.26	PCI/G	30.394	1.52
SP-18	0	0.5	12/13/2013	19.1	PCI/G	460.734	23.04
SP-18-1	0.5	2	6/19/2014	1.18	PCI/G	28.464	1.42
SP-18-1	2	3	6/19/2014	0.927	PCI/G	22.361	1.12
SP-18-1	3	4	6/19/2014	0.817	PCI/G	19.708	0.99
SP-18-1	4	5	6/19/2014	0.761	PCI/G	18.357	0.92
SP-18-1	0	0.5	6/19/2014	1.37	PCI/G	33.047	1.65
SP-18-2	0.5	2	6/19/2014	0.834	PCI/G	20.118	1.01
SP-18-2	2	3	6/19/2014	1.45	PCI/G	34.977	1.75
SP-18-2	3	4	6/19/2014	0.873	PCI/G	21.059	1.05
SP-18-2	4	5	6/19/2014	0.622	PCI/G	15.004	0.75
SP-18-2	0	0.5	6/19/2014	4.93	PCI/G	118.922	5.95
SP-18-3	0.5	2	6/19/2014	0.838	PCI/G	20.214	1.01
SP-18-3	2	3	6/19/2014	0.782	PCI/G	18.864	0.94
SP-18-3	3	4	6/19/2014	0.603	PCI/G	14.546	0.73
SP-18-3	4	5	6/19/2014	0.716	PCI/G	17.271	0.86
SP-18-4	0.5	2	6/20/2014	2.8	PCI/G	67.542	3.38
SP-18-4	2	3	6/20/2014	1.02	PCI/G	24.605	1.23
SP-18-4	3	4	6/20/2014	1.54	PCI/G	37.148	1.86
SP-18-4	4	5	6/20/2014	1.02	PCI/G	24.605	1.23
SP-18-4	0	0.5	6/20/2014	4.29	PCI/G	103.484	5.17
TB201_01	5	5	5/22/2002	2.07	MG/KG	16.967	0.85
TB201_02	1	1	5/22/2002	2.5	MG/KG	20.492	1.02
TB201_03	1	1	5/22/2002	2.09	MG/KG	17.131	0.86
TB201_04	2.4	2.4	5/22/2002	2.41	MG/KG	19.754	0.99
TB202_01	5.2	5.2	5/19/2002	3.61	MG/KG	29.590	1.48
TB202_02	3.5	3.5	5/18/2002	3.26	MG/KG	26.721	1.34
TB202_03	3	3	5/19/2002	3.52	MG/KG	28.852	1.44
TB203_01	1	1	5/18/2002	4.23	MG/KG	34.672	1.73

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
TB203_02	4	4	5/18/2002	13.1	MG/KG	107.377	5.37
TB204_01	8	8	5/31/2002	3.73	MG/KG	30.574	1.53
TB204_02	10	10	5/31/2002	3.37	MG/KG	27.623	1.38
TB204_03	7	7	5/31/2002	3.03	MG/KG	24.836	1.24
TB205_01	3	3	5/31/2002	4.36	MG/KG	35.738	1.79
TB205_02	6.5	6.5	5/31/2002	2.28	MG/KG	18.689	0.93
TB205_03	8	8	5/31/2002	1.9	MG/KG	15.574	0.78
TB301_01	3.5	3.5	5/20/2002	2.75	MG/KG	22.541	1.13
TB301_01-1	0.5	2	12/12/2013	1.02	PCI/G	24.605	1.23
TB301_01-1	2	3	12/12/2013	1.02	PCI/G	24.605	1.23
TB301_01-1	0	0.5	12/12/2013	0.996	PCI/G	24.026	1.20
TB301_01-2	0.5	2	12/12/2013	0.527	PCI/G	12.712	0.64
TB301_01-2	2	3	12/12/2013	0.847	PCI/G	20.431	1.02
TB301_01-2	0	0.5	12/12/2013	0.507	PCI/G	12.230	0.61
TB301_01-3	0.5	2	12/12/2013	0.593	PCI/G	14.304	0.72
TB301_01-3	2	3	12/12/2013	0.597	PCI/G	14.401	0.72
TB301_01-3	0	0.5	12/12/2013	0.624	PCI/G	15.052	0.75
TB301_02	1.5	1.5	5/20/2002	3.05	MG/KG	25.000	1.25
TB301_03	1	1	5/20/2002	11.8	MG/KG	96.721	4.84
TB302_01	8	8	5/21/2002	1.66	MG/KG	13.607	0.68
TB302_02	1	1	5/21/2002	3.78	MG/KG	30.984	1.55
TB302_03	6	6	5/21/2002	1.86	MG/KG	15.246	0.76
TB303_01	5	5	5/17/2002	1.27	MG/KG	10.410	0.52
TB303_02	1	1	5/17/2002	2.9	MG/KG	23.770	1.19
TB303_03	5	5	5/17/2002	0.917	MG/KG	7.516	0.38
TB304_01	1.3	1.3	5/21/2002	31.3	MG/KG	256.557	12.83
TB304_02	6.5	6.5	5/21/2002	1.67	MG/KG	13.689	0.68
TB304_03	7	7	5/21/2002	2.93	MG/KG	24.016	1.20
TB305_01	4	4	6/1/2002	5.73	MG/KG	46.967	2.35
TB305_02	5	5	6/1/2002	3.21	MG/KG	26.311	1.32
TB305_03	5	5	6/1/2002	4.44	MG/KG	36.393	1.82
TB403_01	4	4	5/30/2002	3.67	MG/KG	30.082	1.50
TB403_02	7	7	5/30/2002	1.7	MG/KG	13.934	0.70
TB403_03	8	8	5/30/2002	2.35	MG/KG	19.262	0.96
TB404_01	3.3	3.3	5/17/2002	2.14	MG/KG	17.541	0.88
TB404_02	6.2	6.2	5/17/2002	1.97	MG/KG	16.148	0.81
TB404_03	2.3	2.3	5/17/2002	2.24	MG/KG	18.361	0.92
TB406_01	7	7	5/16/2002	1.46	MG/KG	11.967	0.60
TB406_02	2	2	5/16/2002	5.75	MG/KG	47.131	2.36
TB406_03	1	1	5/16/2002	2.96	MG/KG	24.262	1.21
TB408_01	2.7	2.7	5/16/2002	2.34	MG/KG	19.180	0.96
TB408_02	3.9	3.9	5/16/2002	2.14	MG/KG	17.541	0.88
TB408_03	4.7	4.7	5/16/2002	1.97	MG/KG	16.148	0.81
TB410_01	6	6	5/21/2002	2.38	MG/KG	19.508	0.98
TB410_02	2	2	5/21/2002	2.04	MG/KG	16.721	0.84
TB410_03	4	4	5/21/2002	2.39	MG/KG	19.590	0.98
TB411_01	5	5	5/19/2002	1.74	MG/KG	14.262	0.71
TB411_02	1.5	1.5	5/19/2002	4.82	MG/KG	39.508	1.98
TB411_03	1.5	1.5	5/19/2002	6.1	MG/KG	50.000	2.50
TB411_03-1	0.5	2	12/2/2013	0.965	PCI/G	23.278	1.16
TB411_03-1	2	3	12/2/2013	0.784	PCI/G	18.912	0.95

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
TB411_03-1	0	0.5	12/2/2013	1.07	PCI/G	25.811	1.29
TB411_03-2	0.5	2	12/2/2013	1.43	PCI/G	34.495	1.72
TB411_03-2	2	3	12/2/2013	0.661	PCI/G	15.945	0.80
TB411_03-2	0	0.5	12/2/2013	1.4	PCI/G	33.771	1.69
TB411_03-3	0.5	2	12/2/2013	1.25	PCI/G	30.153	1.51
TB411_03-3	2	3	12/2/2013	0.961	PCI/G	23.181	1.16
TB411_03-3	0	0.5	12/2/2013	1.14	PCI/G	27.499	1.37
TB411_03-4	0.5	2	12/2/2013	0.94	PCI/G	22.675	1.13
TB411_03-4	2	3	12/2/2013	0.502	PCI/G	12.109	0.61
TB411_03-4	0	0.5	12/2/2013	1.16	PCI/G	27.982	1.40
TB412_01	5	5	5/18/2002	2.23	MG/KG	18.279	0.91
TB412_02	5	5	5/18/2002	1.69	MG/KG	13.852	0.69
TB412_03	4	4	5/18/2002	2.05	MG/KG	16.803	0.84
TB413_01	9	9	5/17/2002	1.22	MG/KG	10.000	0.50
TB413_02	3	3	5/18/2002	2.33	MG/KG	19.098	0.95
TB413_03	3	3	5/18/2002	1.81	MG/KG	14.836	0.74
TB414_01	5.5	5.5	5/20/2002	3.78	MG/KG	30.984	1.55
TB414_02	8	8	5/20/2002	5.94	MG/KG	48.689	2.43
TB414_03	1	1	5/20/2002	4.53	MG/KG	37.131	1.86
TB501_01	1.5	1.5	5/21/2002	5.6	MG/KG	45.902	2.30
TB501_02	3	3	5/22/2002	0.411	MG/KG	3.369	0.17
TB501_03	2.7	2.7	5/22/2002	18.2	MG/KG	149.180	7.46
TB802_01	4.2	4.2	5/23/2002	2.61	MG/KG	21.393	1.07
TB802_01-1	0.5	2	11/14/2013	0.7855	PCI/G	18.948	0.95
TB802_01-1	2	3	11/14/2013	3.29	PCI/G	79.362	3.97
TB802_01-1	3	4	11/14/2013	3.88	PCI/G	93.594	4.68
TB802_01-1	3	4	11/14/2013	4.56	PCI/G	109.997	5.50
TB802_01-1	4	5	11/14/2013	4.54	PCI/G	109.515	5.48
TB802_01-1	0	0.5	11/14/2013	0.598	PCI/G	14.425	0.72
TB802_01-2	0.5	2	11/14/2013	0.834	PCI/G	20.118	1.01
TB802_01-2	2	3	11/14/2013	0.792	PCI/G	19.105	0.96
TB802_01-2	0	0.5	11/14/2013	0.834	PCI/G	20.118	1.01
TB802_01-3	2	3	11/14/2013	1.04	PCI/G	25.087	1.25
TB802_01-3	3	4	11/14/2013	0.841	PCI/G	20.287	1.01
TB802_01-3	0	0.5	11/14/2013	0.925	PCI/G	22.313	1.12
TB802_01-4	0.5	2	11/14/2013	0.612	PCI/G	14.763	0.74
TB802_01-4	2	3	11/14/2013	0.817	PCI/G	19.708	0.99
TB802_01-4	0	0.5	11/14/2013	0.596	PCI/G	14.377	0.72
TB802_01-5	0.5	2	6/26/2014	1.78	PCI/G	42.938	2.15
TB802_01-5	2	3	6/26/2014	4.71	PCI/G	113.616	5.68
TB802_01-5	3	5	6/26/2014	14.5	PCI/G	349.772	17.49
TB802_01-5	5	7	6/26/2014	5.1	PCI/G	123.023	6.15
TB802_01-5	0	0.5	6/26/2014	1.35	PCI/G	32.565	1.63
TB802_01-6	0.5	2	6/26/2014	3.62	PCI/G	87.322	4.37
TB802_01-6	2	3	6/26/2014	8.11	PCI/G	195.631	9.78
TB802_01-6	3	5	6/26/2014	6.73	PCI/G	162.342	8.12
TB802_01-6	5	7	6/26/2014	1.09	PCI/G	26.293	1.31
TB802_01-6	0	0.5	6/26/2014	1.49	PCI/G	35.942	1.80
TB802_02	4	4	5/23/2002	7.29	MG/KG	59.754	2.99
TB802A_01	3.8	3.8	5/31/2002	17.8	MG/KG	145.902	7.30
TB802A_01-1	0.5	2	11/14/2013	0.8545	PCI/G	20.612	1.03

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
TB802A_01-1	2	3	11/14/2013	0.758	PCI/G	18.285	0.91
TB802A_01-1	0	0.5	11/14/2013	0.779	PCI/G	18.791	0.94
TB802A_01-2	0.5	2	11/14/2013	0.804	PCI/G	19.394	0.97
TB802A_01-2	2	3	11/14/2013	0.711	PCI/G	17.151	0.86
TB802A_01-2	0	0.5	11/14/2013	0.962	PCI/G	23.206	1.16
TB802A_01-3	0.5	2	11/14/2013	0.918	PCI/G	22.144	1.11
TB802A_01-3	2	3	11/14/2013	1.78	PCI/G	42.938	2.15
TB802A_01-3	3	4	11/14/2013	0.708	PCI/G	17.079	0.85
TB802A_01-3	0	0.5	11/14/2013	0.669	PCI/G	16.138	0.81
TB802A_01-4	0.5	2	11/14/2013	0.734	PCI/G	17.706	0.89
TB802A_01-4	2	3	11/14/2013	0.854	PCI/G	20.600	1.03
TB802A_01-4	0	0.5	11/14/2013	0.767	PCI/G	18.502	0.93
TB808_01	4.5	4.5	5/20/2002	2.49	MG/KG	20.410	1.02
TB808_02	1.5	1.5	5/20/2002	3.44	MG/KG	28.197	1.41
TB808_03	1.5	1.5	5/20/2002	2.72	MG/KG	22.295	1.11
TB809_01	1	1	5/30/2002	3.66	MG/KG	30.000	1.50
TB810_01	2.9	2.9	6/1/2002	3.94	MG/KG	32.295	1.61
TB810_02	1.8	1.8	6/1/2002	6.13	MG/KG	50.246	2.51
TB810_03	5.8	5.8	6/1/2002	2.38	MG/KG	19.508	0.98
TB810_03-1	0.5	2	11/13/2013	1.2	PCI/G	28.947	1.45
TB810_03-1	2	3	11/13/2013	1.03	PCI/G	24.846	1.24
TB810_03-1	0	0.5	11/13/2013	1.09	PCI/G	26.293	1.31
TB810_03-2	0.5	2	11/13/2013	0.942	PCI/G	22.723	1.14
TB810_03-2	2	3	11/13/2013	0.759	PCI/G	18.309	0.92
TB810_03-2	0	0.5	11/13/2013	1.03	PCI/G	24.846	1.24
TB810_03-3	0.5	2	11/13/2013	1.135	PCI/G	27.379	1.37
TB810_03-3	2	3	11/13/2013	0.831	PCI/G	20.046	1.00
TB810_03-3	0	0.5	11/13/2013	1.19	PCI/G	28.705	1.44
TB810_03-4	0.5	2	11/14/2013	1.03	PCI/G	24.846	1.24
TB810_03-4	2	3	11/14/2013	0.922	PCI/G	22.241	1.11
TB810_03-4	0	0.5	11/14/2013	1.17	PCI/G	28.223	1.41
TB811_01	4.8	4.8	6/1/2002	1.84	MG/KG	15.082	0.75
TB811_02	2.3	2.3	6/1/2002	3.31	MG/KG	27.131	1.36
TB811_03	4	4	6/1/2002	4.37	MG/KG	35.820	1.79
TB812_01	3	3	6/1/2002	2.81	MG/KG	23.033	1.15
TB812_02	3	3	6/1/2002	3.15	MG/KG	25.820	1.29
TB812_03	5	5	6/1/2002	2.31	MG/KG	18.934	0.95
TB813_02	1	1	6/1/2002	9.16	MG/KG	75.082	3.75
TB813_03	3.9	3.9	6/1/2002	3.11	MG/KG	25.492	1.27
TBG01_01	6	6	9/11/2002	1.137	PCI/G	27.427	1.37
TBG01_02	3	3	9/12/2002	1.29	PCI/G	31.118	1.56
TBG01_03	2	2	9/11/2002	0.889	PCI/G	21.445	1.07
TBG01_04	5	5	9/12/2002	0.8725	PCI/G	21.047	1.05
TBG01_05	2	2	9/13/2002	1.232	PCI/G	29.719	1.49
TBG01_09	3	3	9/12/2002	1.57	PCI/G	37.872	1.89
TBG02_01	2	2	5/22/2002	1.87	PCI/G	45.109	2.26
TBG02_02	2	2	5/22/2002	1083.5	PCI/G	26136.397	1306.82
TBG02_03	4.5	4.5	9/16/2002	0.798	PCI/G	19.250	0.96
TBG02_06	2	2	9/16/2002	0.838	PCI/G	20.214	1.01
TBG02_07	2	2	9/16/2002	2.16	PCI/G	52.104	2.61
TBG03_01	1	1	9/14/2002	0.917	PCI/G	22.120	1.11

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
TBG03_03	1	1	9/16/2002	21900	PCI/G	528276.035	26413.80
TBG03_04	1	1	9/16/2002	0.956	PCI/G	23.061	1.15
TBG04_01	1	1	9/13/2002	1.37	PCI/G	33.047	1.65
TBG04_02	5	5	9/13/2002	1.201	PCI/G	28.971	1.45
TBG04_03	4	4	9/13/2002	1.29	PCI/G	31.118	1.56
TBG04_04	6	6	9/13/2002	0.709	PCI/G	17.103	0.86
TBG04_05	4	4	9/13/2002	0.723	PCI/G	17.440	0.87
TBG05_01	5	5	9/14/2002	2.84	PCI/G	68.507	3.43
TBG05_02	10	10	9/14/2002	1.12	PCI/G	27.017	1.35
TBG05_03	4	4	9/14/2002	0.967	PCI/G	23.326	1.17
TBG05_04	3	3	9/14/2002	1.342	PCI/G	32.372	1.62
TBG05_05	7	7	9/14/2002	0.75	PCI/G	18.092	0.90
TBG06_01	2	2	9/15/2002	0.945	PCI/G	22.795	1.14
TBG06_02	2	2	9/15/2002	1.215	PCI/G	29.308	1.47
TBG06_03	1	1	9/15/2002	0.767	PCI/G	18.502	0.93
TS203_03	0	0.5	5/18/2002	3.46	MG/KG	28.361	1.42
TS408_04	0	0.5	5/16/2002	0.411	MG/KG	3.369	0.17
TS809_02	0	0.5	5/30/2002	3.02	MG/KG	24.754	1.24
TS809_03	0	0.5	5/30/2002	2.61	MG/KG	21.393	1.07
TS812_04	0	0.5	6/1/2002	2860	MG/KG	23442.623	1172.13
TS812_04-1	0.5	2	12/5/2013	1.19	PCI/G	28.705	1.44
TS812_04-1	2	3	12/5/2013	1.02	PCI/G	24.605	1.23
TS812_04-1	0	0.5	12/5/2013	6.23	PCI/G	150.281	7.51
TS812_04-2	0.5	2	12/5/2013	1.43	PCI/G	34.495	1.72
TS812_04-2	2	3	12/5/2013	0.803	PCI/G	19.370	0.97
TS812_04-2	0	0.5	12/5/2013	0.852	PCI/G	20.552	1.03
TS812_04-3	0.5	2	12/5/2013	1.19	PCI/G	28.705	1.44
TS812_04-3	2	3	12/5/2013	0.988	PCI/G	23.833	1.19
TS812_04-3	0	0.5	12/5/2013	1.67	PCI/G	40.284	2.01
TS812_04-4	0.5	2	12/5/2013	0.93	PCI/G	22.434	1.12
TS812_04-4	2	3	12/5/2013	0.725	PCI/G	17.489	0.87
TSG06_05	0	0.5	9/15/2002	0.96	PCI/G	23.157	1.16
TSG06_06	0	0.5	9/15/2002	0.855	PCI/G	20.624	1.03
TWP830	15	15	10/2/2003	1.47	MG/KG	12.049	0.60
TWP830	0	0.5	10/2/2003	2.64	MG/KG	21.639	1.08
TWP921	14	16	11/23/2009	0.853	PCI/G	20.576	1.03
TWP921	0	0.5	11/23/2009	0.941	PCI/G	22.699	1.13
TWP922	12	14	11/18/2009	0.731	PCI/G	17.633	0.88
TWP922	0	0.5	11/17/2009	1.74	PCI/G	41.973	2.10
TWP923	0	0.5	11/17/2009	0.554	PCI/G	13.364	0.67
TWP923	16	18	11/17/2009	0.677	PCI/G	16.331	0.82
TWP924	12	14	11/19/2009	0.471	PCI/G	11.362	0.57
TWP924	0	0.5	11/19/2009	1.49	PCI/G	35.942	1.80
TWP925	10	12	11/18/2009	1.12	PCI/G	27.017	1.35
TWP925	0	0.5	11/18/2009	2.88	PCI/G	69.472	3.47
TWP926	8	12	11/19/2009	0.9965	PCI/G	24.038	1.20
TWP926	0	0.5	11/19/2009	0.935	PCI/G	22.554	1.13
TWP927	10	12	11/20/2009	0.747	PCI/G	18.019	0.90
TWP927	0	0.5	11/20/2009	0.459	PCI/G	11.072	0.55
TWP928	12	14	11/20/2009	0.851	PCI/G	20.528	1.03
TWP928	0	0.5	11/20/2009	1.38	PCI/G	33.289	1.66

Table 1
Predicted Total Uranium Concentrations in Water
(based on soil sampling results)

Location ID	Top of sampled interval (ft bgs)	Bottom of sampled interval (ft bgs)	Date	Soil Concentration	Units	Estimated Pore Water Concentration (µg/L)	Estimated Groundwater Concentration (µg/L)
TWP929	8	10	11/21/2009	0.736	PCI/G	17.754	0.89
TWP929	0	0.5	11/21/2009	0.885	PCI/G	21.348	1.07
TWP930	15	17	11/21/2009	0.419	PCI/G	10.107	0.51
TWP930	0	0.5	11/21/2009	0.868	PCI/G	20.938	1.05
TWP931	8	10	11/21/2009	1.08	PCI/G	26.052	1.30
TWP931	0	0.5	11/21/2009	0.526	PCI/G	12.688	0.63
TWP932	14	16	12/2/2009	0.978	PCI/G	23.592	1.18
TWP932	0	0.5	12/2/2009	0.789	PCI/G	19.032	0.95
TWP933	10	12	12/3/2009	0.861	PCI/G	20.769	1.04
TWP933	0	0.5	12/3/2009	0.722	PCI/G	17.416	0.87
TWP934	16	18	12/3/2009	0.578	PCI/G	13.943	0.70
TWP934	0	0.5	12/3/2009	0.665	PCI/G	16.041	0.80
TWP935	10	12	11/24/2009	0.811	PCI/G	19.563	0.98
TWP935	0	0.5	11/24/2009	1.15	PCI/G	27.741	1.39
TWP936	12	14	11/22/2009	1.03	PCI/G	24.846	1.24
TWP936	0	0.5	11/22/2009	1.55	PCI/G	37.389	1.87
TWP937	12	14	12/1/2009	0.651	PCI/G	15.704	0.79
TWP937	0	0.5	12/1/2009	0.954	PCI/G	23.013	1.15
TWP937-1	0.5	2	11/18/2013	0.748	PCI/G	18.043	0.90
TWP937-1	2	3	11/18/2013	0.886	PCI/G	21.372	1.07
TWP937-1	0	0.5	11/18/2013	1.15	PCI/G	27.741	1.39
TWP937-2	0.5	2	11/18/2013	0.763	PCI/G	18.405	0.92
TWP937-2	2	3	11/18/2013	0.785	PCI/G	18.936	0.95
TWP937-2	0	0.5	11/18/2013	1.2	PCI/G	28.947	1.45
TWP937-3	0.5	2	11/18/2013	0.773	PCI/G	18.646	0.93
TWP937-3	2	3	11/18/2013	0.574	PCI/G	13.846	0.69
TWP937-3	0	0.5	11/18/2013	0.815	PCI/G	19.660	0.98
TWP937-4	0.5	2	11/18/2013	0.87	PCI/G	20.986	1.05
TWP937-4	2	3	11/18/2013	0.849	PCI/G	20.480	1.02
TWP937-4	0	0.5	11/18/2013	0.873	PCI/G	21.059	1.05
TWP938	14	16	11/24/2009	0.509	PCI/G	12.278	0.61
TWP938	0	0.5	11/24/2009	0.885	PCI/G	21.348	1.07
TWP939	2	4	11/22/2009	0.588	PCI/G	14.184	0.71
TWP939	0	0.5	11/22/2009	1.2	PCI/G	28.947	1.45
TWP940	8	10	12/1/2009	1.297	PCI/G	31.286	1.56
TWP940	0	0.5	12/1/2009	0.985	PCI/G	23.760	1.19
TWP941	10	12	11/30/2009	0.782	PCI/G	18.864	0.94
TWP941	0	0.5	11/30/2009	1.08	PCI/G	26.052	1.30
TWP942	4	6	12/2/2009	0.759	PCI/G	18.309	0.92
TWP942	0	0.5	12/2/2009	0.885	PCI/G	21.348	1.07
TWP943	8	10	12/2/2009	0.72	PCI/G	17.368	0.87
TWP943	0	0.5	12/2/2009	1.34	PCI/G	32.324	1.62

Notes:

NFSS - Niagara Falls Storage Site

µg/L - micrograms per liter

ft - feet

bgs - below ground surface

THIS PAGE INTENTIONALLY LEFT BLANK

Table 2

Groundwater Surface Water Interaction Technical Memorandum, NFSS, Lewiston, NY
Results Summary

Area of Exceedance	[1]Exceedance of 300 pCi/L Screening Level in Pore Water	[2]Exceedances of Canadian Water Quality Guidline in Saturated Groundwater	Exceedances of MCL Screening Level in Saturated Groundwater	[1]Exceedance of 300 pCi/L Screening Level in Saturated Groundwater	Within 1,000-year Groundwater to Surface Water Pathline	Likelyhood of Negatively Impacting Surface Water within 1,000-year
Area 1	Yes	Yes	Yes	No	No	Low
Area 2	Yes	Yes	Yes	Yes	No	Low
Area 3	Yes	Yes	Yes	No	No	Low
Area 4	Yes	Yes	Yes	No	Yes	Low
Area 5	Yes	Yes	Yes	No	No	Low
Area 6	Yes	Yes	Yes	No	Yes	Low
Area 7	Yes	Yes	No	No	No	Low
Area 8	Yes	Yes	Yes	Yes	No	Low

[1]Annual limit on intake of radionuclides in effluent discharge (10 CFR 20 Appendix B)

[2]Canadian Water Quality Guideline for the protection of aquatic life from long term exposure.

Table 3
Average Depth to the Water Table

Area of Interest	Average Depth to Water Table (ft)
Area 1	5.2
Area 2	5.2
Area 3	7.3
Area 4	5.2
Area 5	5.2
Area 6	3.3
Area 7	4.2
Area 8	5.2

Table 4
Initial Uranium Concentrations (µg/L) Assigned in the 1D Column Models

Model Layer Number	Depth Interval (ft, bgs)	Area 1	Area 2	Area 3	Area 4	Area 5	Area 6	Area 7	Area 8
1	0 - 0.5	30.2	46147.5	82.0	26.3	3449.5	440.2	568.9	23442.6
2	0.5 – 1.0	1794.7	134.4	923.9	87.3	3449.5	609.1	568.9	23442.6
3	1.0 – 1.5	1794.7	449.2	923.9	87.3	3449.5	609.1	568.9	23442.6
4	1.5 – 2.0	1794.7	134.4	923.9	103.3	3449.5	609.1	568.9	246.7
5	2.0 – 2.5	9.2	18.6	923.9	25.1	3449.5	67.1	568.9	36.6
6	2.5 – 3.0	9.2	18.6	3.4	25.1	3449.5	189.3	568.9	25.8
7	3.0 – 3.5	9.2	18.6	3.4	145.9	3449.5	426.2	568.9	25.8
8	3.5 – 4.0	9.2	18.6	3.4	145.9	47.0		568.9	25.8
9	4.0 – 4.5	9.2	18.6	3.4	59.8	47.0		568.9	25.8
10	4.5 – 5.0	9.2	5.5	3.4	59.8	36.4			18.9
11	5.0 – 5.5	9.2	5.5	3.4	59.8	36.4			18.9
12	5.5 – 6.0			3.4					
13	6.0 – 6.5			3.4					
14	6.5 – 7.0			3.4					
15	7.0 – 7.5			3.4					
16	7.5 – 8.0								

Notes:

1) Soil sampling results are not available for the gray highlighted cells. In these cases, concentrations were assigned in the model based on sampling results from the nearest interval where samples were collected.
2) The blue highlighted cells represent depth intervals that are typically below the water table.

Table 5
Results of 1D Column Modeling

Area of Interest	[1]Maximum Predicted Uranium Concentration in Pore Water (µg/L)	[2]Maximum Predicted Uranium Concentration in Groundwater (µg/L)
Area 1	9.2	0.5
Area 2	5.5	0.3
Area 3	3.4	0.2
Area 4	59.8	3.0
Area 5	36.4	1.8
Area 6	426.2	21.3
Area 7	568.9	28.4
Area 8	18.9	0.9

Note:

[1] The maximum uranium concentration in porewater represents the uranium concentration in leachate directly above the water table.

[2] The predicted uranium concentration in groundwater was calculated by applying a DAF of 20 to the maximum concentration in pore water.

Table 6
Summary for Reach Segments Where Groundwater Discharge is > 30 µg/L

Reach	Groundwater Discharge Rate (ft^3/d)	Total Uranium Concentration in Groundwater Discharge (ug/L)
WDD-1	0.15	36.3
WDD-2	0.09	37.5
WDD-3	0.24	41.5
CDD-1	0.07	36.7
S31DD-1	0.22	85.7
S16DD-1	0.29	55.8

ft^3/d = cubic feet per day

Table 7
Predicted Discharge and Uranium Concentrations for the West Drainage Ditch

Reach	Groundwater Discharge Rate (ft^3/d)	Total Uranium Concentration in Groundwater Discharge (µg/L)	[1]Estimated Cumulative Surface Water Baseflow (ft^3/d)	Calculated Concentration in Surface Water (µg/L)
1	1.19	9.1	1.19	9.0
2 (WDD-1)	0.15	36.3	1.34	12.0
3	0.48	18.3	1.82	13.7
4 (WDD-2)	0.09	37.5	1.91	14.8
5	0.70	18.4	2.61	15.8
6 (WDD-3)	0.24	41.5	2.84	17.9

[1] Calculated at the downgradient edge of the stream reach.

Table 8
Predicted Discharge and Uranium Concentrations for Central Drainage Ditch

Reach	Drainage Ditch	GW Discharge Rate (ft^3/d)	Total Uranium Concentration in Groundwater Discharge (µg/L)	[1]Estimated Cumulative Surface Water Baseflow (ft^3/d)	Calculated Concentration in Surface Water (µg/L)
8	Central	0.29	10.7	0.29	10.7
9	Central	0.07	36.7	0.36	15.7
10	Central	0.48	17.9	0.85	16.9
11	South 31	1.79	14.8	1.79	14.8
12	South 31	0.22	85.7	2.01	22.4
13	South 31	0.15	19.1	2.16	22.2
14	Central	1.53	5.7	4.54	15.7
15	South 16	0.73	8.3	0.73	8.3
16	South 16	0.29	55.8	1.03	21.9
17	South 16	0.72	17.1	1.75	19.9
18	Central	2.58	15.0	8.87	16.3

[1]Calculated at the downgradient edge of the stream reach.

APPENDIX A-2

NFSS CHLORINATED CONTAMINANT DEGRADATION CALCULATION – NATURAL ATTENUATION SOFTWARE VERSION 2

THIS PAGE INTENTIONALLY LEFT BLANK

NFSS Chlorinated Contaminant Degradation Calculation
Natural Attenuation Software Version 2
August 8, 2018

Note: Shading indicates program calucated value or condition

Hydrogeologic Data and Contaminant Transport Values				**Source**
	Maximum	**Average**	**Minimum**	
Hydraulic Conductivity [ft/yr]	10	3.3	0.04	2007 GW Model Tabble 2.4 (Max is estimated)
Hydraulic Gradient [ft/ft]	0.02	0.01	0 0001	Measured from GW Model Fig 2.27 and 2.28
Total Porosity [-]		0.35		Estimated from Fetter
Effective Porosity [-]		0.08		2007 GW Model, Table 4.7
Groundwater Vel. [ft/yr]	2.5	0.413	0.00	
		NAPL Source		
NAPL Source Length [ft]		63		Measured from 2011 RIR PCE Plume Figure 4.8
NAPL Source Width [ft]		66		Measured from 2011 RIR PCE Plume Figure 4.8
Contaminated Aquifer Thickness [ft]		15		2007 GW Model, Section 2.4.1
Distance to Point of Contact (POC) [ft]		361		Site boundary - Measured from PCE Plume Figure 4 8

Contaminant Concentration Profiles (12/7/2009)							**Source**
	Distance	**Total Chl. Eth.**	**PCE**	**TCE**	**cis-DCE**	**Vinyl Chl.**	
Well Name	**[ft]**	**[µg/L]**	**[µg/L]**	**[µg/L]**	**[µg/L]**	**[µg/L]**	
TWP933	0	576,400,000	561,000,000	15,400,000	BD	BD	USACE Database
MW930	158	74,730	64,200	9,860	670	BD	USACE Database
Redox Indicator Concentration Profiles (10/18/2011)							
	Distance	**Oxygen**	**Nitrate**	**Iron(II)**	**Sulfate**	**Redox**	
Well Name	**[ft]**	**[mg/L]**	**[mg/L]**	**[mg/L]**	**[mg/L]**	**Condition**	
415A	0	NS	0.16	1 2	1 200	SO4/CO2-red.	USACE 2016 Env Surv Tech Memo and Datbase
MW423	102	2.16	1	NS	670	Oxic	USACE 2016 Env Surv Tech Memo and Datbase
MW934	247	1.29	1.2	4 9	2,300	Oxic	USACE 2016 Env Surv Tech Memo and Datbase
MW948	285	1.56	0.39	NS	2,700	Oxic	USACE 2016 Env Surv Tech Memo and Datbase

Time of Stabilization(TOS) and Max Source Concentration Calculations						
			Source Reduction			
	Criteria		**Conc [µg/L]**			
Contaminant	**[µg/L]**	**Well**	**Current**	**Target**		
Total Chl. Eth.			576,400,000			
PCE	5	TPW933	561,000,000	6		
TCE	5	TPW933	15,400,000	6		
cis-DCE	5	MW930	670			
Vinyl Chl.	2	Insufficient Data				
Time of Stabilization [years]	**Breakthrough Time***				**Time to Equilibrium****	
	Maximum	**Average**	**Minimum**	**Maximum**	**Average**	**Minimum**
PCE	19,159,750	1,290.5	156 2	39,465,100	**2,658.2**	321.7
TCE	11,367,010	1,020.6	148 8	23,413,670	**2,102.3**	306.4
* - Time at which 50% of concentration reduction at the POC has been reached. Insufficient data to calculate cis-DCE and VC.						
** - Time at which the concentration has been reduced to the criterion at the POC. Insufficient data to calculate cis-DCE and VC.						

NFSS Chlorinated Contaminant Degradation Calculation
Natural Attenuation Software Version 2
August 8, 2018

Note: Shading indicates program calucated value or condition

Program Calculations					
Contaminant Source Specifications					
	Conc	**NAPL**			
Source Component	**Profile**	**Constituent**			
Total Chl. Eth.	True	True			
PCE	True	True			
TCE	True	True			
cis-DCE	True	True			
Vinyl Chl.	True	False			
Ethene	False	False			
Chloride	False	False			
Dispersion Parameters					
Estimated Plume Length [ft]	356.1				
Longitudinal Dispersivity [ft]	15.14				
Dispersivity Ratio [-]	20				
Transverse Dispersivity [ft]	0.76				
Sorption Parameters					
Fraction Org. Carbon [-]					
Maximum	0 0002				
Average	0 0001				
Minimum	0				
	Total Chl. Eth.	**PCE**	**TCE**	**cis-DCE**	**Vinyl Chl.**
Koc [L/kg]	126	364	126	65	57
Retardation Factor [-]					
Maximum	1.57	2.65	1.57	1.29	1.26
Average	1.16	1.47	1.16	1.08	1.07
Minimum	1.03	1.08	1.03	1.01	1.01
Attenuation Rates	**Total Chl. Eth.**	**PCE**	**TCE**	**cis-DCE**	**Vinyl Chl.**
NAC (Single Zone) [1/ft]	0 0564	0 0572	0 0463	N/A	N/A
Decay Rate [1/yr]					
Maximum	0 2617	0 2671	0.1971	N/A	N/A
Average	0 0432	0 0441	0 0325	N/A	N/A
Minimum	0.000	0.000	0.000	N/A	N/A

APPENDIX A-3

SURFACE WATER DISCHARGE ANALYSIS

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix A-3

Site Surface-Water Discharge Analysis

NFSS Balance of Plant Feasibility Study

INTRODUCTION

Section 1.7.9 of the FS discusses the condition of and risk from surface-water discharging from the NFSS via the Central Drainage Ditch (CDD). The section concludes that no further action is warranted to protect ecological or human-health. The sampling data used in the original 2007 risk assessment has been augmented with additional environmental sampling data via the Environmental Surveillance Program (ESP). Consequently, the USACE presents the following analysis on the current surface-water dataset to exemplify uniformity with the 2007 assessment.

SITE CONDITIONS

The ephemeral nature of most on-site ditches does not afford suitable aquatic habitat to sustain sensitive freshwater life, nor is the NFSS managed for such ecological purposes. The ditch network drains into the northward flowing CDD, which can be nearly ephemeral during the summer months and not suitable for aquatic habitat. Western-most portions of the NFSS contribute runoff to the West Drainage Ditch (WDD) that perennially flows along the western border and then through the northwestern portion of the site. The WDD has a significantly larger watershed than the CDD, so ephemeral flow rates appear notably higher in the WDD.

The two ditches join about one mile north of the site and together discharge into Four Mile Creek, approximately three miles north of the NFSS (Figure 1). Four Mile Creek is a New York State Class B water body from Lake Ontario to approximately 1 mile upstream (or to the bridge crossing under Route 18); Class B waters are best used for swimming, other recreation, and fishing. Upstream of this portion, the creek becomes a New York State Class C water body, including at the confluence with the CDD; Class C waters are best used for fishing.

Uranium concentrations that discharge from the site via the CDD have been monitored for the past twenty years at location SW-011, which is at the northern border of the NFSS and the dominant discharge point for site (Figure 2). The information regarding the site discharge is summarized below.

1. Water samples from the WDD (i.e., locations WDD-1, WDD-2, and WDD-3 of the ESP) normally reflect background ranges for uranium, so any site contributions appear fully dispersed in the flow and are not degrading the surface-water resource.
2. A Pro-UCL analysis of 40 uranium observations (including duplicates) at CDD location SW-011 (Table 1) since 1997 indicates a normal distribution with the following characteristics:
    a. Data range of 3.0 to 19.6 micrograms per liter (µg/l)
    b. Average = 9.0 µg/l

c. Median = 8.6 µg/l
d. Geometric mean = 8.0 µg/l
e. Upper 95% confidence limit = 10.2 µg/l
f. The Mann-Kendall trend analysis = No Trend
g. Three (3) values are above 15 µg/l (7.5% of the data)

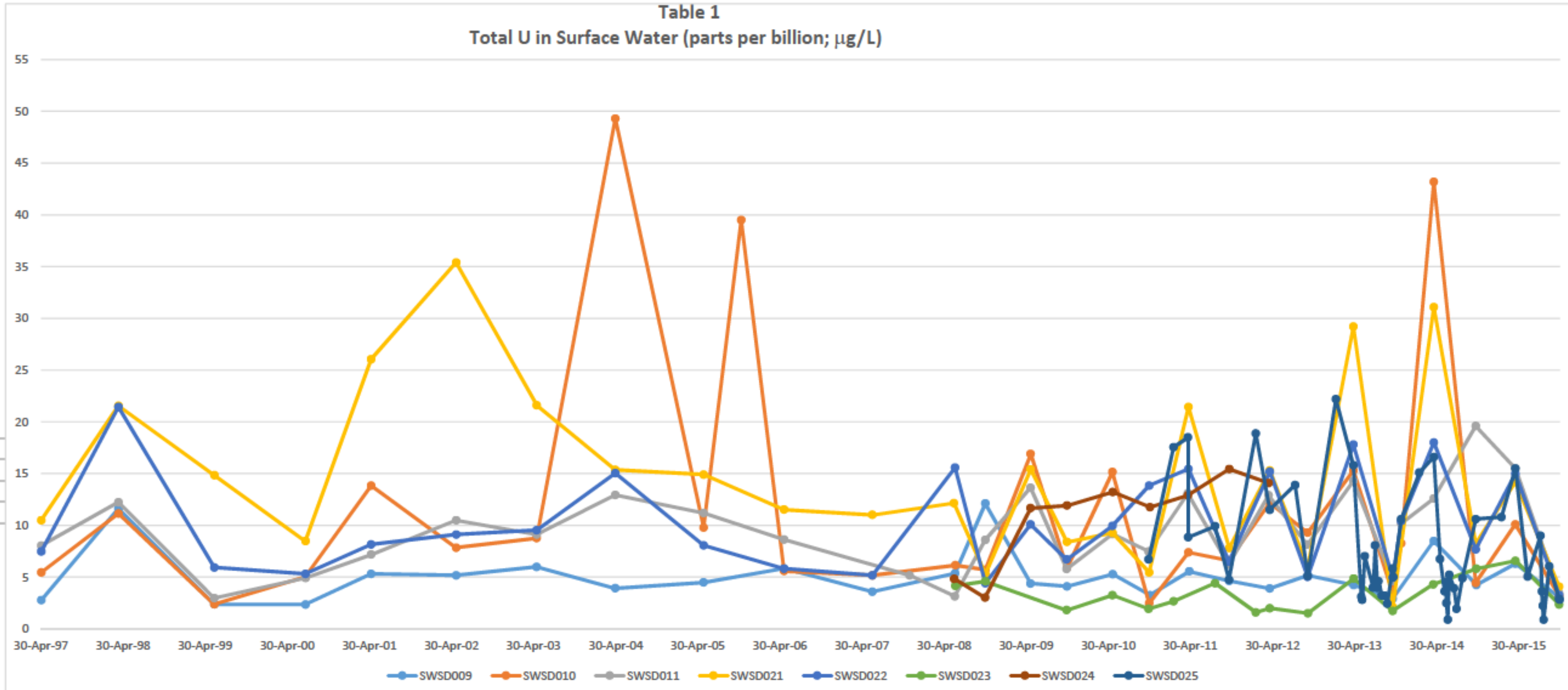
3. Uranium in wet-season discharge normally exceeds dry-season values by about 7 µg/l, indicating runoff from saturated surface soils contributes more uranium to the environment than impacted groundwater (as baseflow).
4. Groundwater modeling indicates site-wide baseflow to the ditches contributes approximately 9 cubic feet per day (~67 gallons per day) to the flow at SW-011 due to the clayey soils and very low flow gradients (see Appendix A-1).
5. This predicted baseflow includes discharges from on-site legacy plumes that contribute between 0.09 cubic feet per day (cfd) to 0.29 cfd (0.7 to 2.2 gallons per day) and have maximum uranium concentrations between 36.3 µg/l and 85.7 µg/l.
6. However, the predictions indicate that the cumulative site-wide baseflow discharging at SW-011 (i.e., 9 cfd) would be approximately 16 µg/l of uranium due to dispersion by other low-concentration baseflow contributions from the site. This value is further dispersed by overland flow into the CDD, which is not accounted for in the model.
7. Surface water discharge rates from the site are not quantified, although flow observations at SW-011 indicate that surface water is present throughout the year and disperses baseflow inputs to below screening levels, as evident in SW-011 data. The observed discharge at SW-011 is likely an artifact of the delayed runoff from site areas that pond precipitation on the flat NFSS topography.
8. The surface-water data and groundwater modeling both indicate that these current conditions should propagate into the future (i.e., the current conditions should persist throughout a 1,000-year performance period).

CONCLUSION

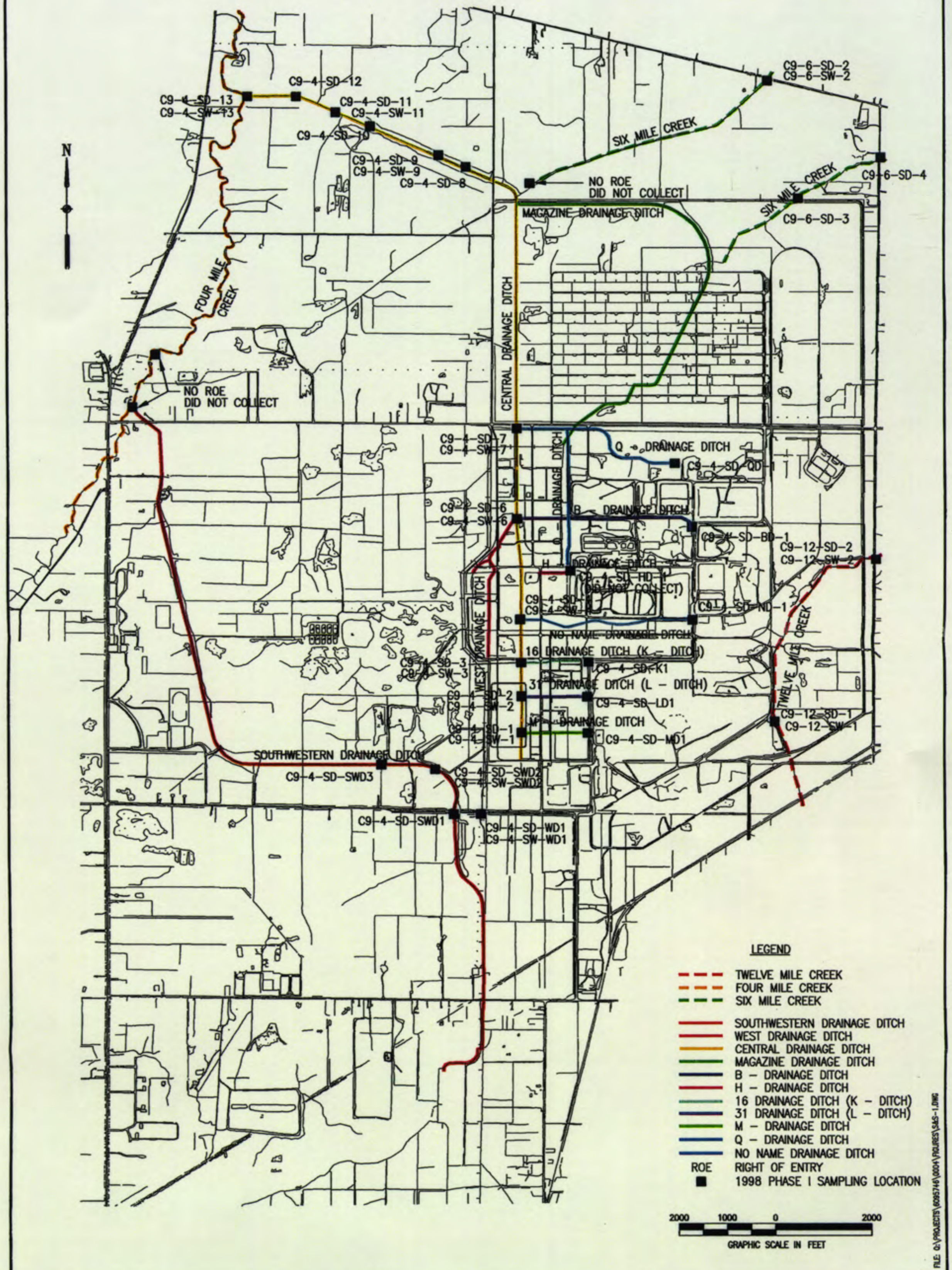
The CWQG discussion in FS Section 1.7.9 articulates a chronic exposure value of 15 µg/l and an acute value of 33 µg/l for the protection of aquatic life from exposure to total uranium (CCME 2011). Data from SW-011 have exceeded 15 µg/l only three times (or 7.5% of the data) and these samples exhibited high turbidity, but never exceeded 33 µg/l.

These observed concentrations of uranium at SW-011 will be further dispersed where the CDD and WDD coalesce about one mile from the NFSS. The USACE expects the CDD discharge to be highly mixed and the cumulative flow to reflect near background conditions (as seen in the WDD). Additional drainage from off-site properties will augment the dispersion (i.e., runoff from tributary ditches along the two-mile reach before joining Four Mile Creek), as well as additional flow in Four Mile Creek. The resulting concentrations in Four Mile Creek are expected to reflect background and not exceed the CWQG-based uranium water quality guidelines. If the uranium concentration at SW-011 rose to exceed the CWQG of 33 µg/l, then the mixing capacity of the WDD flow, along with mixing with Four Mile Creek flow, would logically still manifest a near-background condition in Four Mile Creek. Consequently, surface water continues to not be a media of concern since current conditions are predicted to occur throughout a 1,000-year period of performance.

THIS PAGE INTENTIONALLY LEFT BLANK



		SWSD009	SWSD010	SWSD011	SWSD021	SWSD022	SWSD023	SWSD024	SWSD025
UCL95	**(ug/L)**	**5.88**	**15.52**	**10.66**	**17.95**	**11.63**	**4.07**	**15.4**	**9.08**
COUNT		27	29	28	27	28	16	9	47
MIN	(ug/L)	2.36709	2.376	2.97	2.11	3.26	1.51	3.0294	0.881
MAX	(ug/L)	12.1176	49.302	19.6	35.4	21.4434	6.58	15.444	22.2
MEAN	(ug/L)	5.05767	11.7085	9.33693	14.3206	10.037	3.35543	10.9895	7.51316
Distribution		gamma	gamma	normal	gamma	normal	normal	*data set*	gamma
		lognormal	lognormal	gamma	lognormal	gamma	gamma	*too small*	lognormal
				lognormal		lognormal	lognormal	use max	
		SWSD009	SWSD010	SWSD011	SWSD021	SWSD022	SWSD023	SWSD024	SWSD025
		no trend	no trend	no trend	decreasing	no trend	no trend	increasing	decreasing



EA ENGINEERING, SCIENCE, AND TECHNOLOGY

BASEWIDE RI/FS
LAKE ONTARIO ORDNANCE WORKS
NIAGARA COUNTY, NEW YORK

COMPONENT 9 (SURFACE DRAINAGE)
SEDIMENT AND SURFACE-WATER
SAMPLING LOCATIONS

PROJECT MGR.	DESIGNED BY	DRAWN BY	CHECKED BY	DATE	SCALE	PROJECT NO.	FILE NAME	DRAWING NO.	FIGURE
HGP	DAB	FDV	SMS	MAY 1999	AS SHOWN	60957.46	S&S-1	-	13-1

Figure 1

Legend

Surface Water/Sediment Sample Location

NFSS Site Boundary

0 175 350 700 Feet

US Army Corps of Engineers Buffalo District

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

SURFACE WATER/SEDIMENT SAMPLING LOCATION MAP

Name: 130321_SWaterSed_Aerial.mxd
Drawn By: H5TDESPM
Date Saved: 30 Apr 2013
Time Saved: 12:26:07 PM

NIAGARA FALLS STORAGE SITE
LEWISTON, NEW YORK

FIGURE 2

Document Path: K:\NFSS\PGIS\ArcMap\Sampling_Locations\130321_SWaterSed_Aerial.mxd

APPENDIX A-4

EVALUATION OF POTENTIAL IMPACT OF TOTAL URANIUM GROUNDWATER SEEPAGE TO SURFACE WATER

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix A-4

CUES Evaluation of the Potential Impact of Total Uranium Groundwater Seepage to Surface Water

NFSS Balance of Plant

November 28, 2017

In April 2017, HydroGeoLogic, Inc. (HGL) completed a three-phase study to evaluate the potential impact of uranium in soil and groundwater underlying the NFSS on surface water within the site drainage ditches (*TECHNICAL MEMORANDUM EVALUATION OF GROUNDWATER – SURFACE WATER INTERACTION NIAGARA FALLS STORAGE SITE, LEWISTON, NEW YORK,* April 24, 2017. This study is provided in Appendix A-1.

In Phase 1, partitioning calculations were performed to determine whether uranium concentrations in soil could lead to an exceedance of surface water criteria in the NFSS drainage ditches. Phase 1 also included modeling (particle tracking) to identify areas of shallow groundwater that could migrate to the ditches within 1,000 years. The Phase 1 results indicated that there is a low probability that uranium in NFSS soil will impact surface water quality in the drainage ditches.

In Phase 2, 1D transport modeling was conducted to further evaluate whether uranium in soil could potentially lead to exceedances of surface water criteria. The Phase 2 simulations predicted that there will be little uranium migration through the vadose zone. The Phase 2 results also suggested that the elevated uranium in groundwater may be derived from legacy concentrations caused by historic sources and/or direct contact of saturated groundwater with soils containing elevated uranium, which may occur seasonally via fluctuating water levels.

In Phase 3, the distribution of uranium in groundwater from the Balance of Plant investigation was input to the existing 3D groundwater flow and solute transport model and the model was used to predict potential groundwater discharge and uranium migration to on-site surface water ditches. Six localized areas of groundwater discharge to the ditches were identified where uranium levels exceeded 30 µg/l, but cumulative uranium concentrations in surface water are not expected to exceed reference values such as the drinking water maximum contaminant level (MCL) of 30 µg/l.

To supplement the HGL study, CUES performed an evaluation of the seepage of uranium-impacted groundwater to surface water using the highest detected total uranium groundwater concentration (7,080 µg/l), which was measured in a groundwater sample from investigative excavation IE07 in December of 2012. This value, in combination with its relative proximity to the South 31 ditch, was considered to be the worst-case condition for groundwater to impact surface water in the Balance of Plant (i.e., highest total uranium concentration and close proximity to a surface water body). The objective of this evaluation was to determine the resulting total uranium concentration in the ditch assuming typical ditch flow and the absence of uranium in the ditch surface water (i.e., 0 µg/l total uranium background concentration).

In performing the evaluation, several existing conditions were determined and are presented below and in Table 1:

1. The South 31 Ditch drainage area of 956,494 square feet was measured using recent LiDAR surface topography survey (Figure 1).
2. The LiDAR survey was also used to measure the shortest distance of the IE07 sample location to South 31 Ditch (125 feet) shown on Figure 1.
3. The average run-off flow in the South 31 ditch was calculated assuming no infiltration occurred over the drainage area. The calculation was performed by multiplying the drainage area by the annual rainfall of 29.70 inches, as presented in Table 2.2 of the Groundwater Flow and Contaminant Transport Model Report, December 2007. The average run-off of 33.69 gallons per minute was assumed to be non-impacted for this evaluation (0 µg/l total uranium).
4. The average groundwater elevation of 314.76 feet in the IE07 area was taken from water level measurements in well OW11B as presented in the NFSS 2013 Environmental Surveillance Technical Memorandum. Measurements from four events (February, April, August and October 2013) were used to calculate the average groundwater elevation.

5. The length of South 31 ditch sidewall receiving groundwater from the IE07 uranium-impacted area was assumed to be 100 feet (Figure 1). Based on the ditch base elevation being 312 feet and the average (rounded) groundwater elevation of 315 feet, a discharge depth of 3 feet was used. This represents a flux area of 300 square feet to the ditch from IE07 uranium-impacted area.
6. The groundwater hydraulic gradient from the IE07 location (OW11B) to the ditch was calculated at 0.02206 ft/ft by taking the drop of the averaged groundwater elevation of 314.76 feet at OW11B to the South 31 ditch elevation of 312 feet over the 125 foot distance to South 31 ditch.
7. The hydraulic conductivity (K) 0.19 feet per day was based on Table 2.5 of the Groundwater Flow and Contaminant Transport Model Report, December 2007.
8. The flux of groundwater seepage to the South 31 ditch was calculated by multiplying the gradient, hydraulic conductivity, and the flux area. The seepage results in a volume of 1.26 cubic feet per day or 0.007 gallons per minute on average per year.

Based on these values, the concentration of total uranium in the surface water in South 31 Ditch adjacent to the IE07 area was calculated to be 1.37 µg/l. This assumes a worst case groundwater source (7,080 µg/l) and 0 µg/l total uranium background concentration in the surface water. This simplified evaluation supports the HGL findings that seepage of uranium in groundwater does not result in surface water exceedances of reference values, such as the drinking water MCL.

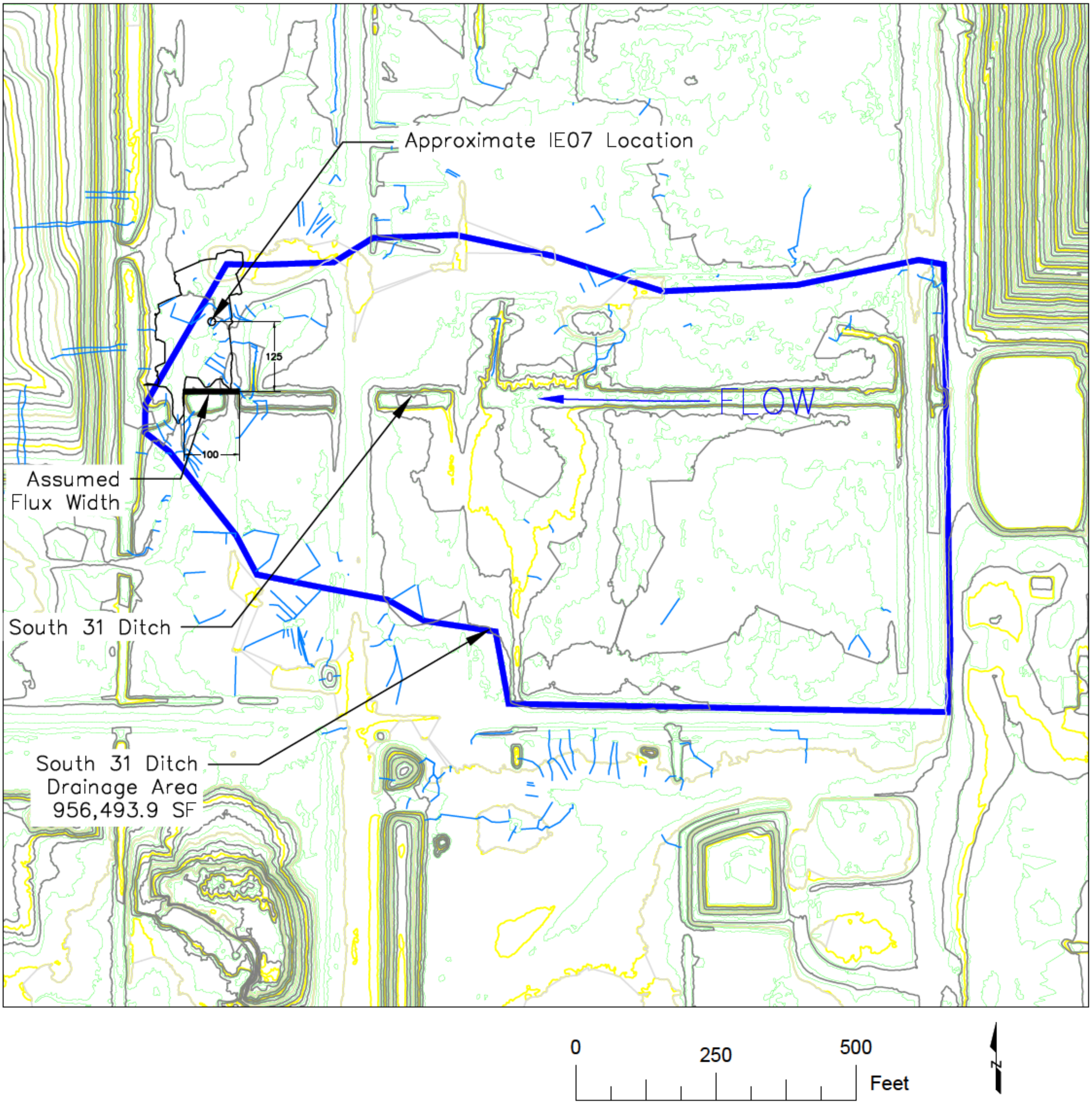


FIGURE 1

CTI-URS
Environmental Services, LLC

LiDAR Contours with S31 Ditch Drainage Area Shown

Table 1
Groundwater Seepage to Surface Water
Total Uranium
NFSS Balance of Plant Feasibility Study

Given	Value	Unit	Other	Comments/Source
Max Total U concentration in groundwater (Cgw)	7,080.00	ug/L		Excavation IE07 groundwater sample collected 12/4/12
South 31 Ditch on site drainage area	956,493.90	square feet		Figure 1 (LiDAR)
Distance to South 31 Ditch	125	feet		Figure 1 (LiDAR)
South 31 Ditch elevation	312	feet		LiDAR
Groundwater elevation at OW11B Near IE07	316.06	feet	2/6/2013	NFSS 2013 Environmental Surveillance Tech Memo
	315.70	feet	4/23/2013	NFSS 2013 Environmental Surveillance Tech Memo
	313.76	feet	8/13/2013	NFSS 2013 Environmental Surveillance Tech Memo
	313.51	feet	10/10/2013	NFSS 2013 Environmental Surveillance Tech Memo
Average GW water elevation (IE07)	314.76	feet		
Rainfall	29.70	inches annualy		Table 2.2, groundwater flow and contaminant transport modeling report, December 2007, Wehran 1990
	2.48	feet annually		
Average run-off flow to S31 Ditch if no infiltration occurs (Qswi)	2,367,322.40	cubic feet/year		Calculated using above data
	33.69	gallons per minute		
Flux to South 31 Ditch from groundwater seepage(Qgw)	100	feet	Width of discharge	Figure 1 (LiDAR)
	3	feet	Depth of discharge	Average groudnwater elevation (rounded) of 315 feet minus ditch bottom elevation (312 feet)
	300	square feet	Area (a)	
	0.02208	foot/foot	Gradient (i)	Groundwater elevation of 314.76 to
	0.19	feet/day	Hydraulic Conductivity (K)	Table 2.5, Groudnwater flow and contaminant transport modeling report, December 2007, Wehran 1990
	1.26	cubic feet/day	Flux (Kia)	Calculated using above data
	0.0065	gallons per minute	Flux	Average per year
Assumed Total U in surface water (SWi)	0	ug/L		
Esitmated final surface water concentrations after seep	**Value**	**Unit**	**Other**	**Source**
Total U in surface water after mixing (Cswf)	1.37	ug/L		Cswf=(Cgw*Qgw+Cswi*Qswi)/(Qgw+Qswi)

Notes:
ug/L - micrograms per liter

APPENDIX A-5

GROUNDWATER INFLOW TO EXCAVATION CALCULATION

THIS PAGE INTENTIONALLY LEFT BLANK

Table 1

Groundwater Inflow to Excavation

NFSS Balance of Plant Feasibility Study

Given		Value	Unit	Other	Comments/Source
In-Situ Soil Volume		3,302.00	CY		Table 2-3
Surface Area		20,153.00	Square Feet (SF)		GIS Data
		80.1	feet	Radius	Estimated from circle and area
Depth Calculated		4.42	feet		Use 5 feet for Inflow Calculations.
Hydraulic Conducttivity		0.19	feet/day	Hydraulic Conductivity (K)	Table 2.5, Groundwater flow and contaminant transport modeling report, December 2007, Wehran 1990
Groundwater Inflow Equations					
Q = (pi)K(H^2-h^2)/ln(R/rp) (see	Q	= groundwater inflow (m^3/day)			
	K	= permeability of the unconfined aquifer (m/day)			
R = 5755(HK)^0.5 (see note)	H	= potentiameteric surface or initial water table elevation (m)			
	R	= radius of influence (m)			
	h	= potentiometric surface elevation at a specific point (m)			
	rp	= radius of the pit at desirerd level (m)			
Input values					
	K	0.19	ft/day	0.06	m/day
	H	5	ft	1.524	m
	h	0	ft	0	m
	rp	80.1	ft	24.41	m
	R	5724.54	ft	1740.26	m
Calculated Groundwater Inflow	Q	7.1	ft^3/day	0.2	m^3/day
Days excavation is left open	62	days			
Accumulated Water	3294.9	gallons	440.2	CF	

Notes:

Based on Krusseman and De Ridder (1979) and Singh et al. (1985).

APPENDIX B

LEAD PRG DEVELOPMENT MEMORANDUM

THIS PAGE INTENTIONALLY LEFT BLANK

AECOM
625 West Ridge Pike,
Suite E-100
Conshohocken, PA 19428
www aecom.com

610-832-3500 tel
610-832-3501 fax

Memorandum

To	[redacted], AECOM Project Manager	Page	1
Subject	**Lead PRG Development –** Site-Wide, Niagara Falls Storage Site		
Cc		AECOM: 60440939	
From	[redacted], AECOM Principal Risk Assessor		
Date	June 6, 2017		

A baseline risk assessment (BRA) was prepared in 2007 for the Niagara Falls Storage Site located in Lewiston, New York. As part of the 2007 BRA, lead was identified as a constituent of concern (COC) in soil, sediment and groundwater. Preliminary remediation goals (PRGs) were derived for lead in soil. As detailed in the 2007 BRA, PRGs for soil were also applied to sediment. PRGs were not derived for lead in groundwater. In support of the Feasibilit Study and at the request of the US Army Corps of Engineers (USACE), AECOM has reviewed the 2007 PRGs to identify portions of the PRG derivation that may require revision and to identify appropriate PRGs for other media (groundwater). The purpose of this memorandum is to detail the findings of this evaluation.

Lead PRG Background

The 2007 BRA identied lead as a COC for the following receptors, exposure units and media associated with current and future industrial land use.

Receptor	Exposure Unit	Medium
Construction Worker	EU 2, EU 4	Soil
Construction Worker	EU 16	Sediment
Construction Worker	EU 17	Groundwater
Maintenance Worker	EU 4	Soil

PRGs for lead in soil and sediment were derived using EPA's Adult Lead Model (EPA, 2003). The EPA model is designed to estimate an average (arithmetic mean) soil or sediment lead concentration that is not expected to result in a greater than 5% probability that the fetus of a woman of child-bearing age has a blood lead (PbB) exceeding the level of concern of 10 micrograms per deciliter (µg/dL). Therefore, the soil or sediment lead concentration so derived is considered protective of all workers, including pregnant women.

EPA ALM default values were used in the soil/sediment PRG derivation with the exception of the exposure frequency and soil ingestion rate. Values for the soil ingestion rate and exposure frequency were consistent with those used in the risk characterization calculations for other constituents. Derived soil/sediment PRGs for maintenance workers and construction workers were 420 mg/kg and 88 mg/kg, respectively.

The Federal Maximum Contaminant Level (MCL) (15 µg/L) was used in the BRA as the risk screening level for groundwater and surface water. Total lead was detected in EU 15, EU 16 and EU 17 surface water above the MCL. In addition to construction workers and maintenance workers identified earlier, receptors also associated with EUs 15 and 17 surface water include industrial workers and recreational users/trespassers (adult/adolescent). Receptors for EU 16 surface water are limited to construction workers. However, as discussed in the 2007 BRA, lead was not identified as a COC in groundwater or surface water. Although the lead exposure point concentration (EPC) exceeded the drinking water action level, it was not a COC for these receptors because groundwater and surface water ingestion is incidental (three orders of a magnitude than that assumed in the drinking water action level derivation). Therefore, groundwater and surface water PRGs were not developed.

Lead PRG Approach and Methodology

Since the PRGs were derived in 2007, default values in the ALM have been updated by EPA (in 2009 and 2016). As a result, the soil and sediment PRGs were re-calculated using EPA's baseline PbB (PbBo) and geometric standard deviations (GSDi) for PbB levels recommended by EPA in the most recent August 2016 update of the ALM (EPA, 2016). Likewise, EPA recommends the use of central tendency exposure factors for input in the ALM because the model output is an estimate of the 95% (i.e., an RME) of PbB levels. As a result, a soil ingestion rate of 100 milligrams per kilogram (mg/kg) was used in the PRG derivation consistent with recommendations by EPA's Technical Review Workgroup (TRW) for Lead rather than the high-end soil ingestion rate of 480 mg/kg used in the 2007 BRA. Consistent with the BRA approach, 1/10 the soil ingestion rate was assumed for the incidental sediment ingestion rate.

Tables 1 and 2 detail the equations, model input parameters, and results of the ALM for the for the soil and sediment PRGs, respectively.

Consistent with EPA recommendations, the ALM is not recommended for use in exposure scenarios with an exposure frequency of less than 1 day per week. Infrequent exposures (i.e., less than 1 day per week) over a minimum duration of 90 days would be expected to produce oscillations in blood lead concentrations associated with the absorption and subsequent clearance of lead from the blood between each exposure event (EPA, 2009b). The exposure factors for worker exposure to sedment met the minimum requirements of the ALM, but being close to the minimum the PRG generated demonstrates that exposure to lead in sediment is likely not to be a concern due to the infrequent exposures.

As noted above, due to the incidental surface water ingestion combined with the infrequent exposure frequency, the derivation of a PRG for surface water was not previously conducted. However, to provide a comparison criteria for the Feasiblity Study (FS), the ALM was modified to derive a PRG protective of construction/maintenance worker or trespasser exposure. However, the ALM was not used to estimate a PRG for potential exposures by industrial workers (due to the exposure frequency of 26 days per year which does not meet the model threshold). As a conservative measure, the PRG generated for construction/maintenance workers was used to assess industrial worker exposure.

Table 3 details the the equations, model input parameters, and results of the ALM for the for the surface water/groundwater PRG. Since the exposure frequency (52 days per year) and ingestion rate was the same for each of the receptors in the BRA, only one iteration of the model was needed.

PRG Summary

A summary of the updated PRGs is provided below. A comparison to the 2007 values (where applicable) is also shown.

Receptor	2007 PRG (mg/kg)	Updated Soil PRG (mg/kg)	Updated Sediment PRG (mg/kg)	Updated Surface Water PRG (mg/L)
Construction Worker	88	1,199	57,640	144,000
Maintenance Worker	420	1,199	57,640	144,000
Trespasser (Adult/Adolescent)	-	-	-	144,000

References

EPA. 2016. Update of the Adult Lead Methodology's Default Baseline Blood Lead Concentration and Geometric Standard Deviation Parameters and the Integrated Exposure Uptake Biokinetic Model's Default Maternal Blood Lead Concentration at Birth Variable. OSWER 9285.6-55. August.

EPA. 2009. Adult Lead Methodology (ALM) Spreadsheet. U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee. Accessed online at: http://www.epa.gov/superfund/health/contaminants/lead/products.htm#alm. June 21.

EPA. 2003. Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil. EPA-540-R-03-001. Technical Review Workgroup for Lead. Washington, DC. January 2003.

THIS PAGE INTENTIONALLY LEFT BLANK

Tables

THIS PAGE INTENTIONALLY LEFT BLANK

Table 1
Adult Lead Model, Construction Worker and Maintenance Worker Exposure to Soil
NFSS - USACE

Calculations of Preliminary Remediation Goals (PRGs)
U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee
Version date 6/21/09

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 2007-2012	Reference
$PbB_{fetal, 0.95}$	95^{th} percentile PbB in fetus	ug/dL	10	Default
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	Default
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4	Default
GSD_i	Geometric standard deviation PbB	--	1.7	EPA currently recommended default value - EPA, 2016
PbB_0	Baseline PbB	ug/dL	0.7	EPA currently recommended default value - EPA, 2016
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.100	TRW recommended value for construction workers
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12	Default
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	250	Table 2.3 in 2007 Baseline Risk Assessment
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365	Default
PRG		**ppm**	**1,199**	

Where:

$$PRG = \frac{(PbB_{adult,central,goal} - PbB_0) \times AT_{S,D}}{(BKSF \times IR_s \times AF_{S,D} \times EF_{S,D})}$$ (Equation 4 - EPA, 2003)

$$PbB_{adult,central,goal} = \frac{PbB_{fetal,0.95}}{GSD_i^{1.645} \times R_{fetal/maternal}}$$ (Equation 2 - EPA, 2003)

USEPA, 2003. *Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil*
EPA-540-R-03-001, OSWER Dir #9285.7-54. January (with 2009 update).

Table 2
Adult Lead Model, Construction Worker and Maintenance Worker Exposure to Sediment
NFSS - USACE

Calculations of Preliminary Remediation Goals (PRGs)
U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee
Version date 6/21/09

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 2007-2012	Reference
$PbB_{fetal, 0.95}$	95th percentile PbB in fetus	ug/dL	10	Default
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	Default
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4	Default
GSD_i	Geometric standard deviation PbB	--	1.7	EPA currently recommended default value - EPA, 2016
PbB_0	Baseline PbB	ug/dL	0.7	EPA currently recommended default value - EPA, 2016
IR_S	Soil ingestion rate (including soil-derived indoor dust)	g/day	0.010	1/10 of soil ingestion rate
$AF_{S, D}$	Absorption fraction (same for soil and dust)	--	0.12	Default
$EF_{S, D}$	Exposure frequency (same for soil and dust)	days/yr	52	Site-specific value, assumes 1 day per week on average for 52 weeks per year
$AT_{S, D}$	Averaging time (same for soil and dust)	days/yr	365	Default
PRG		**ppm**	**57,640**	

Where:

$$PRG = \frac{(PbB_{adult,central,goal} - PbB_0) \times AT_{S,D}}{(BKSF \times IR_s \times AF_{S,D} \times EF_{S,D})}$$ (Equation 4 - EPA, 2003)

$$PbB_{adult,central,goal} = \frac{PbB_{fetal,0.95}}{GSD_i^{1.645} \times R_{fetal/maternal}}$$ (Equation 2 - EPA, 2003)

USEPA, 2003. *Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil* EPA-540-R-03-001, OSWER Dir #9285.7-54. January (with 2009 update).

Table 3
Adult Lead Model, Groundwater/Surface Water Exposure
NFSS - USACE

Calculations of Preliminary Remediation Goals (PRGs)
U.S. EPA Technical Review Workgroup for Lead, Adult Lead Committee
Version date 6/21/09

Variable	Description of Variable	Units	GSDi and PbBo from Analysis of NHANES 1999-2004	Reference
$PbB_{fetal,\ 0.95}$	95th percentile PbB in fetus	ug/dL	10	Default
$R_{fetal/maternal}$	Fetal/maternal PbB ratio	--	0.9	Default
BKSF	Biokinetic Slope Factor	ug/dL per ug/day	0.4	Default
GSD_i	Geometric standard deviation PbB	--	1.7	EPA currently recommended default value - EPA, 2016
PbB_0	Baseline PbB	ug/dL	0.7	EPA currently recommended default value - EPA, 2016
IRw	Water Ingestion Rate	L/day	0.0024	Table 2.3 in 2007 Baseline Risk Assessment
AFw	Water Absorption fraction	--	0.20	Default
EFw	Exposure frequency	days/yr	52	Site-specific value, assumes 1 day per week on average for 52 weeks per year
ATw	Averaging time	days/yr	365	Default
PRG		**ppm**	**144,099**	

Where:

$$PRG = \frac{(PbB_{adult,central\ goal} - PbB_0) \times AT_W}{(BKSF \times IRw \times AFw_{,D} \times EF_{W,D})} \quad \text{(Equation 4 - EPA, 2003)}$$

$$PbB_{adult,central,goal} = \frac{PbB_{fetal,0.95}}{GSD_i^{1.645} \times R_{fetal/maternal}} \quad \text{(Equation 2 - EPA, 2003)}$$

USEPA, 2003. *Recommendations of the Technical Review Workgroup for Lead for an Approach to Assessing Risks Associated with Adult Exposures to Lead in Soil*
EPA-540-R-03-001, OSWER Dir #9285.7-54. January (with 2009 update).

APPENDIX C

EVALUATION OF POTENTIAL ARARs IDENTIFUED BY NYSDEC

THIS PAGE INTENTIONALLY LEFT BLANK

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION

Division of Environmental Remediation, Remedial Bureau A
625 Broadway, 12th Floor, Albany, NY 12233-7015
P: (518) 402-9625 I F: (518) 402-9627
www.dec.ny.gov

August 31, 2016

[redacted]
FUSRAP Project Manager
Department of the Army
Buffalo District, Corps of Engineers
1776 Niagara Street
Buffalo, New York 14207-3199

[redacted]

The New York State Department of Environmental Conservation (Department) is in receipt of your July 28, 2016 letter requesting that the Department provide all potential ARARs that addresses both chemical and radiological constituents for the Feasibility Study for the Balance of Plant and Groundwater Operable Units at the Niagara Falls Storage Site, Niagara County New York. Enclosed is this Department's list of State ARAR's which should be included and/or considered.

Please be aware that DEC is currently in the process of drafting NYCRR Part 384 (Cleanup Criteria for Remediation of Sites Contaminated with Radioactive Material), which will propose a 25 mRem/year effective dose equivalent clean up limit. Once promulgated (scheduled for 2017), this regulation will also be an ARAR.

If you have any questions, please contact [redacted]

Sincerely,

[redacted]

Director
Remedial Bureau A

ecc: [redacted]

State ARAR's for the Feasibility Study and Balance of Plant study area at the Niagara Falls Storage Site

State ARARs specific to radiation would include DER-38 (formerly DSHM-RAD-05-01 and TAGM 4003

Other suggested State ARARs are as follows:

6 NYCRR Part 360 - Solid Waste Management Facility Regulations and Environmental Conservation Law. :

6 NYCRR Part 375 - Inactive Hazardous Waste Disposal Site Remedial Program

6 NYCRR Part 370 - Hazardous Waste Management System: General

6 NYCRR Part 371 -Identification and Listing of Hazardous Wastes

6 NYCRR Part 372 - Hazardous Waste Manifest System and Related Standards for, Generators, Transporters and Facilities

6 NYCRR Part 376 - Land Disposal Restrictions

6 NYCRR Subpart 373-1 -Hazardous Waste Treatment, Storage and Disposal Facility Permitting Requirements

6 NYCRR Subpart 373-2 - Final Status Standards for Owners and Operators of Hazardous Waste Treatment Storage and Disposal Facilities

6 NYCRR Subpart 373-3 -Interim Status Standards for Owners and Operators of Hazardous Waste Facilities

6 NYCRR Part 380 - Rules and Regulations for the Prevention and Control of Environmental Pollution from Radioactive Materials

6 NYCRR Part 702.15(a), (b), (c), (d), (e) & (f)

6 NYCRR Part 700-706 - NYSDEC Water Quality Regulations for Surface Waters and Groundwater

6 NYCRR Part 750-757 - Implementation of NPDES Program in NYS

6 NYCRR Part 608 - Use and Protection of Waters

6 NYCRR Part 200 (200.6) - General Provisions

6 NYCRR Part 211 (211.1) - General Prohibitions

6 NYCRR Part 364 - Waste Transporter Permits

Environmental Conservation Law Article 23, Title 27, Land Reclamation Law and 6 NYCRR Parts 420 - 426 (may apply to mining clay for the cover)

10 NYCRR Part 5 -Drinking Water Supplies

10 NYCRR Part 170 - Water Supply Sources

19 NYCRR Part 600 - Department of State, Waterfront Revitalization and Coastal Resources Act Regulations

THIS PAGE INTENTIONALLY LEFT BLANK

USACE RESPONSE TO NYSDEC-RECOMMNDED ARARS

SUGGESTED ARAR	USACE RESPONSE
DER-38	DER-38 is not promulgated, and therefore is not an ARAR.
6 NYCRR Part 360	6 NYCRR 360 regulates solid waste management facilities located partially or wholly within the State of New York. This regulation applies to all solid waste other than low-level radioactive waste and naturally-occurring and accelerator-produced radioactive materials (NARM) waste, and disposal activities involving those wastes. This regulation does not meet the definition of an ARAR, as that term is defined in CERCLA or the NCP, because it does not contain substantive criteria pertaining to the hazardous substances or pollutants and contaminants or the circumstances of their release at the site. However, any substantive requirements of the regulation that may apply to other matters will be complied with during the course of the CERCLA action.
6 NYCRR Part 370	6 NYCRR 370 provides definitions of terms and general standards applicable to Parts 370 through 376, and 376. The regulation also sets forth the regulations that the department will use in making information it receives available to the public and sets forth the requirements that generators, transporters, or owners or operators of treatment, storage, or disposal facilities must follow to assert claims of business confidentiality with respect to information that is submitted to the department under Parts 370 through 374 and 376. This regulation does not meet the definition of an ARAR, as that term is defined in CERCLA or the NCP, because it does not contain substantive criteria pertaining to the hazardous substances or pollutants and contaminants or the circumstances of their release at the site. Instead, the regulation pertains to hazardous waste. MED/AEC materials are not hazardous waste. However, any of the substantive requirements of the regulation that may apply to other matters will be complied with during the course of the CERCLA action.
6 NYCRR Part 371	6 NYCRR 371 establishes the procedures for identifying those solid wastes which are subject to regulation as hazardous wastes under Parts 370 through 373, and 376. However, even though a given material is defined as a hazardous waste under this Part, it may be exempt from one or more of the substantive provisions of those Parts, as specified in each respectively.

USACE RESPONSE TO NYSDEC-RECOMMNDED ARARS

SUGGESTED ARAR	USACE RESPONSE
	This regulation does not meet the definition of an ARAR, as that term is defined in CERCLA or the NCP, because it does not contain substantive criteria pertaining to the hazardous substances or pollutants and contaminants or the circumstances of their release at the site. Instead, the regulation pertains to hazardous waste. MED/AEC materials are not hazardous waste. However, any of the substantive requirements of the regulation that may apply will be complied with during the course of the CERCLA action.
6 NYCRR Part 372	6 NYCRR 372 establishes standards for generators and transporters of hazardous waste and standards for generators, transporters, and treatment, storage or disposal facilities relating to the use of the manifest system and its record-keeping requirements. This regulation does not meet the definition of an ARAR, as that term is defined in CERCLA or the NCP, because it does not contain substantive criteria pertaining to the hazardous substances or pollutants and contaminants or the circumstances of their release at the site. However, any of the substantive requirements of the regulation that may apply to other matters will be complied with during the course of the CERCLA action.
6 NYCRR Part 373-1	6 NYCRR 373-1 regulates hazardous waste management facilities located partially or wholly within New York State. This regulation does not meet the definition of an ARAR, as that term is defined in CERCLA or the NCP, because it does not contain substantive criteria pertaining to the hazardous substances or pollutants and contaminants or the circumstances of their release at the site. Instead it is procedural in nature. However, any of the substantive requirements of the regulation that may apply to other matters will be complied with during the course of the CERCLA action.
6 NYCRR Part 373-2	6 NYCRR 373-2 establishes minimum State standards which define the acceptable management of hazardous waste. The standards in this Subpart apply to owners and operators of all facilities which treat, store, or dispose of hazardous waste, except as specifically provided otherwise in this Part or Part 371.

USACE RESPONSE TO NYSDEC-RECOMMMNDED ARARS

SUGGESTED ARAR	USACE RESPONSE
	This regulation does not meet the definition of an ARAR, as that term is defined in CERCLA or the NCP, because it does not contain substantive criteria pertaining to the hazardous substances or pollutants and contaminants or the circumstances of their release at the site. However, any of the substantive requirements of the regulation that may apply to other matters will be complied with during the course of the CERCLA action.
6 NYCRR Part 373-3	The regulations in 6 NYCRR 373-3 establish minimum statewide standards that define the acceptable management of hazardous waste during the period of interim status and until certification of final closure or, if the facility is subject to post-closure requirements, until post-closure responsibilities are fulfilled. This regulation does not meet the definition of an ARAR, as that term is defined in CERCLA or the NCP, because it does not contain substantive criteria pertaining to the hazardous substances or pollutants and contaminants or the circumstances of their release at the site. Instead, the regulation pertains to hazardous waste. MED/AEC materials are not hazardous waste. However, any of the substantive requirements of the regulation that may apply to other matters will be complied with during the course of the CERCLA action.
6 NYCRR Part 375	6 NYCRR 375 establishes the development and implementation of remedial programs for inactive hazardous waste disposal sites, specifically under subpart 375-2, including, but not limited to, sites listed in the Registry which are either on the national priorities list (NPL) or are being addressed by the Department of Defense or the Department of Energy. This regulation (other than Table 375-6.8(b): Restricted Use Soil Cleanup Objectives) does not meet the definition of an ARAR, as that term is defined in CERCLA or the NCP, because it does not contain substantive criteria pertaining to the hazardous substances or pollutants and contaminants or the circumstances of their release at the site. Instead, the regulation pertains to hazardous waste. MED/AEC materials are not hazardous waste. However, any of the substantive requirements of the regulation that may apply to other matters will be complied with during the course of the CERCLA action.

USACE RESPONSE TO NYSDEC-RECOMMNDED ARARS

SUGGESTED ARAR	USACE RESPONSE
6 NYCRR 376	6 NYCRR 376 identifies hazardous wastes that are restricted from land disposal and defines those limited circumstances under which an otherwise prohibited waste may be land disposed. Except as specifically provided otherwise in this Part or Part 371, the requirements of this Part apply to persons who generate or transport hazardous waste and owners and operators of hazardous waste treatment, storage, and disposal facilities. This regulation does not meet the definition of an ARAR, as that term is defined in CERCLA or the NCP, because it does not contain substantive criteria pertaining to the hazardous substances or pollutants and contaminants or the circumstances of their release at the site. Instead it is procedural in nature. However, any of the substantive requirements of the regulation that may apply to other matters will be complied with during the course of the CERCLA action.
6 NYCRR Part 380	6 NYCRR 380 establishes standards to protect against ionizing radiation resulting from the disposal and discharge of radioactive material to the environment. The purpose of the requirements in this regulation is to control the disposal and discharge of radioactive material to the environment so that the total dose to an individual member of the public (including doses resulting from licensed and unlicensed radioactive material and from radiation sources other than background radiation) does not exceed the standards for protection against radiation prescribed in Subpart 380-5. This regulation does not meet the definition of an ARAR, as that term is defined in CERCLA or the NCP, because it does not contain substantive criteria pertaining to the hazardous substances or pollutants and contaminants or the circumstances of their release at the site.
6 NYCRR Parts 700-706	6 NYCRR Parts 700-706 govern standards and guidance values for surface and groundwater. There are no public water supply wells in the site area, and the groundwater resources reflect the U.S. EPA Class IIIB criteria for non-potable and limited beneficial use water and therefore standards for drinking water do not apply. This is not an ARAR.
6 NYCRR Part 750-757	Part 750 relates to SPDES permits and permitting systems (administrative requirements) are not ARARs. Parts 751-757 have been repealed.

USACE RESPONSE TO NYSDEC-RECOMMMNDED ARARS

SUGGESTED ARAR	USACE RESPONSE
	This regulation does not meet the definition of an ARAR, as that term is defined in CERCLA or the NCP, because it does not contain substantive criteria pertaining to the hazardous substances or pollutants and contaminants or the circumstances of their release at the site. Instead it is procedural in nature. However, any of the substantive requirements of the regulation that may apply to other matters will be complied with during the course of the CERCLA action.
6 NYCRR Part 608	6 NYCRR Part 608 regulates permits issued for "use and protection of waters." This regulation does not meet the definition of an ARAR, as that term is defined in CERCLA or the NCP, because it does not contain substantive criteria pertaining to the hazardous substances or pollutants and contaminants or the circumstances of their release at the site.
6 NYCRR Part 200 (200.6)	6 NYCRR Part 200 (200.6) discusses "acceptable ambient air quality." Air quality emissions for this project are governed by the Clean Air Act and National Ambient Air Quality Standards. 6 NYCRR Part 200.6 is not an ARAR.
6 NYCRR Part 211 (211.1)	This regulation prohibits air pollution. Air quality emissions for this project are governed by the Clean Air Act and National Ambient Air Quality Standards. This is not an ARAR.
6 NYCRR Part 364	This regulation requires permits for waste transporters. It is not an ARAR because it deals with off-site activity and contains procedural requirements.
ECL Article 23	Environmental Conservation Law Article 23, Title 27, NYS Mined Land Reclamation Law involves permitting by DEC to ensure environmentally sound economic development of NY mineral resources. On-site CERCLA activities are not subject to State permitting requirements, and therefore this is not an ARAR.
6 NYCRR Part 420-426	This regulation covers mining clay for cover. Under these provisions, to "mine" means "any excavation from which a mineral is to be produced for sale or exchange..." The proposed remedial alternatives involve earth moving, which is not considered mining. Therefore, these sections are not ARARs.
10 NYCRR Part 5	This regulation addresses public water systems, water well construction, and water quality treatment districts, among other things. There are no public water supply wells in the site area, and the groundwater resources reflect the U.S. EPA Class IIIB

USACE RESPONSE TO NYSDEC-RECOMMNDED ARARS

SUGGESTED ARAR	USACE RESPONSE
	criteria for non-potable and limited beneficial use water and therefore standards for drinking water do not apply. This is not an ARAR.
10 NYCRR Part 170	This regulation provides standards for water quality. There are no public water supply wells in the site area, and the groundwater resources reflect the U.S. EPA Class IIIB criteria for non-potable and limited beneficial use water and therefore standards for drinking water do not apply. This is not an ARAR.
19 NYCRR Part 600	This Part provides State agencies acting in the coastal area and inland waterways the necessary framework for the consideration and application of the State's policies with respect to waterfront revitalization and coastal resources, as contained in Article 42 of the Executive Law. It is intended “to achieve a balance between economic development and preservation that will permit the beneficial use of coastal and inland waterway resources while preventing the loss of living marine resources and wildlife, diminution of open space areas or public access to the waterfront, shoreline erosion, impairment of scenic beauty, or permanent adverse changes to ecological systems.” This regulation does not meet the definition of an ARAR, as that term is defined in CERCLA or the NCP, because it does not contain substantive criteria pertaining to the hazardous substances or pollutants and contaminants or the circumstances of their release at the site.

APPENDIX D

DEVELOPMENT OF RADIOLOGICAL SOIL REMEDIATION GOALS

(DERIVED CONCENTRATION GUIDELINE LIMITS DCGLs)

THIS PAGE INTENTIONALLY LEFT BLANK

Appendix D: Development of Radiological Soil Remediation Goals (Derived Concentration Guideline Limits DCGLs)

Introduction

The Baseline Risk Assessment (BRA) for the NFSS Balance of Plant (BOP) was published in December 2007 (USACE 2007). Generally, at the conclusion of a BRA, preliminary remediation goals (PRGs) may be generated. However, at that time, a comprehensive set of risk-based PRGs were published only for chemicals (Tables A697 through A705, USACE 2007a). For radionuclides, PRGs were only developed for screening purposes at the onset of the Remedial Investigation and only for the subsistence farmer exposure scenario (Table B.1, USACE 2007a). Those radiological PRGs were based on the lower end of the NCP's acceptable cancer risk range of 1 in a million excess cancers (EPA 1990).

Since the time that the BRA was drafted (which began in 2003), work has progressed on the RI/FS of the NFSS, including the following efforts which would affect development of radiological DCGLs

- Additional groundwater modeling efforts (provides additional site-specific characterization of soil and subsurface properties which affect RESRAD modeling)
- Additional sampling of site groundwater, surface water, sediment, and soils (may affect radiological soil source term), and
- Identification of proposed Applicable or Relevant and Appropriate Requirements (ARARs) (which affects the limits used for DCGL development)

Furthermore, the RESRAD computer code has undergone several revisions since the BRA was drafted. The version of the RESRAD code that was used to generate baseline radiological doses and cancer risks was version 6.2.2. The current version of the RESRAD code is version 6.5. (See attachment 1 for version history list of changes between versions 6.2.2 and 6.5).

The results of the BRA were used in conjunction with the information or changes listed above in order to develop soil remediation goals (DCGLs) for radionuclides of concern for the BOP FS.

Evaluation of BRA Source Term

The NFSS BRA database consisted of analytical results for samples collected from June 30, 1998, through October 7, 2003. The database consists of analytical results for 954 soil samples, 238 groundwater samples, 115 sediment samples, and 98 surface water samples (USACE 2007a). Site samples were collected across all of the 191-acre NFSS. Various laboratory analyses for radionuclides and chemicals were performed on samples from different phases of the remedial investigation.

Annual surveillance of groundwater, sediment, and surface water has been conducted since that time. However, those environmental monitoring efforts do not include soil sampling.

In April 2011, the Corps published an Addendum to the Remedial Investigation Report (RIRA, USACE 2011). This addendum was focused towards further characterization of various groundwater impacts, and no new soil samples were obtained as part of the development of the RIRA.

In November and December 2012, an additional 109 soil samples were obtained in an effort to characterize the source term for specified areas of uranium contamination in the groundwater (USACE 2013a). Those soil samples did not reveal any significantly elevated radionuclides in the soil.

Therefore, the radiological soil source term does not need to be revised based on what was used in the BRA.

Identification of ARARs

Applicable or Relevant and Appropriate Requirements (ARARs) are used to guide the development of remedial action objectives and remedial action alternatives at the site. USACE is identifying the *Criteria Relating to the Operations of Uranium Mills and the Disposition of Tailings or Wastes Produced by the Extraction or Concentration of Source Material from Ores Processed Primarily for their Source Material Content*, 10 CFR 40 Appendix A, as a potential ARAR for the Interim Waste Contaminant Structure (IWCS) IWCS Operable Unit (OU) (USACE 2013b).

10 CFR Part 40, Appendix A, Criterion 6(6) provides a means to derive cleanup goals for radionuclides other than radium. As per 40 CFR Part 192, radium-226 is limited to 5 pCi/g in the top 15 cm of soil and 15 pCi/g below the top 15 cm of soil. 10 CFR Part 40, Appendix A, Criterion 6(6) requires that if other radionuclides are present, their cleanup goals are the concentration of the radionuclide that would produce the same dose as 5 pCi/g of radium-226 in the top 15 cm and 15 pCi/g of radium-226 below the top 15 cm of soil. This dose for radium is called the 'benchmark' dose. The cleanup goals for radionuclides other than radium must also be As Low As Reasonably Achievable (ALARA). 10 CFR Part 40, Appendix A, Criterion 6(6) also states if more than one residual radionuclide is present in the same 100-square-meter area, the sum of the ratios (SOR) shall not exceed "1" (unity).

Reasonable Future Land Use

Based on current ownership of the site and the adjacent land use, the reasonable future land use for the NFSS BOP would be either restricted access, or industrial/commercial use, with or without redevelopment, depending on final disposition of the wastes under the IWCS. To be conservative, redevelopment under an industrial land use is considered because this would entail some type of construction at the site. The protection of a construction worker from unacceptable radiological exposures would drive soil cleanup goals lower (for radionuclides other than radium-226 and thorium-230) than the cleanup goals that may be developed for a restricted access land use for these other radionuclides.

Identification of Radionuclides of Concern

In the BRA, Table 3.25 lists the ROPCs that are ROCs by medium and receptor, where an ROC is any ROPC with a cancer risk of at least 1 in 100,000 when the total risk from exposure to all ROPCs combined is equal to or greater than 1 in 10,000. The identification of ROCs depends on the receptor (critical group) utilized for cleanup goal development. Table 3.25 indicates that for the construction worker, the following radionuclides would be considered radionuclides of concern (ROCs):

- Actinium-227 (Ac-227)
- Protactinium-231 (Pa-231)
- Lead-210 (Pb-210)
- Radium-226 (Ra-226)
- Thorium-230 (Th-230)
- Uranium-234 (U-234)
- Uranium-235 (U-235)
- Uranium-238 (U-238)

Although Pb-210 is listed as an ROC, and it could be considered to be present in equilibrium with its parent Ra-226, a separate DCGL will not be developed for Pb-210. This is because it has never been measured at the site, and laboratory analysis for this radionuclide is not commonly performed. One way to account for its presence would be to add its dose to the dose of its parent Ra-226. This was not done for the NFSS BOP because the dose contribution from Pb-210 is orders of magnitude smaller than the Ra-226 dose. Furthermore, adding the Pb-210 dose contribution to the Ra-226 dose would increase the benchmark dose used to calculate cleanup goals under 10 CFR 40 Appendix A Criterion 6(6), which would result in larger DCGLs for other radionuclides (i.e., it would not be conservative).

Derived Concentration Guideline Limits (DCGLs)

Derived concentration guideline limits (DCGLs) were developed for the ROCs listed above, using the construction worker as the critical group and the benchmark dose (as per 10 CFR 40 Appendix A Criterion 6(6)) as the dose limit. The RESRAD input parameters used in the BRA for the construction worker were reviewed and updated as noted in Table 1, mainly by using the additional soil and subsurface characterization that occurred as part of the groundwater modeling (USACE 2007b). Each of the radionuclides of concern, listed above, were entered into the RESRAD program with an initial concentration of 1 pCi/g. The resulting RESRAD run was examined for the times of peak dose (for total dose and doses from individual radionuclides) and dose-to-source ratios at those times were extracted from the RESRAD output into an excel file. The benchmark dose for surface soil was calculated by multiplying the initial Ra-226 dose to source ratio (units of mrem/year/pCi/g) by a factor of five to account for the 5 pCi/g limit for surface soil set by 10 CFR 40. The benchmark dose for subsurface soil was calculated by multiplying the initial Ra-226 dose to source ratio by a factor of 15 to account for the 15 pCi/g limit for subsurface soil set by 10 CFR 40. The DCGL's were then calculated in excel spreadsheets for each radionuclide of concern by dividing the time specific benchmark dose by the surface and subsurface dose to source ratio. The minimum DCGL (at time of peak dose per individual nuclide) was chosen as the DCGL for the FS for both surface and subsurface soil calculations.

To simplify the presentation of DCGLs as well as the resulting sampling and analysis that would be needed to plan for and verify remediation, a combined total uranium DCGL was calculated, and then the U-238 concentration was determined which could be used as a surrogate for the total uranium DCGL. This was done by combining the DCGLs for the uranium isotopes (U-234, U-235, and U-238) according to the ratio in which they occur naturally (1:0.046:1). Results for U-238 can then be used to substitute for total uranium by multiplying the total U DCGL by 0.489. In addition, the dose contributions from Ac-227 and Pa-231 were added to their parent radionuclide U-235 in order to allow these daughter nuclides to be accounted in the overall benchmark dose and DCGL, without necessitating that these nuclides be measured and evaluated in the SOR calculation to show benchmark dose compliance during remediation.

Therefore, only the DCGLs for Ra-226, Th-230, and U-238 will be used in the SOR calculation.

The surface soil DCGLs are:

- 5 pCi/g Ra-226
- 18 pCi/g Th-230
- 115 pCi/g U-238

The subsurface DCGLs are:

- 15 pCi/g Ra-226
- 55 pCi/g Th-230
- 346 pCi/g U-238

These will be applied incrementally to (above) average background concentrations of radionuclides.

References

EPA 1990 (1994), *National Oil and Hazardous Substances Pollution Contingency Plan; Final Rule (40 CFR Part 300)*, Federal Register, 55 (46):8666-8865 (March 8); http://ecfr.gpoaccess.gov/cgi/t/text/textidx?c=ecfr&tpl=/ecfrbrowse/Title40/40cfr300_main_02.tpl

USACE 2007a, *Baseline Risk Assessment for the Niagara Falls Storage Site, Final,* prepared by Sciences Applications International Corporation for the Buffalo District

USACE 2007b, *Groundwater Flow and Contaminant Transport Modeling, Niagara Falls Storage Site,* prepared by HydroGeoLogic for the Buffalo District

USACE 2011, *Remedial Investigation Report Addendum Niagara Falls Storage Site, prepared by Sciences Applications International Corporation for the Buffalo District*

USACE 2013a, *Balance of Plant Operable Unit Field Investigation Niagara Falls Storage Site*, Lewiston NY, prepared by URS Group Inc. for the Buffalo District

USACE 2013b, *Applicable or Relevant and Appropriate Requirements for the Interim Waste Contaminant Structure Feasibility Study Technical Memorandum, Niagara Falls Storage Site* prepared by Sciences Applications International Corporation for the Buffalo District

<u>Attachment 1: RESRAD Version History</u>

RESRAD 6.5 (10/30/09):

- C-14 gaseous and particulate contributions to dose and risk available
- Partially or fully submerged contaminated zone now treated
- Choice between ICRP60 or FGR12 for External dose factors added
- 64-bit and Vista computers now supported

RESRAD 6.4 (12/20/07):

- Added ICRP 72 age-dependent DCFs
- Improved data storage and retrieval, user specified directories.
- User specified ground DCF's now possible.
- C-14 inhalation dose and risk improved.

RESRAD 6.3 (8/25/05):

- Added ICRP-38 radionuclides
- Allow variable half-life cutoff
- DCF Editor is now common between RESRAD and RESRAD-BUILD

RESRAD 6.22 (2/6/04):

- Added Tl-206 and Bi-210m

THIS PAGE INTENTIONALLY LEFT BLANK

Attachment 2: RESRAD Summary Report for Construction Worker

THIS PAGE INTENTIONALLY LEFT BLANK

Table of Contents

Part I: Mixture Sums and Single Radionuclide Guidelines

Dose Conversion Factor (and Related) Parameter Summary
Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
A-1	DCF's for external ground radiation, (mrem/yr)/(pCi/g)			
A-1	Ac-227 (Source: FGR 12)	4.951E-04	4.951E-04	DCF1(1)
A-1	At-218 (Source: FGR 12)	5.847E-03	5.847E-03	DCF1(2)
A-1	Bi-210 (Source: FGR 12)	3.606E-03	3.606E-03	DCF1(3)
A-1	Bi-211 (Source: FGR 12)	2.559E-01	2.559E-01	DCF1(4)
A-1	Bi-214 (Source: FGR 12)	9.808E+00	9.808E+00	DCF1(5)
A-1	Fr-223 (Source: FGR 12)	1.980E-01	1.980E-01	DCF1(6)
A-1	Pa-231 (Source: FGR 12)	1.906E-01	1.906E-01	DCF1(7)
A-1	Pa-234 (Source: FGR 12)	1.155E+01	1.155E+01	DCF1(8)
A-1	Pa-234m (Source: FGR 12)	8.967E-02	8.967E-02	DCF1(9)
A-1	Pb-210 (Source: FGR 12)	2.447E-03	2.447E-03	DCF1(10)
A-1	Pb-211 (Source: FGR 12)	3.064E-01	3.064E-01	DCF1(11)
A-1	Pb-214 (Source: FGR 12)	1.341E+00	1.341E+00	DCF1(12)
A-1	Po-210 (Source: FGR 12)	5.231E-05	5.231E-05	DCF1(13)
A-1	Po-211 (Source: FGR 12)	4.764E-02	4.764E-02	DCF1(14)
A-1	Po-214 (Source: FGR 12)	5.138E-04	5.138E-04	DCF1(15)
A-1	Po-215 (Source: FGR 12)	1.016E-03	1.016E-03	DCF1(16)
A-1	Po-218 (Source: FGR 12)	5.642E-05	5.642E-05	DCF1(17)
A-1	Ra-223 (Source: FGR 12)	6.034E-01	6.034E-01	DCF1(18)
A-1	Ra-226 (Source: FGR 12)	3.176E-02	3.176E-02	DCF1(19)
A-1	Rn-219 (Source: FGR 12)	3.083E-01	3.083E-01	DCF1(20)
A-1	Rn-222 (Source: FGR 12)	2.354E-03	2.354E-03	DCF1(21)
A-1	Th-227 (Source: FGR 12)	5.212E-01	5.212E-01	DCF1(22)
A-1	Th-230 (Source: FGR 12)	1.209E-03	1.209E-03	DCF1(23)
A-1	Th-231 (Source: FGR 12)	3.643E-02	3.643E-02	DCF1(24)
A-1	Th-234 (Source: FGR 12)	2.410E-02	2.410E-02	DCF1(25)
A-1	Tl-207 (Source: FGR 12)	1.980E-02	1.980E-02	DCF1(26)
A-1	Tl-210 (Source: no data)	0.000E+00	-2.000E+00	DCF1(27)
A-1	U-234 (Source: FGR 12)	4.017E-04	4.017E-04	DCF1(28)
A-1	U-235 (Source: FGR 12)	7.211E-01	7.211E-01	DCF1(29)
A-1	U-238 (Source: FGR 12)	1.031E-04	1.031E-04	DCF1(30)
B-1	Dose conversion factors for inhalation, mrem/pCi:			
B-1	Ac-227+D	6.724E+00	6.700E+00	DCF2(1)
B-1	Pa-231	1.280E+00	1.280E+00	DCF2(2)
B-1	Pb-210+D	2.320E-02	1.360E-02	DCF2(3)
B-1	Ra-226+D	8.594E-03	8.580E-03	DCF2(4)
B-1	Th-230	3.260E-01	3.260E-01	DCF2(5)
B-1	U-234	1.320E-01	1.320E-01	DCF2(6)
B-1	U-235+D	1.230E-01	1.230E-01	DCF2(7)
B-1	U-238	1.180E-01	1.180E-01	DCF2(8)
B-1	U-238+D	1.180E-01	1.180E-01	DCF2(9)
D-1	Dose conversion factors for ingestion, mrem/pCi:			
D-1	Ac-227+D	1.480E-02	1.410E-02	DCF3(1)
D-1	Pa-231	1.060E-02	1.060E-02	DCF3(2)
D-1	Pb-210+D	7.276E-03	5.370E-03	DCF3(3)
D-1	Ra-226+D	1.321E-03	1.320E-03	DCF3(4)
D-1	Th-230	5.480E-04	5.480E-04	DCF3(5)
D-1	U-234	2.830E-04	2.830E-04	DCF3(6)

Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-1	U-235+D	2.673E-04	2.660E-04	DCF3(7)
D-1	U-238	2.550E-04	2.550E-04	DCF3(8)
D-1	U-238+D	2.687E-04	2.550E-04	DCF3(9)
D-34	Food transfer factors:			
D-34	Ac-227+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(1,1)
D-34	Ac-227+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,2)
D-34	Ac-227+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	2.000E-05	2.000E-05	RTF(1,3)
D-34				
D-34	Pa-231 , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(2,1)
D-34	Pa-231 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	5.000E-03	5.000E-03	RTF(2,2)
D-34	Pa-231 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(2,3)
D-34				
D-34	Pb-210+D , plant/soil concentration ratio, dimensionless	1.000E-02	1.000E-02	RTF(3,1)
D-34	Pb-210+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	8.000E-04	8.000E-04	RTF(3,2)
D-34	Pb-210+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	3.000E-04	3.000E-04	RTF(3,3)
D-34				
D-34	Ra-226+D , plant/soil concentration ratio, dimensionless	4.000E-02	4.000E-02	RTF(4,1)
D-34	Ra-226+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,2)
D-34	Ra-226+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	1.000E-03	1.000E-03	RTF(4,3)
D-34				
D-34	Th-230 , plant/soil concentration ratio, dimensionless	1.000E-03	1.000E-03	RTF(5,1)
D-34	Th-230 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	1.000E-04	1.000E-04	RTF(5,2)
D-34	Th-230 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	5.000E-06	5.000E-06	RTF(5,3)
D-34				
D-34	U-234 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(6,1)
D-34	U-234 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(6,2)
D-34	U-234 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(6,3)
D-34				
D-34	U-235+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(7,1)
D-34	U-235+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(7,2)
D-34	U-235+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(7,3)
D-34				
D-34	U-238 , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(8,1)
D-34	U-238 , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(8,2)
D-34	U-238 , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(8,3)
D-34				
D-34	U-238+D , plant/soil concentration ratio, dimensionless	2.500E-03	2.500E-03	RTF(9,1)
D-34	U-238+D , beef/livestock-intake ratio, (pCi/kg)/(pCi/d)	3.400E-04	3.400E-04	RTF(9,2)
D-34	U-238+D , milk/livestock-intake ratio, (pCi/L)/(pCi/d)	6.000E-04	6.000E-04	RTF(9,3)
D-5	Bioaccumulation factors, fresh water, L/kg:			
D-5	Ac-227+D , fish	1.500E+01	1.500E+01	BIOFAC(1,1)
D-5	Ac-227+D , crustacea and mollusks	1.000E+03	1.000E+03	BIOFAC(1,2)
D-5				
D-5	Pa-231 , fish	1.000E+01	1.000E+01	BIOFAC(2,1)
D-5	Pa-231 , crustacea and mollusks	1.100E+02	1.100E+02	BIOFAC(2,2)
D-5				
D-5	Pb-210+D , fish	3.000E+02	3.000E+02	BIOFAC(3,1)
D-5	Pb-210+D , crustacea and mollusks	1.000E+02	1.000E+02	BIOFAC(3,2)

Summary : NFSS FS BOP Construction Worker for DCGLs

File   : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\NFSS_BOP_CONSTRUCTION.RAD

Dose Conversion Factor (and Related) Parameter Summary (continued)

Dose Library: FGR 12 & FGR 11

Menu	Parameter	Current Value#	Base Case*	Parameter Name
D-5	Ra-226+D , fish	5.000E+01	5.000E+01	BIOFAC(4,1)
D-5	Ra-226+D , crustacea and mollusks	2.500E+02	2.500E+02	BIOFAC(4,2)
D-5				
D-5	Th-230 , fish	1.000E+02	1.000E+02	BIOFAC(5,1)
D-5	Th-230 , crustacea and mollusks	5.000E+02	5.000E+02	BIOFAC(5,2)
D-5				
D-5	U-234 , fish	1.000E+01	1.000E+01	BIOFAC(6,1)
D-5	U-234 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(6,2)
D-5				
D-5	U-235+D , fish	1.000E+01	1.000E+01	BIOFAC(7,1)
D-5	U-235+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(7,2)
D-5				
D-5	U-238 , fish	1.000E+01	1.000E+01	BIOFAC(8,1)
D-5	U-238 , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(8,2)
D-5				
D-5	U-238+D , fish	1.000E+01	1.000E+01	BIOFAC(9,1)
D-5	U-238+D , crustacea and mollusks	6.000E+01	6.000E+01	BIOFAC(9,2)

#For DCF1(xxx) only, factors are for infinite depth & area. See ETFG table in Ground Pathway of Detailed Report.

*Base Case means Default.Lib w/o Associate Nuclide contributions.

Site-Specific Parameter Summary

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R011	Area of contaminated zone (m**2)	1.000E+02	1.000E+04	---	AREA
R011	Thickness of contaminated zone (m)	1.000E+00	2.000E+00	---	THICK0
R011	Fraction of contamination that is submerged	0.000E+00	0.000E+00	---	SUBMFRACT
R011	Length parallel to aquifer flow (m)	not used	1.000E+02	---	LCZPAQ
R011	Basic radiation dose limit (mrem/yr)	2.500E+01	3.000E+01	---	BRDL
R011	Time since placement of material (yr)	0.000E+00	0.000E+00	---	TI
R011	Times for calculations (yr)	1.000E+00	1.000E+00	---	T(2)
R011	Times for calculations (yr)	3.000E+00	3.000E+00	---	T(3)
R011	Times for calculations (yr)	1.000E+01	1.000E+01	---	T(4)
R011	Times for calculations (yr)	3.000E+01	3.000E+01	---	T(5)
R011	Times for calculations (yr)	2.000E+02	1.000E+02	---	T(6)
R011	Times for calculations (yr)	3.000E+02	3.000E+02	---	T(7)
R011	Times for calculations (yr)	1.000E+03	1.000E+03	---	T(8)
R011	Times for calculations (yr)	1.842E+03	0.000E+00	---	T(9)
R011	Times for calculations (yr)	1.000E+05	0.000E+00	---	T(10)
R012	Initial principal radionuclide (pCi/g): Ac-227	1.000E+00	0.000E+00	---	S1(1)
R012	Initial principal radionuclide (pCi/g): Pa-231	1.000E+00	0.000E+00	---	S1(2)
R012	Initial principal radionuclide (pCi/g): Pb-210	1.000E+00	0.000E+00	---	S1(3)
R012	Initial principal radionuclide (pCi/g): Ra-226	1.000E+00	0.000E+00	---	S1(4)
R012	Initial principal radionuclide (pCi/g): Th-230	1.000E+00	0.000E+00	---	S1(5)
R012	Initial principal radionuclide (pCi/g): U-234	1.000E+00	0.000E+00	---	S1(6)
R012	Initial principal radionuclide (pCi/g): U-235	1.000E+00	0.000E+00	---	S1(7)
R012	Initial principal radionuclide (pCi/g): U-238	1.000E+00	0.000E+00	---	S1(8)
R012	Concentration in groundwater (pCi/L): Ac-227	not used	0.000E+00	---	W1(1)
R012	Concentration in groundwater (pCi/L): Pa-231	not used	0.000E+00	---	W1(2)
R012	Concentration in groundwater (pCi/L): Pb-210	not used	0.000E+00	---	W1(3)
R012	Concentration in groundwater (pCi/L): Ra-226	not used	0.000E+00	---	W1(4)
R012	Concentration in groundwater (pCi/L): Th-230	not used	0.000E+00	---	W1(5)
R012	Concentration in groundwater (pCi/L): U-234	not used	0.000E+00	---	W1(6)
R012	Concentration in groundwater (pCi/L): U-235	not used	0.000E+00	---	W1(7)
R012	Concentration in groundwater (pCi/L): U-238	not used	0.000E+00	---	W1(8)
R013	Cover depth (m)	0.000E+00	0.000E+00	---	COVER0
R013	Density of cover material (g/cm**3)	not used	1.500E+00	---	DENSCV
R013	Cover depth erosion rate (m/yr)	not used	1.000E-03	---	VCV
R013	Density of contaminated zone (g/cm**3)	1.200E+00	1.500E+00	---	DENSCZ
R013	Contaminated zone erosion rate (m/yr)	6.000E-05	1.000E-03	---	VCZ
R013	Contaminated zone total porosity	4.500E-01	4.000E-01	---	TPCZ
R013	Contaminated zone field capacity	3.050E-01	2.000E-01	---	FCCZ
R013	Contaminated zone hydraulic conductivity (m/yr)	1.010E+00	1.000E+01	---	HCCZ
R013	Contaminated zone b parameter	1.040E+01	5.300E+00	---	BCZ
R013	Average annual wind speed (m/sec)	4.500E+00	2.000E+00	---	WIND
R013	Humidity in air (g/m**3)	not used	8.000E+00	---	HUMID
R013	Evapotranspiration coefficient	7.000E-01	5.000E-01	---	EVAPTR
R013	Precipitation (m/yr)	8.130E-01	1.000E+00	---	PRECIP
R013	Irrigation (m/yr)	2.000E-01	2.000E-01	---	RI
R013	Irrigation mode	overhead	overhead	---	IDITCH
R013	Runoff coefficient	3.130E-01	2.000E-01	---	RUNOFF
R013	Watershed area for nearby stream or pond (m**2)	not used	1.000E+06	---	WAREA

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R013	Accuracy for water/soil computations	not used	1.000E-03	---	EPS
R014	Density of saturated zone (g/cm**3)	not used	1.500E+00	---	DENSAQ
R014	Saturated zone total porosity	not used	4.000E-01	---	TPSZ
R014	Saturated zone effective porosity	not used	2.000E-01	---	EPSZ
R014	Saturated zone field capacity	not used	2.000E-01	---	FCSZ
R014	Saturated zone hydraulic conductivity (m/yr)	not used	1.000E+02	---	HCSZ
R014	Saturated zone hydraulic gradient	not used	2.000E-02	---	HGWT
R014	Saturated zone b parameter	not used	5.300E+00	---	BSZ
R014	Water table drop rate (m/yr)	not used	1.000E-03	---	VWT
R014	Well pump intake depth (m below water table)	not used	1.000E+01	---	DWIBWT
R014	Model: Nondispersion (ND) or Mass-Balance (MB)	not used	ND	---	MODEL
R014	Well pumping rate (m**3/yr)	not used	2.500E+02	---	UW
R015	Number of unsaturated zone strata	not used	1	---	NS
R015	Unsat. zone 1, thickness (m)	not used	4.000E+00	---	H(1)
R015	Unsat. zone 1, soil density (g/cm**3)	not used	1.500E+00	---	DENSUZ(1)
R015	Unsat. zone 1, total porosity	not used	4.000E-01	---	TPUZ(1)
R015	Unsat. zone 1, effective porosity	not used	2.000E-01	---	EPUZ(1)
R015	Unsat. zone 1, field capacity	not used	2.000E-01	---	FCUZ(1)
R015	Unsat. zone 1, soil-specific b parameter	not used	5.300E+00	---	BUZ(1)
R015	Unsat. zone 1, hydraulic conductivity (m/yr)	not used	1.000E+01	---	HCUZ(1)
R016	Distribution coefficients for Ac-227				
R016	Contaminated zone (cm**3/g)	1.500E+03	2.000E+01	---	DCNUCC(1)
R016	Unsaturated zone 1 (cm**3/g)	not used	2.000E+01	---	DCNUCU(1,1)
R016	Saturated zone (cm**3/g)	not used	2.000E+01	---	DCNUCS(1)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.264E-04	ALEACH(1)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(1)
R016	Distribution coefficients for Pa-231				
R016	Contaminated zone (cm**3/g)	1.500E+03	5.000E+01	---	DCNUCC(2)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(2,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(2)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.264E-04	ALEACH(2)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(2)
R016	Distribution coefficients for Pb-210				
R016	Contaminated zone (cm**3/g)	3.632E+04	1.000E+02	---	DCNUCC(3)
R016	Unsaturated zone 1 (cm**3/g)	not used	1.000E+02	---	DCNUCU(3,1)
R016	Saturated zone (cm**3/g)	not used	1.000E+02	---	DCNUCS(3)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	5.221E-06	ALEACH(3)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(3)
R016	Distribution coefficients for Ra-226				
R016	Contaminated zone (cm**3/g)	2.710E+02	7.000E+01	---	DCNUCC(4)
R016	Unsaturated zone 1 (cm**3/g)	not used	7.000E+01	---	DCNUCU(4,1)
R016	Saturated zone (cm**3/g)	not used	7.000E+01	---	DCNUCS(4)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	6.988E-04	ALEACH(4)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(4)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R016	Distribution coefficients for Th-230				
R016	Contaminated zone (cm**3/g)	1.000E+03	6.000E+04	---	DCNUCC(5)
R016	Unsaturated zone 1 (cm**3/g)	not used	6.000E+04	---	DCNUCU(5,1)
R016	Saturated zone (cm**3/g)	not used	6.000E+04	---	DCNUCS(5)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.896E-04	ALEACH(5)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(5)
R016	Distribution coefficients for U-234				
R016	Contaminated zone (cm**3/g)	1.220E+02	5.000E+01	---	DCNUCC(6)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(6,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(6)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.550E-03	ALEACH(6)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(6)
R016	Distribution coefficients for U-235				
R016	Contaminated zone (cm**3/g)	1.220E+02	5.000E+01	---	DCNUCC(7)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(7,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(7)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.550E-03	ALEACH(7)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(7)
R016	Distribution coefficients for U-238				
R016	Contaminated zone (cm**3/g)	1.220E+02	5.000E+01	---	DCNUCC(8)
R016	Unsaturated zone 1 (cm**3/g)	not used	5.000E+01	---	DCNUCU(8,1)
R016	Saturated zone (cm**3/g)	not used	5.000E+01	---	DCNUCS(8)
R016	Leach rate (/yr)	0.000E+00	0.000E+00	1.550E-03	ALEACH(8)
R016	Solubility constant	0.000E+00	0.000E+00	not used	SOLUBK(8)
R017	Inhalation rate (m**3/yr)	7.300E+03	8.400E+03	---	INHALR
R017	Mass loading for inhalation (g/m**3)	6.000E-04	1.000E-04	---	MLINH
R017	Exposure duration	1.000E+00	3.000E+01	---	ED
R017	Shielding factor, inhalation	4.000E-01	4.000E-01	---	SHF3
R017	Shielding factor, external gamma	4.000E-01	7.000E-01	---	SHF1
R017	Fraction of time spent indoors	0.000E+00	5.000E-01	---	FIND
R017	Fraction of time spent outdoors (on site)	2.280E-01	2.500E-01	---	FOTD
R017	Shape factor flag, external gamma	1.000E+00	1.000E+00	>0 shows circular AREA.	FS
R017	Radii of shape factor array (used if FS = -1):				
R017	Outer annular radius (m), ring 1:	not used	5.000E+01	---	RAD_SHAPE(1)
R017	Outer annular radius (m), ring 2:	not used	7.071E+01	---	RAD_SHAPE(2)
R017	Outer annular radius (m), ring 3:	not used	0.000E+00	---	RAD_SHAPE(3)
R017	Outer annular radius (m), ring 4:	not used	0.000E+00	---	RAD_SHAPE(4)
R017	Outer annular radius (m), ring 5:	not used	0.000E+00	---	RAD_SHAPE(5)
R017	Outer annular radius (m), ring 6:	not used	0.000E+00	---	RAD_SHAPE(6)
R017	Outer annular radius (m), ring 7:	not used	0.000E+00	---	RAD_SHAPE(7)
R017	Outer annular radius (m), ring 8:	not used	0.000E+00	---	RAD_SHAPE(8)
R017	Outer annular radius (m), ring 9:	not used	0.000E+00	---	RAD_SHAPE(9)
R017	Outer annular radius (m), ring 10:	not used	0.000E+00	---	RAD_SHAPE(10)
R017	Outer annular radius (m), ring 11:	not used	0.000E+00	---	RAD_SHAPE(11)
R017	Outer annular radius (m), ring 12:	not used	0.000E+00	---	RAD_SHAPE(12)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R017	Fractions of annular areas within AREA:				
R017	Ring 1	not used	1.000E+00	---	FRACA(1)
R017	Ring 2	not used	2.732E-01	---	FRACA(2)
R017	Ring 3	not used	0.000E+00	---	FRACA(3)
R017	Ring 4	not used	0.000E+00	---	FRACA(4)
R017	Ring 5	not used	0.000E+00	---	FRACA(5)
R017	Ring 6	not used	0.000E+00	---	FRACA(6)
R017	Ring 7	not used	0.000E+00	---	FRACA(7)
R017	Ring 8	not used	0.000E+00	---	FRACA(8)
R017	Ring 9	not used	0.000E+00	---	FRACA(9)
R017	Ring 10	not used	0.000E+00	---	FRACA(10)
R017	Ring 11	not used	0.000E+00	---	FRACA(11)
R017	Ring 12	not used	0.000E+00	---	FRACA(12)
R018	Fruits, vegetables and grain consumption (kg/yr)	not used	1.600E+02	---	DIET(1)
R018	Leafy vegetable consumption (kg/yr)	not used	1.400E+01	---	DIET(2)
R018	Milk consumption (L/yr)	not used	9.200E+01	---	DIET(3)
R018	Meat and poultry consumption (kg/yr)	not used	6.300E+01	---	DIET(4)
R018	Fish consumption (kg/yr)	not used	5.400E+00	---	DIET(5)
R018	Other seafood consumption (kg/yr)	not used	9.000E-01	---	DIET(6)
R018	Soil ingestion rate (g/yr)	1.752E+02	3.650E+01	---	SOIL
R018	Drinking water intake (L/yr)	not used	5.100E+02	---	DWI
R018	Contamination fraction of drinking water	not used	1.000E+00	---	FDW
R018	Contamination fraction of household water	not used	1.000E+00	---	FHHW
R018	Contamination fraction of livestock water	not used	1.000E+00	---	FLW
R018	Contamination fraction of irrigation water	not used	1.000E+00	---	FIRW
R018	Contamination fraction of aquatic food	not used	5.000E-01	---	FR9
R018	Contamination fraction of plant food	not used	-1	---	FPLANT
R018	Contamination fraction of meat	not used	-1	---	FMEAT
R018	Contamination fraction of milk	not used	-1	---	FMILK
R019	Livestock fodder intake for meat (kg/day)	not used	6.800E+01	---	LFI5
R019	Livestock fodder intake for milk (kg/day)	not used	5.500E+01	---	LFI6
R019	Livestock water intake for meat (L/day)	not used	5.000E+01	---	LWI5
R019	Livestock water intake for milk (L/day)	not used	1.600E+02	---	LWI6
R019	Livestock soil intake (kg/day)	not used	5.000E-01	---	LSI
R019	Mass loading for foliar deposition (g/m**3)	not used	1.000E-04	---	MLFD
R019	Depth of soil mixing layer (m)	5.000E-02	1.500E-01	---	DM
R019	Depth of roots (m)	not used	9.000E-01	---	DROOT
R019	Drinking water fraction from ground water	not used	1.000E+00	---	FGWDW
R019	Household water fraction from ground water	not used	1.000E+00	---	FGWHH
R019	Livestock water fraction from ground water	not used	1.000E+00	---	FGWLW
R019	Irrigation fraction from ground water	not used	1.000E+00	---	FGWIR
R19B	Wet weight crop yield for Non-Leafy (kg/m**2)	not used	7.000E-01	---	YV(1)
R19B	Wet weight crop yield for Leafy (kg/m**2)	not used	1.500E+00	---	YV(2)
R19B	Wet weight crop yield for Fodder (kg/m**2)	not used	1.100E+00	---	YV(3)
R19B	Growing Season for Non-Leafy (years)	not used	1.700E-01	---	TE(1)
R19B	Growing Season for Leafy (years)	not used	2.500E-01	---	TE(2)
R19B	Growing Season for Fodder (years)	not used	8.000E-02	---	TE(3)

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
R19B	Translocation Factor for Non-Leafy	not used	1.000E-01	---	TIV(1)
R19B	Translocation Factor for Leafy	not used	1.000E+00	---	TIV(2)
R19B	Translocation Factor for Fodder	not used	1.000E+00	---	TIV(3)
R19B	Dry Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RDRY(1)
R19B	Dry Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RDRY(2)
R19B	Dry Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RDRY(3)
R19B	Wet Foliar Interception Fraction for Non-Leafy	not used	2.500E-01	---	RWET(1)
R19B	Wet Foliar Interception Fraction for Leafy	not used	2.500E-01	---	RWET(2)
R19B	Wet Foliar Interception Fraction for Fodder	not used	2.500E-01	---	RWET(3)
R19B	Weathering Removal Constant for Vegetation	not used	2.000E+01	---	WLAM
C14	C-12 concentration in water (g/cm**3)	not used	2.000E-05	---	C12WTR
C14	C-12 concentration in contaminated soil (g/g)	not used	3.000E-02	---	C12CZ
C14	Fraction of vegetation carbon from soil	not used	2.000E-02	---	CSOIL
C14	Fraction of vegetation carbon from air	not used	9.800E-01	---	CAIR
C14	C-14 evasion layer thickness in soil (m)	not used	3.000E-01	---	DMC
C14	C-14 evasion flux rate from soil (1/sec)	not used	7.000E-07	---	EVSN
C14	C-12 evasion flux rate from soil (1/sec)	not used	1.000E-10	---	REVSN
C14	Fraction of grain in beef cattle feed	not used	8.000E-01	---	AVFG4
C14	Fraction of grain in milk cow feed	not used	2.000E-01	---	AVFG5
STOR	Storage times of contaminated foodstuffs (days):				
STOR	Fruits, non-leafy vegetables, and grain	1.400E+01	1.400E+01	---	STOR_T(1)
STOR	Leafy vegetables	1.000E+00	1.000E+00	---	STOR_T(2)
STOR	Milk	1.000E+00	1.000E+00	---	STOR_T(3)
STOR	Meat and poultry	2.000E+01	2.000E+01	---	STOR_T(4)
STOR	Fish	7.000E+00	7.000E+00	---	STOR_T(5)
STOR	Crustacea and mollusks	7.000E+00	7.000E+00	---	STOR_T(6)
STOR	Well water	1.000E+00	1.000E+00	---	STOR_T(7)
STOR	Surface water	1.000E+00	1.000E+00	---	STOR_T(8)
STOR	Livestock fodder	4.500E+01	4.500E+01	---	STOR_T(9)
R021	Thickness of building foundation (m)	not used	1.500E-01	---	FLOOR1
R021	Bulk density of building foundation (g/cm**3)	not used	2.400E+00	---	DENSFL
R021	Total porosity of the cover material	not used	4.000E-01	---	TPCV
R021	Total porosity of the building foundation	not used	1.000E-01	---	TPFL
R021	Volumetric water content of the cover material	not used	5.000E-02	---	PH2OCV
R021	Volumetric water content of the foundation	not used	3.000E-02	---	PH2OFL
R021	Diffusion coefficient for radon gas (m/sec):				
R021	in cover material	not used	2.000E-06	---	DIFCV
R021	in foundation material	not used	3.000E-07	---	DIFFL
R021	in contaminated zone soil	not used	2.000E-06	---	DIFCZ
R021	Radon vertical dimension of mixing (m)	not used	2.000E+00	---	HMIX
R021	Average building air exchange rate (1/hr)	not used	5.000E-01	---	REXG
R021	Height of the building (room) (m)	not used	2.500E+00	---	HRM
R021	Building interior area factor	not used	0.000E+00	---	FAI
R021	Building depth below ground surface (m)	not used	-1.000E+00	---	DMFL
R021	Emanating power of Rn-222 gas	not used	2.500E-01	---	EMANA(1)
R021	Emanating power of Rn-220 gas	not used	1.500E-01	---	EMANA(2)
TITL	Number of graphical time points	32	---	---	NPTS

Site-Specific Parameter Summary (continued)

Menu	Parameter	User Input	Default	Used by RESRAD (If different from user input)	Parameter Name
TITL	Maximum number of integration points for dose	17	---	---	LYMAX
TITL	Maximum number of integration points for risk	257	---	---	KYMAX

Summary of Pathway Selections

Pathway	User Selection
1 -- external gamma	active
2 -- inhalation (w/o radon)	active
3 -- plant ingestion	suppressed
4 -- meat ingestion	suppressed
5 -- milk ingestion	suppressed
6 -- aquatic foods	suppressed
7 -- drinking water	suppressed
8 -- soil ingestion	active
9 -- radon	suppressed
Find peak pathway doses	active

Summary : NFSS FS BOP Construction Worker for DCGLs

File   : C:\RESRAD_FAMILY\RESRAD\6.5\USERFILES\NFSS_BOP_CONSTRUCTION.RAD

Contaminated Zone Dimensions	
Area:	100.00 square meters
Thickness:	1.00 meters
Cover Depth:	0.00 meters

Initial Soil Concentrations, pCi/g	
Ac-227	1.000E+00
Pa-231	1.000E+00
Pb-210	1.000E+00
Ra-226	1.000E+00
Th-230	1.000E+00
U-234	1.000E+00
U-235	1.000E+00
U-238	1.000E+00

Total Dose TDOSE(t), mrem/yr

Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Total Mixture Sum M(t) = Fraction of Basic Dose Limit Received at Time (t)

t (years):	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	2.000E+02	3.000E+02	1.000E+03	1.842E+03	1.000E+05
TDOSE(t):	3.119E+00	3.117E+00	3.113E+00	3.101E+00	3.065E+00	2.787E+00	2.644E+00	1.944E+00	1.489E+00	0.000E+00
M(t):	1.247E-01	1.247E-01	1.245E-01	1.240E-01	1.226E-01	1.115E-01	1.058E-01	7.774E-02	5.957E-02	0.000E+00

Maximum TDOSE(t): 3.119E+00 mrem/yr   at t = 0.000E+00 years

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	3.653E-01	0.1171	2.948E-01	0.0945	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.817E-02	0.0187
Pa-231	4.087E-02	0.0131	6.174E-02	0.0198	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.327E-02	0.0139
Pb-210	1.119E-03	0.0004	1.018E-03	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.862E-02	0.0092
Ra-226	2.010E+00	0.6446	3.986E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.720E-03	0.0018
Th-230	6.644E-04	0.0002	1.452E-02	0.0047	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.190E-03	0.0007
U-234	7.728E-05	0.0000	5.877E-03	0.0019	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.130E-03	0.0004
U-235	1.424E-01	0.0457	5.477E-03	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.068E-03	0.0003
U-238	2.749E-02	0.0088	5.255E-03	0.0017	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.073E-03	0.0003
Total	2.588E+00	0.8299	3.891E-01	0.1248	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.412E-01	0.0453

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 0.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.183E-01	0.2303
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.459E-01	0.0468
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.076E-02	0.0099
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.017E+00	0.6466
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.738E-02	0.0056
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.084E-03	0.0023
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.490E-01	0.0478
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.382E-02	0.0108
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.119E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	3.538E-01	0.1135	2.856E-01	0.0916	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.634E-02	0.0181
Pa-231	5.231E-02	0.0168	7.097E-02	0.0228	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.509E-02	0.0145
Pb-210	1.085E-03	0.0003	9.864E-04	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.774E-02	0.0089
Ra-226	2.008E+00	0.6443	4.293E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.589E-03	0.0021
Th-230	1.535E-03	0.0005	1.452E-02	0.0047	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.192E-03	0.0007
U-234	7.717E-05	0.0000	5.868E-03	0.0019	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.128E-03	0.0004
U-235	1.422E-01	0.0456	5.470E-03	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.067E-03	0.0003
U-238	2.745E-02	0.0088	5.247E-03	0.0017	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.071E-03	0.0003
Total	2.587E+00	0.8299	3.891E-01	0.1248	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.412E-01	0.0453

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.957E-01	0.2232
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.684E-01	0.0540
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.981E-02	0.0096
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.015E+00	0.6465
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.825E-02	0.0059
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.073E-03	0.0023
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.487E-01	0.0477
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.377E-02	0.0108
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.117E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	3.319E-01	0.1066	2.679E-01	0.0860	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.285E-02	0.0170
Pa-231	7.412E-02	0.0238	8.856E-02	0.0284	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.855E-02	0.0156
Pb-210	1.019E-03	0.0003	9.270E-04	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.607E-02	0.0084
Ra-226	2.004E+00	0.6436	4.877E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.245E-03	0.0026
Th-230	3.272E-03	0.0011	1.452E-02	0.0047	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.198E-03	0.0007
U-234	7.697E-05	0.0000	5.850E-03	0.0019	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.124E-03	0.0004
U-235	1.418E-01	0.0455	5.456E-03	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.066E-03	0.0003
U-238	2.737E-02	0.0088	5.231E-03	0.0017	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.068E-03	0.0003
Total	2.583E+00	0.8297	3.889E-01	0.1249	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.412E-01	0.0453

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+00 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.527E-01	0.2096
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.112E-01	0.0678
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.802E-02	0.0090
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.012E+00	0.6464
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.998E-02	0.0064
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.051E-03	0.0023
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.483E-01	0.0476
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.366E-02	0.0108
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.113E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	2.654E-01	0.0856	2.142E-01	0.0691	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.226E-02	0.0136
Pa-231	1.403E-01	0.0452	1.419E-01	0.0458	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.905E-02	0.0190
Pb-210	8.199E-04	0.0003	7.457E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.097E-02	0.0068
Ra-226	1.988E+00	0.6412	6.644E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.326E-02	0.0043
Th-230	9.315E-03	0.0030	1.450E-02	0.0047	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.228E-03	0.0007
U-234	7.653E-05	0.0000	5.788E-03	0.0019	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.112E-03	0.0004
U-235	1.403E-01	0.0452	5.414E-03	0.0017	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.062E-03	0.0003
U-238	2.707E-02	0.0087	5.174E-03	0.0017	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.056E-03	0.0003
Total	2.571E+00	0.8293	3.884E-01	0.1253	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.410E-01	0.0455

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.218E-01	0.1683
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.413E-01	0.1101
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.254E-02	0.0073
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.002E+00	0.6457
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.604E-02	0.0084
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.976E-03	0.0022
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.467E-01	0.0473
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.330E-02	0.0107
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.101E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	1.400E-01	0.0457	1.130E-01	0.0369	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.230E-02	0.0073
Pa-231	2.645E-01	0.0863	2.421E-01	0.0790	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.872E-02	0.0257
Pb-210	4.403E-04	0.0001	4.004E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.126E-02	0.0037
Ra-226	1.944E+00	0.6343	9.904E-04	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.255E-02	0.0074
Th-230	2.628E-02	0.0086	1.445E-02	0.0047	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.378E-03	0.0008
U-234	7.736E-05	0.0000	5.613E-03	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.079E-03	0.0004
U-235	1.361E-01	0.0444	5.331E-03	0.0017	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.059E-03	0.0003
U-238	2.625E-02	0.0086	5.017E-03	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.024E-03	0.0003
Total	2.538E+00	0.8280	3.869E-01	0.1262	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.404E-01	0.0458

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+01 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.754E-01	0.0898
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.853E-01	0.1910
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.210E-02	0.0039
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.967E+00	0.6419
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.310E-02	0.0141
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.769E-03	0.0022
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.425E-01	0.0465
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.229E-02	0.0105
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.065E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	6.117E-04	0.0002	4.937E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.741E-05	0.0000
Pa-231	3.940E-01	0.1414	3.459E-01	0.1241	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.843E-02	0.0353
Pb-210	2.231E-06	0.0000	2.029E-06	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.707E-05	0.0000
Ra-226	1.604E+00	0.5755	1.158E-03	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.818E-02	0.0101
Th-230	1.534E-01	0.0550	1.405E-02	0.0050	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.395E-03	0.0016
U-234	1.873E-04	0.0001	4.330E-03	0.0016	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.331E-04	0.0003
U-235	1.057E-01	0.0379	5.145E-03	0.0018	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.117E-03	0.0004
U-238	2.017E-02	0.0072	3.857E-03	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.871E-04	0.0003
Total	2.278E+00	0.8174	3.750E-01	0.1345	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.339E-01	0.0480

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 2.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.203E-03	0.0004
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.384E-01	0.3008
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.133E-05	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.633E+00	0.5861
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.719E-01	0.0617
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.350E-03	0.0019
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.120E-01	0.0402
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.481E-02	0.0089
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.787E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	2.503E-05	0.0000	2.020E-05	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.986E-06	0.0000
Pa-231	3.888E-01	0.1471	3.413E-01	0.1291	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.708E-02	0.0367
Pb-210	9.962E-08	0.0000	9.061E-08	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.548E-06	0.0000
Ra-226	1.432E+00	0.5417	1.036E-03	0.0004	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.521E-02	0.0095
Th-230	2.154E-01	0.0815	1.383E-02	0.0052	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.453E-03	0.0021
U-234	3.154E-04	0.0001	3.719E-03	0.0014	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.174E-04	0.0003
U-235	9.132E-02	0.0345	5.080E-03	0.0019	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.148E-03	0.0004
U-238	1.727E-02	0.0065	3.304E-03	0.0012	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.743E-04	0.0003
Total	2.145E+00	0.8114	3.683E-01	0.1393	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.303E-01	0.0493

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 3.000E+02 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.922E-05	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.272E-01	0.3129
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.738E-06	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.459E+00	0.5516
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.347E-01	0.0888
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.752E-03	0.0018
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.755E-02	0.0369
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.125E-02	0.0080
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.644E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	4.808E-15	0.0000	3.880E-15	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.656E-16	0.0000
Pa-231	3.507E-01	0.1804	3.078E-01	0.1584	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	8.756E-02	0.0451
Pb-210	3.527E-17	0.0000	3.208E-17	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.022E-16	0.0000
Ra-226	6.484E-01	0.3336	4.689E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.142E-02	0.0059
Th-230	4.650E-01	0.2392	1.223E-02	0.0063	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.632E-03	0.0050
U-234	1.582E-03	0.0008	1.304E-03	0.0007	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.738E-04	0.0001
U-235	3.417E-02	0.0176	4.621E-03	0.0024	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.214E-03	0.0006
U-238	5.837E-03	0.0030	1.119E-03	0.0006	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.284E-04	0.0001
Total	1.506E+00	0.7747	3.276E-01	0.1685	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.103E-01	0.0568

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.454E-15	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.461E-01	0.3839
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.695E-16	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.603E-01	0.3397
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.868E-01	0.2505
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.160E-03	0.0016
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.000E-02	0.0206
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.185E-03	0.0037
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.944E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.842E+03 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	9.871E-27	0.0000	7.967E-27	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.572E-27	0.0000
Pa-231	3.097E-01	0.2080	2.719E-01	0.1826	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	7.733E-02	0.0519
Pb-210	1.511E-28	0.0000	1.374E-28	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.865E-27	0.0000
Ra-226	2.499E-01	0.1678	1.808E-04	0.0001	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.401E-03	0.0030
Th-230	5.319E-01	0.3572	1.045E-02	0.0070	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.059E-02	0.0071
U-234	2.617E-03	0.0018	3.998E-04	0.0003	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.182E-04	0.0001
U-235	1.250E-02	0.0084	4.096E-03	0.0028	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.138E-03	0.0008
U-238	1.586E-03	0.0011	3.043E-04	0.0002	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.215E-05	0.0000
Total	1.108E+00	0.7442	2.873E-01	0.1929	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	9.364E-02	0.0629

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.842E+03 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.941E-26	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	6.589E-01	0.4425
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	4.153E-27	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	2.545E-01	0.1709
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	5.529E-01	0.3713
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	3.135E-03	0.0021
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.774E-02	0.0119
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.952E-03	0.0013
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	1.489E+00	1.0000

*Sum of all water independent and dependent pathways.

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+05 years

Water Independent Pathways (Inhalation excludes radon)

Radio-	Ground		Inhalation		Radon		Plant		Meat		Milk		Soil	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

Total Dose Contributions TDOSE(i,p,t) for Individual Radionuclides (i) and Pathways (p)
As mrem/yr and Fraction of Total Dose At t = 1.000E+05 years

Water Dependent Pathways

Radio-	Water		Fish		Radon		Plant		Meat		Milk		All Pathways*	
Nuclide	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.	mrem/yr	fract.
Ac-227	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pa-231	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Pb-210	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Ra-226	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Th-230	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-234	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-235	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
U-238	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000
Total	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000	0.000E+00	0.0000

*Sum of all water independent and dependent pathways.

Dose/Source Ratios Summed Over All Pathways

Parent and Progeny Principal Radionuclide Contributions Indicated

Parent	Product	Thread	DSR(j,t) At Time in Years (mrem/yr)/(pCi/g)									
(i)	(j)	Fraction	0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	2.000E+02	3.000E+02	1.000E+03	1.842E+03	1.000E+05
Ac-227+D	Ac-227+D	1.000E+00	7.183E-01	6.957E-01	6.527E-01	5.218E-01	2.754E-01	1.203E-03	4.922E-05	9.454E-15	1.941E-26	0.000E+00
Pa-231	Pa-231	1.000E+00	1.344E-01	1.344E-01	1.343E-01	1.342E-01	1.338E-01	1.305E-01	1.286E-01	1.160E-01	1.024E-01	0.000E+00
Pa-231	Ac-227+D	1.000E+00	1.149E-02	3.400E-02	7.689E-02	2.071E-01	4.515E-01	7.079E-01	6.986E-01	6.301E-01	5.565E-01	0.000E+00
Pa-231	∑DSR(j)		1.459E-01	1.684E-01	2.112E-01	3.413E-01	5.853E-01	8.384E-01	8.272E-01	7.461E-01	6.589E-01	0.000E+00
Pb-210+D	Pb-210+D	1.000E+00	3.076E-02	2.981E-02	2.802E-02	2.254E-02	1.210E-02	6.133E-05	2.738E-06	9.695E-16	4.153E-27	0.000E+00
Ra-226+D	Ra-226+D	1.000E+00	2.016E+00	2.014E+00	2.009E+00	1.993E+00	1.949E+00	1.608E+00	1.435E+00	6.499E-01	2.505E-01	0.000E+00
Ra-226+D	Pb-210+D	1.000E+00	4.803E-04	1.420E-03	3.212E-03	8.643E-03	1.875E-02	2.577E-02	2.306E-02	1.044E-02	4.026E-03	0.000E+00
Ra-226+D	∑DSR(j)		2.017E+00	2.015E+00	2.012E+00	2.002E+00	1.967E+00	1.633E+00	1.459E+00	6.603E-01	2.545E-01	0.000E+00
Th-230	Th-230	1.000E+00	1.694E-02	1.694E-02	1.693E-02	1.691E-02	1.684E-02	1.628E-02	1.596E-02	1.389E-02	1.175E-02	0.000E+00
Th-230	Ra-226+D	1.000E+00	4.367E-04	1.309E-03	3.051E-03	9.112E-03	2.612E-02	1.536E-01	2.157E-01	4.658E-01	5.329E-01	0.000E+00
Th-230	Pb-210+D	1.000E+00	6.954E-08	4.823E-07	2.497E-06	2.077E-05	1.440E-04	2.031E-03	3.038E-03	7.112E-03	8.249E-03	0.000E+00
Th-230	∑DSR(j)		1.738E-02	1.825E-02	1.998E-02	2.604E-02	4.310E-02	1.719E-01	2.347E-01	4.868E-01	5.529E-01	0.000E+00
U-234	U-234	1.000E+00	7.084E-03	7.073E-03	7.051E-03	6.974E-03	6.761E-03	5.193E-03	4.446E-03	1.499E-03	4.056E-04	0.000E+00
U-234	Th-230	1.000E+00	7.621E-08	2.285E-07	5.322E-07	1.587E-06	4.530E-06	2.573E-05	3.547E-05	6.851E-05	7.168E-05	0.000E+00
U-234	Ra-226+D	1.000E+00	1.310E-09	9.163E-09	4.835E-08	4.296E-07	3.554E-06	1.306E-04	2.670E-04	1.568E-03	2.618E-03	0.000E+00
U-234	Pb-210+D	1.000E+00	1.567E-13	2.334E-12	2.679E-11	6.708E-10	1.403E-08	1.509E-06	3.426E-06	2.339E-05	4.015E-05	0.000E+00
U-234	∑DSR(j)		7.084E-03	7.073E-03	7.051E-03	6.976E-03	6.769E-03	5.350E-03	4.752E-03	3.160E-03	3.135E-03	0.000E+00
U-235+D	U-235+D	1.000E+00	1.490E-01	1.487E-01	1.483E-01	1.467E-01	1.422E-01	1.093E-01	9.358E-02	3.162E-02	8.575E-03	0.000E+00
U-235+D	Pa-231	1.000E+00	1.421E-06	4.260E-06	9.923E-06	2.959E-05	8.452E-05	4.825E-04	6.671E-04	1.319E-03	1.428E-03	0.000E+00
U-235+D	Ac-227+D	1.000E+00	8.125E-08	5.634E-07	2.914E-06	2.417E-05	1.663E-04	2.251E-03	3.306E-03	7.062E-03	7.733E-03	0.000E+00
U-235+D	∑DSR(j)		1.490E-01	1.487E-01	1.483E-01	1.467E-01	1.425E-01	1.120E-01	9.755E-02	4.000E-02	1.774E-02	0.000E+00
U-238	U-238	5.400E-05	3.398E-07	3.393E-07	3.382E-07	3.346E-07	3.243E-07	2.492E-07	2.134E-07	7.213E-08	1.956E-08	0.000E+00
U-238+D	U-238+D	9.999E-01	3.382E-02	3.377E-02	3.366E-02	3.330E-02	3.228E-02	2.481E-02	2.124E-02	7.179E-03	1.947E-03	0.000E+00
U-238+D	U-234	9.999E-01	1.004E-08	3.007E-08	6.995E-08	2.076E-07	5.846E-07	2.952E-06	3.789E-06	4.259E-06	2.124E-06	0.000E+00
U-238+D	Th-230	9.999E-01	7.200E-14	5.035E-13	2.656E-12	2.358E-11	1.945E-10	6.984E-09	1.409E-08	7.593E-08	1.165E-07	0.000E+00
U-238+D	Ra-226+D	9.999E-01	9.283E-16	1.391E-14	1.620E-13	4.262E-12	1.020E-10	2.402E-08	7.249E-08	1.268E-06	3.377E-06	0.000E+00
U-238+D	Pb-210+D	9.999E-01	8.893E-20	2.740E-18	6.811E-17	5.074E-15	3.151E-13	2.465E-10	8.524E-10	1.842E-08	5.119E-08	0.000E+00
U-238+D	∑DSR(j)		3.382E-02	3.377E-02	3.366E-02	3.330E-02	3.229E-02	2.481E-02	2.125E-02	7.185E-03	1.952E-03	0.000E+00

The DSR includes contributions from associated (half-life ≤ 180 days) daughters.

Single Radionuclide Soil Guidelines G(i,t) in pCi/g
Basic Radiation Dose Limit = 2.500E+01 mrem/yr

Nuclide (i)	t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	2.000E+02	3.000E+02	1.000E+03	1.842E+03	1.000E+05
Ac-227	3.480E+01	3.593E+01	3.830E+01	4.791E+01	9.079E+01	2.079E+04	5.080E+05	*7.232E+13	*7.232E+13	*7.232E+13
Pa-231	1.714E+02	1.485E+02	1.184E+02	7.326E+01	4.271E+01	2.982E+01	3.022E+01	3.351E+01	3.794E+01	*4.723E+10
Pb-210	8.129E+02	8.385E+02	8.923E+02	1.109E+03	2.066E+03	4.077E+05	9.129E+06	*7.634E+13	*7.634E+13	*7.634E+13
Ra-226	1.240E+01	1.241E+01	1.242E+01	1.249E+01	1.271E+01	1.531E+01	1.714E+01	3.786E+01	9.822E+01	*9.885E+11
Th-230	1.439E+03	1.370E+03	1.251E+03	9.601E+02	5.800E+02	1.455E+02	1.065E+02	5.135E+01	4.521E+01	*2.018E+10
U-234	3.529E+03	3.535E+03	3.545E+03	3.583E+03	3.693E+03	4.673E+03	5.261E+03	7.913E+03	7.974E+03	*6.247E+09
U-235	1.678E+02	1.681E+02	1.686E+02	1.704E+02	1.755E+02	2.232E+02	2.563E+02	6.249E+02	1.409E+03	*2.161E+06
U-238	7.392E+02	7.403E+02	7.426E+02	7.507E+02	7.743E+02	1.008E+03	1.177E+03	3.480E+03	1.280E+04	*3.361E+05

*At specific activity limit

Summed Dose/Source Ratios DSR(i,t) in (mrem/yr)/(pCi/g)
and Single Radionuclide Soil Guidelines G(i,t) in pCi/g
at tmin = time of minimum single radionuclide soil guideline
and at tmax = time of maximum total dose = 0.000E+00 years

Nuclide (i)	Initial (pCi/g)	tmin (years)	DSR(i,tmin)	G(i,tmin) (pCi/g)	DSR(i,tmax)	G(i,tmax) (pCi/g)
Ac-227	1.000E+00	0.000E+00	7.183E-01	3.480E+01	7.183E-01	3.480E+01
Pa-231	1.000E+00	163.3 ± 0.3	8.402E-01	2.975E+01	1.459E-01	1.714E+02
Pb-210	1.000E+00	0.000E+00	3.076E-02	8.129E+02	3.076E-02	8.129E+02
Ra-226	1.000E+00	0.000E+00	2.017E+00	1.240E+01	2.017E+00	1.240E+01
Th-230	1.000E+00	1846 ± 4	5.529E-01	4.521E+01	1.738E-02	1.439E+03
U-234	1.000E+00	0.000E+00	7.084E-03	3.529E+03	7.084E-03	3.529E+03
U-235	1.000E+00	0.000E+00	1.490E-01	1.678E+02	1.490E-01	1.678E+02
U-238	1.000E+00	0.000E+00	3.382E-02	7.392E+02	3.382E-02	7.392E+02

Individual Nuclide Dose Summed Over All Pathways

Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	DOSE(j,t), mrem/yr t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	2.000E+02	3.000E+02	1.000E+03	1.842E+03	1.000E+05
Ac-227	Ac-227	1.000E+00	7.183E-01	6.957E-01	6.527E-01	5.218E-01	2.754E-01	1.203E-03	4.922E-05	9.454E-15	1.941E-26	0.000E+00
Ac-227	Pa-231	1.000E+00	1.149E-02	3.400E-02	7.689E-02	2.071E-01	4.515E-01	7.079E-01	6.986E-01	6.301E-01	5.565E-01	0.000E+00
Ac-227	U-235	1.000E+00	8.125E-08	5.634E-07	2.914E-06	2.417E-05	1.663E-04	2.251E-03	3.306E-03	7.062E-03	7.733E-03	0.000E+00
Ac-227	∑DOSE(j)		7.298E-01	7.297E-01	7.296E-01	7.289E-01	7.271E-01	7.113E-01	7.020E-01	6.372E-01	5.642E-01	0.000E+00
Pa-231	Pa-231	1.000E+00	1.344E-01	1.344E-01	1.343E-01	1.342E-01	1.338E-01	1.305E-01	1.286E-01	1.160E-01	1.024E-01	0.000E+00
Pa-231	U-235	1.000E+00	1.421E-06	4.260E-06	9.923E-06	2.959E-05	8.452E-05	4.825E-04	6.671E-04	1.319E-03	1.428E-03	0.000E+00
Pa-231	∑DOSE(j)		1.344E-01	1.344E-01	1.343E-01	1.342E-01	1.339E-01	1.310E-01	1.292E-01	1.173E-01	1.038E-01	0.000E+00
Pb-210	Pb-210	1.000E+00	3.076E-02	2.981E-02	2.802E-02	2.254E-02	1.210E-02	6.133E-05	2.738E-06	9.695E-16	4.153E-27	0.000E+00
Pb-210	Ra-226	1.000E+00	4.803E-04	1.420E-03	3.212E-03	8.643E-03	1.875E-02	2.577E-02	2.306E-02	1.044E-02	4.026E-03	0.000E+00
Pb-210	Th-230	1.000E+00	6.954E-08	4.823E-07	2.497E-06	2.077E-05	1.440E-04	2.031E-03	3.038E-03	7.112E-03	8.249E-03	0.000E+00
Pb-210	U-234	1.000E+00	1.567E-13	2.334E-12	2.679E-11	6.708E-10	1.403E-08	1.509E-06	3.426E-06	2.339E-05	4.015E-05	0.000E+00
Pb-210	U-238	9.999E-01	8.893E-20	2.740E-18	6.811E-17	5.074E-15	3.151E-13	2.465E-10	8.524E-10	1.842E-08	5.119E-08	0.000E+00
Pb-210	∑DOSE(j)		3.124E-02	3.123E-02	3.123E-02	3.120E-02	3.100E-02	2.786E-02	2.611E-02	1.758E-02	1.231E-02	0.000E+00
Ra-226	Ra-226	1.000E+00	2.016E+00	2.014E+00	2.009E+00	1.993E+00	1.949E+00	1.608E+00	1.435E+00	6.499E-01	2.505E-01	0.000E+00
Ra-226	Th-230	1.000E+00	4.367E-04	1.309E-03	3.051E-03	9.112E-03	2.612E-02	1.536E-01	2.157E-01	4.658E-01	5.329E-01	0.000E+00
Ra-226	U-234	1.000E+00	1.310E-09	9.163E-09	4.835E-08	4.296E-07	3.554E-06	1.306E-04	2.670E-04	1.568E-03	2.618E-03	0.000E+00
Ra-226	U-238	9.999E-01	9.283E-16	1.391E-14	1.620E-13	4.262E-12	1.020E-10	2.402E-08	7.249E-08	1.268E-06	3.377E-06	0.000E+00
Ra-226	∑DOSE(j)		2.016E+00	2.015E+00	2.012E+00	2.002E+00	1.975E+00	1.761E+00	1.651E+00	1.117E+00	7.861E-01	0.000E+00
Th-230	Th-230	1.000E+00	1.694E-02	1.694E-02	1.693E-02	1.691E-02	1.684E-02	1.628E-02	1.596E-02	1.389E-02	1.175E-02	0.000E+00
Th-230	U-234	1.000E+00	7.621E-08	2.285E-07	5.322E-07	1.587E-06	4.530E-06	2.573E-05	3.547E-05	6.851E-05	7.168E-05	0.000E+00
Th-230	U-238	9.999E-01	7.200E-14	5.035E-13	2.656E-12	2.358E-11	1.945E-10	6.984E-09	1.409E-08	7.593E-08	1.165E-07	0.000E+00
Th-230	∑DOSE(j)		1.694E-02	1.694E-02	1.693E-02	1.691E-02	1.685E-02	1.631E-02	1.600E-02	1.396E-02	1.182E-02	0.000E+00
U-234	U-234	1.000E+00	7.084E-03	7.073E-03	7.051E-03	6.974E-03	6.761E-03	5.193E-03	4.446E-03	1.499E-03	4.056E-04	0.000E+00
U-234	U-238	9.999E-01	1.004E-08	3.007E-08	6.995E-08	2.076E-07	5.846E-07	2.952E-06	3.789E-06	4.259E-06	2.124E-06	0.000E+00
U-234	∑DOSE(j)		7.084E-03	7.073E-03	7.051E-03	6.975E-03	6.762E-03	5.196E-03	4.450E-03	1.504E-03	4.077E-04	0.000E+00
U-235	U-235	1.000E+00	1.490E-01	1.487E-01	1.483E-01	1.467E-01	1.422E-01	1.093E-01	9.358E-02	3.162E-02	8.575E-03	0.000E+00
U-238	U-238	5.400E-05	3.398E-07	3.393E-07	3.382E-07	3.346E-07	3.243E-07	2.492E-07	2.134E-07	7.213E-08	1.956E-08	0.000E+00
U-238	U-238	9.999E-01	3.382E-02	3.377E-02	3.366E-02	3.330E-02	3.228E-02	2.481E-02	2.124E-02	7.179E-03	1.947E-03	0.000E+00
U-238	∑DOSE(j)		3.382E-02	3.377E-02	3.366E-02	3.330E-02	3.229E-02	2.481E-02	2.125E-02	7.179E-03	1.947E-03	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

Individual Nuclide Soil Concentration

Parent Nuclide and Branch Fraction Indicated

Nuclide (j)	Parent (i)	THF(i)	S(j,t), pCi/g t= 0.000E+00	1.000E+00	3.000E+00	1.000E+01	3.000E+01	2.000E+02	3.000E+02	1.000E+03	1.842E+03	1.000E+05
Ac-227	Ac-227	1.000E+00	1.000E+00	9.685E-01	9.086E-01	7.264E-01	3.833E-01	1.674E-03	6.851E-05	1.316E-14	2.702E-26	0.000E+00
Ac-227	Pa-231	1.000E+00	0.000E+00	3.133E-02	9.105E-02	2.723E-01	6.127E-01	9.699E-01	9.573E-01	8.634E-01	7.625E-01	3.911E-07
Ac-227	U-235	1.000E+00	0.000E+00	3.330E-07	2.931E-06	3.018E-05	2.216E-04	3.076E-03	4.523E-03	9.674E-03	1.060E-02	5.900E-09
Ac-227	∑S(j):		1.000E+00	9.999E-01	9.996E-01	9.987E-01	9.962E-01	9.746E-01	9.619E-01	8.731E-01	7.731E-01	3.970E-07
Pa-231	Pa-231	1.000E+00	1.000E+00	9.999E-01	9.996E-01	9.985E-01	9.956E-01	9.709E-01	9.567E-01	8.628E-01	7.620E-01	3.908E-07
Pa-231	U-235	1.000E+00	0.000E+00	2.114E-05	6.331E-05	2.098E-04	6.188E-04	3.583E-03	4.957E-03	9.815E-03	1.063E-02	5.896E-09
Pa-231	∑S(j):		1.000E+00	9.999E-01	9.996E-01	9.987E-01	9.962E-01	9.745E-01	9.617E-01	8.726E-01	7.726E-01	3.967E-07
Pb-210	Pb-210	1.000E+00	1.000E+00	9.694E-01	9.110E-01	7.328E-01	3.935E-01	1.994E-03	8.904E-05	3.152E-14	1.350E-25	0.000E+00
Pb-210	Ra-226	1.000E+00	0.000E+00	3.059E-02	8.888E-02	2.656E-01	5.947E-01	8.253E-01	7.387E-01	3.345E-01	1.290E-01	0.000E+00
Pb-210	Th-230	1.000E+00	0.000E+00	6.661E-06	5.868E-05	6.059E-04	4.480E-03	6.486E-02	9.711E-02	2.277E-01	2.641E-01	1.111E-09
Pb-210	U-234	1.000E+00	0.000E+00	2.003E-11	5.318E-10	1.859E-08	4.290E-07	4.807E-05	1.093E-04	7.484E-04	1.285E-03	7.384E-12
Pb-210	U-238	9.999E-01	0.000E+00	1.422E-17	1.135E-15	1.335E-13	9.468E-12	7.829E-09	2.715E-08	5.891E-07	1.638E-06	1.549E-14
Pb-210	∑S(j):		1.000E+00	1.000E+00	9.999E-01	9.990E-01	9.926E-01	8.922E-01	8.360E-01	5.629E-01	3.943E-01	1.118E-09
Ra-226	Ra-226	1.000E+00	1.000E+00	9.989E-01	9.966E-01	9.887E-01	9.666E-01	7.974E-01	7.120E-01	3.224E-01	1.243E-01	0.000E+00
Ra-226	Th-230	1.000E+00	0.000E+00	4.329E-04	1.297E-03	4.303E-03	1.274E-02	7.596E-02	1.068E-01	2.309E-01	2.642E-01	1.104E-09
Ra-226	U-234	1.000E+00	0.000E+00	1.948E-09	1.750E-08	1.931E-07	1.705E-06	6.446E-05	1.320E-04	7.771E-04	1.298E-03	7.338E-12
Ra-226	U-238	9.999E-01	0.000E+00	1.840E-15	4.958E-14	1.822E-12	4.812E-11	1.182E-08	3.578E-08	6.281E-07	1.674E-06	1.539E-14
Ra-226	∑S(j):		1.000E+00	9.993E-01	9.979E-01	9.930E-01	9.794E-01	8.734E-01	8.190E-01	5.540E-01	3.898E-01	1.111E-09
Th-230	Th-230	1.000E+00	1.000E+00	9.998E-01	9.994E-01	9.980E-01	9.941E-01	9.611E-01	9.422E-01	8.199E-01	6.937E-01	2.379E-09
Th-230	U-234	1.000E+00	0.000E+00	8.994E-06	2.693E-05	8.923E-05	2.631E-04	1.516E-03	2.091E-03	4.043E-03	4.231E-03	1.581E-11
Th-230	U-238	9.999E-01	0.000E+00	1.275E-11	1.145E-10	1.262E-09	1.111E-08	4.104E-07	8.293E-07	4.479E-06	6.878E-06	3.317E-14
Th-230	∑S(j):		1.000E+00	9.998E-01	9.994E-01	9.981E-01	9.943E-01	9.626E-01	9.443E-01	8.240E-01	6.979E-01	2.394E-09
U-234	U-234	1.000E+00	1.000E+00	9.984E-01	9.954E-01	9.846E-01	9.545E-01	7.330E-01	6.276E-01	2.117E-01	5.726E-02	0.000E+00
U-234	U-238	9.999E-01	0.000E+00	2.830E-06	8.465E-06	2.791E-05	8.118E-05	4.157E-04	5.340E-04	6.009E-04	2.998E-04	0.000E+00
U-234	∑S(j):		1.000E+00	9.985E-01	9.954E-01	9.846E-01	9.546E-01	7.335E-01	6.282E-01	2.123E-01	5.756E-02	0.000E+00
U-235	U-235	1.000E+00	1.000E+00	9.985E-01	9.954E-01	9.846E-01	9.546E-01	7.335E-01	6.282E-01	2.123E-01	5.756E-02	0.000E+00
U-238	U-238	5.400E-05	5.400E-05	5.392E-05	5.375E-05	5.317E-05	5.155E-05	3.961E-05	3.392E-05	1.146E-05	3.108E-06	0.000E+00
U-238	U-238	9.999E-01	9.999E-01	9.984E-01	9.953E-01	9.846E-01	9.545E-01	7.334E-01	6.281E-01	2.123E-01	5.756E-02	0.000E+00
U-238	∑S(j):		1.000E+00	9.985E-01	9.954E-01	9.846E-01	9.546E-01	7.335E-01	6.282E-01	2.123E-01	5.756E-02	0.000E+00

THF(i) is the thread fraction of the parent nuclide.

RESCALC.EXE execution time =   1.28 seconds

THIS PAGE INTENTIONALLY LEFT BLANK

Table 1. RESRAD Input Parameter Values for Derivation of Guideline Concentration Levels (Cleanup Goals)

RESRAD Parameter	Units	Value	Receptor	Comment/Reference
Area of contaminated zone	m^2	100	All	Use 100 m2 for 10CFR40 Appendix A compliance
Thickness of contaminated zone	m	1	Al1	Most contamination is within the top 3 feet
Length parallel to aquifer flow	m	10	Resident only	10 m would be more appropriate if the area is reduced to 100 m2
Does the initial contamination penetrate the water table?	yes/no	No	All	Majority of contamination (at least for primary radionuclide Ra-226) is surficial
Contaminated fraction below the water table	unitless	NU	All	Only needed if initial contamination penetrates the water table
Time since placement of material	yr	0	All	RESRAD default
Cover depth	m	0	All	Assumes no cover
Density of cover material	g/cm^3	NU	All	Not used
Cover depth erosion rate	m/yr	NU	All	Not used
Density of contaminated zone	g/cm^3	1.2	All	Consistent with HGL (USACE 2007) Table 4.6 for tower soil and clay soil type
Contaminated zone erosion rate	m/yr	0.00006	All others	2% slope with no farming/gardening (DCH)
Contaminated zone total porosity	unitless	0.45	All	Site-wide value consistent with sandy silty clay (DCH)
Contaminated zone field capacity	unitless	0.305	All	HELP V3 Manual, Table 2 (1994)
Contaminated zone hydraulic conductivity	m/yr	1.01	All	Value for upper clay till, 3.2E-06 cm/sec (USACE HGL 2007 Table 2.5)
Contaminated zone b parameter	unitless	10.4	All	Assumed for silty/sandy clay per DCH, Table 13.1 (brown clay layer has silty sand lenses)
Average annual wind speed	m/sec	4.5	All	NOAA average for Lewiston, NY (10 mph)
Humidity in air	g/m^3	NU	All	Not used
Evapotranspiration coefficient	unitless	0.700	All	Per DCH equation 12.1 assuming 0.533 m/yr evapotranspiration from measured value (HGL Table 2.8)
Precipitation	m/yr	0.813	All	Measured value (32 in/yr from USACE HGL 2007 table 2.8)
Irrigation	m/yr	0.2	All	RESRAD default
Irrigation mode	unitless	Overhead	All	RESRAD default
Runoff coefficient	unitless	0.313	All	Site-specific value: (precip. rate - evapotranspiration rate - infiltration rate) ÷ precip. rate or (0.813 - 0.533 - 0.0254) ÷ 0.813; inputs derived from HGL Table 2.8
Watershed area for nearby stream or pond	m^2	2.7E+09	Resident only	Oak Orchard-Twelve Mile watershed (1040 sq. miles)
Accuracy for water/soil computations	unitless	0.001	Resident only	RESRAD default
Saturated zone density	g/cm^3	1.52	Resident only	Sandy, silty clay (NLO/HGL); sand value selected (DCH)
Saturated zone total porosity	unitless	0.395	Resident only	Sandy, silty clay (NLO/HGL); sand value selected (DCH)
Saturated zone effective porosity	unitless	0.30	Resident only	Sandy, silty clay (NLO/HGL); sand value selected (SEF 2006)

Table 1. RESRAD Input Parameter Values for Derivation of Guideline Concentration Levels (Cleanup Goals)

RESRAD Parameter	Units	Value	Receptor	Comment/Reference
Saturated zone field capacity	unitless	0.062	Resident only	HELP V3 Manual, sand (1994)
Saturated zone hydraulic conductivity	m/yr	315	Resident only	Assumed value for sand at 1.0E-03 cm/sec; within range of K-values for BCT/SL in HGL Table 2.4; also consistent with literature values for sand (e.g., HELP)
Saturated zone hydraulic gradient	unitless	0.005	Resident only	Assigned based on HGL Figs. 2.27 and 2.28 and EU-13 (USACE 2007)
Saturated zone b parameter	unitless	4.05	Resident only	Sandy, silty clay (NLO/HGL), sand value selected (DCH)
Water table drop rate	m/yr	0.001	Resident only	RESRAD default
Well pump intake depth (m below water table)	m	4	Resident only	Upper water bearing zone depth (USACE HGL 2007)
Model: Nondispersion (ND) or Mass-Balance (MB)	unitless	ND	Resident only	RESRAD default
Well pumping rate	m^3/yr	250	Resident only	RESRAD default
Number of unsaturated zone strata	unitless	1	Resident only	RESRAD default
Unsaturated zone thickness	m	0.9	Resident only	Specific to EU-13 (USACE HGL 2007)
Unsaturated zone soil density	g/cm^3	1.7	Resident only	Specific to EU-13 (USACE HGL 2007)
Unsaturated zone total porosity	unitless	0.37	Resident only	Specific to EU-13 (USACE HGL 2007)
Unsaturated zone effective porosity	unitless	0.08	Resident only	Value from table 4.7 for BCT (USACE HGL 2007)
Unsaturated zone field capacity	unitless	0.305	Resident only	Value from HGL Table 4.7 for BCT
Unsaturated zone b parameter	unitless	10.4	Resident only	Value from DCH Table 13.1 assuming silty clay (NLO/HGL)
Unsaturated zone hydraulic conductivity	m/yr	1.01	Resident only	Value for upper clay till, 3.2E-06 cm/sec (HGL, Table 2.5)
Distribution coefficient – actinium	cm^3/g	1,500	All	Site-wide measured value (USACE HGL 2007, App. D Table 2)
Distribution coefficient – protactinium	cm^3/g	1,500	All	Site-wide measured value (USACE HGL 2007, App. D Table 2)
Distribution coefficient – lead	cm^3/g	36,321	All	Site-wide measured value (USACE HGL 2007, App. D Table 2)
Distribution coefficient – radium	cm^3/g	271	All	Site-wide measured value (USACE HGL 2007, App. D Table 2)
Distribution coefficient – thorium	cm^3/g	1,000	All	Site-wide measured value (USACE HGL 2007, App. D Table 2)
Distribution coefficient – uranium	cm^3/g	122	All	Calculated from site soil/groundwater data; reasonable lower limit (USACE HGL 2011)
Inhalation rate	m^3/yr	7,300	Workers	Assuming RAGS default rate of 20 m^3/day for workers (industrial and construction)
Mass Loading for Inhalation	kg/m^3	6E-04 1E-04	Construction Worker Industrial Worker	Assumed for construction activities (DCH) RESRAD default
Shielding factor, inhalation	unitless	0.4	All	RESRAD default.
Shielding factor, external gamma	unitless	0.4	All	60% shielding per SSG-2000 for all indoor receptors.
Fraction of time spent outdoors (on site soil)	unitless	0.228 0.0285	Construction Worker Industrial Worker	Assumes a supervisor type worker (8 hr/day, 250 days/year) Assumes 1 hour/day, 250 days/year

Table 1. RESRAD Input Parameter Values for Derivation of Guideline Concentration Levels (Cleanup Goals)

RESRAD Parameter	Units	Value	Receptor	Comment/Reference
Fraction of time spent indoors	unitless	0 0.200	Construction Worker Industrial Worker	All work performed outside Assumes 7 hours/day, 250 days/year
Shape factor flag, external gamma	unitless	1	All	RESRAD default
Fruits, vegetables and grain consumption	kg/yr	NU	Worker	Not used
Leafy vegetable consumption	kg/yr	NU	Worker	Not used
Milk consumption	L/yr	NU	Worker	Not used
Meat and poultry consumption	kg/yr	NU	Worker	Not used
Fish consumption	kg/yr	NU	All	Not used
Other seafood consumption	kg/yr	NU	All	Not used
Soil ingestion rate	g/yr	175.2 18.25	ConstructionWorker Industrial Worker	480 mg/day for RME assuming outdoor summer activities (EFH 1997, Table 4-16, no activity-specific updates for adults were made in the 2011 version of the EFH). 50 mg/day EFH 2011 recommended value for adults
Drinking water intake	L/yr	NU	Worker	Not used
Contamination fraction of drinking water	unitless	NU	Worker	RESRAD default, where applicable
Contamination fraction of household water	unitless	NU	Worker	RESRAD default, where applicable
Contamination fraction of livestock water	unitless	NU	Worker	RESRAD default, where applicable
Contamination fraction of irrigation water	unitless	NU	Worker	RESRAD default RESRAD default
Contamination fraction of aquatic food	unitless	NU	All	Not used
Contamination fraction of plant food	unitless	NU	Worker	Not used
Contamination fraction of meat	unitless	NU	Worker	Not used
Contamination fraction of milk	unitless	NU	Worker	Not used
Livestock fodder intake for meat	kg/day	NU	Worker	Not used
Livestock fodder intake for milk	kg/day	NU	Worker	Not used
Livestock water intake for meat	L/day	NU	Worker	Not used
Livestock water intake for milk	L/day	NU	Worker	Not used
Livestock soil intake	kg/day	NU	Worker	Not used
Mass loading for foliar deposition	g/m^3	NU	Worker	Not used
Depth of soil mixing layer	m	0.05	All others	Assumed for non-gardening/non-tilling scenarios
Depth of roots	m	0.9	All *	RESRAD default
Drinking water fraction from ground water	unitless	NU	Worker	Not used
Household water fraction from ground water	unitless	NU	Worker	Not used

Table 1. RESRAD Input Parameter Values for Derivation of Guideline Concentration Levels (Cleanup Goals)

RESRAD Parameter	Units	Value	Receptor	Comment/Reference
Livestock water fraction from ground water	unitless	NU	Worker	Not used
Irrigation fraction from ground water	unitless	NU	Worker	Not used
Wet weight crop yield for non-leafy	kg/m^2	NU	Worker	Not used
Wet weight crop yield for leafy	kg/m^2	NU	Worker	Not used
Wet weight crop yield for fodder	kg/m^2	NU	Worker	Not used
Growing season for non-leafy	years	NU	Worker	Not used
Growing season for leafy	years	NU	Worker	Not used
Growing season for fodder	years	NU	Worker	Not used
Translocation factor for non-leafy	unitless	NU	Worker	Not used
Translocation factor for leafy	unitless	NU	Worker	Not used
Translocation factor for fodder	unitless	NU	Worker	Not used
Dry foliar interception fraction for non-leafy	unitless	NU	Worker	Not used
Dry foliar interception fraction for leafy	unitless	NU	Worker	Not used
Dry foliar interception fraction for fodder	unitless	NU	Worker	Not used
Wet foliar interception fraction for non-leafy	unitless	NU	Worker	Not used
Wet foliar interception fraction for leafy	unitless	NU	Worker	Not used
Wet foliar interception fraction for fodder	unitless	NU	Worker	Not used
Weathering removal constant for vegetation	unitless	NU	Worker	Not used
Storage time: fruits, non-leafy vegetables, and grain	days	NU	Worker	Not used
Storage time: leafy vegetables	days	NU	Worker	Not used
Storage time: milk	days	NU	Worker	Not used
Storage time: meat and poultry	days	NU	Worker	Not used
Storage time: fish	days	NU	Worker	Not used
Storage time: crustacea and mollusks	days	NU	Worker	Not used
Storage time: well water	days	NU	Worker	Not used
Storage time: surface water	days	NU	Worker	Not used
Storage time: livestock fodder	days	NU	Worker	Not used
Thickness of building foundation	m	NU	All	Not used
Bulk density of building foundation	g/cm^3	NU	All	Not used
Total porosity of the cover material	unitless	NU	All	Not used
Total porosity of the building foundation	unitless	NU	All	Not used
Volumetric water constant of the cover material	unitless	NU	All	Not used

Table 1. RESRAD Input Parameter Values for Derivation of Guideline Concentration Levels (Cleanup Goals)

RESRAD Parameter	Units	Value	Receptor	Comment/Reference
Volumetric water constant of the foundation	unitless	NU	All	Not used
Diffusion coef. for radon gas in cover material	m/sec	NU	All	Not used
Diffusion coef. for radon gas in foundation material	m/sec	NU	All	Not used
Diffusion coef. for radon gas in contaminated zone soil	m/sec	NU	All	Not used
Radon vertical dimension of mixing	m	NU	All	Not used
Average building air exchange rate	1/hour	NU	All	Not used
Height of the building (room)	m	NU	All	Not used
Building interior area factor	unitless	NU	All	Not used
Building depth below ground surface	m	NU	All	Not used
Emanating power of Rn-222 gas	unitless	NU	All	Not used
Emanating power of Rn-220 gas	unitless	NU	All	Not used
Pathway – external gamma	unitless	Active	All	Assumed complete for all receptors
Pathway – inhalation (w/o radon)	unitless	Active	All	Assumed complete for all receptors
Pathway – plant ingestion	unitless	Inactive	Worker	Assumed incomplete for all other receptors
Pathway – meat ingestion	unitless	Inactive	Worker	Assumed incomplete for all other receptors
Pathway – milk ingestion	unitless	Inactive	Worker	Assumed incomplete for all other receptors
Pathway – aquatic foods	unitless	Inactive	All	Assumed incomplete for all receptors
Pathway – drinking water	unitless	Inactive	Worker	Assumed incomplete for all other receptors
Pathway – soil ingestion	unitless	Active	All	Assumed complete for all receptors
Pathway – radon	unitless	Inactive	All	Inactive for all receptors

Other Assumptions, Notes, References, and Abbreviations

* Not used for some receptors when pathway is incomplete. Value can still be entered in RESRAD for all receptor whether eventually used or not.
DCH = Data Collection Handbook (ANL 1993)
EFH = Exposure Factors Handbook (EPA 1997)
RAGS = Risk Assessment Guidance for Superfund, specifically Volume 1 Part B (EPA 1991)
RME = reasonable maximum exposure
SSG-1996 = Soil Screening Guidance: User's Guide (EPA 1996)
SSG-2000 = Soil Screening Guidance for Radionuclides: Technical Background Document (EPA 2000)
NU = not used

Table 2. Derived Concentration Guideline Levels for NFSS BOP FS (surface)

Radionuclide / units	DSR year 0 (mrem/year)/(pCi/g)	DCGL year 0 pCi/g	DSR year 1000 (mrem/year)/(pCi/g)	DCGL year 1000 pCi/g	DSR year 1844 (mrem/year)/(pCi/g)	DCGL year 1844 pCi/g	DCGL for FS pCi/g
Ac-227	7.18E-01	1.4E+01	9.45E-15	1.1E+15	1.71E-26	5.9E+26	14
Pa-231	1.46E-01	6.9E+01	7.46E-01	1.4E+01	6.59E-01	1.5E+01	14
Pb-210	3.08E-02	3.3E+02	9.70E-16	1.0E+16	3.67E-27	2.7E+27	328
Ra-226	2.02E+00	5.0E+00	6.60E-01	1.5E+01	2.53E-01	4.0E+01	**5**
Th-230	1.74E-02	5.8E+02	4.87E-01	2.1E+01	5.53E-01	1.8E+01	**18**
U-234	7.08E-03	1.4E+03	3.16E-03	3.2E+03	3.14E-03	3.2E+03	1424
U-235	1.49E-01	6.8E+01	4.00E-02	2.5E+02	1.77E-02	5.7E+02	68
U-238	3.38E-02	3.0E+02	7.19E-03	1.4E+03	1.94E-03	5.2E+03	298
Total U*	2.33E-02	4.3E+02	5.96E-03	1.7E+03	2.88E-03	3.5E+03	432
U-238 as total U surrogate		2.11E+02		8.28E+02		1.71E+03	211
U-235 with Ac, Pa contributions	1.01E+00	1.0E+01	7.86E-01	1.3E+01	6.76E-01	1.5E+01	10
Total U with Ac,Pa	4.28E-02	2.4E+02	2.27E-02	4.4E+02	1.77E-02	5.7E+02	236
U-238 as total U surrogate		1.15E+02		2.17E+02		2.79E+02	**115**

Benchmark dose is 10 mrem/year

DSR Dose to source ratio (amount of radiological dose per unit activity of radionuclide)

DCGL Derived concentration guideline level (preliminary remediation goal)

*Total U assumes that the uranium isotopes exist in their natural abundance, i.e., U-234:U-235:U-238 assumed to be 1:0.046:1

Bolded radionuclides will be included in the SOR calculation.

Table 3. Derived Concentration Guideline Levels for NFSS BOP FS (subsurface)

Radionuclide / units	DSR year 0 (mrem/year)/(pCi/g)	DCGL year 0 pCi/g	DSR year 1000 (mrem/year)/(pCi/g)	DCGL year 1000 pCi/g	DSR year 1844 (mrem/year)/(pCi/g)	DCGL year 1844 pCi/g	DCGL for FS pCi/g
Ac-227	7.18E-01	4.2E+01	9.45E-15	3.2E+15	1.71E-26	1.8E+27	42
Pa-231	1.46E-01	2.1E+02	7.46E-01	4.1E+01	6.59E-01	4.6E+01	41
Pb-210	3.08E-02	9.8E+02	9.70E-16	3.1E+16	3.67E-27	8.2E+27	984
Ra-226	2.02E+00	1.5E+01	6.60E-01	4.6E+01	2.53E-01	1.2E+02	**15**
Th-230	1.74E-02	1.7E+03	4.87E-01	6.2E+01	5.53E-01	5.5E+01	**55**
U-234	7.08E-03	4.3E+03	3.16E-03	9.6E+03	3.14E-03	9.6E+03	4271
U-235	1.49E-01	2.0E+02	4.00E-02	7.6E+02	1.77E-02	1.7E+03	203
U-238	3.38E-02	8.9E+02	7.19E-03	4.2E+03	1.94E-03	1.6E+04	895
Total U*	2.33E-02	1.3E+03	5.96E-03	5.1E+03	2.88E-03	1.1E+04	1296
U-238 as total U surrogate		6.34E+02		2.48E+03		5.14E+03	634
U-235 with Ac, Pa contributions	1.01E+00	3.0E+01	7.86E-01	3.8E+01	6.76E-01	4.5E+01	30
Total U with Ac,Pa	4.28E-02	7.1E+02	2.27E-02	1.3E+03	1.77E-02	1.7E+03	707
U-238 as total U surrogate		3.46E+02		6.51E+02		8.37E+02	**346**

Benchmark dose is 30 mrem/year

DSR Dose to source ratio (amount of radiological dose per unit activity of radionuclide)

DCGL Derived concentration guideline level (preliminary remediation goal)

*Total U assumes that the uranium isotopes exist in their natural abundance, i.e., U-234:U-235:U-238 assumed to be 1:0.046:1

Bolded radionuclides will be included in the SOR calculation.

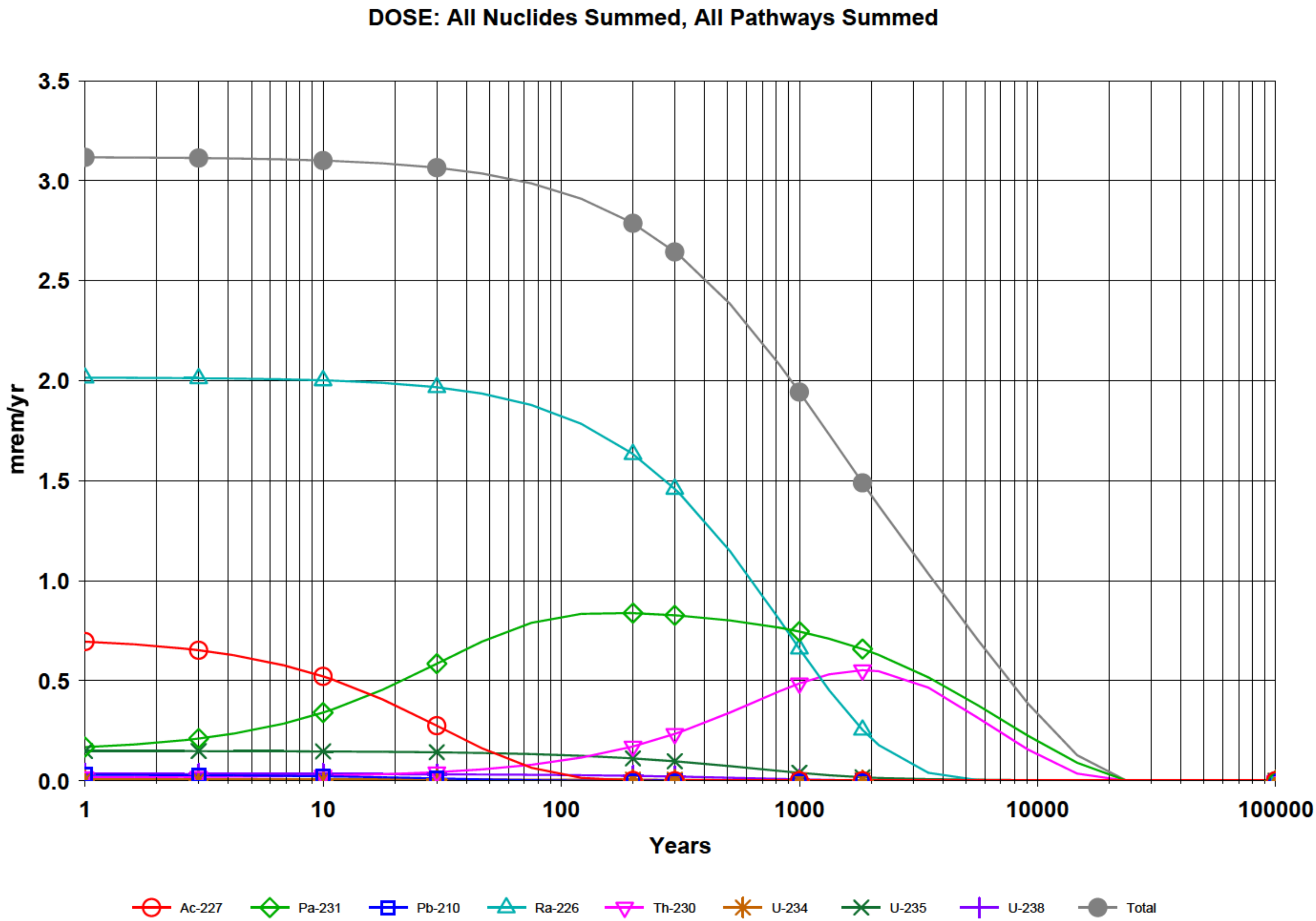


FIGURE 1 Construction Worker Dose-to-Source Ra ios for Soil DCGLs

APPENDIX E

CONSTRUCTION WORKER PRG UPDATE MEMORANDUM (CHLORINATED VOCS)

THIS PAGE INTENTIONALLY LEFT BLANK

AECOM
625 West Ridge Pike,
Suite E-100
Conshohocken, PA 19428
www aecom.com

610-832-3500 tel
610-832-3501 fax

Memorandum

To	[redacted], AECOM Project Manager	Page	1
Subject	**Construction Worker PRG Update** – EU4 Groundwater, Niagara Falls Storage Site		
Cc		AECOM:	60440939
From	[redacted], AECOM Principal Risk Assessor		
Date	June 14, 2016	Revised August 23, 2018	

A baseline risk assessment (BRA) was prepared in 2007 for the Niagara Falls Storage Site located in Lewiston, New York. As part of the 2007 BRA, groundwater preliminary remediation goals (PRGs) for the construction worker exposure scenario were derived for groundwater exposure unit (EU) 4. Groundwater PRGs were presented in Table A-702 of the 2007 BRA. At the request of the US Army Corps of Engineers (USACE), AECOM has reviewed the 2007 PRGs to identify portions of the PRG derivation that may require revision. As a result of the review, the following components of the 2007 PRG derivation were identified for updating: exposure assumptions, toxicity factors, and PRG calculation. Each of these updates is detailed within this memorandum.

Exposure Assumptions

In February 2014, the United States Environmental Protection Agency (USEPA) released OSWER Directive 9200. 1-120 entitled "*Human Health Evaluation Manual Supplemental Guidance: Update to Standard Default Exposure Factors*"'. The following recommended exposure assumptions in the OSWER Directive[1] were used in the PRG updates:

- Body Weight [80 kilograms (kg)]
- Worker Skin Surface Area [3,527 centimeters squared (cm^2)]

The 2007 PRG used an upper-bound volatilization constant (K) that is based on all uses of household water (e.g., to evaluate vapor-phase chemicals released from groundwater to indoor air as a result of showering, laundering, and dish washing) to evaluate construction worker exposure to trench air. This K value is not considered appropriate for the construction worker pathway. As a result, concentrations of VOCs in air above a pool of groundwater in a construction trench were evaluated using a mass transfer coefficient and a simple box dispersion model (the “box” represents the exposure volume in the trench). The mass transfer coefficient (K) algorithm is from USEPA *Air Emissions Models for Waste and Wastewater* (USEPA, 1994). Tables 1 and 2 provide the mass transfer coefficient and volatilization factor (VF) calculations, respectively. The chemical-specific VF calculation was found to be consistent with that derived by the USACE for the St. Louis Ordnance Plant,

[1] Corrections to the 2014 OSWER Directive were released in 2015. These assumptions reflect the corrected version.

Former Hanley Area, St. Louis, Missouri (see Appendix B of the *Final Long-Term Management / Land Use Control Implementation Plan – Operable Unit 1*).

The 2007 PRG estimated the dermal absorbed dose (DAD) consistent with equations and parameters specified in RAGs Part E (USEPA, 2004). The following chemical-specific dermal factors available from USEPA's most recent edition of the Regional Screening Level (RSL) Table (May 2016) were applied in the update: dermal permeability constant (Kp), lag time per event (tau-event), and time to reach steady state (t*). These values are detailed in Table 3.

Toxicity Factors

Toxicity values for use in the updated PRG are provided in Table 4. The table contains slope factors (SFs) and inhalation unit risk factors (IURs) for carcinogenic effects, cancer weight of evidence classification for chemicals with carcinogenic effects, and reference doses (RfDs) and inhalation reference concentrations (RfCs) for chemicals with noncarcinogenic effects. Toxicity values specific to the oral and inhalation pathways were obtained from USEPA's Integrated Risk Information System (IRIS). Updates to the toxicity values were identified for each of the five constituents evaluated.

Oral toxicity values used to evaluate dermal absorption were considered for adjustment in the PRG derivation using the recommended criteria as found in the 2004 USEPA *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment)*. Following the guidance document, toxicity values are adjusted for gastrointestinal absorption only where chemical-specific gastrointestinal absorption values were less than 50%. None of five constituents evaluated met this criterion.

Similar to the 2007 PRG derivation, subchronic RfDs and RfCs were not identified for use. However, in accordance with USEPA's 2009 *Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment)* (RAGS Part F), inhalation toxicity values (RfCs and IURs), expressed in terms of concentration in air rather than in terms of dose, were used in the PRG update.

PRG Calculation

For this update, PRGs protective of multiple-route exposure were calculated using USEPA risk assessment methodology (USEPA, 1989 and USEPA, 2009). The USEPA risk assessment equations calculate risk levels based on the constituent concentration, magnitude of exposure, and the toxicity of the constituent. To calculate PRGs, the equations are rearranged to solve for an allowable constituent concentration based on a target risk level, magnitude of exposure, and toxicity. The PRG for the inhalation pathway was calculated consistent with equations provided in RAGs Part F. PRG equations are detailed in Table 5.

Consistent with the 2007 PRGs, updated PRGs were developed by varying the target cancer risk (1×10^{-4} and 1×10^{-6}). The target hazard quotient was set at 1. PRG calculations are provided in Tables 6 and 7. The lower of the values for the carcinogenic and non-carcinogenic endpoints for each constituent are shown in the tables.

A summary of the updated PRGs is provided below. A comparison to the 2007 values is also shown.

Constituent	Updated PRG (mg/L)[1]				2007 PRG (mg/L)[2]
	HQ=1, TR=10^{-6}		HQ=1, TR=10^{-4}		
	PRGn	PRGc	PRGn	PRGc	
cis-1,2-Dichloroethene	**2.41E+00**	-	**2.41E+00**	-	9.70E+00
trans-1,2-Dichloroethene	**2.41E+01**	-	**2.41E+01**	-	1.90E+01
Tetrachloroethylene	**1.51E+00**	8.48E+00	**1.51E+00**	8.48E+02	1.10E-02
Trichloroethylene	**3.31E-01**	1.25E+00	**3.31E-01**	1.25E+02	7.10E-02
Vinyl chloride	4.95E+00	**1.74E-01**	**4.95E+00**	1.74E+01	1.40E-02

Notes:

PRGn = Preliminary Remediation Goal for noncancer effects (mg/L)

PRGc = Preliminary Remediation Goal for carcinogens (mg/L)

HQ =Target hazard quotient for noncancer effects

TR = Target cancer risk level

1 - Lower of the PRGn and PRGc values is highlighted in **bold**.

2 - Lower of the PRGn and PRGc values is shown. Based on TR=10^{-6} and a HQ=1.

The PRG calculations were cross-checked with the excel calculation spreadsheet provided by USACE (also updated with the aforementioned items) to AECOM. The updated spreadsheet has been provided to USACE electronically along with this memorandum.

References

United States Environmental Protection Agency (USEPA). 1989. Risk Assessment Guidance for Superfund (RAGS) Interim Final. (Volume 1 Part A Human Health Evaluation Manual). EPA /540/1-89/002. December 1989.

USEPA. 1994. Air Emissions Models for Waste and Wastewater. Office of Air Quality Planning and Standards. EPA-453/R-94-080A.

USEPA. 2004. Risk Assessment Guidance for Superfund Volume I: Human Health Evaluation Manual (Part E, Supplemental Guidance for Dermal Risk Assessment). United States Environmental Protection Agency, EPA/540/R/99/005, July 2004 (with corrections published October 2007).

USEPA. 2009. Risk Assessment Guidance for Superfund, Volume I: Human Health Evaluation Manual (Part F, Supplemental Guidance for Inhalation Risk Assessment). January.

USEPA. 2016. USEPA Regional Screening Level Table. (On-Line). Available: http://www.epa.gov/reg3hwmd/risk/index.htm. May.

THIS PAGE INTENTIONALLY LEFT BLANK

Tables

THIS PAGE INTENTIONALLY LEFT BLANK

Table 1
Overall Mass Transfer Coefficient (K) Calculation
Groundwater EU4, Niagara Falls Storage Site

	1/K = 1/KL + 1/(KG*Keq)	USEPA 1994, eqn 5-2	
	Parameter	**Value**	**Reference**
where:			
K =	overall mass transfer coefficient, m/sec		
KL =	liquid-phase mass transfer coefficient, m/sec	calculated	
KG =	gas-phase mass transfer coefficient, m/sec	calculated	
Keq =	dimensionless Henry's Law Constant, unitless		
=	Henry's law constant (H) in atm-m^3/mol / 41	chem-specific	
where:			
KL =	2.78E-06*(Dw/Dether)^2/3		USEPA 1994, Table 5-1.
Dw =	diffusivity of constituent in water, cm^2/sec	chem-specific	
Dether =	diffusivity of diethyl ether in water, cm^2/sec	8.50E-06	
KG =	4.82E-03*V^ 0.78*Scg^ -0.67*de^ -0.11	calculated	
V =	windspeed, m/sec	2.25	Default
Scg =	Schmidt number on gas side, unitless	calculated	
where:			
Scg =	ug/(pg*Da)		
ug =	viscosity of air, g/cm*sec	1.81E-04	
pg =	density of air, g/cm^3	1.20E-03	
Da =	diffusivity of constituent in air, cm^2/sec	chem-specific	
De =	effective diameter of impoundment, m	calculated	
where:			
De =	4A/pi^0.5	11.28	Calculated.
A =	water surface area in trench, m^2	100	Estimated.
pi =	pi, or 3.1416	3.1416	

Constituent	Dw	Da	KL	KG	Keq	1/K	K (m/sec)
cis-1,2-Dichloroethene	1.13E-05	8.84E-02	3.36E-06	4.86E-03	1.67E-01	2.98E+05	3.35E-06
trans-1,2-Dichloroethene	1.12E-05	8.76E-02	3.34E-06	4.83E-03	3.83E-01	3.00E+05	3.34E-06
Tetrachloroethylene	9.46E-06	5.05E-02	2.99E-06	3.34E-03	7.24E-01	3.35E+05	2.98E-06
Trichloroethylene	1.02E-05	6.87E-02	3.14E-06	4.10E-03	4.03E-01	3.19E+05	3.14E-06
Vinyl chloride	1.20E-05	1.07E-01	3.50E-06	5.53E-03	1.14E+00	2.86E+05	3.50E-06

*Chemical-specific values obtained from USEPA's Regional Screening Level Table (May 2016).

References:

USEPA. 1994. *Air Emissions Models for Waste and Wastewater* . Office of Air Quality Planning and Standards. EPA-453/R-94-080A.
USEPA. 1996. *Soil Screening Guidance: User's Guide* , United States Environmental Protection Agency, EPA/540/R-96/018, July 1996.

Table 2
Trench Air Volatilization Factor
Groundwater EU4, Niagara Falls Storage Site

$$VF = \frac{K \times CF}{W \times V \times D/A}$$

	Parameter	Value	Reference
VF =	Volatilization factor in trench air, L/m^3	calculated	
CF=	Concentration in air conversion factor, L/m^3	1.00E+03	
K =	Overall mass transfer coefficient, m/s	chem-specific (Table 1)	
W =	Width of contaminated area, m	1.52	Estimated width of trench (5 feet)
V =	Wind velocity, m/s	2.25	USEPA default (USEPA, 1996).
D =	Air mixing zone height, m	2	USEPA default (USEPA, 1996).
A =	Area of square pool, m^2	100	Area of square pool.

	Ventilated Box		
Constituent	K	W*V*D/A	VF
cis-1,2-Dichloroethene	3.35E-06	6.86E-02	4.89E-02
trans-1,2-Dichloroethene	3.34E-06	6.86E-02	4.87E-02
Tetrachloroethylene	2.98E-06	6.86E-02	4.35E-02
Trichloroethylene	3.14E-06	6.86E-02	4.57E-02
Vinyl chloride	3.50E-06	6.86E-02	5.10E-02

References:

USEPA. 1996. *Soil Screening Guidance: User’s Guide* , United States Environmental Protection Agency, EPA/540/R-96/018, July 1996.

Table 3
Dermal Absorbed Dose Calculation
Groundwater EU4, Niagara Falls Storage Site

Parameter		Value	Reference
DAevent =	Dermal factor, cm/event	calculated	
for organics, Z = function of Kp and t_{event}, as below:			
if t_{event}<t*, then Z = 2FA*Kp*((6*r)*t_{event})/pi)^0.5)			USEPA, 2004 eqn 3.2
where:			
FA =	Fraction absorbed water, dimensionless	Chemical-Specific	USEPA, 2004 - Appendix B
Kp =	Dermal permeability coefficient of compound in water, cm/hr	Chemical-Specific	USEPA, 2016
t_{event} =	Event duration, hr/event	1	
r =	Lag time per event, hr/event	Chemical-Specific	USEPA, 2016
t* =	time to reach steady state = 2.4* r, hr	Chemical-Specific	USEPA, 2016
for B<0.1, t* =	2.4r		
where:			
B =	Kow/10000	Chemical-Specific	USEPA, 2016
r =	lag time, hr/event		
r =	lag time, dimensionless, calculated as Lsc^2/(6*Dsc)		
where:			
log(Dsc/Lsc) =	-2.80 - 0.0056*MW		
Lsc =	1E-03 cm		
pi =	3.1416	3.1416	
if t_{event}>t*, then Z = FA*Kp*[t_{event}/(1+ B) + 2r*(1 + 3B + $3B^2$/$(1+B)^2$)]			USEPA, 2004 eqn 3.3

Constituent	t*	B	FA	Kp	r	DAevent (cm/event)
cis-1,2-Dichloroethene	8.81E-01	4.17E-02	1.00E+00	1.10E-02	3.67E-01	1.90E-02
trans-1,2-Dichloroethene	8.81E-01	4.17E-02	1.00E+00	1.10E-02	3.67E-01	1.90E-02
Tetrachloroethylene	2.14E+00	1.65E-01	1.00E+00	3.34E-02	8.92E-01	8.72E-02
Trichloroethylene	1.37E+00	5.11E-02	1.00E+00	1.16E-02	5.72E-01	2.43E-02
Vinyl chloride	5.65E-01	2.55E-02	1.00E+00	8.38E-03	2.35E-01	1.22E-02

References:

USEPA, 2004. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E Supplemental Guidance for Dermal Risk Assessment). Final. EPA/540/R/99/005. July 2004 (with 2007 errata).

USEPA, 2016. Regional Screening Level Table. May 2016.

Table 4
Toxicity Factors and Dermal Constants
Groundwater EU4, Niagara Falls Storage Site

Constituent	RfDo		RfC		GIabs	Adjust Req.?	RfD	SFo		IUR		SfD
Volatile Organic Compounds												
cis-1,2-Dichloroethene	2.00E-03	i	-		1.00	No	2.00E-03	-		-		-
trans-1,2-Dichloroethene	2.00E-02	i	-		1.00	No	2.00E-02	-		-		-
Tetrachloroethylene	6.00E-03	i	4.00E-02	i	1.00	No	6.00E-03	2.10E-03	i	2.60E-07	i	2.10E-03
Trichloroethylene	5.00E-04	i	2.00E-03	i	1.00	No	5.00E-04	4.60E-02	i	4.10E-06	i	4.60E-02
Vinyl chloride	3.00E-03	i	1.00E-01	i	1.00	No	3.00E-03	7.20E-01	i	4.40E-06	i	7.20E-01

RfDo = oral reference dose RfC = inhalation reference concentration RfDd = dermal reference dose = RfDo x GI ABS
SFo = oral slope factor IUR = inhalation unit risk factor SFd = dermal slope factor = SFo / GI ABS

<u>Toxicity Factor Sources:</u>
i -IRIS USEPA's Integrated Risk Information System (IRIS) (http://www.epa.gov/ngispgm3/iris/irisdat/) (searched June 2016)

GI ABS = Gastrointestinal absorbed fraction (USEPA, 2004). GI absorption efficiencies may be used to adjust oral toxicity factors for use in evaluating dermally absorbed doses.
Following recommendations by USEPA, the oral toxicity factors were adjusted if the GI absorption fraction was significantly less than 1 (I.e., less than 50%).
Only values reported for non-aqueous media were used.

References:
USEPA, 2004. Risk Assessment Guidance for Superfund Volume 1: Human Health Evaluation Manual (Part E Supplemental Guidance for Dermal Risk Assessment).Final. EPA/540/R/99/005. July 2004 (updated November 2007)

Table 5
PRG Equations
Groundwater EU4, Niagara Falls Storage Site

$$\textit{Preliminary Remediation Goal}\ (\text{mg/L}) = \frac{1}{\frac{1}{PRG_{ing}} + \frac{1}{PRG_{der}} + \frac{1}{PRG_{inh}}}$$

Ingestion (PRG_{ing})

$PRG_{ing\text{-}n}$ = HQ x IFWn x RfDo

$PRG_{ing\text{-}c}$ = TR x IFWc / SFo

Dermal Contact (PRG_{der})

$PRG_{der\text{-}n}$ = HQ x IFDn x RfDd/DAevent

$PRG_{der\text{-}c}$ = TR x IFDc / (SFd x DAevent)

Inhalation (PRG_{inh})

$PRG_{inh\text{-}n}$ = HQ x IFIn x RfC x (1/VF)

$PRG_{inh\text{-}c}$ = TR x IFIc x (1/URF) x (1/VF) x CFa

Where:

PRGn = PRG for noncancer effects (mg/L)
PRGc = PRG for carcinogens or mutagens (mg/L)
HQ =Target hazard quotient for noncancer effects
TR = Target cancer risk level

RfDo = Oral Reference Dose, mg/kgBW-day
RfDd = Dermal Reference Dose, mg/kgBW-day
SF = Cancer Slope Factor, $(\text{mg/kgBW-day})^{-1}$
RfC = Inhalation Reference Concentration (mg/m^3)
IUR = Inhalation Unit Risk Factor $(\text{ug/m}^3)^{-1}$

VF = Volatilization Factor, L/m^3
CFa = Conversion Factor, air (1 mg/1000 ug)

And:

IFS = Intake Factor Groundwater Ingestion

IFD = Intake Factor Groundwater Dermal

IFI = Intake Factor Groundwater Inhalation

Workers - Noncancer

$$IFWn\ (\text{kgBW–day/L}) = \frac{ATn\ x\ BW}{IR\ x\ EF\ x\ ED}$$

$$IFDn\ (\text{kgBW–day–cm/L–event}) = \frac{ATn\ x\ BW}{SA\ x\ EF\ x\ ED\ x\ EV\ x\ CF}$$

$$IFIn\ (\text{day/day}) = \frac{ATn}{ET\ x\ EF\ x\ ED\ x\ \left(\frac{1\ day}{24\ hours}\right)}$$

Workers - Cancer

$$IFWc\ (\text{kgBW–day/L}) = \frac{ATc\ x\ BW}{IR\ x\ EF\ x\ ED}$$

$$IFDc\ (\text{kgBW–day–cm/L–event}) = \frac{ATc\ x\ BW}{SA\ x\ EF\ x\ ED\ x\ EV\ x\ CF}$$

$$IFIc\ (\text{day/day}) = \frac{ATc}{ET\ x\ EF\ x\ ED\ x\ \left(\frac{1\ day}{24\ hours}\right)}$$

And:

IR - Ingestion Rate, groundwater (L/day)	0.0024
DAevent - Dermal Factor (cm/event)	See Table 3
SA - Skin Surface Area (cm^2)	3,527
ET - Exposure Time (hours/day)	1
EF - Exposure Frequency (days/year)	350
ED - Exposure Duration (years)	1
EV - Event Frequency (event/day)	1
CF - Conversion Factor, water (L/cm^3)	1.E-03
BW - Body Weight (kg)	70
AT - Averaging Time (days)	
Noncarcinogenic, ED x 365 d/yr	365
Carcinogenic,70 yr x 365d/yr	25,550

Table 6

Construction Worker PRG Calculations, Target Risk 1 x 10 $^{-6}$

Groundwater EU4, Niagara Falls Storage Site

Groundwater Ingestion
PRGn = HQ x IFWn x RfDo
PRGc = TR x IFWc / SFo
Where:

Groundwater Dermal Absorption
PRGn = HQ x IFDn x RfDd/(DAevent)
PRGc = TR x IFDc / (SFd x DAevent)

Groundwater Inhalation
PRGn = HQ x IFIn x RfC x (1/VF)
PRGc = TR x IFIc x (1/IUR) x (1/VF) x CFa

Multiple Pathway

$$PRG = \frac{1}{(1/PRGing + 1/PRGder + 1/PRGinh)}$$

IF = Intake Factors

IFW = IF Groundwater Ingestion	noncancer	3.48E+04
	cancer	2.43E+06
IFD = IF, Groundwater Dermal	noncancer	2.37E+01
	cancer	1.66E+03
IFI = IF, Groundwater Inhalation	noncancer	2.50E+01
	cancer	1.75E+03

PRGn = Preliminary Remediation Goal for noncancer effects (mg/L)	Calculated
PRGc = Preliminary Remediation Goal for carcinogens (mg/L)	Calculated
HQ =Target hazard quotient for noncancer effects	1
TR = Target cancer risk level	1.00E-06
RfDo = Oral Reference Dose, mg/kgBW-day	chem-spec
RfDd = Dermal Reference Dose, mg/kgBW-day	chem-spec
SF = Cancer Slope Factor, (mg/kgBW-day)$^{-1}$	chem-spec
RfC = Inhalation Reference Concentration (mg/m^3)	chem-spec
IUR = Inhalation Unit Risk Factor (ug/m^3)$^{-1}$	chem-spec
DAevent = Dermal Absorbed Dose per event (cm/event)	chem-spec
VF = Volatilization Factor, L/m^3	chem-spec
CFa = Conversion Factor, air (mg/ug)	1.00E-03

Noncancer Effects	Ingestion			Dermal			Inhalation				Multi-pathway
Constituent	**RfDo**	**Source**	**PRGn**	**DAevent**	**RfDd**	**PRGn**	**RfC**	**Source**	**VF**	**PRGn**	**PRGn**
cis-1,2-Dichloroethene	2.00E-03	IRIS	6.95E+01	1.90E-02	2.00E-03	2.49E+00	-	-	4.89E-02	-	2.41E+00
trans-1,2-Dichloroethene	2.00E-02	IRIS	6.95E+02	1.90E-02	2.00E-02	2.49E+01	-	-	4.87E-02	-	2.41E+01
Tetrachloroethylene	6.00E-03	IRIS	2.09E+02	8.72E-02	6.00E-03	1.63E+00	4.00E-02	IRIS	4.35E-02	2.30E+01	1.51E+00
Trichloroethylene	5.00E-04	IRIS	1.74E+01	2.43E-02	5.00E-04	4.88E-01	2.00E-03	IRIS	4.57E-02	1.09E+00	3.31E-01
Vinyl chloride	3.00E-03	IRIS	1.04E+02	1.22E-02	3.00E-03	5.81E+00	1.00E-01	IRIS	5.10E-02	4.90E+01	4.95E+00

Cancer Effects	Ingestion			Dermal			Inhalation				Multi-pathway
Constituent	**SFo**	**Source**	**PRGc**	**DAevent**	**SFd**	**PRGc**	**IUR**	**Source**	**VF**	**PRGc**	**PRGc**
cis-1,2-Dichloroethene	-	IRIS	-	1.90E-02	-	-	-	-	4.89E-02	-	-
trans-1,2-Dichloroethene	-	IRIS	-	1.90E-02	-		-	-	4.87E-02	-	-
Tetrachloroethylene	2.10E-03	IRIS	1.16E+03	8.72E-02	2.10E-03	9.04E+00	2.60E-07	IRIS	4.35E-02	1.55E+02	8.48E+00
Trichloroethylene	4.60E-02	IRIS	5.29E+01	2.43E-02	4.60E-02	1.48E+00	4.10E-06	IRIS	4.57E-02	9.35E+00	1.25E+00
Vinyl chloride	7.20E-01	IRIS	3.38E+00	1.22E-02	7.20E-01	1.88E-01	4.40E-06	IRIS	5.10E-02	7.80E+00	1.74E-01

Lower of the PRGn and PRGc

Constituent	**PRG (mg/L)**
cis-1,2-Dichloroethene	2.41E+00
trans-1,2-Dichloroethene	2.41E+01
Tetrachloroethylene	1.51E+00
Trichloroethylene	3.31E-01
Vinyl chloride	1.74E-01

Table 7
Construction Worker PRG Calculations, Target Risk $1x10^{-4}$
Groundwater EU4, Niagara Falls Storage Site

Groundwater Ingestion
PRGn = HQ x IFWn x RfDo
PRGc = TR x IFWc / SFo

Groundwater Dermal Absorption
PRGn = HQ x IFDn x RfDd/(DAevent)
PRGc = TR x IFDc / (SFd x DAevent)

Groundwater Inhalation
PRGn = HQ x IFIn x RfC x (1/VF)
PRGc = TR x IFIc x (1/IUR) x (1/VF) x CFa

Multiple Pathway
PRG = $\frac{1}{(1/PRGing + 1/PRGder + 1/PRGinh)}$

Where:

IF = Intake Factors		
IFW = IF Groundwater Ingestion	noncancer	3.48E+04
	cancer	2.43E+06
IFD = IF, Groundwater Dermal	noncancer	2.37E+01
	cancer	1.66E+03
IFI = IF, Groundwater Inhalation	noncancer	2.50E+01
	cancer	1.75E+03

PRGn = Preliminary Remediation Goal for noncancer effects (mg/L)	Calculated
PRGc = Preliminary Remediation Goal for carcinogens (mg/L)	Calculated
HQ =Target hazard quotient for noncancer effects	1
TR = Target cancer risk level	1.00E-04
RfDo = Oral Reference Dose, mg/kgBW-day	chem-spec
RfDd = Dermal Reference Dose, mg/kgBW-day	chem-spec
SF = Cancer Slope Factor, $(mg/kgBW\text{-}day)^{-1}$	chem-spec
RfC = Inhalation Reference Concentration (mg/m^3)	chem-spec
IUR = Inhalation Unit Risk Factor $(ug/m^3)^{-1}$	chem-spec
DAevent = Dermal Absorbed Dose per event (cm/event)	chem-spec
VF = Volatilization Factor, L/m^3	chem-spec
CFa = Conversion Factor, air (mg/ug)	1.00E-03

Noncancer Effects	Ingestion			Dermal			Inhalation				Multi-pathway
Constituent	**RfDo**	**Source**	**PRGn**	**DAevent**	**RfDd**	**PRGn**	**RfC**	**Source**	**VF**	**PRGn**	**PRGn**
cis-1,2-Dichloroethene	2.00E-03	IRIS	6.95E+01	1.90E-02	2.00E-03	2.49E+00	-	-	4.89E-02	-	2.41E+00
trans-1,2-Dichloroethene	2.00E-02	IRIS	6.95E+02	1.90E-02	2.00E-02	2.49E+01	-	-	4.87E-02	-	2.41E+01
Tetrachloroethylene	6.00E-03	IRIS	2.09E+02	8.72E-02	6.00E-03	1.63E+00	4.00E-02	IRIS	4.35E-02	2.30E+01	1.51E+00
Trichloroethylene	5.00E-04	IRIS	1.74E+01	2.43E-02	5.00E-04	4.88E-01	2.00E-03	IRIS	4.57E-02	1.09E+00	3.31E-01
Vinyl chloride	3.00E-03	IRIS	1.04E+02	1.22E-02	3.00E-03	5.81E+00	1.00E-01	IRIS	5.10E-02	4.90E+01	4.95E+00

Cancer Effects	Ingestion			Dermal			Inhalation				Multi-pathway
Constituent	**SFo**	**Source**	**PRGc**	**DAevent**	**SFd**	**PRGc**	**IUR**	**Source**	**VF**	**PRGc**	**PRGc**
cis-1,2-Dichloroethene	-	IRIS	-	1.90E-02	-	-	-	-	4.89E-02	-	-
trans-1,2-Dichloroethene	-	IRIS	-	1.90E-02	-		-	-	4.87E-02	-	-
Tetrachloroethylene	2.10E-03	IRIS	1.16E+05	8.72E-02	2.10E-03	9.04E+02	2.60E-07	IRIS	4.35E-02	1.55E+04	8.48E+02
Trichloroethylene	4.60E-02	IRIS	5.29E+03	2.43E-02	4.60E-02	1.48E+02	4.10E-06	IRIS	4.57E-02	9.35E+02	1.25E+02
Vinyl chloride	7.20E-01	IRIS	3.38E+02	1.22E-02	7.20E-01	1.88E+01	4.40E-06	IRIS	5.10E-02	7.80E+02	1.74E+01

Lower of the PRGn and PRGc

Constituent	**PRG (mg/L)**
cis-1,2-Dichloroethene	2.41E+00
trans-1,2-Dichloroethene	2.41E+01
Tetrachloroethylene	1.51E+00
Trichloroethylene	3.31E-01
Vinyl chloride	4.95E+00

NFSS-Specific Protection of Groundwater Soil Criteria

Equation:

Ct=Cw[Kd + ((ϴw + ϴaH')/ρb)]

Where:

Ct = screening level in soil (mg/kg)
Cw = target leachate concentration (mg/L)
Kd = soil-water partition coefficient (L/kg)
θ - soil porosity - 0.4 (Lpore/Lsoil)
θw = water-filled soil porosity (Lwater/Lsoil)
θa = air-filled soil porosity (Lair/Lsoil)
H’ = dimensionless Henry’s law constant
ρb = soil particle density (kg/L)

Compound	Koc	foc	ϴw	ϴa	ρ_b	Cw	H'	Kd	Ct	2016 Soil PRG	Pt 375 PGW
	L/kg	Unitless	Lw/Ls	La/Ls	kg/L	mg/L	unitless	L/kg	mg/kg	mg/kg	mg/kg
Tetrachloroethylene	1.55E+02	0.005	0.15	0.25	1.4	1.5	7.54E-01	7.75E-01	1.53	1.53	1.3
Trichloroethylene	1.66E+02	0.005	0.15	0.25	1.4	0.33	4.22E-01	8.30E-01	0.33	0.33	0.47
cis-1,2-Dichloroethylene	3.55E+01	0.005	0.15	0.25	1.4	2.4	1.67E-01	1.78E-01	0.75	0.75	0.25
trans-1,2-Dichloroethylene	5.25E+01	0.005	0.15	0.25	1.4	24	3.85E-01	2.63E-01	10.52	10.52	0.19
Vinyl chloride	1.86E+01	0.005	0.15	0.25	1.4	0.17	1.11E+00	9.30E-02	0.07	0.07	0.02

Notes:
Pt 375 PGW - Part 375 Protection of Groundwater SCO

Sources:
Cw and foc - site specific
koc and H" - OWSER 9355.4-24, December 2002
θ - Linsley, 1982
θw - Golder, 1993
ρb - Dragum, 1998

APPENDIX F

NFSS BALANCE OF PLANT AND GROUNDWATER OPERABLE UNIT REMEDIATION COST ESTIMATE

THIS PAGE INTENTIONALLY LEFT BLANK

NIAGARA FALLS STORAGE SITE

FEASIBILITY STUDY REPORT

FOR THE REMEDIATION OF THE

BALANCE OF PLANT

AND GROUNDWATER OPERABLE UNITS

COST ESTIMATE

Prepared by:

United States Army Corps of Engineers Buffalo District
1776 Niagara Street
Buffalo, NY 14207

Date:

Revised April 2020 from September 2019

TABLE OF CONTENTS

Page No.

TABLES

ATTACHMENTS

1.0 INTRODUCTION

This document has been prepared to provide cost estimates for the feasibility study (FS) for the remediation of the Balance of Plant and Groundwater Operable Units (OUs) at the Niagara Falls Storage Site (NFSS) in Niagara Falls, NY. The FS identified various remedial technologies and process options to address contaminated soil, groundwater, concrete foundations, and building drains. In addition to No Action, four remedial alternatives were developed. This document provides a description of the cost estimate approach and the calculated FS-level cost estimate for each alternative.

2.0 APPROACH

The FS-level cost estimate provides an approximation of anticipated cost and to allow for a cost comparison of the various remediation processes. The processes being evaluated for the Balance of Plant and Groundwater OUs apply to the following:

- Excavation, transport and disposal of contaminated soils, concrete foundations, drains, and groundwater.
- Excavation, transport and disposal of contaminated soils, groundwater, and, the Building 401 foundation slab; and decontamination of concrete foundations.
- Excavation, transport and disposal of contaminated soils, groundwater, and, the Building 401 foundation slab; decontamination of concrete foundations; and *in situ* treatment of volatile organic compound (VOC)-contaminated soils and groundwater.
- Excavation, transport and disposal of contaminated soils, groundwater, and, the Building 401 foundation slab; decontamination of concrete foundations; and *ex situ* treatment of VOC-contaminated soils.

As shown in Table 3-1 of the FS, five remedial alternatives are considered. Each alternative is a combination of the selected general response actions (GRAs), technology types, and process options as outlined in Table 2-5 of the FS. For each alternative, long-term operation and maintenance (O&M) is required over a 1,000-year period.

Micro-Computer Aided Cost Estimating System (MCACES) Second Generation (MII) cost estimating software was used to compile the cost estimates for the individual alternatives. The MII report for the individual alternatives is presented in Attachment A. Each alternative is divided into capital remediation cost and O&M cost and presented in the report as such. For capital cost, the report presents unit cost data broken down by labor, materials, equipment and vendor quotes; and also presents markups, the cost to the prime contractor, and total contract costs. The O&M cost is the present value for 1,000 years of site visits based on an annual cost.

An overall summary page presents the costs for four alternatives (no costs are associated with the No Action alternative), broken down by account code, for a side-by-side comparison and is included as Table 1. Table 2 presents a breakdown of the major tasks and identifies the work that is expected to be done for each remedial alternative. Minor discrepancies exist between the costs shown on the MII report and in Table 1 due to rounding. Table 4 summarizes the calculation performed to determine the present value for long-term O&M costs (this is described in more detail in Section 4.3 of this report).

Sources for the estimates include vendor quotes, pricing from the 2015 Cost Book (the cost estimating database used in MII), costs for relevant tasks on similar projects, and engineering judgment. To account for various factors, including site conditions and anticipated delays due to the nature of the contamination, crews and productivity rates were adjusted using engineering judgement. Vendor quotes used in the cost estimate are presented in Attachment B.

Where appropriate, and noted in the estimate, custom crews were created based on engineering judgement and experience on similar projects. These custom crews include hand-picked equipment and labor.

Labor rates were taken from the most current Davis Bacon Wage Rates for Niagara County, NY (General Decision Number NY160011 - March 3, 2017) for heavy and highway construction projects. Labor rates are included in Attachment C.

An FS-level construction schedule, presented in Attachment D, shows a comparison of the expected duration for each alternative.

3.0 SCHEDULE

The purpose of the schedule, presented in Attachment D, is to present a side-by-side comparison of the task durations that are anticipated for each alternative. For FS-level consideration, the schedule is general and includes only tasks that are currently considered potential critical path items. Since Alternatives 2 through 5 consist of very similar scopes with only minor differences, the schedule highlights the specific items unique to each alternative and how they impact that alternative's schedule.

The durations used for the individual tasks presented in the schedule were determined by evaluating the durations presented in the MII estimate for certain cost items. The durations were then adjusted to values that were deemed appropriate for the specific tasks based on engineering judgement and project experience.

For simplicity, it was assumed that there are no special circumstances limiting the schedule (e.g., endangered species migration or land use restrictions). Eight-hour workdays and 5-day work weeks were considered.

4.0 COMMON COSTS

Common Costs are those costs that are the same for each alternative. These include mobilization and preparatory work, general requirements, and demobilization. These common costs are discussed below, and are summarized on Table 3**.**

4.1 Mobilization and Preparatory Work/ Demobilization

Mobilization/demobilization was estimated by itemizing several components of the work: mobilization/demobilization of large equipment, preparation of work plans and submittals, and setup of temporary site facilities and utilities. In addition, a 5% markup was applied to the estimate for general mobilization of personnel and small tools, subcontractor procurement, start-up costs and project close-out costs.

4.2 General Requirements

General Requirements have been considered for items such as health and safety (which includes perimeter air monitoring and radiological monitoring equipment), utility usage, and rental of temporary facilities.

4.3 Monitoring

4.3.1 Health and Safety Monitoring

Health and Safety (H&S) Monitoring will be required throughout the project. H&S Monitoring costs are summarized for each alternative in Table 1, and identified in Table 2. In general, these costs include personnel and equipment for safety monitoring, community air monitoring and radiation monitoring/protection.

4.3.2 Long-Term Operation and Maintenance

Long-term O&M costs are presented separately from the Capital Remediation Costs for each alternative (note that markups for prime contractor overhead and profit, 10% each, have been applied to these costs).

It is assumed that an inspector will make four quarterly visits per year, over the course of a 1,000-year monitoring period. In addition, an allowance for management supervision and administration, an allowance for 5-year reviews and a material allowance for fence and gate repairs have been considered as part of the long-term O&M. The table below presents the estimated annual O&M costs used for the calculation. A breakdown of how each task was developed is presented in Attachment E.

Task	Name	Amount
1	TASK 1 - Quarterly Site Visits (four per year)	$2,266.56
2	TASK 2 - Annual Supervision and Administration	$2,480.18
3	TASK 3 - 5-year Review Report (Average per year)	$8,713.22
	Total	$ **13,459.96**

The present value cost for each O&M task was determined by using a discount rate of 3.25%, per USACE guidance, and calculated for the 1,000-year monitoring period using the methods described in Chapter 4 of the United States Environmental Protection Agency (USEPA) *A Guide to Developing and Documenting Cost Estimates During the Feasibility Study.* The total of the present value cost for each of the O&M tasks is shown for each alternative in Table 1. Tables 4a through 4d summarize the calculated present value, showing 10-year increments up to 300 years, at which point the present value becomes zero due to the period of the calculation.

5.0 MARKUPS

Contractor Overhead – A markup to account for costs for contractor and home office overhead, including project management, accounting, scheduling, corporate health and safety, as-built production, etc. has been included at a rate of 10 %.

Subcontractor Overhead – A markup to account for costs for subcontractor and home office overhead, including project management, accounting, scheduling, corporate health and safety, as-built production, etc. has been included at a rate of 10 %.

Contractor Profit – A markup for profit of 10.02%, using profit weighted guidelines, has been applied to the Contractor cost. Rationale for selection of the weights for the seven guidelines (risk, difficulty, job size, period, Contractor's investment, assistance by government, and Subcontracting) is described in the cost estimate notes included with the MII estimate.

Subcontractor Profit – A markup of 10% has been included for Subcontractor Profit.

Bonds and Insurance - Costs for bid/performance/ payment bonds and specialty insurances is included as 3% of the marked-up subtotal.

Mobilization - Costs for mobilization and demobilization of major pieces of equipment has been itemized. Cost for preparation of work plans has been included as an allowance, based on information provided USACE for a similar project. Cost for procurement of subcontractors, materials, and equipment; submittals; and, project close-out documentation has been included at a rate of 5% of the total for each alternative.

Planning, Engineering and Design, and, Site Inspection and Construction Management – A markup of 10% has been applied to account for costs incurred by engineering tasks, and construction management and inspectors (vehicle rental, per-diem, labor, report production, and meetings).

Escalation - Costs in this estimate are in 2017 dollars. Escalation is not applied to FS costs per USACE Regulation ER 1110-3-1301 (*Environmental Remediation and Removal Programs Cost Engineering).* Capital costs (including construction, S&A and design) are priced based on 2017 dollars. Present value for long-term O&M costs is based on a 1,000-year period with a discount rate of 3.5%.

5.1 Contingency

Project risk management includes the processes associated with conducting risk management planning, identification, analysis, responses, and monitoring and control on a project. USACE conducted a review of the cost estimates for each alternative to identify uncertain events or conditions that, if they occur, have a positive or negative effect on a project's objectives.

USACE conducted an abbreviated risk analysis in accordance with the USACE Headquarters requirements and guidance provided by the Cost Engineering Directory of Expertise for Civil Works. The abbreviated risk analysis involves a multi-disciplinary team which develops a risk register for each remedial alternative, evaluates risk by likelihood and impact, and produces a contingency percentage to be included in the individual alternative cost estimates.

The abbreviated risk analysis is a qualitative method of evaluating risk that does not specifically account for schedule risks or use formal statistical simulations, such as Monte Carlo risk simulation. The risk analysis results are intended to serve several functions, including the establishment of reasonable contingencies to successfully accomplish the project work within the established contingency amount.

Risk analysis results are also intended to provide leadership with contingency information for scheduling, budgeting, and project control purposes and tools to support decision making and risk management as the project progresses through planning and implementation. To fully recognize its benefits, cost and schedule risk analyses should be considered an on-going process conducted concurrent to, and iteratively with, other important project processes, such as scope and execution plan development, resource planning, procurement planning, cost estimating, budgeting, and scheduling.

USACE discussed the project scope and reviewed the Basis of the Government Estimate for each alternative. USACE developed potential risk elements, assigned the "likelihood" of occurrence, and assigned the impact level if an occurrence happens. USACE reviewed individual cost categories including:

- Mobilization & Preparatory Work / Demobilization;
- Monitoring, Sampling, Testing & Analysis;
- Site Work;
- Solids Collection and Containment;
- Liquids/Sediments/Sludges Collection and Containment;
- Drums/Tanks/Structures/Miscellaneous Demolition and Removal;
- Disposal;
- Site Restoration;
- General Requirements;
- Planning, Engineering and Design;
- Construction Management; and,
- Operation and Maintenance.

The Cost Categories were evaluated for risks in the following areas:

- Project Management and Scope Growth;
- Acquisition Strategy;
- Construction Elements;
- Specialty Construction or Fabrication;
- Technical Design and Quantities;
- Cost Estimate Assumptions; and,
- External Project Risks.

USACE completed the risk analysis and the recommended project contingency was applied to the cost estimates for each alternative (Attachment F). The contingency was not incorporated into the MII estimate, but added as a "bottom line" cost, as shown in the summaries in Sections 7 and 8, and on Table 1.

6.0 REMEDIAL TECHNOLOGY AND PROCESS OPTIONS

The sections below provide basic overviews of the remedial technology and process options for cost estimating considerations. Complete descriptions of these processes are presented in the FS report. Table 2 summarizes the tasks associated with the various processes.

6.1 Process 1 – Excavation, Transport, and Disposal of Contaminated Soil

Process 1 consists of excavating, transporting and disposing of contaminated soils, backfilling and restoring excavations, and dewatering as necessary. Process 1 would include excavating contaminated soils and stockpiling them at a temporary staging area, where they would then be loaded onto specialized transport media to be delivered to a disposal facility. Soil contaminants at this site include various radionuclides of concern (ROCs), polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs).

Prior to excavation, clearing of trees and brush would be necessary to gain access to some of the excavation areas. In addition, some of the existing asphalt roadways on site would require removal, transport and disposal. It is anticipated that approximately 50 trees would need to be removed, and approximately 2.4 hectares (6 acres) of brush clearing will be necessary. Approximately 2,500 cubic meters (m^3) (3,300 cubic yards (yd^3)) of road material would require removal as well. In order to gain access to the VOC-contaminated soil for excavation, approximately 38 m^3 (50 yd^3) of concrete, in the form of tank foundations, would need to be removed. It is expected that these foundations are not contaminated and would be disposed of at a nearby C&D landfill.

Quantities of soil removed are dependent on the remedial process being selected. Generally, the approximate quantities of soil that would be excavated including over-excavation are as follows:

- Radiological/PAH-contaminated soil (approximated): 1,529 m^3 or 2,000 yd^3
- Building 431/432 Trench soil (approximated): 382 m^3 or 500 yd^3
- VOC-contaminated soil (approximated): 2,600 m^3 or 3,400 yd^3

Dewatering may be required in some excavations; it is approximated that 3.8 liters (1 gallon) of water for every cubic yard of soil removed would need to be pumped into a transport to be disposed of at a nearby wastewater treatment plant.

Following excavation, confirmation sidewall and bottom samples would be collected to establish whether the excavation had been performed to the extent required. Upon approval from the engineer, excavations would be backfilled using material similar to what was removed. Topsoil and seeding would be applied as a restoration measure to control erosion, and asphalt roadways would require replacement where they were removed to facilitate the excavation. It is approximated that 80,300 m^2 (96,000 yd^2) of restoration would be required, and that about 8,300 m^2 (9,900 yd^2) of new asphalt roadway would be installed.

Alongside the remedial excavation, a temporary staging area would be constructed to temporarily stockpile soils while they await transport off site. The temporary staging area would consist of a high-density polyethylene liner placed on the ground, and would be surrounded by silt fence. Stockpiled soils that were not removed from the site at the end of the day would be covered with poly liner for overnight storage.

Surveying will be required to document the extent of excavations. It is expected that one pre-construction survey would be required to establish monuments, benchmarks, etc. and then a survey crew would be required on site daily during excavation work to document excavation depths and horizontal limits.

6.2 Process 2 – Excavation, Transport and Disposal of Concrete Foundations

Process 2 consists of demolition, excavation, transport and disposal of contaminated concrete building slabs followed by restoration. Process 2 would include demolishing concrete slabs using standard methods, and then excavating and stockpiling them at a temporary staging area, where they would then be loaded onto specialized transport media to be delivered to a disposal facility.

One alternative identifies that approximately 2,100 m^3 (2,700 yd^3) of concrete would be removed from the foundations for Buildings 401, 430, 431/432, and 433, and the trench associated with Building 431/432. Under three alternatives, only the concrete slab at building 401 would be removed; the estimated quantity is approximately 560 m^3 (730 yd^3). Following removal of the concrete slabs, backfill, topsoil and seeding would be applied as a restoration measure to control erosion.

For this process, surveying would be required both prior to construction to establish monuments, benchmarks, etc. and during excavation to document excavation bottoms and horizontal limits.

It is assumed that removal of the drains at Building 401 would be ancillary to this, and that the drains would be easily removed during removal of the concrete slab.

6.3 Process 3 – Concrete Building Slab Decontamination

Process 3 consists of decontamination of contaminated concrete building slabs using scarification. A concrete shaver would be utilized to remove up to approximately 1.27 centimeters (½ inch) of concrete from the top of each slab. An estimated 5,000 m^2 (53,510 square feet) of concrete would be scarified. This method requires that dust be collected, resulting in the need for transport and disposal of approximately 63 m^3 (83 yd^3) of contaminated concrete dust, assuming that 1.27 centimeters (½ inch) of material is removed. Confirmation wipe samples would be collected from the decontaminated slab.

6.4 Process 4 – *In Situ* Treatment of VOC-Contaminated Soil

Process 4 consists of *in situ* treatment of VOC-contaminated soils in the VOC Plume area. This process would include the remediation of approximately 2,600 m^3 (3,400 yd^3) of contaminated material in-place. This method includes the treatment of off-gasses from the thermal treatment process using catalytic thermal oxidation. This method would also treat VOC-contaminated groundwater.

6.5 Process 5 – *Ex Situ* Treatment of VOC-Contaminated Soil

Process 5 consists of *ex situ* treatment of soils contaminated with VOCs. This process would include the remediation of approximately 2,600 m^3 (3,400 yd^3) of contaminated material by removal and on-site treatment. In order to gain access to the contaminated soil for excavation, approximately 38 m^3 (50 yd^3) of concrete, in the form of tank foundations, would need to be removed. It is expected that these foundations are not contaminated and can be disposed of at a nearby C&D landfill. This method would require that water be pumped from the excavation and treated or transported off site for disposal. It is approximated that one gallon of water would be removed for every cubic yard of soil excavated. This method also includes the treatment of off-gasses from the thermal treatment process using catalytic thermal oxidation. Cost for excavation and backfill are built into the unit cost.

As a contingency, an allowance for chemical oxidation products, which can be applied directly into the open excavation, will be included to address any potential residual VOC groundwater contamination.

6.6 Process 6 – *In Situ* Treatment of VOC-Contaminated Water

Process 6 consists of *in situ* treatment of groundwater contaminated with VOCs. This process would include the remediation of contaminated groundwater in-place, and would take place inherently as *in situ* soil treatment takes place. This is technically part of Process 4.

6.7 Process 7 – Dewatering - VOC-Contaminated Water

Process 7 consists of removal groundwater contaminated with VOCs. This process would include the dewatering and off-site disposal, and would be the chosen groundwater remediation process should *ex situ* treatment of VOC-contaminated soil be selected.

7.0 REMEDIAL ALTERNATIVES

The sections below describe of the approaches considered for each of the five remedial alternatives. This section is intended to clarify the approach to each alternative in terms of the remedial processes described in Section 5. Complete discussions of these alternatives are presented in the FS report.

7.1 Alternative 1 – No action

Alternative 1 does not include any remedial action at the site whatsoever. Under this alternative, impacted soils, groundwater, foundations and other media would remain in place. Thereby, no cost is associated with this alternative, and there would be no capital construction or long-term O&M scheduling required.

Capital Cost:	$0
O&M Cost:	$0
Total Cost:	$0

Duration: N/A

7.2 Alternative 2 – Complete Removal

Alternative 2 consists of excavating all impacted soil and other media at the Site that exceeds the preliminary remediation goals (PRGs), and disposing the materials off site. This includes the excavation and removal of the ROC/PAH-contaminated soil, VOC plume area soil, the contaminated building foundations, and the Building 401 foundation and drains. VOC plume area groundwater in EU4 would be removed via dewatering ancillary to the excavation of the impacted soil from that area of the Site. Amendments would be added to the EU4 VOC plume excavation prior to backfilling to enhance degradation of residual, dissolved-phase impacts.

Following the removal of all materials exceeding the PRGs, the excavated areas would be backfilled and the Site would be restored.

In general, the following tasks are associated with the capital remedial action:

- Work Plan preparation
- Mobilization/demobilization
- Excavation/dewatering
- Material handling/transport/off-site disposal
- Confirmatory sampling/analysis
- Backfill and site restoration

Ancillary to the tasks listed above are general site preparation, temporary site facilities, health and safety, decontamination of equipment and personnel, construction oversight, and long-term O&M. The recommended contingency amount for both the capital costs and O&M costs, based on the risk analysis performed by USACE, are included.

The primary cost driver for this alternative is the removal, transport and disposal of material, with disposal having the most significant impact on the cost. Removal and disposal costs are responsible for approximately half of the total cost of this alternative. The cost summary below includes contingency costs.

Capital Cost:	$35,225,753
O&M Cost:	$ 443,144
Total Cost:	$35,668,897

Duration: Capital Construction – 4.5 Months; Long-Term O&M – 1,000 years

7.3 Alternative 3 – Removal with Building Decontamination

Alternative 3 consists of excavating all impacted soil at the Site that exceeds the PRGs, and disposing the materials off site. This includes the excavation and removal of the ROC-, PAH- and VOC-contaminated soil. VOC-contaminated groundwater would be removed via dewatering ancillary to the excavation of the impacted soil from that area of the Site. Following the removal of all soil exceeding the PRGs, the excavated areas would be backfilled and the Site would be restored.

The Building 430, 431/432, and 433 foundations would be left in place, but would be decontaminated to remove the risk associated with these media. The Building 401 foundation and drains would be removed.

In general, the following tasks are associated with the capital remedial action. Approximate durations and costs for each task are included in this list:

- Work Plan preparation
- Mobilization/demobilization
- Excavation/dewatering
- Building foundation decontamination
- Material handling/transport/off-site disposal
- Confirmatory sampling/analysis
- Backfill and site restoration

Ancillary to the tasks listed above are general site preparation, temporary site facilities, health and safety, decontamination of equipment and personnel, construction oversight, and long-term O&M.

The recommended contingency amount for both the capital costs and O&M costs, based on the risk analysis performed by USACE, are included.

The primary cost driver for this alternative is the removal, transport and disposal of material, with disposal having the most significant impact on the cost. Removal and disposal costs are responsible for greater than half of the total cost of this alternative. The cost impact from decontamination of in-place building foundations is negligible for this alternative. The cost summary below includes contingency costs.

Capital Cost:	$24,093,324
O&M Cost:	$ 443,144
Total Cost:	$24,536,468

Duration: Capital Construction – 4.5 Months; Long-Term O&M – 1,000 years

7.4 Alternative 4 – Removal with Building Decontamination and *In Situ* Remediation

Alternative 4 consists of excavating all ROC-, PAH-, and VOC-contaminated soil (excluding the EU4 VOC plume area soil) at the Site that exceeds the PRGs, and disposing the materials off-site. Following the removal of all ROC and PAH soil exceeding the PRGs, the excavated areas would be backfilled and the Site would be restored. VOC plume area soil and groundwater would be treated via *in situ* thermal treatment methods. Construction O&M would only be required during active *in situ* remediation to ensure proper operation of the remediation system components.

The Building 430, 431/432, and 433 foundations would be left in place, but would be decontaminated to remove the risk associated with these media. The Building 401 foundation and drains would be removed.

In general, the following tasks are associated with the capital remedial action. Approximate durations and costs for each task are included in this list:

- Work Plan preparation
- Mobilization/demobilization
- Excavation/dewatering
- Building foundation decontamination
- Material handling/transport/off-site disposal
- Thermal treatment of soil and groundwater *in situ* at EU4 (and off-gas treatment)
- Confirmatory sampling/analysis
- Backfill and site restoration

Ancillary to the tasks listed above are general site preparation, temporary site facilities, health and safety, decontamination of equipment and personnel, construction oversight, and long-term O&M.

The recommended contingency amount for both the capital costs and O&M costs, based on the risk analysis performed by USACE, are included.

The primary cost driver for this alternative is the removal, transport and disposal of material, with disposal having the most significant impact on the cost. Removal and disposal costs are responsible for approximately half of the total cost of this alternative. The cost impact from decontamination of in-place building foundations is negligible for this alternative. Remediation of VOC contamination using *in situ* thermal treatment instead of excavation does not bare a significant impact on the capital cost for this Alternative. The cost summary below includes contingency costs.

Capital Cost:	$22,472,009
O&M Cost:	$ 443,144
Total Cost:	$22,915,153

Duration: Capital Construction – 13 Months; Long-Term O&M – 1,000 years

7.5 Alternative 5 – Removal with Building Decontamination and *Ex Situ* Remediation

Alternative 5 consists of excavating all ROC- and PAH-impacted soil and EU13 VOC-impacted soil at the Site that exceeds the PRGs, and disposing the materials off site. Following the removal of all soil exceeding the PRGs, the excavated areas would be backfilled and the Site would be restored. EU4 VOC plume area soil and groundwater would be excavated and treated via *ex situ* thermal treatment methods.

The Building 430, 431/432, and 433 foundations would be left in place, but would be decontaminated to remove the risk associated with these media. The Building 401 foundation and drains would be removed.

In general, the following tasks are associated with the capital remedial action. Approximate durations and costs for each task are included in this list:

- Work Plan preparation
- Mobilization/demobilization
- Excavation/dewatering
- Building foundation decontamination
- Material handling/transport/off-site disposal
- Temporary excavation of VOC-impacted soils at EU4
- Thermal treatment of soil and groundwater *ex situ* at EU4 (and off-gas treatment)
- Backfill of soils from EU4 following successful *ex situ* remediation of VOC contamination
- Confirmatory sampling/analysis

- Backfill and site restoration

Ancillary to the tasks listed above are general site preparation, temporary site facilities, health and safety, decontamination of equipment and personnel, construction oversight, and long-term O&M. The recommended contingency amount for both the capital costs and O&M costs, based on the risk analysis performed by USACE, are included.

The primary cost driver for this alternative is the removal, transport and disposal of material, with disposal having the most significant impact on the cost. Removal and disposal costs are responsible for approximately half of the total cost of this alternative. The cost impact from decontamination of in-place building foundations is negligible for this alternative. Remediation of VOC contamination using *ex situ* thermal treatment instead of excavation results in a slightly higher capital cost than the other alternatives. The cost summary below includes contingency costs.

Capital Cost:	$26,822,389
O&M Cost:	$ 443,144
Total Cost:	$27,265,533

Duration: Capital Construction – 13 Months; Long-Term O&M – 1,000 years

8.0 SUMMARY

Table 1 presents a general summary of the costs for each alternative. Table 2 presents a breakdown of the work items required to complete each of the remedial processes. The MII cost estimate reports for each of the alternatives are included in Attachment A. As indicated on these reports and on Table 1, the total estimated costs for the eight alternatives are as follows:

Alternative 1: Capital Cost - $0.00
Long-term O&M Cost - $0.00

Alternative 2: Capital Cost - $35,225,753
Long-term O&M Cost - $443,144

Alternative 3: Capital Cost - $24,093,324
Long-term O&M Cost - $443,144

Alternative 4: Capital Cost - $22,472,009
Long-term O&M Cost - $443,144

Alternative 5: Capital Cost - $26,822,389
Long-term O&M Cost - $443,144

8.1 Program Management or Owner Cost

USACE oversight cost includes Program Management, Project Management, Construction Management, Design Reviews, Quality Assurance, HP Support, Cooperative Agreements with Others, and Engineering During Construction and have not been included in this estimate.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLES

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE 1
SUMMARY OF ALTERNATIVES BY ACCOUNT CODE
BALANCE OF PLANT AND GROUNDWATER OPERABLE UNITS
NIAGARA FALLS STORAGE SITE

COST TYPE	SOURCE TAG	DESCRIPTION	T&D Subtotals	PROJECT COST
	ALT 2	**Removal with Offsite Disposal (Capital Cost)**		**$ 35,225,753**
Capital	ALT2 - 331XX01	Mobilize and Preparatory Work		$ 225,900
Capital	ALT2 - 331XX02	Monitoring,Samplng,Test,Analysis		$ 198,097
Capital	ALT2 - 331XX03	Site Work		$ 149,214
Capital	ALT2 - 331XX08	Solids Collect And Containment		$ 225,190
Capital	ALT2 - 331XX09	Liq/Sed/Sludges Collect,Contain		$ 25,803
Capital	ALT2 - 331XX10	Drums/Tanks/Struct/Misc Removal		$ 127,880
Capital	ALT2 - 331XX18	Transport and Disposal - Radiological		$ 19,780,864
Capital	ALT2 - 331XX19	Transport and Disposal - Non-Radiological		$ 692,307
		Non-contaminated trees, brush, concrete tank foundations	$ 8,335	
		VOC-Contaminated soil and debris	$ 682,868	
		Water from Excavations	$ 1,104	
Capital	ALT2 - 331XX20	Site Restoration		$ 1,942,314
Capital	ALT2 - 331XX21	Demobilization		$ 69,835
Capital	ALT2 - 331XX22	Gen Requirements (Opt Breakout)		$ 376,922
Capital Cost Contingency		*48%*		*$ 11,411,427*
	ALT 2	**O&M**		**$ 443,144**
O&M	ALT2 - 342XX	Long-Term Operation and Maintenance (O&M)		$ 414,153
O&M	*Contingency*	*7%*		*$ 28,991*
ALTERNATIVE 2 TOTAL COST				***$ 35,668,897.00***
	ALT 3	**Decon Foundations (Capital Cost)**		**$ 24,093,324**
Capital	ALT 3 - 331XX01	Mobilize and Preparatory Work		$ 225,900
Capital	ALT 3 - 331XX02	Monitoring,Samplng,Test,Analysis		$ 198,097
Capital	ALT 3 - 331XX03	Site Work		$ 149,214
Capital	ALT 3 - 331XX08	Solids Collect And Containment		$ 225,190
Capital	ALT 3 - 331XX09	Liq/Sed/Sludges Collect,Contain		$ 25,803
Capital	ALT 3 - 331XX10	Drums/Tanks/Struct/Misc Removal		$ 42,661
Capital	ALT 3 - 331XX18	Transport and Disposal - Radiological		$ 13,545,015
Capital	ALT 3 - 331XX19	Transport and Disposal - Non-Radiological		$ 758,391
		Non-contaminated trees, brush, concrete tank foundations	$ 8,335	
		VOC-Contaminated soil and debris	$ 748,952	
		Water from Excavations	$ 1,104	
Capital	ALT 3 - 331XX20	Site Restoration		$ 1,883,325
Capital	ALT 3 - 331XX21	Demobilization		$ 69,835
Capital	ALT 3 - 331XX22	Gen Requirements (Opt Breakout)		$ 376,922
Capital	ALT 3 - 331XX90	Decon		$ 57,182
Capital Cost Contingency		*37%*		*$ 6,535,788*
	ALT 3	**O&M**		**$ 443,144**
O&M	ALT 3 - 342XX	Long-Term Operation and Maintenance (O&M)		$ 414,153
O&M	*Contingency*	*7%*		*$ 28,991*
ALTERNATIVE 3 TOTAL COST				**$ 24,536,468**
	ALT 4	**Soil and GW Removal w/ Offsite Disposal; Remove Bldg 401 Foundation and Drains; Decon Foundations; and In-Situ VOC Treatment (Capital Cost)**		**$ 22,472,009**
Capital	ALT 4 - 331XX01	Mobilize and Preparatory Work		$ 225,900
Capital	ALT 4 - 331XX02	Monitoring,Samplng,Test,Analysis		$ 201,923
Capital	ALT 4 - 331XX03	Site Work		$ 149,214
Capital	ALT 4 - 331XX08	Solids Collect And Containment		$ 129,063
Capital	ALT 4 - 331XX09	Liq/Sed/Sludges Collect,Contain		$ 25,803
Capital	ALT 4 - 331XX10	Drums/Tanks/Struct/Misc Removal		$ 31,270
Capital	ALT 4 - 331XX14	Thermal Treatment		$ 1,216,396
Capital	ALT 4 - 331XX18	Transport and Disposal - Radiological		$ 13,008,352
Capital	ALT 4 - 331XX19	Transport and Disposal - Non-Radiological		$ 8,387
		Non-contaminated trees, brush, concrete tank foundations	$ 7,919	
		Water from Excavations	$ 468	
Capital	ALT 4 - 331XX20	Site Restoration		$ 1,679,916
Capital	ALT 4 - 331XX21	Demobilization		$ 69,835
Capital	ALT 4 - 331XX22	Gen Requirements (Opt Breakout)		$ 376,922
Capital	ALT 4 - 331XX90	Decon		$ 57,182
Capital Cost Contingency		*31%*		*$ 5,291,845*
	ALT 4	**O&M**		**$ 443,144**
O&M	ALT 4 - 342XX	Long-Term Operation and Maintenance (O&M)		$ 414,153
O&M	*Contingency*	*7%*		*$ 28,991*
ALTERNATIVE 4 TOTAL COST				***$ 22,915,153***

TABLE 1
SUMMARY OF ALTERNATIVES BY ACCOUNT CODE
BALANCE OF PLANT AND GROUNDWATER OPERABLE UNITS
NIAGARA FALLS STORAGE SITE

COST TYPE	SOURCE TAG	DESCRIPTION	T&D Subtotals	PROJECT COST
	ALT 5	**Soil and GW Removal w/ Offsite Disposal; Remove Bldg 401 Foundation and Drains; Decon Foundations; and Ex-Situ VOC Treatment (Capital Cost)**		**$ 26,822,389**
Capital	ALT 5 - 331XX01	Mobilize and Preparatory Work		$ 225,900
Capital	ALT 5 - 331XX02	Monitoring,Samplng,Test,Analysis		$ 201,923
Capital	ALT 5 - 331XX03	Site Work		$ 149,214
Capital	ALT 5 - 331XX08	Solids Collect And Containment		$ 129,063
Capital	ALT 5 - 331XX09	Liq/Sed/Sludges Collect,Contain		$ 25,803
Capital	ALT 5 - 331XX10	Drums/Tanks/Struct/Misc Removal		$ 42,661
Capital	ALT 5 - 331XX14	Thermal Treatment		$ 2,097,163
Capital	ALT 5 - 331XX18	Transport and Disposal - Radiological		$ 14,720,472
Capital	ALT 5 - 331XX19	Transport and Disposal - Non-Radiological		$ 8,803
		Non-contaminated trees, brush, concrete tank foundations	$ 8,335	
		Water from Excavations	$ 468	
Capital	ALT 5 - 331XX20	Site Restoration		$ 1,679,916
Capital	ALT 5 - 331XX21	Demobilization		$ 69,835
Capital	ALT 5 - 331XX22	Gen Requirements (Opt Breakout)		$ 376,922
Capital	ALT 5 - 331XX90	Decon		$ 57,182
Capital Cost Contingency		*36%*		*$ 7,037,530*
	ALT 5	**O&M**		**$ 443,144**
O&M	ALT 5 - 342XX	Long-Term Operation and Maintenance (O&M)		$ 414,153
O&M Contingency		*7%*		*$ 28,991*
ALTERNATIVE 5 TOTAL COST				***$ 27,265,533***

Notes:

1 - Only Long-term Operation and Maintenance Costs are presented under Cost Code 342XX for each alternative. All other O&M costs are included inder either "Monitoring, Sampling, Test, Analysis" or "General Requirements"

2 - The subtotal lines at the top of each alternative represent the capital construction cost only; O&M cost is not included in these subtotals. The individual capital costs shown here are rounded, so there may be some minor discrepancies between the values shown on this table and the values shown on the MII Estimate Report in Attachment A.

TABLE 2
BREAKDOWN OF WORK ITEMS REQUIRED FOR REMEDIAL PROCESSES
BALANCE OF PLANT AND GROUNDWATER OPERABLE UNITS
NIAGARA FALLS STORAGE SITE

PROCESS	DESCRIPTION	WORK COMPONENTS
1	**Excavation, Transport and Disposal of Contaminated Soil**	**Monitoring, Sampling, Testing, Analysis ***
		Water Sampling
		Excavation Sidewall and Bottom Sampling
		Laboratory Analysis of Soil, Concrete Chip and Water Samples
		General Site Work
		Asphalt Road Demolition and Removal
		Concrete Tank Foundation Demolition and Removal
		Clearing and Grubbing
		Transport and Disposal of Non-Contaminated Materials
		Temporary Staging Area Construction
		Removal of Contaminated Soil
		Excavation
		Temporary Material Staging
		Hauling and Disposal of Radiological Contamination
		Hauling and Disposal of VOC contamination
		Removal of Contaminated Water
		Temporary On-Site Water Storage
		Survey
		Dewatering
		Transport and Disposal of Contaminated Water
		Disposal
		Disposal of Non-Contaminated Concrete, Asphalt and Debris
		Disposal of Trees and Brush
		Restoration
		Backfill and Compaction
		Grading
		Seeding
		Asphalt Road Replacement
		Disposal of Radiologically Contamined Soil
		Disposal of Radiologically/VOC Contaminated Water
2	**Excavation, Transport and Disposal of Concrete Foundations**	**Monitoring, Sampling, Testing, Analysis ***
		Laboratory Analysis of Soil, Concrete Chip and Water Samples
		General Site Work
		Clearing and Grubbing
		Temporary Staging Area Construction
		Miscelaneous Structure Removal
		Demolition of Concrete Building Slabs
		Transport and Disposal of Concrete Building Slabs
		Water Sampling
		Concrete Chip Sampling
		Disposal
		Disposal of Radiologically Contamined Concrete and Debris
		Disposal of Trees and Brush
		Restoration
		Backfill and Compaction
		Grading
		Seeding
3	**Concrete Building Slab Decontamination**	**Monitoring, Sampling, Testing, Analysis ***
		Concrete Chip Sampling
		Laboratory Analysis of Soil, Concrete Chip and Water Samples
		Disposal
		Disposal of Radiologically Contamined Concrete and Debris
		Decontamination
		Concrete Slab Shaving

TABLE 2
BREAKDOWN OF WORK ITEMS REQUIRED FOR REMEDIAL PROCESSES
BALANCE OF PLANT AND GROUNDWATER OPERABLE UNITS
NIAGARA FALLS STORAGE SITE

PROCESS	DESCRIPTION	WORK COMPONENTS
4	**In-Situ Treatment of VOC-Contaminated Soil**	**Monitoring, Sampling, Testing, Analysis ***
		Water Sampling
		Laboratory Analysis of Soil, Concrete Chip and Water Samples
		General Site Work
		Clearing and Grubbing
		Thermal Treatment of VOC Soils
		In-Situ Thermal Treatment
		Disposal
		Disposal of Trees and Brush
		Restoration
		Grading
		Seeding
5	**Ex-Situ Treatment of VOC-Contaminated Soil**	**Monitoring, Sampling, Testing, Analysis ***
		Water Sampling
		Excavation Sidewall and Bottom Sampling
		Concrete Chip Sampling
		Laboratory Analysis of Soil, Concrete Chip and Water Samples
		Thermal Treatment of VOC Soils
		In-Situ Thermal Treatment
		Disposal
		Disposal of Trees and Brush
		General Site Work
		Asphalt Road Demolition and Removal
		Concrete Tank Foundation Demolition and Removal
		Clearing and Grubbing
		Temporary Staging Area Construction
		Survey
		Removal of Contaminated Water
		Dewatering
		Temporary On-Site Water Storage
		Transport and Disposal of Contaminated Water
		Thermal Treatment of VOC Soils
		Ex-Situ Thermal Treatment
		Disposal
		Disposal of Radiologically/VOC Contaminated Water
		Restoration
		Backfill and Compaction
		Grading
		Seeding
		Asphalt Road Replacement
6	**In-Situ Treatment of VOC-Contaminated Water**	****NA - Completed inherently during In-Situ Soil Treatment****
7	**Dewatering VOC-Contaminated Water**	**Monitoring, Sampling, Testing, Analysis ***
		Water Sampling
		Laboratory Analysis of Soil, Concrete Chip and Water Samples
		General Site Work
		Asphalt Road Demolition and Removal
		Concrete Tank Foundation Demolition and Removal
		Clearing and Grubbing
		Removal of Contaminated Water
		Dewatering
		Temporary On-Site Water Storage
		Transport and Disposal of Contaminated Water
		Disposal
		Disposal of Radiologically/VOC Contaminated Water
		Restoration
		Grading
		Seeding

TABLE 2
BREAKDOWN OF WORK ITEMS REQUIRED FOR REMEDIAL PROCESSES
BALANCE OF PLANT AND GROUNDWATER OPERABLE UNITS
NIAGARA FALLS STORAGE SITE

PROCESS	DESCRIPTION	WORK COMPONENTS
Health and Safety Monitoring		**Operation and Maintenance**
		Community Air Monitoring Program (CAMP)
		Radiological Monitoring
		Radiation Protection Tech Crew
		Site Safety and Health Officer

** - O&M is required throughout the project so it is presented at the bottom of this table for clarity. The CAMP and Radiological monitoring tasks are included under "Monitoring, Sampling, Testing, Analysis" in the cost estimate.*

TABLE 3
SUMMARY OF COMMON COST ITEMS
BALANCE OF PLANT AND GROUNDWATER OPERABLE UNITS
NIAGARA FALLS STORAGE SITE

CATEGORY	WORK COMPONENTS
Mobilization and Preparatory Work	Construction/Setup of Temporary Facilities
	Mobilization of Large Construction Equipment
	Preparation of Work Plans/Submittals
	Utility Connection
General Requirements	Health and Safety
	Project Utility Usage
	Temporary Site Facility Usage/Rental
Demobilization	Deconstruct/Remove Temporary Facilities
	Demobilization of Large Construction Equipment
	Disconnect Utilities

Note - There is a separate mobilization/demobilization markup included in the cost estimate, which includes items not presented on this table. The separate markup is intended to account for start-up and completion tasks such as procurement of subcontractors, materials and equipment, preparation of work plans and submittals, and project close-out documentation

TABLE 4A
SUMMARY OF PRESENT VALUE COST CALCULATION
BALANCE OF PLANT AND GROUNDWATER
NIAGARA FALLS STORAGE SITE

Task 1 - Quarterly Site Visits

Year	Yearly Cost	Present Value Factor	Present Value
0	$0	1.00000	$0
1	$2,267	0.96618	$2,190
2	$2,267	0.93351	$2,116
3	$2,267	0.90194	$2,044
4	$2,267	0.87144	$1,975
5	$2,267	0.84197	$1,908
6	$2,267	0.81350	$1,844
7	$2,267	0.78599	$1,781
8	$2,267	0.75941	$1,721
9	$2,267	0.73373	$1,663
10	$2,267	0.70892	$1,607
20	$2,267	0.50257	$1,139
30	$2,267	0.35628	$808
40	$2,267	0.25257	$572
50	$2,267	0.17905	$406
60	$2,267	0.12693	$288
70	$2,267	0.08999	$204
80	$2,267	0.06379	$145
90	$2,267	0.04522	$103
100	$2,267	0.03206	$73
110	$2,267	0.02273	$52
120	$2,267	0.01611	$37
130	$2,267	0.01142	$26
140	$2,267	0.00810	$18
150	$2,267	0.00574	$13
200	$2,267	0.00103	$2
300	$2,267	0.00003	$0
SUM OF PRESENT VALUES			**$69,740**
Interest Rate			3.25%
n=1,000 years			1000

TOTAL PRESENT VALUE COST **$414,153**

TABLE 4B
SUMMARY OF PRESENT VALUE COST CALCULATION
BALANCE OF PLANT AND GROUNDWATER
NIAGARA FALLS STORAGE SITE

Task 2 - Annual Supervision and Administration

Year	Yearly Cost	Present Value Factor	Present Value
0	$0	1.00000	$0
1	$2,480	0.96618	$2,396
2	$2,480	0.93351	$2,315
3	$2,480	0.90194	$2,237
4	$2,480	0.87144	$2,161
5	$2,480	0.84197	$2,088
6	$2,480	0.81350	$2,018
7	$2,480	0.78599	$1,949
8	$2,480	0.75941	$1,883
9	$2,480	0.73373	$1,820
10	$2,480	0.70892	$1,758
20	$2,480	0.50257	$1,246
30	$2,480	0.35628	$884
40	$2,480	0.25257	$626
50	$2,480	0.17905	$444
60	$2,480	0.12693	$315
70	$2,480	0.08999	$223
80	$2,480	0.06379	$158
90	$2,480	0.04522	$112
100	$2,480	0.03206	$80
110	$2,480	0.02273	$56
120	$2,480	0.01611	$40
130	$2,480	0.01142	$28
140	$2,480	0.00810	$20
150	$2,480	0.00574	$14
200	$2,480	0.00103	$3
300	$2,480	0.00003	$0
SUM OF PRESENT VALUES			**$76,313**
Interest Rate			3.25%
n=1,000 years			1000

TOTAL PRESENT VALUE COST **$414,153**

TABLE 4C
SUMMARY OF PRESENT VALUE COST CALCULATION
BALANCE OF PLANT AND GROUNDWATER
NIAGARA FALLS STORAGE SITE

Task 3 - Five-Year Review Report

Year	Yearly Cost	Present Value Factor	Present Value
0	$0	1.00000	$0
1	$8,713	0.96618	$8,419
2	$8,713	0.93351	$8,134
3	$8,713	0.90194	$7,859
4	$8,713	0.87144	$7,593
5	$8,713	0.84197	$7,336
6	$8,713	0.81350	$7,088
7	$8,713	0.78599	$6,849
8	$8,713	0.75941	$6,617
9	$8,713	0.73373	$6,393
10	$8,713	0.70892	$6,177
20	$8,713	0.50257	$4,379
30	$8,713	0.35628	$3,104
40	$8,713	0.25257	$2,201
50	$8,713	0.17905	$1,560
60	$8,713	0.12693	$1,106
70	$8,713	0.08999	$784
80	$8,713	0.06379	$556
90	$8,713	0.04522	$394
100	$8,713	0.03206	$279
110	$8,713	0.02273	$198
120	$8,713	0.01611	$140
130	$8,713	0.01142	$100
140	$8,713	0.00810	$71
150	$8,713	0.00574	$50
200	$8,713	0.00103	$9
300	$8,713	0.00003	$0
SUM OF PRESENT VALUES			**$268,099**
Interest Rate			3.25%
n=1,000 years			1000

TOTAL PRESENT VALUE COST **$414,153**

ATTACHMENT A

MII COST ESTIMATE REPORTS

THIS PAGE INTENTIONALLY LEFT BLANK

U.S. Army Corps of Engineers
Project : Niagara Falls Storage Site FS Cost Estimate
Niagara Falls Storage Site Feasibility Study Cost Estimate

Estimated by AECOM
Designed by US Army Corps of Engineers
Prepared by [redacted]
Preparation Date 3/15/2017
Effective Date of Pricing 3/15/2017
Estimated Construction Time 90 Days

Designed by
US Army Corps of Engineers

Estimated by
AECOM

Prepared by
[redacted]

Design Document Niagara Falls Storage Site Feasibility Study
Document Date 5/24/2017

District Buffalo, NY
Contact [redacted]

Budget Year 2017
UOM System Original

Direct Costs
LaborCost
EQCost
MatlCost
SubBidCost
UserCost1

Timeline/Currency
Preparation Date 3/15/2017
Escalation Date 1/1/2015
Eff. Pricing Date 3/15/2017
Estimated Duration 90 Day(s)

Currency US dollars
Exchange Rate 1.000000

Costbook CB15EngA: MII English Cost Book 2015 Rev A

Labor WDOL: Davis Bacon GD NY16001
Note: http://www.wdol.gov is the website for current Davis Bacon & Service Labor Rates. Fringes paid to the laborers are taxable. In a non-union job the whole fringes are taxable. In a union job, the vacation pay fringes are taxable.

Equipment EP14R01: MII Equipment 2014 Region 01

01 NORTHEAST	
Sales Tax	8.00
Working Hours per Year	1,360
Labor Adjustment Factor	1.15
Cost of Money	2.50
Cost of Money Discount	25.00
Tire Recap Cost Factor	1.50
Tire Recap Wear Factor	1.80
Tire Repair Factor	0.15
Equipment Cost Factor	1.00
Standby Depreciation Factor	0.50

Fuel	
Electricity	0.132
Gas	2.630
Diesel Off-Road	2.190
Diesel On-Road	2.740

Shipping Rates	
Over 0 CWT	19.34
Over 240 CWT	17.80
Over 300 CWT	15.56
Over 400 CWT	13.43
Over 500 CWT	6.79
Over 700 CWT	6.79
Over 800 CWT	11.41

Date	Author	Note
3/3/2017	Profit	Profit

Profit

10.02 % Based on profit weighted guidelines

Degree of Risk: 0.04 (very slight - the project is straightforward with minimal anticipated surprises)

Relative Difficulty of Work: 0.05 (below average - the project is straightforward and easy to execute)

Size of Job: 0.3 (The project is expected to cost more than $10,000,000 in Capital Costs)

Period of Performance: 0.041 (The prime contractor work is expected to take about 3 months)

Contractor's Investment: 0.07 (This is a fairly common project, so the contractor's investment should be about average)

Assistance by Government: 0.075 (Assistance by the Government is expected to be average)

Subcontracting: 0.105 (Subcontracting, primarily for transportation of materials, is expected to account for about 30% of the total capital cost)

3/3/2017 1:19:39 PM

_Rad Equipment

Radiological Monitoring Equipment Rentals

Item	Purpose	Qty
Ludlum 2221 w/ rs232	digital scalar/ratemeter	2
Ludlum 44-10	2"NaI	2
Polyshield lead columinator (2"NaI)	1	
Ludlum 2360	Dual channel scaler	2
Ludlum 43-93	Alpha beta	2
Ludlum 2241	digital scalar/ratemeter	2

Date	Author	Note

Ludlum 44-9	Pancake	2
Ludlum 19	Dose Rate	1
Ludlum 2929 W/	1	
43-10-1 Smear Counter		
Alpha	Th-230	1
Beta	Tc-99	1
Gamma	CS-137	1
MSA Escort Elf	Lapel Air sampler	1
SS hand auger		1

3/9/2017 8:39:23 AM Fuel

Fuel

Fuel Prices are current as of the week ending May 15, 2017. Fuel pricing obtained from US Energy Information Administration Weekly Retail Gasoline and Diesel Prices for Central Atlantic. Gas prices are for Regular-grade. Off-Road diesel cost is calculated by subtracting the state and federal taxes ($0.55) from the current on-road diesel price.

3/9/2017 11:18:44 AM L/E/M

Labor rates are based on Davis Bacon, www.wdol.gov, General Decision # NY 160011 for Heavy/Highway construction (Niagara County), and are current as of March 3, 2017.

Equipment rates from the most current (2014) MII cost book were escalated to 2017 rates based on the Producer Price Index Table 9 - Commodity and Service Groupings, "Construction Machinery and Equipment." Based on the table, the most recent 1-year change was 0.7%; so assuming 0.7% over 3 years (2014 to 2017), an equipment escalation markup of 2.1% has been applied.

Direct Cost Markups		**Category**		**Method**		
CAMP Overtime		Overtime		Overtime		
	Days/Week	*Hours/Shift*	*Shifts/Day*	*1st Shift*	*2nd Shift*	*3rd Shift*
Standard	*5.00*	*8.00*	*1.00*	*8.00*	*0.00*	*0.00*
Actual	*5.00*	*8.00*	*1.00*	*10.00*	*0.00*	*0.00*

Day	*OT Factor*	*Working*	*OT Percent*	*FCCM Percent*
Monday	*1.50*	*Yes*	*10.00*	*(20.00)*
Tuesday	*1.50*	*Yes*		
Wednesday	*1.50*	*Yes*		
Thursday	*1.50*	*Yes*		
Friday	*1.50*	*Yes*		
Saturday	*1.50*	*No*		
Sunday	*2.00*	*No*		

Sales Tax	TaxAdj	Running % on Selected Costs
MatlCost		
Inspector Escalation	MiscDirect	Running % on Selected Costs
LaborCost		
Equipment Escalation	TaxAdj	Running % on Selected Costs
EQCost		

Contractor Markups	**Category**		**Method**	
Prime Profit	Profit		Profit Weighted Guidelines	
Guideline		*Value*	*Weight*	*Percentage*
Risk		*0.040*	*20*	*0.80*
Difficulty		*0.050*	*15*	*0.75*
Size		*0.300*	*15*	*4.50*
Period		*0.041*	*15*	*0.62*
Invest (Contractor's)		*0.070*	*5*	*0.35*
Assist (Assistance by)		*0.075*	*5*	*0.38*
SubContracting		*0.105*	*25*	*2.63*
Total			*100*	*10.02*

Bond&Insurance	Bond	Running %
Sub Overhead	Allowance	Running %
Sub Profit	Allowance	Running %
Prime Overhead	Allowance	Running %
Mobilization	Allowance	Running %

Owner Markups	**Category**	**Method**
Escalation	Escalation	Running %
P,E,D & CM/Inspection	SIOH	Running %

Description	Quantity	UOM	BareCost	DirectCost	CostToPrime	ProjectCost
Summary of Alternatives						
ALT 2 - Removal with Offsite Disposal	**1.00**	**LS**	**16,734,005.34**	**16,944,890.93**	**16,541,964.86**	**24,228,478.10**
			16,319,852.34	*16,530,737.93*	*16,541,964.86*	*23,814,325.10*
ALT 2 - CAPITAL COSTS	**1.00**	**EA**	**16,319,852.34**	**16,530,737.93**	**16,541,964.86**	**23,814,325.10**
			414,153.00	*414,153.00*	*0.00*	*414,153.00*
ALT 2 - O&M	**1.00**	**EA**	**414,153.00**	**414,153.00**	**0.00**	**414,153.00**
ALT 3 - Soil and GW Removal w/ Offsite Disposal; Remove Bldg 401 Foundation and Drains; and Decon Foundations	**1.00**	**LS**	**12,393,779.06**	**12,599,107.69**	**12,196,181.62**	**17,971,687.86**
ALT 3 - CAPITAL COSTS	**1.00**	**LS**	**11,979,626.06**	**12,184,954.69**	**12,196,181.62**	**17,557,534.86**
			414,153.00	*414,153.00*	*0.00*	*414,153.00*
ALT 3 - O&M	**1.00**	**EA**	**414,153.00**	**414,153.00**	**0.00**	**414,153.00**
ALT 4 - Soil and GW Removal w/ Offsite Disposal; Remove Bldg 401 Foundation and Drains; Decon Foundations; and In-Situ VOC Treatment	**1.00**	**LS**	**12,017,371.10**	**12,203,923.86**	**11,950,475.79**	**17,594,316.46**
ALT 4 - CAPITAL COSTS	**1.00**	**LS**	**11,603,218.10**	**11,789,770.86**	**11,950,475.79**	**17,180,163.46**
			414,153.00	*414,153.00*	*0.00*	*414,153.00*
ALT 4 - O&M	**1.00**	**EA**	**414,153.00**	**414,153.00**	**0.00**	**414,153.00**
ALT 5 - Soil and GW Removal w/ Offsite Disposal; Remove Bldg 401 Foundation and Drains; Decon Foundations; and Ex-Situ VOC Treatment	**1.00**	**LS**	**13,728,601.59**	**13,916,712.87**	**13,771,498.80**	**20,199,010.60**
ALT 5 - CAPITAL COSTS	**1.00**	**LS**	**13,314,448.59**	**13,502,559.87**	**13,771,498.80**	**19,784,857.60**
			414,153.00	*414,153.00*	*0.00*	*414,153.00*
ALT 5 - O&M	**1.00**	**EA**	**414,153.00**	**414,153.00**	**0.00**	**414,153.00**

Description	Quantity	UOM	BareCost	DirectCost	CostToPrime	ContractCost	ProjectCost
Summary of Each Alternative by Cost Code			**54,873,757.09**	**55,664,635.35**	**54,460,121.07**	**72,871,958.39**	**79,993,493.03**
2 ALT 2 - Removal with Offsite Disposal	**1.0000**	**LS**	**16,734,005.34**	**16,944,890.93**	**16,541,964.86**	**22,063,539.46**	**24,228,478.10**
			16,319,852.3403	*16,530,737.9325*	*16,541,964.8621*	*21,649,386.4590*	*23,814,325.1049*
331XX ALT 2 - CAPITAL COSTS	**1.0000**	**EA**	**16,319,852.34**	**16,530,737.93**	**16,541,964.86**	**21,649,386.46**	**23,814,325.10**
ALT2 - 331XX01 Mobilize and Preparatory Work	**1.0000**	**LS**	**150,596.58**	**156,903.74**	**156,903.74**	**205,363.92**	**225,900.31**
ALT2 - 331XX02 Monitoring,Samplng,Test,Analysis	**1.0000**	**LS**	**137,457.00**	**137,592.36**	**137,592.36**	**180,088.16**	**198,096.98**
ALT2 - 331XX03 Site Work	**1.0000**	**LS**	**82,412.82**	**93,644.79**	**104,871.72**	**135,648.94**	**149,213.83**
ALT2 - 331XX08 Solids Collect And Containment	**1.0000**	**LS**	**140,921.16**	**156,410.06**	**156,410.06**	**204,717.77**	**225,189.54**
ALT2 - 331XX09 Liq/Sed/Sludges Collect,Contain	**1.0000**	**LS**	**16,366.49**	**17,922.33**	**17,922.33**	**23,457.69**	**25,803.46**
ALT2 - 331XX10 Drums/Tanks/Struct/Misc Removal	**1.0000**	**LS**	**77,814.01**	**88,821.38**	**88,821.38**	**116,254.12**	**127,879.53**
			13,739,208.5185	*13,739,208.5185*	*13,739,208.5185*	*17,982,603.3253*	*19,780,863.6579*
ALT2 - 331XX18 Transport and Disposal - Radiological	**1.0000**	**EA**	**13,739,208.52**	**13,739,208.52**	**13,739,208.52**	**17,982,603.33**	**19,780,863.66**
ALT2 - 331XX19 Transport and Disposal - Non-Radiological	**1.0000**	**LS**	**480,856.00**	**480,856.00**	**480,856.00**	**629,369.78**	**692,306.76**
ALT2 - 331XX20 Site Restoration	**1.0000**	**LS**	**1,241,018.33**	**1,349,074.22**	**1,349,074.22**	**1,765,739.75**	**1,942,313.73**
ALT2 - 331XX21 Demobilization	**1.0000**	**LS**	**42,537.02**	**48,505.56**	**48,505.56**	**63,486.65**	**69,835.31**
ALT2 - 331XX22 Gen Requirements (Opt Breakout)	**1.0000**	**LS**	**210,664.42**	**261,798.97**	**261,798.97**	**342,656.35**	**376,921.99**
			414,153.0000	*414,153.0000*	*0.0000*	*414,153.0000*	*414,153.0000*
342XX ALT 2 - O&M	**1.0000**	**EA**	**414,153.00**	**414,153.00**	**0.00**	**414,153.00**	**414,153.00**
3 ALT 3 - Soil and GW Removal w/ Offsite Disposal; Remove Bldg 401 Foundation and Drains; and Decon Foundations	**1.0000**	**LS**	**12,393,779.06**	**12,599,107.69**	**12,196,181.62**	**16,375,548.33**	**17,971,687.86**
331XX ALT 3 - CAPITAL COSTS	**1.0000**	**LS**	**11,979,626.06**	**12,184,954.69**	**12,196,181.62**	**15,961,395.33**	**17,557,534.86**
ALT 3 - 331XX01 Mobilize and Preparatory Work	**1.0000**	**LS**	**150,596.58**	**156,903.74**	**156,903.74**	**205,363.92**	**225,900.31**
ALT 3 - 331XX02 Monitoring,Samplng,Test,Analysis	**1.0000**	**LS**	**137,457.00**	**137,592.36**	**137,592.36**	**180,088.16**	**198,096.98**
ALT 3 - 331XX03 Site Work	**1.0000**	**LS**	**82,412.82**	**93,644.79**	**104,871.72**	**135,648.94**	**149,213.83**
ALT 3 - 331XX08 Solids Collect And Containment	**1.0000**	**LS**	**140,921.16**	**156,410.06**	**156,410.06**	**204,717.77**	**225,189.54**
ALT 3 - 331XX09 Liq/Sed/Sludges Collect,Contain	**1.0000**	**LS**	**16,366.49**	**17,922.33**	**17,922.33**	**23,457.69**	**25,803.46**
ALT 3 - 331XX10 Drums/Tanks/Struct/Misc Removal	**1.0000**	**LS**	**25,828.93**	**29,631.27**	**29,631.27**	**38,782.97**	**42,661.27**
			9,407,970.3889	*9,407,970.3889*	*9,407,970.3889*	*12,313,649.6089*	*13,545,014.5697*
ALT 3 - 331XX18 Transport and Disposal - Radiological	**1.0000**	**EA**	**9,407,970.39**	**9,407,970.39**	**9,407,970.39**	**12,313,649.61**	**13,545,014.57**
ALT 3 - 331XX19 Transport and Disposal - Non-Radiological	**1.0000**	**LS**	**526,756.00**	**526,756.00**	**526,756.00**	**689,446.13**	**758,390.75**
ALT 3 - 331XX20 Site Restoration	**1.0000**	**LS**	**1,203,095.50**	**1,308,102.52**	**1,308,102.52**	**1,712,113.82**	**1,883,325.20**
ALT 3 - 331XX21 Demobilization	**1.0000**	**LS**	**42,537.02**	**48,505.56**	**48,505.56**	**63,486.65**	**69,835.31**
ALT 3 - 331XX22 Gen Requirements (Opt Breakout)	**1.0000**	**LS**	**210,664.42**	**261,798.97**	**261,798.97**	**342,656.35**	**376,921.99**
ALT 3 - 331XX90 Decon	**1.0000**	**LS**	**35,019.75**	**39,716.70**	**39,716.70**	**51,983.32**	**57,181.65**
			414,153.0000	*414,153.0000*	*0.0000*	*414,153.0000*	*414,153.0000*
342XX ALT 3 - O&M	**1.0000**	**EA**	**414,153.00**	**414,153.00**	**0.00**	**414,153.00**	**414,153.00**
4 ALT 4 - Soil and GW Removal w/ Offsite Disposal; Remove Bldg 401 Foundation and Drains; Decon Foundations; and In-Situ VOC Treatment	**1.0000**	**LS**	**12,017,371.10**	**12,203,923.86**	**11,950,475.79**	**16,032,483.42**	**17,594,316.46**
331XX ALT 4 - CAPITAL COSTS	**1.0000**	**LS**	**11,603,218.10**	**11,789,770.86**	**11,950,475.79**	**15,618,330.42**	**17,180,163.46**
ALT 4 - 331XX01 Mobilize and Preparatory Work	**1.0000**	**LS**	**150,596.58**	**156,903.74**	**156,903.74**	**205,363.92**	**225,900.31**
ALT 4 - 331XX02 Monitoring,Samplng,Test,Analysis	**1.0000**	**LS**	**140,114.50**	**140,249.86**	**140,249.86**	**183,566.44**	**201,923.08**
ALT 4 - 331XX03 Site Work	**1.0000**	**LS**	**82,412.82**	**93,644.79**	**104,871.72**	**135,648.94**	**149,213.83**
ALT 4 - 331XX08 Solids Collect And Containment	**1.0000**	**LS**	**81,258.56**	**89,643.47**	**89,643.47**	**117,330.12**	**129,063.14**

Description	Quantity	UOM	BareCost	DirectCost	CostToPrime	ContractCost	ProjectCost
ALT 4 - 331XX09 Liq/Sed/Sludges Collect,Contain	**1.0000**	**LS**	**16,366.49**	**17,922.33**	**17,922.33**	**23,457.69**	**25,803.46**
ALT 4 - 331XX10 Drums/Tanks/Struct/Misc Removal	**1.0000**	**LS**	**19,075.44**	**21,719.26**	**21,719.26**	**28,427.32**	**31,270.05**
			711,800.0000	*711,800.0000*	*861,278.0000*	*1,105,814.1151*	*1,216,395.5266*
ALT 4 - 331XX14 Thermal Treatment	**1.0000**	**EA**	**711,800.00**	**711,800.00**	**861,278.00**	**1,105,814.12**	**1,216,395.53**
			9,035,220.3889	*9,035,220.3889*	*9,035,220.3889*	*11,825,774.6792*	*13,008,352.1471*
ALT 4 - 331XX18 Transport and Disposal - Radiological	**1.0000**	**EA**	**9,035,220.39**	**9,035,220.39**	**9,035,220.39**	**11,825,774.68**	**13,008,352.15**
ALT 4 - 331XX19 Transportation and Disposal - Non-Radiological	**1.0000**	**LS**	**5,825.00**	**5,825.00**	**5,825.00**	**7,624.07**	**8,386.48**
ALT 4 - 331XX20 Site Restoration	**1.0000**	**LS**	**1,072,327.14**	**1,166,820.78**	**1,166,820.78**	**1,527,196.80**	**1,679,916.48**
ALT 4 - 331XX21 Demobilization	**1.0000**	**LS**	**42,537.02**	**48,505.56**	**48,505.56**	**63,486.65**	**69,835.31**
ALT 4 - 331XX22 Gen Requirements (Opt Breakout)	**1.0000**	**LS**	**210,664.42**	**261,798.97**	**261,798.97**	**342,656.35**	**376,921.99**
ALT 4 - 331XX90 Decon	**1.0000**	**LS**	**35,019.75**	**39,716.70**	**39,716.70**	**51,983.32**	**57,181.65**
			414,153.0000	*414,153.0000*	*0.0000*	*414,153.0000*	*414,153.0000*
342XX ALT 4 - O&M	**1.0000**	**EA**	**414,153.00**	**414,153.00**	**0.00**	**414,153.00**	**414,153.00**
5 ALT 5 - Soil and GW Removal w/ Offsite Disposal; Remove Bldg 401 Foundation and Drains; Decon Foundations; and Ex-Situ VOC Treatment	**1.0000**	**LS**	**13,728,601.59**	**13,916,712.87**	**13,771,498.80**	**18,400,387.19**	**20,199,010.60**
331XX ALT 5 - CAPITAL COSTS	**1.0000**	**LS**	**13,314,448.59**	**13,502,559.87**	**13,771,498.80**	**17,986,234.19**	**19,784,857.60**
ALT 5 - 331XX01 Mobilize and Preparatory Work	**1.0000**	**LS**	**150,596.58**	**156,903.74**	**156,903.74**	**205,363.92**	**225,900.31**
ALT 5 - 331XX02 Monitoring,Samplng,Test,Analysis	**1.0000**	**LS**	**140,114.50**	**140,249.86**	**140,249.86**	**183,566.44**	**201,923.08**
ALT 5 - 331XX03 Site Work	**1.0000**	**LS**	**82,412.82**	**93,644.79**	**104,871.72**	**135,648.94**	**149,213.83**
ALT 5 - 331XX08 Solids Collect And Containment	**1.0000**	**LS**	**81,258.56**	**89,643.47**	**89,643.47**	**117,330.12**	**129,063.14**
ALT 5 - 331XX09 Liq/Sed/Sludges Collect,Contain	**1.0000**	**LS**	**16,366.49**	**17,922.33**	**17,922.33**	**23,457.69**	**25,803.46**
ALT 5 - 331XX10 Drums/Tanks/Struct/Misc Removal	**1.0000**	**LS**	**25,828.93**	**29,631.27**	**29,631.27**	**38,782.97**	**42,661.27**
ALT 5 - 331XX14 Thermal Treatment	**1.0000**	**LS**	**1,226,800.00**	**1,227,200.00**	**1,484,912.00**	**1,906,511.78**	**2,097,162.95**
			10,224,408.3889	*10,224,408.3889*	*10,224,408.3889*	*13,382,246.8773*	*14,720,471.5650*
ALT 5 - 331XX18 Transport and Disposal - Radiological	**1.0000**	**EA**	**10,224,408.39**	**10,224,408.39**	**10,224,408.39**	**13,382,246.88**	**14,720,471.57**
ALT 5 - 331XX19 Transport and Disposal - Non-Radiological	**1.0000**	**LS**	**6,114.00**	**6,114.00**	**6,114.00**	**8,002.33**	**8,802.56**
ALT 5 - 331XX20 Site Restoration	**1.0000**	**LS**	**1,072,327.14**	**1,166,820.78**	**1,166,820.78**	**1,527,196.80**	**1,679,916.48**
ALT 5 - 331XX21 Demobilization	**1.0000**	**LS**	**42,537.02**	**48,505.56**	**48,505.56**	**63,486.65**	**69,835.31**
ALT 5 - 331XX22 Gen Requirements (Opt Breakout)	**1.0000**	**LS**	**210,664.42**	**261,798.97**	**261,798.97**	**342,656.35**	**376,921.99**
ALT 5 - 331XX90 Decon	**1.0000**	**LS**	**35,019.75**	**39,716.70**	**39,716.70**	**51,983.32**	**57,181.65**
			414,153.0000	*414,153.0000*	*0.0000*	*414,153.0000*	*414,153.0000*
342XX ALT 5 - O&M	**1.0000**	**EA**	**414,153.00**	**414,153.00**	**0.00**	**414,153.00**	**414,153.00**

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
Detailed Estimate			**2,397,076.78**	**624,902.54**	**4,578,170.35**	**420,000.00**	**55,664,635.35**	**72,871,958.39**	**79,993,493.03**
2 ALT 2 - Removal with Offsite Disposal	**1.0000**	**LS**	**631,582.14**	**178,820.13**	**1,239,621.14**	**105,000.00**	**16,944,890.93**	**22,063,539.46**	**24,228,478.10**
			631,582.1430	*178,820.1284*	*1,239,621.1425*		*16,530,737.9325*	*21,649,386.4590*	*23,814,325.1049*
331XX ALT 2 - CAPITAL COSTS	**1.0000**	**EA**	**631,582.14**	**178,820.13**	**1,239,621.14**	**105,000.00**	**16,530,737.93**	**21,649,386.46**	**23,814,325.10**
ALT2 - 331XX01 Mobilize and Preparatory Work	**1.0000**	**LS**	**27,481.55**	**5,647.46**	**18,774.72**	**105,000.00**	**156,903.74**	**205,363.92**	**225,900.31**
			15,469.9117	*5,180.0213*	*1,663.2000*		*22,313.1330*	*29,204.6095*	*32,125.0705*
331XX0101 Mob Construction Equip & Fac	**1.0000**	**EA**	**15,469.91**	**5,180.02**	**1,663.20**	**0.00**	**22,313.13**	**29,204.61**	**32,125.07**
			0.0000	*0.0000*	*1,663.2000*		*1,663.2000*	*2,176.8842*	*2,394.5726*
331XX010190 Site Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**1,663.20**	**0.00**	**1,663.20**	**2,176.88**	**2,394.57**
			0.0000	*0.0000*	*475.2000*		*475.2000*	*621.9669*	*684.1636*
331XX010191 Office Trailers	**1.0000**	**EA**	**0.00**	**0.00**	**475.20**	**0.00**	**475.20**	**621.97**	**684.16**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Office trailer, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: assume 10 miles per haul, 2 trailers. double to account for demob)									
			0.0000	*0.0000*	*712.8000*		*712.8000*	*932.9504*	*1,026.2454*
331XX010192 Toilets	**1.0000**	**EA**	**0.00**	**0.00**	**712.80**	**0.00**	**712.80**	**932.95**	**1,026.25**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Portable toilet and hand wash, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: Assume same cost for delivering storage trailers - three toilets and two hand washes delivered on two trucks. Double to account for demob)									
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Portable hand wash station, delivery, add per mile	20.0000	MI	0.00	0.00	237.60	0.00	237.60	310.98	342.08
(Note: Assume same cost for delivering storage trailers - three delivered on one truck. Double to account for demob)									
			0.0000	*0.0000*	*475.2000*		*475.2000*	*621.9669*	*684.1636*
331XX010193 Storage Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**475.20**	**0.00**	**475.20**	**621.97**	**684.16**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Storage trailer, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: Assume same cost for delivering storage trailers - 2 deliveries double to account for demob)									
			15,469.9117	*5,180.0213*	*0.0000*		*20,649.9330*	*27,027.7253*	*29,730.4979*
331XX010191 Construction Equipment	**1.0000**	**EA**	**15,469.91**	**5,180.02**	**0.00**	**0.00**	**20,649.93**	**27,027.73**	**29,730.50**
			509.8944	*173.1983*	*0.0000*	*0.0000*	*683.0927*	*894.0678*	*983.4746*
RSM 015436501400 Mobilization or demobilization, delivery charge for equipment, hauled on 20-ton capacity towed trailer	20.0000	EA	10,197.89	3,463.97	0.00	0.00	13,661.85	17,881.36	19,669.49
(Note: Mobilization/demobilization of medium-sized equipment. 1 paver, 1 medium excavator, 3 medium FE loaders/backhoes/skidsteers, 3 rollers, 2 dozers)									
			540.2320	*191.5054*	*0.0000*	*0.0000*	*731.7374*	*957.7366*	*1,053.5102*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
RSM 015436501500 Mobilization or demobilization, delivery charge for equipment, hauled on 40-ton capacity towed trailer	8.0000	EA	4,321.86	1,532.04	0.00	0.00	5,853.90	7,661.89	8,428.08
(Note: Mobilization/demobilization of heavy equipment. 1 grader, 2 large excavators, 1 large FE loader)									
			118.7710	*23.0016*	*0.0000*	*0.0000*	*141.7726*	*185.5595*	*204.1155*
RSM 015436501200 Mobilization or demobilization, delivery charge for small equipment, placed in rear of, or towed by pickup truck	8.0000	EA	950.17	184.01	0.00	0.00	1,134.18	1,484.48	1,632.92
(Note: Assume 4 loads each way for smaller equipment (saws, pumps, excavator attachments, etc.))									
			0.0000	*0.0000*	*0.0000*		*105,000.0000*	*137,429.5577*	*151,172.5134*
331XX0103 Submittals/Implementation Plans	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**105,000.00**	**105,000.00**	**137,429.56**	**151,172.51**
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Community Air Monitoring Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Remedial Action Work Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Quality Control Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Sampling and Analysis Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Materials Handling/Transportation and Disposal Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Health and Safety Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Stormwater Pollution Prevention Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Community Participation Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
complex.)									
			0.0000	*0.0000*	*0.0000*	*5,000.0000*	*5,000.0000*	*6,544.2647*	*7,198.6911*
USR Project Schedule	1.0000	EA	0.00	0.00	0.00	5,000.00	5,000.00	6,544.26	7,198.69
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by 75% for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Site Access/Site Security Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Site Management/Long-term O&M Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			2,538.6206	*467.4417*	*2,515.3200*		*5,521.3824*	*7,226.6775*	*7,949.3452*
331XX0104 Setup/Construct Temp Facilities	**1.0000**	**EA**	**2,538.62**	**467.44**	**2,515.32**	**0.00**	**5,521.38**	**7,226.68**	**7,949.35**
			0.0000	*0.0000*	*1,089.7200*		*1,089.7200*	*1,426.2832*	*1,568.9115*
331XX010411 Barricades	**1.0000**	**EA**	**0.00**	**0.00**	**1,089.72**	**0.00**	**1,089.72**	**1,426.28**	**1,568.91**
			0.0000	*0.0000*	*114.4800*	*0.0000*	*114.4800*	*149.8375*	*164.8212*
RSM 015623100410 Barricades, PVC pipe barricade, break-a-way, buy, 3" diam. PVC, with 3 each 1' x 4' reflectorized panels	4.0000	EA	0.00	0.00	457.92	0.00	457.92	599.35	659.28
(Note: Quantity approximated - will be used to protect open excavations and active work areas)									
			0.0000	*0.0000*	*21.0600*	*0.0000*	*21.0600*	*27.5644*	*30.3209*
RSM 015623100850 Barricades, traffic cones, PVC, 28" high	30.0000	EA	0.00	0.00	631.80	0.00	631.80	826.93	909.63
(Note: Quantity approximated - will be used to protect open excavations and active work areas)									
			1,334.6250	*10.9816*	*777.6000*		*2,123.2067*	*2,778.9653*	*3,056.8618*
331XX010430 Erosion Control	**1.0000**	**EA**	**1,334.63**	**10.98**	**777.60**	**0.00**	**2,123.21**	**2,778.97**	**3,056.86**
			1.3346	*0.0110*	*0.7776*	*0.0000*	*2.1232*	*2.7790*	*3.0569*
RSM 312514161000 Synthetic erosion control, silt fence, install and maintain, remove, 3' high	1,000.0000	LF	1,334.63	10.98	777.60	0.00	2,123.21	2,778.97	3,056.86
(Note: Quantity approximated - will be used to protect temporary staging areas and other sensitive areas)									
			1,203.9956	*456.4601*	*648.0000*		*2,308.4557*	*3,021.4290*	*3,323.5719*
331XX010491 Temporary Staging Areas	**1.0000**	**EA**	**1,204.00**	**456.46**	**648.00**	**0.00**	**2,308.46**	**3,021.43**	**3,323.57**
			0.1204	*0.0456*	*0.0648*	*0.0000*	*0.2308*	*0.3021*	*0.3324*
USR Create Stockpile area	10,000.0000	SF	1,204.00	456.46	648.00	0.00	2,308.46	3,021.43	3,323.57
(Note: User-created crew utilized due to lack of appropriate options in the Cost Book. Assume 100 x 100 ft temporary staging area. Assume 1 half day to construct. Created using a loader for moving earth, and laborers for spotting and placing liner. Silt fence installation included under 10430 - Erosion Control Material cost for poly liner per Uline online - $0.5/sy or approx. $0.06/sf. Removal will be covered under general site restoration.)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			9,473.0211	*0.0000*	*14,596.2000*		*24,069.2211*	*31,503.0706*	*34,653.3777*
331XX0105 Construct Temporary Utilities	**1.0000**	**EA**	**9,473.02**	**0.00**	**14,596.20**	**0.00**	**24,069.22**	**31,503.07**	**34,653.38**
			9,473.0211	*0.0000*	*14,596.2000*		*24,069.2211*	*31,503.0706*	*34,653.3777*
331XX010502 Power Connection/Distribution	**1.0000**	**EA**	**9,473.02**	**0.00**	**14,596.20**	**0.00**	**24,069.22**	**31,503.07**	**34,653.38**
			128.2738	*0.0000*	*124.2000*	*0.0000*	*252.4738*	*330.4511*	*363.4962*
RSM 015113500870 Temporary electrical power equipment (pro-rated per job), connections, office trailer, 60 amp	2.0000	EA	256.55	0.00	248.40	0.00	504.95	660.90	726.99
			461.7857	*0.0000*	*793.8000*	*0.0000*	*1,255.5857*	*1,643.3771*	*1,807.7148*
RSM 015113500030 Temporary electrical power equipment (pro-rated per job), overhead feed, 3 uses, 100 amp	1.0000	EA	461.79	0.00	793.80	0.00	1,255.59	1,643.38	1,807.71
			1,443.0804	*0.0000*	*3,888.0000*	*0.0000*	*5,331.0804*	*6,977.6002*	*7,675.3602*
RSM 015113500240 Temporary electrical power equipment (pro-rated per job), transformers, 3 uses, 112.5 kVA	1.0000	EA	1,443.08	0.00	3,888.00	0.00	5,331.08	6,977.60	7,675.36
			7.2154	*0.0000*	*7.1280*	*0.0000*	*14.3434*	*18.7734*	*20.6507*
RSM 015113500420 Temporary electrical power equipment (pro-rated per job), feeder, EMT and aluminum wire, 100 amp (Note: Quantity approximated)	1,000.0000	LF	7,215.40	0.00	7,128.00	0.00	14,343.40	18,773.40	20,650.74
			48.1027	*0.0000*	*1,269.0000*	*0.0000*	*1,317.1027*	*1,723.8937*	*1,896.2831*
RSM 015113500560 Temporary electrical power equipment (pro-rated per job), temporary feeder cords, 100 amp, 3 uses, 100' long	2.0000	EA	96.21	0.00	2,538.00	0.00	2,634.21	3,447.79	3,792.57
ALT2 - 331XX02 Monitoring,Samplng,Test,Analysis	**1.0000**	**LS**	**0.00**	**0.00**	**1,827.36**	**0.00**	**137,592.36**	**180,088.16**	**198,096.98**
			0.0000	*0.0000*	*0.0000*		*5,795.0000*	*7,584.8027*	*8,343.2830*
331XX0202 Radiation Monitoring	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**5,795.00**	**7,584.80**	**8,343.28**
			0.0000	*0.0000*	*0.0000*		*5,795.0000*	*7,584.8027*	*8,343.2830*
331XX020201 Area Monitoring	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**5,795.00**	**7,584.80**	**8,343.28**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*2,657.5000*	*3,478.2767*	*3,826.1043*
USR Rent Radiological Monitoring Equipment	2.0000	MO	0.00	0.00	0.00	0.00	5,315.00	6,956.55	7,652.21
(Note: Cost per bid results from a recent similar project. Refer to project notes for a list of equipment and quantities.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*240.0000*	*314.1247*	*345.5372*
USR Shipping for Radiological Monitoring Equipment	2.0000	EA	0.00	0.00	0.00	0.00	480.00	628.25	691.07
(Note: Cost per bid results from a recent similar project. Cost is per delivery, each way.)									
			0.0000	*0.0000*	*0.0000*		*23,000.0000*	*30,103.6174*	*33,113.9791*
331XX0203 Air Monitoring & Sampling	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**23,000.00**	**30,103.62**	**33,113.98**
			0.0000	*0.0000*	*0.0000*		*23,000.0000*	*30,103.6174*	*33,113.9791*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
331XX020301 CAMP	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**23,000.00**	**30,103.62**	**33,113.98**
USR Camp Equipment Rental, Mobilization, and Weekly Reporting	1.0000	LS	0.00	0.00	0.00	0.00	23,000.00	30,103.62	33,113.98
(Note: Cost obtained from estimate for recent similar nearby project. Assumes 3 perimiter air monitoring stations (including 1 dust monitor, 1 PID, 1 datalogger and 1 radio), one meteorological tower, one computer and one telemetry system. Cost includes mobilization/setup by vendor, weekly summary reports and demobilization. The cost assumes a duration of three months.)									
			0.0000	*0.0000*	*38.8800*		*38.8800*	*50.8882*	*55.9770*
331XX0205 Sample Surface wt/Grdwtr/Liquid	**1.0000**	**EA**	**0.00**	**0.00**	**38.88**	**0.00**	**38.88**	**50.89**	**55.98**
			0.0000	*0.0000*	*38.8800*		*38.8800*	*50.8882*	*55.9770*
331XX020505 Sample Shipping and Handling	**1.0000**	**EA**	**0.00**	**0.00**	**38.88**	**0.00**	**38.88**	**50.89**	**55.98**
			0.0000	*0.0000*	*38.8800*	*0.0000*	*38.8800*	*50.8882*	*55.9770*
RSM 029110100230 Sample packaging & shipping, packaging, vials & bottles, 32 ounce HDPE bottle, case of 12	1.0000	EA	0.00	0.00	38.88	0.00	38.88	50.89	55.98
(Note: Labor for sample collection is accounted for elsewhere in the estimate; it is expected that sample collection will be performed by an on-site engineer, health and safety officer, environmental technician or otherwise.)									
			0.0000	*0.0000*	*1,555.2000*		*1,555.2000*	*2,035.5281*	*2,239.0809*
331XX0206 Sampling Soil and Sediment	**1.0000**	**EA**	**0.00**	**0.00**	**1,555.20**	**0.00**	**1,555.20**	**2,035.53**	**2,239.08**
			0.0000	*0.0000*	*1,555.2000*		*1,555.2000*	*2,035.5281*	*2,239.0809*
331XX020604 Sample Shipping and Handling	**1.0000**	**EA**	**0.00**	**0.00**	**1,555.20**	**0.00**	**1,555.20**	**2,035.53**	**2,239.08**
			0.0000	*0.0000*	*38.8800*	*0.0000*	*38.8800*	*50.8882*	*55.9770*
RSM 029110100230 Sample packaging & shipping, packaging, vials & bottles, 32 ounce HDPE bottle, case of 12	40.0000	EA	0.00	0.00	1,555.20	0.00	1,555.20	2,035.53	2,239.08
(Note: Assume 2 bottles per sample. Labor for sample collection is accounted for elsewhere in the estimate; it is expected that sample collection will be performed by an on-site engineer, health and safety officer, environmental technician or otherwise.)									
			0.0000	*0.0000*	*233.2800*		*233.2800*	*305.3292*	*335.8621*
331XX0208 Sampling Radioactve Contam Media	**1.0000**	**EA**	**0.00**	**0.00**	**233.28**	**0.00**	**233.28**	**305.33**	**335.86**
			0.0000	*0.0000*	*233.2800*		*233.2800*	*305.3292*	*335.8621*
331XX020808 Sample Shipping and Handling	**1.0000**	**EA**	**0.00**	**0.00**	**233.28**	**0.00**	**233.28**	**305.33**	**335.86**
			0.0000	*0.0000*	*38.8800*	*0.0000*	*38.8800*	*50.8882*	*55.9770*
RSM 029110100230 Sample packaging & shipping, packaging, vials & bottles, 32 ounce HDPE bottle, case of 12	6.0000	EA	0.00	0.00	233.28	0.00	233.28	305.33	335.86
(Note: Assume 2 bottles per sample. Labor for sample collection is accounted for elsewhere in the estimate; it is expected that sample collection will be performed by an on-site engineer, health and safety officer, environmental technician or otherwise.)									
			0.0000	*0.0000*	*0.0000*		*106,970.0000*	*140,007.9979*	*154,008.7977*
331XX0209 Laboratory Chemical Analysis	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**106,970.00**	**140,008.00**	**154,008.80**
			0.0000	*0.0000*	*0.0000*		*355.0000*	*464.6428*	*511.1071*
331XX020902 Gen Water Qual & Wastewtr Analys	**2.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**710.00**	**929.29**	**1,022.21**
(Note: Assume only 2 samples will be collected due to the relatively small volume)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*0.0000*	*0.0000*	*110.0000*	*143.9738*	*158.3712*
USR Ra-226 Analysis	2.0000	EA	0.00	0.00	0.00	0.00	220.00	287.95	316.74
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR Th-232 Analysis	2.0000	EA	0.00	0.00	0.00	0.00	160.00	209.42	230.36
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR U-238 Analysis	2.0000	EA	0.00	0.00	0.00	0.00	160.00	209.42	230.36
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*85.0000*	*111.2525*	*122.3777*
USR PAH Analysis	2.0000	EA	0.00	0.00	0.00	0.00	170.00	222.50	244.76
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*		*385.0000*	*503.9084*	*554.2992*
331XX020907 Soil & Sediment Analysis	**240.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**92,400.00**	**120,938.01**	**133,031.81**
(Note: For approximately 40 individual excavations, with 6 samples per excavation.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*70.0000*	*91.6197*	*100.7817*
USR Ra-226 Analysis	240.0000	EA	0.00	0.00	0.00	0.00	16,800.00	21,988.73	24,187.60
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR Th-232 Analysis	240.0000	EA	0.00	0.00	0.00	0.00	19,200.00	25,129.98	27,642.97
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR U-238 Analysis	240.0000	EA	0.00	0.00	0.00	0.00	19,200.00	25,129.98	27,642.97
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*85.0000*	*111.2525*	*122.3777*
USR PAH Analysis	240.0000	EA	0.00	0.00	0.00	0.00	20,400.00	26,700.60	29,370.66
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*70.0000*	*91.6197*	*100.7817*
USR VOC Analysis	240.0000	EA	0.00	0.00	0.00	0.00	16,800.00	21,988.73	24,187.60
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*		*385.0000*	*503.9084*	*554.2992*
331XX020991 Contaminated Concrete Analysis	**36.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**13,860.00**	**18,140.70**	**19,954.77**
(Note: It is assumed that the cost for analysis of concrete chips is the same as for soil/sediment. Quantity assumes 12 samples per concrete slab.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*70.0000*	*91.6197*	*100.7817*
USR Ra-226 Analysis	36.0000	EA	0.00	0.00	0.00	0.00	2,520.00	3,298.31	3,628.14
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR Th-232 Analysis	36.0000	EA	0.00	0.00	0.00	0.00	2,880.00	3,769.50	4,146.45
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR U-238 Analysis	36.0000	EA	0.00	0.00	0.00	0.00	2,880.00	3,769.50	4,146.45
(Note: Cost obtained from lab contract for similar project.)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*0.0000*	*0.0000*	*85.0000*	*111.2525*	*122.3777*
USR PAH Analysis (Note: Cost obtained from lab contract for similar project.)	36.0000	EA	0.00	0.00	0.00	0.00	3,060.00	4,005.09	4,405.60
			0.0000	*0.0000*	*0.0000*	*0.0000*	*70.0000*	*91.6197*	*100.7817*
USR VOC Analysis (Note: Cost obtained from lab contract for similar project.)	36.0000	EA	0.00	0.00	0.00	0.00	2,520.00	3,298.31	3,628.14
ALT2 - 331XX03 Site Work	**1.0000**	**LS**	**64,384.25**	**29,066.14**	**194.40**	**0.00**	**93,644.79**	**135,648.94**	**149,213.83**
			15,657.7157	*8,664.3221*	*194.4000*		*24,516.4377*	*32,088.4114*	*35,297.2525*
331XX0301 Demolition and Removal of Asphalt Roadways	**1.0000**	**EA**	**15,657.72**	**8,664.32**	**194.40**	**0.00**	**24,516.44**	**32,088.41**	**35,297.25**
			0.6809	*0.2178*	*0.1296*		*1.0283*	*1.3459*	*1.4805*
331XX030190 Saw-cut asphalt roadway	**1,500.0000**	**LF**	**1,021.32**	**326.70**	**194.40**	**0.00**	**1,542.42**	**2,018.80**	**2,220.68**
			0.6809	*0.2178*	*0.1296*	*0.0000*	*1.0283*	*1.3459*	*1.4805*
RSM 024119250015 Selective demolition, saw cutting, asphalt, up to 3" deep (Note: Quantity approximated based on aerial photo)	1,500.0000	LF	1,021.32	326.70	194.40	0.00	1,542.42	2,018.80	2,220.68
			4.4353	*2.5266*	*0.0000*		*6.9618*	*9.1120*	*10.0232*
331XX030191 Asphalt road removal	**3,300.0000**	**CY**	**14,636.39**	**8,337.62**	**0.00**	**0.00**	**22,974.02**	**30,069.61**	**33,076.57**
			1.9449	*0.6451*	*0.0000*	*0.0000*	*2.5900*	*3.3899*	*3.7289*
RSM 312316425100 Excavating, bulk bank measure, sandy clay/loam, open site, 1 C.Y. capacity = 120 C.Y./hour, excavator, hydraulic, crawler mounted, excluding truck loading (Note: Crew output reduced to 90 because material being excavated is asphalt and gravel.)	3,300.0000	BCY	6,418.21	2,128.75	0.00	0.00	8,546.96	11,186.71	12,305.39
			1.9157	*1.4473*	*0.0000*	*0.0000*	*3.3630*	*4.4016*	*4.8418*
RSM 312323203626 Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min load/wait/unload, 16.5 C.Y. truck, cycle 0.5 mile, 20 MPH, excludes loading equipment (Note: Hauling from excavation site to temporary stockpiling area. Assumes a swell factor of 30%.)	4,290.0000	LCY	8,218.19	6,208.87	0.00	0.00	14,427.06	18,882.89	20,771.18
			33,293.0302	*20,168.5391*	*0.0000*		*53,461.5693*	*83,055.0126*	*91,360.5139*
331XX0302 Clearing and Grubbing	**1.0000**	**EA**	**33,293.03**	**20,168.54**	**0.00**	**0.00**	**53,461.57**	**83,055.01**	**91,360.51**
			17,634.6331	*5,835.1298*	*0.0000*		*23,469.7629*	*36,461.3586*	*40,107.4945*
331XX030290 Tree removal	**1.0000**	**EA**	**17,634.63**	**5,835.13**	**0.00**	**0.00**	**23,469.76**	**36,461.36**	**40,107.49**
			1,513.6451	*1,385.5629*	*0.0000*	*0.0000*	*2,899.2080*	*4,504.0532*	*4,954.4585*
RSM 311110100250 Clearing & grubbing, trees to 12" diameter, grub stumps and remove	2.0000	ACR	3,027.29	2,771.13	0.00	0.00	5,798.42	9,008.11	9,908.92
			292.1469	*61.2801*	*0.0000*	*0.0000*	*353.4269*	*549.0650*	*603.9715*
HNC 311110107320 Tree removal, congested area, 12" to 24" diameter, tree removal, cutting and chipping	50.0000	EA	14,607.34	3,064.00	0.00	0.00	17,671.35	27,453.25	30,198.58

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
(Note: Quantity is approximated)									
			15,658.3972	*14,333.4093*	*0.0000*		*29,991.8065*	*46,593.6540*	*51,253.0194*
331XX030291 Brush clearing	**1.0000**	**ACR**	**15,658.40**	**14,333.41**	**0.00**	**0.00**	**29,991.81**	**46,593.65**	**51,253.02**
			2,609.7329	*2,388.9016*	*0.0000*	*0.0000*	*4,998.6344*	*7,765.6090*	*8,542.1699*
RSM 311110100160 Clearing & grubbing, brush, including stumps	6.0000	ACR	15,658.40	14,333.41	0.00	0.00	29,991.81	46,593.65	51,253.02
			15,433.5049	*233.2781*	*0.0000*		*15,666.7830*	*20,505.5148*	*22,556.0663*
331XX0393 Survey	**1.0000**	**EA**	**15,433.50**	**233.28**	**0.00**	**0.00**	**15,666.78**	**20,505.51**	**22,556.07**
			907.8532	*13.7222*	*0.0000*	*0.0000*	*921.5755*	*1,206.2068*	*1,326.8274*
RSM 017123131100 Boundary & survey markers, crew for building layout, 2 person crew	17.0000	DAY	15,433.50	233.28	0.00	0.00	15,666.78	20,505.51	22,556.07
(Note: Assume surveyor will be on site daily during excavation phase to set up control points, locate and survey excavations, and locate any other key site features; and 5 additional days to complete final grade surveys)									
ALT2 - 331XX08 Solids Collect And Containment	**1.0000**	**LS**	**80,869.00**	**50,566.06**	**8,100.00**	**0.00**	**156,410.06**	**204,717.77**	**225,189.54**
			13.7066	*8.5705*	*1.3729*		*26.5102*	*34.6979*	*38.1677*
331XX0801 Contaminated Soil Collection	**5,900.0000**	**BCY**	**80,869.00**	**50,566.06**	**8,100.00**	**0.00**	**156,410.06**	**204,717.77**	**225,189.54**
(Note: This includes the excavation of RAD/PAH and VOC-contaminated soils. Costs for concrete demolition are estimated under section 331XX10.)									
			2.9174	*0.9676*	*0.0000*		*3.8850*	*5.0849*	*5.5934*
331XX080102 Excavation	**5,900.0000**	**BCY**	**17,212.46**	**5,708.93**	**0.00**	**0.00**	**22,921.39**	**30,000.73**	**33,000.81**
			2.9174	*0.9676*	*0.0000*	*0.0000*	*3.8850*	*5.0849*	*5.5934*
RSM 312316425100 Excavating, bulk bank measure, sandy clay/loam, open site, 1 C.Y. capacity = 120 C.Y./hour, excavator, hydraulic, crawler mounted, excluding truck loading	5,900.0000	BCY	17,212.46	5,708.93	0.00	0.00	22,921.39	30,000.73	33,000.81
(Note: Crew output reduced to 60 to account for movement between excavations, equipment frisking, and waiting for transport trucks. Note that this item includes excavation of both radiological and VOC impacted soils.)									
			3.9464	*1.4473*	*1.0561*		*8.6498*	*11.3214*	*12.4535*
331XX080103 Hauling	**7,670.0000**	**LCY**	**30,268.52**	**11,100.70**	**8,100.00**	**0.00**	**66,344.22**	**86,834.83**	**95,518.32**
(Note: Hauling to temporary staging area from excavation site. Volume assumes a swell factor of 30%)									
			1.9157	*1.4473*	*0.0000*	*0.0000*	*3.3630*	*4.4016*	*4.8418*
RSM 312323203626 Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min load/wait/unload, 16.5 C.Y. truck, cycle 0.5 mile, 20 MPH, excludes loading equipment	7,670.0000	LCY	14,693.12	11,100.70	0.00	0.00	25,793.83	33,760.33	37,136.36
(Note: Hauling from excavation site to temporary stockpiling area. Assume a swell factor of 30%.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*450.0000*	*588.9838*	*647.8822*
USR Intermodal Shipping Container Rental	37.5000	MO	0.00	0.00	0.00	0.00	16,875.00	22,086.89	24,295.58
(Note: Cost per quote from Secur LLC. Quantity assumes 1 week roundtrip for a 25 ton truck.)									
			103.8360	*0.0000*	*54.0000*	*0.0000*	*157.8360*	*206.5841*	*227.2425*
USR Shipping container prep	150.0000	EA	15,575.40	0.00	8,100.00	0.00	23,675.40	30,987.61	34,086.37
(Note: User-created crew utilized due to lack of appropriate options in the Cost Book. Cost assumes two laborers for inspection of shipping containers and installation of specialty liners. Liner cost is per quote from Secur LLC. Assume 1/2 hour per truck)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			4.3531	*4.4011*	*0.0000*		*8.7542*	*11.4579*	*12.6037*
331XX080104 Stockpiling	**7,670.0000**	**LCY**	**33,388.02**	**33,756.42**	**0.00**	**0.00**	**67,144.44**	**87,882.20**	**96,670.42**
(Note: Temporary staging area for excavated material)									
			112.8696	*114.1150*	*0.0000*	*0.0000*	*226.9846*	*297.0895*	*326.7984*
RSM B10U Stockpile Management	247.4194	HR	27,926.13	28,234.27	0.00	0.00	56,160.39	73,505.69	80,856.26
(Note: Assume 1 loader with a spotter half-time for managing temporary stockpile. Quantity is based on the calculated extended duration for the cycle hauling item)									
			0.7121	*0.7200*	*0.0000*	*0.0000*	*1.4321*	*1.8744*	*2.0618*
HTW 312316133106 Load Truck for Transport to Disposal Facility, 5.5 CY wheel loader	7,670.0000	LCY	5,461.89	5,522.16	0.00	0.00	10,984.05	14,376.51	15,814.16
ALT2 - 331XX09 Liq/Sed/Sludges Collect,Contain	**1.0000**	**LS**	**5,730.36**	**3,119.09**	**7,112.88**	**0.00**	**17,922.33**	**23,457.69**	**25,803.46**
			2,159.4379	*1,392.9879*	*7,112.8800*		*12,625.3058*	*16,524.6685*	*18,177.1353*
331XX0903 Waste Containment, Portable	**1.0000**	**EA**	**2,159.44**	**1,392.99**	**7,112.88**	**0.00**	**12,625.31**	**16,524.67**	**18,177.14**
			2,159.4379	*1,392.9879*	*7,112.8800*		*12,625.3058*	*16,524.6685*	*18,177.1353*
331XX090301 Bulk Liquid Containers/Roll-Offs	**1.0000**	**EA**	**2,159.44**	**1,392.99**	**7,112.88**	**0.00**	**12,625.31**	**16,524.67**	**18,177.14**
			626.0872	*266.0433*	*0.0000*	*0.0000*	*892.1305*	*1,167.6676*	*1,284.4343*
HTW 028610106152 Secondary containment and storage, storage systems, loading hazardous waste for shipment, load liquid or sludge into 5,000 gal. bulk tank truck	1.0000	EA	626.09	266.04	0.00	0.00	892.13	1,167.67	1,284.43
(Note: It is approximated that 1 gallon of water will need to be pumped for every cubic yard excavated, so for a total of 4,700 cy, this equals 4,700 gallons. Therefore only one load will be required)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*980.0000*	*1,282.6759*	*1,410.9435*
HTW 029110409118 Wastewater holding tanks, above ground, steel, closed, stationary, monthly rental, 21,000 gal	2.0000	MO	0.00	0.00	0.00	0.00	1,960.00	2,565.35	2,821.89
			1,384.5622	*1,105.7423*	*0.0000*	*0.0000*	*2,490.3046*	*3,259.4424*	*3,585.3867*
HTW 026510104315 Clean and rinse tank interior, high pressure water, 20,001 to 30,000 gallons	1.0000	EA	1,384.56	1,105.74	0.00	0.00	2,490.30	3,259.44	3,585.39
			74.3942	*10.6011*	*3,556.4400*	*0.0000*	*3,641.4354*	*4,766.1034*	*5,242.7137*
USR 221353203142 Wastewater holding tanks, above ground, saddle, f berglass, 200 gal	2.0000	MO	148.79	21.20	7,112.88	0.00	7,282.87	9,532.21	10,485.43
(Note: Pickup truck with 200 gallon tank for storing water pumped from excavations for transport to main storage tank. 1 truck, 1 laborer assume full time. Material cost is for the purchase price, so since the quantity is not 1, the material cost needs to be divided by the quantity to accurately reflect the purchase price.)									
			3,570.9236	*1,726.0991*	*0.0000*		*5,297.0227*	*6,933.0237*	*7,626.3260*
331XX0906 Pumping/Draining/Collection	**1.0000**	**EA**	**3,570.92**	**1,726.10**	**0.00**	**0.00**	**5,297.02**	**6,933.02**	**7,626.33**
			3,570.9236	*1,726.0991*	*0.0000*		*5,297.0227*	*6,933.0237*	*7,626.3260*
331XX090603 Dewatering	**1.0000**	**EA**	**3,570.92**	**1,726.10**	**0.00**	**0.00**	**5,297.02**	**6,933.02**	**7,626.33**
			595.1539	*287.6832*	*0.0000*	*0.0000*	*882.8371*	*1,155.5039*	*1,271.0543*
RSM 312319201100 Dewatering, pumping 8 hours, attended 2 hrs per day, 6" centrifugal pump, includes 20 LF of suction hose and 250 LF of discharge hose	6.0000	DAY	3,570.92	1,726.10	0.00	0.00	5,297.02	6,933.02	7,626.33
(Note: It is assumed that dewatering will be required for half of the days that excavation is taking place. Approximately 12 total days of excavation are required, so pumping will be necessary for roughly 6 days.)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
ALT2 - 331XX10 Drums/Tanks/Struct/Misc Removal	**1.0000**	**LS**	**61,223.92**	**27,597.46**	**0.00**	**0.00**	**88,821.38**	**116,254.12**	**127,879.53**
331XX1003 Structure Removal (Building Slabs)	**1.0000**	**LS**	**54,379.97**	**26,529.40**	**0.00**	**0.00**	**80,909.37**	**105,898.47**	**116,488.32**
331XX100302 Demolition	**1.0000**	**LS**	**37,111.44**	**17,502.57**	**0.00**	**0.00**	**54,614.01**	**71,481.70**	**78,629.87**
			0.5074	*0.2393*	*0.0000*	*0.0000*	*0.7467*	*0.9773*	*1.0750*
RSM 024116170400 Buillding footings and foundations demolition, floors, concrete slab on grade, plain concrete, 6" thick, excludes disposal costs and dump fees	73,145.0000	SF	37,111.44	17,502.57	0.00	0.00	54,614.01	71,481.70	78,629.87
(Note: Crew output reduced to 300 because slabs are assumed to be 12 inches thick. Quantity assumes 12 inch slabs. Building 401 Drains will be removed along with the concrete slabs, at no expected additional effort.)									
			17,268.5377	*9,026.8291*	*0.0000*		*26,295.3669*	*34,416.7680*	*37,858.4448*
331XX100390 Excavation, hauling, stockpiling and transport off-site	**1.0000**	**EA**	**17,268.54**	**9,026.83**	**0.00**	**0.00**	**26,295.37**	**34,416.77**	**37,858.44**
(Note: For concrete slabs)									
			3.5008	*1.1611*	*0.0000*	*0.0000*	*4.6620*	*6.1018*	*6.7120*
RSM 312316425100 Excavating, bulk bank measure, sandy clay/loam, open site, 1 C.Y. capacity = 120 C.Y./hour, excavator, hydraulic, crawler mounted, excluding truck loading	2,709.0741	BCY	9,484.03	3,145.61	0.00	0.00	12,629.65	16,530.35	18,183.38
(Note: Crew output reduced to 50 from 120 because material being excavated is reinforcecd concrete, and material needs to be transported to the temporary stockpile areas. This item includes the building foundations, and the building 431/432 trench. Quantity is based on 73,145 square feet of foundation at an assumed 1 ft thick.)									
			1.9157	*1.4473*	*0.0000*	*0.0000*	*3.3630*	*4.4016*	*4.8418*
RSM 312323203626 Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min load/wait/unload, 16.5 C.Y. truck, cycle 0.5 mile, 20 MPH, excludes loading equipment	4,063.6111	LCY	7,784.50	5,881.22	0.00	0.00	13,665.72	17,886.42	19,675.06
(Note: Hauling from excavation site to temporary stockpiling area. Quantity is based on 73,145 square feet of foundation at an assumed 1 ft thick assuming a swell factor of 1.5.)									
			136.8790	*21.3611*	*0.0000*		*158.2401*	*207.1130*	*227.8243*
331XX1091 Structure Removal (Tank Foundations)	**50.0000**	**CY**	**6,843.95**	**1,068.06**	**0.00**	**0.00**	**7,912.01**	**10,355.65**	**11,391.22**
331XX100302 Demolition	**1.0000**	**LS**	**6,622.19**	**941.73**	**0.00**	**0.00**	**7,563.91**	**9,900.05**	**10,890.06**
			132.4437	*18.8346*	*0.0000*	*0.0000*	*151.2783*	*198.0010*	*217.8011*
HNC 024113332110 Minor site demolition, concrete, unreinforced, 7" to 24" thick, remove with backhoe, excludes hauling	50.0000	CY	6,622.19	941.73	0.00	0.00	7,563.91	9,900.05	10,890.06
(Note: Removal of concrete tank foundations. Hydraulic hammer attachment added 1/4 time for breakdown of concrete pieces as needed. Quantity is approximated.)									
			4.4353	*2.5266*	*0.0000*		*6.9618*	*9.1120*	*10.0232*
331XX100390 Excavation, hauling, stockpiling	**50.0000**	**CY**	**221.76**	**126.33**	**0.00**	**0.00**	**348.09**	**455.60**	**501.16**

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
and transport off-site									
			1.9449	*0.6451*	*0.0000*	*0.0000*	*2.5900*	*3.3899*	*3.7289*
RSM 312316425100 Excavating, bulk bank measure, sandy clay/loam, open site, 1 C.Y. capacity = 120 C.Y./hour, excavator, hydraulic, crawler mounted, excluding truck loading	50.0000	BCY	97.25	32.25	0.00	0.00	129.50	169.50	186.45
(Note: Crew output reduced to 90 because material being excavated is reinforcecd concrete.)									
			1.9157	*1.4473*	*0.0000*	*0.0000*	*3.3630*	*4.4016*	*4.8418*
RSM 312323203626 Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min load/wait/unload, 16.5 C.Y. truck, cycle 0.5 mile, 20 MPH, excludes loading equipment	65.0000	LCY	124.52	94.07	0.00	0.00	218.59	286.10	314.71
(Note: Hauling from excavation site to temporary stockpiling area. Assumes a swell factor of 30%.)									
			0.0000	*0.0000*	*0.0000*		*13,739,208.5185*	*17,982,603.3253*	*19,780,863.6579*
ALT2 - 331XX18 Transport and Disposal - Radiological	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**13,739,208.52**	**17,982,603.33**	**19,780,863.66**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*497.0000*	*650.4999*	*715.5499*
USR Radiological Contaminated Soil Disposal	3,250.0000	LCY	0.00	0.00	0.00	0.00	1,615,250.00	2,114,124.70	2,325,537.16
(Note: Cost based on a contract for a similar project provided by WCS Texas Quantity assumes a swell factor of 30%.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*924.0000*	*1,209.3801*	*1,330.3181*
USR Radiological Contaminated Debris Disposal (asphalt roadway)	4,290.0000	LCY	0.00	0.00	0.00	0.00	3,963,960.00	5,188,240.66	5,707,064.73
(Note: Cost based on a contract for a similar project provided by WCS Texas.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*924.0000*	*1,209.3801*	*1,330.3181*
USR Radiological Contaminated Debris Disposal (concrete slabs)	5,418.1481	LCY	0.00	0.00	0.00	0.00	5,006,368.89	6,552,600.59	7,207,860.65
(Note: Cost based on a contract for a similar project provided by WCS Texas. Quantity assumes a swell factor of 1.5)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*200.0000*	*261.7706*	*287.9476*
USR Transport Contaminated Concrete to Radiological Disposal Facility	5,418.1481	TON	0.00	0.00	0.00	0.00	1,083,629.63	1,418,311.82	1,560,143.00
(Note: This item is for transporting radiologically contaminated concrete to the disposal facility. Cost per quote from Secur LLC. Assumes 2 tons/CY. Quantity is based on cycle hauling volume, assuming 2 tons per cy.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*200.0000*	*261.7706*	*287.9476*
USR Transport contaminated soil to Radiological Disposal Facility	3,750.0000	TON	0.00	0.00	0.00	0.00	750,000.00	981,639.70	1,079,803.67
(Note: Cost per quote from Secur LLC. Assumes 1.5 tons/CY.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*200.0000*	*261.7706*	*287.9476*
USR Transport Contaminated Asphalt to Radiological Disposal Facility	6,600.0000	TON	0.00	0.00	0.00	0.00	1,320,000.00	1,727,685.87	1,900,454.45
(Note: This item is for transporting radiologically contaminated asphalt to the disposal facility. Cost per quote from Secur LLC. Assumes 2 tons/CY.)									
ALT2 - 331XX19 Transport and Disposal - Non-Radiological	**1.0000**	**LS**	**0.00**	**0.00**	**0.00**	**0.00**	**480,856.00**	**629,369.78**	**692,306.76**

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*0.0000*		*5,789.0000*	*7,576.9496*	*8,334.6446*
331XX1990 Transport and Disposal - Non-Contaminated	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**5,789.00**	**7,576.95**	**8,334.64**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*55.0000*	*71.9869*	*79.1856*
USR Chipped tree and brush transport disposal	100.0000	TON	0.00	0.00	0.00	0.00	5,500.00	7,198.69	7,918.56
(Note: Cost per vendor quote - Triad Recycling, $55/ton Quantity assumes 1 ton per tree, and an additional 50 tons of brush, so 100 tons total)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*2.8900*	*3.7826*	*4.1608*
USR Hauling and Disposal of non-contaminated concrete tank foundations	100.0000	MI	0.00	0.00	0.00	0.00	289.00	378.26	416.08
(Note: Mileage assumes transport to Swift River in Tonawanda, NY (approximately 20 miles). Quantity assumes 50 cy or about 100 tons, 20 ton per load so 5 total trips (100 miles total). Cost reduced by 25% (from $3.85 to $2.89) since this item was for hazardous waste transport, and the item being estimated is just concrete and/or debris.)									
			0.0000	*0.0000*	*0.0000*		*474,300.0000*	*620,788.9447*	*682,867.8392*
331XX1991 Transport and Disposal - VOC-Contaminated Soil and Debris	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**474,300.00**	**620,788.94**	**682,867.84**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*53.0000*	*69.3692*	*76.3061*
USR VOC Contaminated Soil Disposal	4,650.0000	TON	0.00	0.00	0.00	0.00	246,450.00	322,566.80	354,823.49
(Note: Cost based on a quote from ESMI. Quantity assumes a swell factor of 30% and 1.5 ton/CY.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*49.0000*	*64.1338*	*70.5472*
USR Transport contaminated soil to Incineration facility	4,650.0000	TON	0.00	0.00	0.00	0.00	227,850.00	298,222.14	328,044.35
(Note: Transporation of VOC contaminated soils to Ft. Edward, NY per quote provided by ESMI. Assumes 1.5 ton/CY. 3,400 cy.)									
			0.0000	*0.0000*	*0.0000*		*767.0000*	*1,003.8902*	*1,104.2792*
331XX1992 Transport and Disposal - Water	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**767.00**	**1,003.89**	**1,104.28**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*0.1300*	*0.1702*	*0.1872*
USR Contaminated Water From Excavations -Transport and Disposal	5,900.0000	GAL	0.00	0.00	0.00	0.00	767.00	1,003.89	1,104.28
(Note: This item is for a 5,000-gallon tanker. It is assumed that a 21,000 gallon fractionalization tank will be used to temporarily store water that is pumped during various remediation alternatives. From there, water will be transferred to the tanker and transported to the nearby wastewater treatment plant. The total cost, based on a 2013 purchase order from Western New York Septic, escalated by 3% per year to 2016, would be $0.13 per gallon, before tax. Quantity assumes approximately 1 gal per cy excavated.)									
ALT2 - 331XX20 Site Restoration	**1.0000**	**LS**	**113,576.17**	**57,632.92**	**1,177,865.13**	**0.00**	**1,349,074.22**	**1,765,739.75**	**1,942,313.73**
331XX2001 Earthwork	**1.0000**	**LS**	**14,824.78**	**16,352.40**	**410,130.00**	**0.00**	**441,307.17**	**577,606.19**	**635,366.81**
			2,296.9955	*2,322.3408*	*164,430.0000*		*169,049.3363*	*221,260.7192*	*243,386.7911*
331XX200103 Backfill	**1.0000**	**EA**	**2,297.00**	**2,322.34**	**164,430.00**	**0.00**	**169,049.34**	**221,260.72**	**243,386.79**
			0.3168	*0.3203*	*22.6800*	*0.0000*	*23.3171*	*30.5187*	*33.5706*
RSM 312323155080 Borrow, select granular fill, 5 C.Y. bucket, loading and/or spreading, front end loader, wheel mounted	7,250.0000	ECY	2,297.00	2,322.34	164,430.00	0.00	169,049.34	221,260.72	243,386.79
(Note: Quantity incorporates the volumes required to replace soils removed as well as half of the volume of concrete foundation excavated. So 5,900 cy soil + (2,700/2) cy concrete = 7,250 cy)									
			0.0000	*0.0000*	*122,148.0000*		*122,148.0000*	*159,873.7677*	*175,861.1445*
331XX200104 Borrow	**1.0000**	**EA**	**0.00**	**0.00**	**122,148.00**	**0.00**	**122,148.00**	**159,873.77**	**175,861.14**
			0.0000	*0.0000*	*12.9600*	*0.0000*	*12.9600*	*16.9627*	*18.6590*
USR Backfill Material including Delivery	9,425.0000	LCY	0.00	0.00	122,148.00	0.00	122,148.00	159,873.77	175,861.14
(Note: Assume a swell factor of 1.3)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			3,334.8162	*1,983.2015*	*0.0000*		*5,318.0176*	*6,960.5029*	*7,656.5532*
331XX200107 Grading	**1.0000**	**EA**	**3,334.82**	**1,983.20**	**0.00**	**0.00**	**5,318.02**	**6,960.50**	**7,656.55**
			3,334.8162	*1,983.2015*	*0.0000*	*0.0000*	*5,318.0176*	*6,960.5029*	*7,656.5532*
RSM 312213200280 Rough grading sites, open, 75100-100000 S.F., grader	1.0000	EA	3,334.82	1,983.20	0.00	0.00	5,318.02	6,960.50	7,656.55
			1,258.9302	*763.7603*	*0.0000*		*2,022.6905*	*2,647.4044*	*2,912.1448*
331XX200108 Compaction	**1.0000**	**EA**	**1,258.93**	**763.76**	**0.00**	**0.00**	**2,022.69**	**2,647.40**	**2,912.14**
			0.1736	*0.1053*	*0.0000*	*0.0000*	*0.2790*	*0.3652*	*0.4017*
RSM 312323235060 Compaction, riding, vibrating roller, 2 passes, 12" lifts	7,250.0000	ECY	1,258.93	763.76	0.00	0.00	2,022.69	2,647.40	2,912.14
			2,377.3773	*5,665.1250*	*0.0000*		*8,042.5023*	*10,526.4527*	*11,579.0980*
331XX200113 Stockpiling	**1.0000**	**EA**	**2,377.38**	**5,665.13**	**0.00**	**0.00**	**8,042.50**	**10,526.45**	**11,579.10**
			0.2522	*0.6011*	*0.0000*	*0.0000*	*0.8533*	*1.1169*	*1.2286*
HNC 312213103020 Rough grading, open site, large area, 300 H.P., dozer	9,425.0000	LCY	2,377.38	5,665.13	0.00	0.00	8,042.50	10,526.45	11,579.10
(Note: This item is used for maintaining stockpiled fill material)									
			5,556.6576	*5,617.9704*	*123,552.0000*		*134,726.6279*	*176,337.3417*	*193,971.0759*
331XX200114 Topsoil	**1.0000**	**EA**	**5,556.66**	**5,617.97**	**123,552.00**	**0.00**	**134,726.63**	**176,337.34**	**193,971.08**
			0.3473	*0.3511*	*0.0000*	*0.0000*	*0.6984*	*0.9141*	*1.0055*
RSM 312323157080 Borrow, topsoil or loam, 5 C.Y. bucket, loading and/or spreading, front end loader, wheel mounted	16,000.0000	ECY	5,556.66	5,617.97	0.00	0.00	11,174.63	14,625.94	16,088.54
(Note: Material cost removed since it is accounted for under a separate item. Topsoil quantity is approximated based on aerial photos (approx. 96,000 sy), assuming 6" is placed over the entire area. 6" = 0.167 yd, so 96,000 sy x 0.167 yd = 16,000 cy)									
			0.0000	*0.0000*	*23.7600*	*0.0000*	*23.7600*	*31.0983*	*34.2082*
USR Topsoil Purchase and Delivery	5,200.0000	LCY	0.00	0.00	123,552.00	0.00	123,552.00	161,711.40	177,882.54
(Note: Since the majority of stripped topsoil can be re-used, it is assumed that only 25% of the topsoil placed needs to be purchased. Assume a swell factor of 1.3)									
			80,677.3136	*33,934.9982*	*585,258.3333*		*699,870.6451*	*916,027.7445*	*1,007,630.5190*
331XX2003 Permanent Features	**1.0000**	**EA**	**80,677.31**	**33,935.00**	**585,258.33**	**0.00**	**699,870.65**	**916,027.74**	**1,007,630.52**
			0.9075	*0.3817*	*6.5833*		*7.8726*	*10.3040*	*11.3344*
331XX200301 Road Replacement	**88,900.0000**	**SF**	**80,677.31**	**33,935.00**	**585,258.33**	**0.00**	**699,870.65**	**916,027.74**	**1,007,630.52**
			4.9905	*1.2719*	*75.6000*	*0.0000*	*81.8623*	*107.1457*	*117.8603*
RSM 321126132007 Plant mixed asphaltic base courses, for roadways and large paved areas, alternate method to figure base course, bituminous concrete, 8" thick	4,390.1235	TON	21,908.71	5,583.68	331,893.33	0.00	359,385.73	470,383.06	517,421.37
(Note: Quantity approximated based on aerial photos. Assume 2 ton/cy. 88,900 sf of pavement need to be replaced, at 8" thick this is approximately 2,200 cy)									
			1.5912	*0.4055*	*16.4700*	*0.0000*	*18.4667*	*24.1702*	*26.5872*
RSM 321216130200 Plant-mix asphalt paving, for highways and large paved areas, binder course, 4" thick, no hauling included	9,877.7778	SY	15,717.12	4,005.68	162,687.00	0.00	182,409.80	238,747.61	262,622.37
			1.1336	*0.3344*	*9.1800*	*0.0000*	*10.6480*	*13.9367*	*15.3304*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
RSM 321216130380 Plant-mix asphalt paving, for highways and large paved areas, wearing course, 2" thick, no hauling included	9,877.7778	SY	11,197.59	3,303.47	90,678.00	0.00	105,179.06	137,663.92	151,430.31
			0.4515	*0.2123*	*0.0000*	*0.0000*	*0.6638*	*0.8688*	*0.9556*
RSM 312216100011 Fine grading, finish grading granular subbase for highway paving, +/- 1"	9,877.7778	SY	4,459.36	2,097.16	0.00	0.00	6,556.52	8,581.52	9,439.67
			5.9386	*4.1069*	*0.0000*	*0.0000*	*10.0454*	*13.1480*	*14.4628*
HNC 312323180555 Hauling, excavated or borrow material, loose cubic yards, 12 mile round trip @ base wide rate, 12 C.Y. truck, highway haulers, excludes loading	4,613.0000	LCY	27,394.54	18,945.00	0.00	0.00	46,339.54	60,651.64	66,716.81
(Note: This item is for hauling Asphalt from the plant. Distance is assumed. Productivity reduced by half to account for extra waiting time at the site. Quantity assumes 2 ton/cy for base, so 4,390/2 = 2,195 cy; 9,878 sy @ 4" thick binder = 1,098 cy; 9,878 sy @ 2" thick top = 549 cy; total = 3,842 cy, assume 20% compaction so total volume required = 4,610 cy.)									
			18,074.0808	*7,345.5234*	*182,476.8000*		*207,896.4042*	*272,105.8178*	*299,316.3996*
331XX2004 Revegetation And Planting	**1.0000**	**EA**	**18,074.08**	**7,345.52**	**182,476.80**	**0.00**	**207,896.40**	**272,105.82**	**299,316.40**
			18,074.0808	*7,345.5234*	*182,476.8000*		*207,896.4042*	*272,105.8178*	*299,316.3996*
331XX200401 Seeding/Mulch/Fertilizer	**1.0000**	**EA**	**18,074.08**	**7,345.52**	**182,476.80**	**0.00**	**207,896.40**	**272,105.82**	**299,316.40**
			0.1883	*0.0765*	*1.9008*	*0.0000*	*2.1656*	*2.8344*	*3.1179*
RSM 329219131100 Seeding, mechanical seeding hydro or air seeding for large areas, includes lime, fertilizer and seed with wood fiber mulch added	96,000.0000	SY	18,074.08	7,345.52	182,476.80	0.00	207,896.40	272,105.82	299,316.40
(Note: Quantity approximated based on aerial photos)									
ALT2 - 331XX21 Demobilization	**1.0000**	**LS**	**26,277.56**	**5,191.00**	**17,037.00**	**0.00**	**48,505.56**	**63,486.65**	**69,835.31**
			15,469.9117	*5,180.0213*	*1,663.2000*		*22,313.1330*	*29,204.6095*	*32,125.0705*
331XX2101 Demob of Construction Equip & Fac	**1.0000**	**EA**	**15,469.91**	**5,180.02**	**1,663.20**	**0.00**	**22,313.13**	**29,204.61**	**32,125.07**
			0.0000	*0.0000*	*1,663.2000*		*1,663.2000*	*2,176.8842*	*2,394.5726*
331XX010190 Site Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**1,663.20**	**0.00**	**1,663.20**	**2,176.88**	**2,394.57**
			0.0000	*0.0000*	*475.2000*		*475.2000*	*621.9669*	*684.1636*
331XX010191 Office Trailers	**1.0000**	**EA**	**0.00**	**0.00**	**475.20**	**0.00**	**475.20**	**621.97**	**684.16**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Office trailer, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: assume 10 miles per haul, 2 trailers. double to account for demob)									
			0.0000	*0.0000*	*712.8000*		*712.8000*	*932.9504*	*1,026.2454*
331XX010192 Toilets	**1.0000**	**EA**	**0.00**	**0.00**	**712.80**	**0.00**	**712.80**	**932.95**	**1,026.25**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Portable toilet and hand wash, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: Assume same cost for delivering storage trailers - three toilets and two hand washes delivered on two trucks. Double to account for demob)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Portable hand wash station, delivery, add per mile	20.0000	MI	0.00	0.00	237.60	0.00	237.60	310.98	342.08
(Note: Assume same cost for delivering storage trailers - three delivered on one truck. Double to account for demob)									
			0.0000	*0.0000*	*475.2000*		*475.2000*	*621.9669*	*684.1636*
331XX010193 Storage Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**475.20**	**0.00**	**475.20**	**621.97**	**684.16**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Storage trailer, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: Assume same cost for delivering storage trailers - 2 deliveries double to account for demob)									
			15,469.9117	*5,180.0213*	*0.0000*		*20,649.9330*	*27,027.7253*	*29,730.4979*
331XX010191 Construction Equipment	**1.0000**	**EA**	**15,469.91**	**5,180.02**	**0.00**	**0.00**	**20,649.93**	**27,027.73**	**29,730.50**
			509.8944	*173.1983*	*0.0000*	*0.0000*	*683.0927*	*894.0678*	*983.4746*
RSM 015436501400 Mobilization or demobilization, delivery charge for equipment, hauled on 20-ton capacity towed trailer	20.0000	EA	10,197.89	3,463.97	0.00	0.00	13,661.85	17,881.36	19,669.49
(Note: Mobilization/demobilization of medium-sized equipment. 1 paver, 1 medium excavator, 3 medium FE loaders/backhoes/skidsteers, 3 rollers, 2 dozers)									
			540.2320	*191.5054*	*0.0000*	*0.0000*	*731.7374*	*957.7366*	*1,053.5102*
RSM 015436501500 Mobilization or demobilization, delivery charge for equipment, hauled on 40-ton capacity towed trailer	8.0000	EA	4,321.86	1,532.04	0.00	0.00	5,853.90	7,661.89	8,428.08
(Note: Mobilization/demobilization of heavy equipment. 1 grader, 2 large excavators, 1 large FE loader)									
			118.7710	*23.0016*	*0.0000*	*0.0000*	*141.7726*	*185.5595*	*204.1155*
RSM 015436501200 Mobilization or demobilization, delivery charge for small equipment, placed in rear of, or towed by pickup truck	8.0000	EA	950.17	184.01	0.00	0.00	1,134.18	1,484.48	1,632.92
(Note: Assume 4 loads each way for smaller equipment (saws, pumps, excavator attachments, etc.))									
			9,473.0211	*0.0000*	*14,596.2000*		*24,069.2211*	*31,503.0706*	*34,653.3777*
331XX2102 Removal of Temporary Utilities	**1.0000**	**EA**	**9,473.02**	**0.00**	**14,596.20**	**0.00**	**24,069.22**	**31,503.07**	**34,653.38**
			9,473.0211	*0.0000*	*14,596.2000*		*24,069.2211*	*31,503.0706*	*34,653.3777*
331XX010502 Power Connection/Distribution	**1.0000**	**EA**	**9,473.02**	**0.00**	**14,596.20**	**0.00**	**24,069.22**	**31,503.07**	**34,653.38**
			128.2738	*0.0000*	*124.2000*	*0.0000*	*252.4738*	*330.4511*	*363.4962*
RSM 015113500870 Temporary electrical power equipment (pro-rated per job), connections, office trailer, 60 amp	2.0000	EA	256.55	0.00	248.40	0.00	504.95	660.90	726.99
			461.7857	*0.0000*	*793.8000*	*0.0000*	*1,255.5857*	*1,643.3771*	*1,807.7148*
RSM 015113500030 Temporary electrical power equipment (pro-rated per job), overhead feed, 3 uses, 100 amp	1.0000	EA	461.79	0.00	793.80	0.00	1,255.59	1,643.38	1,807.71
			1,443.0804	*0.0000*	*3,888.0000*	*0.0000*	*5,331.0804*	*6,977.6002*	*7,675.3602*
RSM 015113500240 Temporary electrical power equipment (pro-rated per job), transformers, 3 uses, 112.5 kVA	1.0000	EA	1,443.08	0.00	3,888.00	0.00	5,331.08	6,977.60	7,675.36

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			7.2154	*0.0000*	*7.1280*	*0.0000*	*14.3434*	*18.7734*	*20.6507*
RSM 015113500420 Temporary electrical power equipment (pro-rated per job), feeder, EMT and aluminum wire, 100 amp (Note: Quantity approximated)	1,000.0000	LF	7,215.40	0.00	7,128.00	0.00	14,343.40	18,773.40	20,650.74
			48.1027	*0.0000*	*1,269.0000*	*0.0000*	*1,317.1027*	*1,723.8937*	*1,896.2831*
RSM 015113500560 Temporary electrical power equipment (pro-rated per job), temporary feeder cords, 100 amp, 3 uses, 100' long	2.0000	EA	96.21	0.00	2,538.00	0.00	2,634.21	3,447.79	3,792.57
			1,334.6250	*10.9816*	*777.6000*		*2,123.2067*	*2,778.9653*	*3,056.8618*
331XX0104 Deconstruct/Remove Temp Facilities	**1.0000**	**EA**	**1,334.63**	**10.98**	**777.60**	**0.00**	**2,123.21**	**2,778.97**	**3,056.86**
			1,334.6250	*10.9816*	*777.6000*		*2,123.2067*	*2,778.9653*	*3,056.8618*
331XX010430 Erosion Control	**1.0000**	**EA**	**1,334.63**	**10.98**	**777.60**	**0.00**	**2,123.21**	**2,778.97**	**3,056.86**
			1.3346	*0.0110*	*0.7776*	*0.0000*	*2.1232*	*2.7790*	*3.0569*
RSM 312514161000 Synthetic erosion control, silt fence, install and maintain, remove, 3' high (Note: Assume cost for removal is the same as for installation)	1,000.0000	LF	1,334.63	10.98	777.60	0.00	2,123.21	2,778.97	3,056.86
ALT2 - 331XX22 Gen Requirements (Opt Breakout)	**1.0000**	**LS**	**252,039.32**	**0.00**	**8,709.65**	**0.00**	**261,798.97**	**342,656.35**	**376,921.99**
			226,704.6412	*0.0000*	*1,080.0000*		*227,784.6412*	*298,136.5950*	*327,950.2545*
331XX2207 Health & Safety	**1.0000**	**EA**	**226,704.64**	**0.00**	**1,080.00**	**0.00**	**227,784.64**	**298,136.60**	**327,950.25**
			198,573.4083	*0.0000*	*0.0000*		*198,573.4083*	*259,903.3873*	*285,893.7261*
331XX220702 Radiation Protection Tech (RPT)	**1.0000**	**EA**	**198,573.41**	**0.00**	**0.00**	**0.00**	**198,573.41**	**259,903.39**	**285,893.73**
			150.4344	*0.0000*	*0.0000*	*0.0000*	*150.4344*	*196.8965*	*216.5862*
USR Rad-Technician crew (Note: 2 technicians for duration of project (352 hours per month + 2 hr per day OT). Overtime assumed for daily setup and takedown of equipment and report generation.)	1,320.0000	HR	198,573.41	0.00	0.00	0.00	198,573.41	259,903.39	285,893.73
			28,131.2328	*0.0000*	*0.0000*		*28,131.2328*	*36,819.6465*	*40,501.6112*
331XX220707 Site Safety & Health Officer	**1.0000**	**EA**	**28,131.23**	**0.00**	**0.00**	**0.00**	**28,131.23**	**36,819.65**	**40,501.61**
			42.6231	*0.0000*	*0.0000*	*0.0000*	*42.6231*	*55.7873*	*61.3661*
USR CAMP Monitor Labor (Note: Full time for duration of project (3 months at 176 hr/month + 2 hr per day OT). Rate obtained from a similar nearby recent project. Overtime assumed for daily setup and takedown of equipment and report generation.)	660.0000	HR	28,131.23	0.00	0.00	0.00	28,131.23	36,819.65	40,501.61
			0.0000	*0.0000*	*1,080.0000*		*1,080.0000*	*1,413.5612*	*1,554.9173*
331XX220716 Personal Protection Equipment	**1.0000**	**EA**	**0.00**	**0.00**	**1,080.00**	**0.00**	**1,080.00**	**1,413.56**	**1,554.92**
USR Personal Protective Equipment (Note: Assume an allowance of $10,000 for PPE (gloves, eyewear, safety vests, ear plugs, boot covers, tyvek, etc.))	1.0000	LS	0.00	0.00	1,080.00	0.00	1,080.00	1,413.56	1,554.92

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*1,393.2000*		*1,393.2000*	*1,823.4939*	*2,005.8433*
331XX2210 Project Utilities	**1.0000**	**EA**	**0.00**	**0.00**	**1,393.20**	**0.00**	**1,393.20**	**1,823.49**	**2,005.84**
			0.0000	*0.0000*	*91.8000*	*0.0000*	*91.8000*	*120.1527*	*132.1680*
RSM 015213400140 Field office expense, Internet (Note: 2 hookups for 3 months)	6.0000	MO	0.00	0.00	550.80	0.00	550.80	720.92	793.01
			0.0000	*0.0000*	*842.4000*		*842.4000*	*1,102.5777*	*1,212.8355*
331XX221002 Electrical Usage	**1.0000**	**EA**	**0.00**	**0.00**	**842.40**	**0.00**	**842.40**	**1,102.58**	**1,212.84**
			0.0000	*0.0000*	*0.1404*	*0.0000*	*0.1404*	*0.1838*	*0.2021*
HTW 015113800460 Electrical Charge Industrial Use (Note: Assume 2,000 kwH per month for 3 months)	6,000.0000	KWH	0.00	0.00	842.40	0.00	842.40	1,102.58	1,212.84
			25,334.6836	*0.0000*	*6,236.4492*		*32,621.1328*	*42,696.2652*	*46,965.8918*
331XX2208 Temp Const Facilities-Ownership	**1.0000**	**EA**	**25,334.68**	**0.00**	**6,236.45**	**0.00**	**32,621.13**	**42,696.27**	**46,965.89**
			0.0000	*0.0000*	*1,863.0000*		*1,863.0000*	*2,438.3930*	*2,682.2323*
331XX220801 Office Trailers and Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**1,863.00**	**0.00**	**1,863.00**	**2,438.39**	**2,682.23**
			0.0000	*0.0000*	*258.1200*	*0.0000*	*258.1200*	*337.8411*	*371.6252*
RSM 015213200350 Office trailer, furnished, rent per month, 32' x 8', excl. hookups (Note: Two trailers for three months.)	6.0000	EA	0.00	0.00	1,548.72	0.00	1,548.72	2,027.05	2,229.75
			0.0000	*0.0000*	*52.3800*	*0.0000*	*52.3800*	*68.5577*	*75.4135*
RSM 015213200700 Office trailer, excl. hookups, air conditioning, rent per month, add (Note: Two trailers for three months.)	6.0000	EA	0.00	0.00	314.28	0.00	314.28	411.35	452.48
			0.0000	*0.0000*	*1,814.4000*		*1,814.4000*	*2,374.7828*	*2,612.2610*
331XX220802 Office Furniture & Office Equip	**1.0000**	**EA**	**0.00**	**0.00**	**1,814.40**	**0.00**	**1,814.40**	**2,374.78**	**2,612.26**
			0.0000	*0.0000*	*216.0000*	*0.0000*	*216.0000*	*282.7122*	*310.9835*
RSM 015213400100 Field office expense, office equipment rental, average (Note: 2 offices for 3 months)	6.0000	MO	0.00	0.00	1,296.00	0.00	1,296.00	1,696.27	1,865.90
			0.0000	*0.0000*	*86.4000*	*0.0000*	*86.4000*	*113.0849*	*124.3934*
RSM 015213400120 Field office expense, office supplies, average (Note: Two offices for three months)	6.0000	MO	0.00	0.00	518.40	0.00	518.40	678.51	746.36
			0.0000	*0.0000*	*534.6000*		*534.6000*	*699.7128*	*769.6841*
331XX220803 Warehouse & Stor Trailers/Facil	**1.0000**	**EA**	**0.00**	**0.00**	**534.60**	**0.00**	**534.60**	**699.71**	**769.68**
			0.0000	*0.0000*	*89.1000*	*0.0000*	*89.1000*	*116.6188*	*128.2807*
RSM 015213201250 Storage boxes, rent per month, 20' x 8' (Note: Two boxes for three months.)	6.0000	EA	0.00	0.00	534.60	0.00	534.60	699.71	769.68

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*937.9800*		*1,987.9800*	*2,601.9734*	*2,862.1708*
331XX220808 Construction Portable Toilets	**1.0000**	**EA**	**0.00**	**0.00**	**937.98**	**0.00**	**1,987.98**	**2,601.97**	**2,862.17**
			0.0000	*0.0000*	*104.2200*	*0.0000*	*104.2200*	*136.4087*	*150.0495*
HNC 015213201400 Toilet, portable, chemical, rent per month (Note: 3 toilets for 3 months)	9.0000	MO	0.00	0.00	937.98	0.00	937.98	1,227.68	1,350.45
			0.0000	*0.0000*	*0.0000*	*0.0000*	*175.0000*	*229.0493*	*251.9542*
USR Portable Handwash Station	6.0000	MO	0.00	0.00	0.00	0.00	1,050.00	1,374.30	1,511.73
(Note: Cost for rental $175/month based on a recent quote for a similar item. Included delivery. Assume 2 are required.)									
			0.0000	*0.0000*	*1,086.4692*		*1,086.4692*	*1,422.0284*	*1,564.2312*
331XX220811 Decon Facilities for Personnel	**1.0000**	**EA**	**0.00**	**0.00**	**1,086.47**	**0.00**	**1,086.47**	**1,422.03**	**1,564.23**
			0.0000	*0.0000*	*362.1564*	*0.0000*	*362.1564*	*474.0095*	*521.4104*
HTW 019413205977 Decontamination kit in 3 gallon metal drum, 27 items	3.0000	EA	0.00	0.00	1,086.47	0.00	1,086.47	1,422.03	1,564.23
			25,334.6836	*0.0000*	*0.0000*		*25,334.6836*	*33,159.3748*	*36,475.3123*
331XX220812 Decon Facil for Const Equip/Veh	**1.0000**	**EA**	**25,334.68**	**0.00**	**0.00**	**0.00**	**25,334.68**	**33,159.37**	**36,475.31**
			664.9966	*0.0000*	*0.0000*	*0.0000*	*664.9966*	*870.3827*	*957.4210*
HTW 019413103112 Spray washing, decontaminate heavy equipment, decontaminate heavy equipment	20.0000	EA	13,299.93	0.00	0.00	0.00	13,299.93	17,407.65	19,148.42
(Note: Assume decontamination of all equipment once during release from site. Approximate 20 pieces of equipment.)									
			300.8688	*0.0000*	*0.0000*	*0.0000*	*300.8688*	*393.7930*	*433.1723*
USR Release Surveys and Equipment Frisks	40.0000	EA	12,034.75	0.00	0.00	0.00	12,034.75	15,751.72	17,326.89
(Note: Assume 2 hour average per survey and/or frisk. These will need to be done during entry to and exit from site, so assuming 20 pieces of equipment, quantity is 40.)									
			0.0000	*0.0000*	*0.0000*		*414,153.0000*	*414,153.0000*	*414,153.0000*
342XX ALT 2 - O&M	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**414,153.00**	**414,153.00**	**414,153.00**
USR Present Value for Long-Term O&M	1.0000	LS	0.00	0.00	0.00	0.00	414,153.00	414,153.00	414,153.00
(Note: Present value calculated per Chapter 4 of the USEPA Guide to Developing and Documenting Cost Estimates During the Feasibility Study, and additional guidance from USACE using a yearly cost of $13,460, discount rate of 3.25% and period of 1,000 years.)									
3 ALT 3 - Soil and GW Removal w/ Offsite Disposal; Remove Bldg 401 Foundation and Drains; and Decon Foundations	**1.0000**	**LS**	**617,719.09**	**171,212.68**	**1,200,646.53**	**105,000.00**	**12,599,107.69**	**16,375,548.33**	**17,971,687.86**
331XX ALT 3 - CAPITAL COSTS	**1.0000**	**LS**	**617,719.09**	**171,212.68**	**1,200,646.53**	**105,000.00**	**12,184,954.69**	**15,961,395.33**	**17,557,534.86**
ALT 3 - 331XX01 Mobilize and Preparatory Work	**1.0000**	**LS**	**27,481.55**	**5,647.46**	**18,774.72**	**105,000.00**	**156,903.74**	**205,363.92**	**225,900.31**
			15,469.9117	*5,180.0213*	*1,663.2000*		*22,313.1330*	*29,204.6095*	*32,125.0705*
331XX0101 Mob Construction Equip & Fac	**1.0000**	**EA**	**15,469.91**	**5,180.02**	**1,663.20**	**0.00**	**22,313.13**	**29,204.61**	**32,125.07**
			0.0000	*0.0000*	*1,663.2000*		*1,663.2000*	*2,176.8842*	*2,394.5726*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
331XX010190 Site Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**1,663.20**	**0.00**	**1,663.20**	**2,176.88**	**2,394.57**
			0.0000	*0.0000*	*475.2000*		*475.2000*	*621.9669*	*684.1636*
331XX010191 Office Trailers	**1.0000**	**EA**	**0.00**	**0.00**	**475.20**	**0.00**	**475.20**	**621.97**	**684.16**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Office trailer, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: assume 10 miles per haul, 2 trailers. double to account for demob)									
			0.0000	*0.0000*	*712.8000*		*712.8000*	*932.9504*	*1,026.2454*
331XX010192 Toilets	**1.0000**	**EA**	**0.00**	**0.00**	**712.80**	**0.00**	**712.80**	**932.95**	**1,026.25**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Portable toilet and hand wash, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: Assume same cost for delivering storage trailers - three toilets and two hand washes delivered on two trucks. Double to account for demob)									
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Portable hand wash station, delivery, add per mile	20.0000	MI	0.00	0.00	237.60	0.00	237.60	310.98	342.08
(Note: Assume same cost for delivering storage trailers - three delivered on one truck. Double to account for demob)									
			0.0000	*0.0000*	*475.2000*		*475.2000*	*621.9669*	*684.1636*
331XX010193 Storage Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**475.20**	**0.00**	**475.20**	**621.97**	**684.16**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Storage trailer, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: Assume same cost for delivering storage trailers - 2 deliveries double to account for demob)									
			15,469.9117	*5,180.0213*	*0.0000*		*20,649.9330*	*27,027.7253*	*29,730.4979*
331XX010191 Construction Equipment	**1.0000**	**EA**	**15,469.91**	**5,180.02**	**0.00**	**0.00**	**20,649.93**	**27,027.73**	**29,730.50**
			509.8944	*173.1983*	*0.0000*	*0.0000*	*683.0927*	*894.0678*	*983.4746*
RSM 015436501400 Mobilization or demobilization, delivery charge for equipment, hauled on 20-ton capacity towed trailer	20.0000	EA	10,197.89	3,463.97	0.00	0.00	13,661.85	17,881.36	19,669.49
(Note: Mobilization/demobilization of medium-sized equipment. 1 paver, 1 medium excavator, 3 medium FE loaders/backhoes/skidsteers, 3 rollers, 2 dozers)									
			540.2320	*191.5054*	*0.0000*	*0.0000*	*731.7374*	*957.7366*	*1,053.5102*
RSM 015436501500 Mobilization or demobilization, delivery charge for equipment, hauled on 40-ton capacity towed trailer	8.0000	EA	4,321.86	1,532.04	0.00	0.00	5,853.90	7,661.89	8,428.08
(Note: Mobilization/demobilization of heavy equipment. 1 grader, 2 large excavators, 1 large FE loader)									
			118.7710	*23.0016*	*0.0000*	*0.0000*	*141.7726*	*185.5595*	*204.1155*
RSM 015436501200 Mobilization or demobilization, delivery charge for small equipment, placed in rear	8.0000	EA	950.17	184.01	0.00	0.00	1,134.18	1,484.48	1,632.92

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
of, or towed by pickup truck (Note: Assume 4 loads each way for smaller equipment (saws, pumps, excavator attachments, etc.))									
			0.0000	*0.0000*	*0.0000*		*105,000.0000*	*137,429.5577*	*151,172.5134*
331XX0103 Submittals/Implementation Plans	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**105,000.00**	**105,000.00**	**137,429.56**	**151,172.51**
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Community Air Monitoring Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Remedial Action Work Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Quality Control Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Sampling and Analysis Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Materials Handling/Transportation and Disposal Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Health and Safety Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Stormwater Pollution Prevention Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Community Participation Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*5,000.0000*	*5,000.0000*	*6,544.2647*	*7,198.6911*
USR Project Schedule	1.0000	EA	0.00	0.00	0.00	5,000.00	5,000.00	6,544.26	7,198.69
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by 75% for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Site Access/Site Security Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Site Management/Long-term O&M Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			2,538.6206	*467.4417*	*2,515.3200*		*5,521.3824*	*7,226.6775*	*7,949.3452*
331XX0104 Setup/Construct Temp Facilities	**1.0000**	**EA**	**2,538.62**	**467.44**	**2,515.32**	**0.00**	**5,521.38**	**7,226.68**	**7,949.35**
			0.0000	*0.0000*	*1,089.7200*		*1,089.7200*	*1,426.2832*	*1,568.9115*
331XX010411 Barricades	**1.0000**	**EA**	**0.00**	**0.00**	**1,089.72**	**0.00**	**1,089.72**	**1,426.28**	**1,568.91**
			0.0000	*0.0000*	*114.4800*	*0.0000*	*114.4800*	*149.8375*	*164.8212*
RSM 015623100410 Barricades, PVC pipe barricade, break-a-way, buy, 3" diam. PVC, with 3 each 1' x 4' reflectorized panels	4.0000	EA	0.00	0.00	457.92	0.00	457.92	599.35	659.28
(Note: Quantity approximated - will be used to protect open excavations and active work areas)									
			0.0000	*0.0000*	*21.0600*	*0.0000*	*21.0600*	*27.5644*	*30.3209*
RSM 015623100850 Barricades, traffic cones, PVC, 28" high	30.0000	EA	0.00	0.00	631.80	0.00	631.80	826.93	909.63
(Note: Quantity approximated - will be used to protect open excavations and active work areas)									
			1,334.6250	*10.9816*	*777.6000*		*2,123.2067*	*2,778.9653*	*3,056.8618*
331XX010430 Erosion Control	**1.0000**	**EA**	**1,334.63**	**10.98**	**777.60**	**0.00**	**2,123.21**	**2,778.97**	**3,056.86**
			1.3346	*0.0110*	*0.7776*	*0.0000*	*2.1232*	*2.7790*	*3.0569*
RSM 312514161000 Synthetic erosion control, silt fence, install and maintain, remove, 3' high	1,000.0000	LF	1,334.63	10.98	777.60	0.00	2,123.21	2,778.97	3,056.86
(Note: Quantity approximated - will be used to protect temporary staging areas and other sensitive areas)									
			1,203.9956	*456.4601*	*648.0000*		*2,308.4557*	*3,021.4290*	*3,323.5719*
331XX010491 Temporary Staging Areas	**1.0000**	**EA**	**1,204.00**	**456.46**	**648.00**	**0.00**	**2,308.46**	**3,021.43**	**3,323.57**
			0.1204	*0.0456*	*0.0648*	*0.0000*	*0.2308*	*0.3021*	*0.3324*
USR Create Stockpile area	10,000.0000	SF	1,204.00	456.46	648.00	0.00	2,308.46	3,021.43	3,323.57
(Note: User-created crew utilized due to lack of appropriate options in the Cost Book. Assume 100 x 100 ft temporary staging area. Assume 1 half day to construct. Created using a loader for moving earth, and laborers for spotting and placing liner. Silt fence installation included under 10430 - Erosion Control Material cost for poly liner per Uline online - $0.5/sy or approx. $0.06/sf. Removal will be covered under general site restoration.)									
			9,473.0211	*0.0000*	*14,596.2000*		*24,069.2211*	*31,503.0706*	*34,653.3777*
331XX0105 Construct Temporary Utilities	**1.0000**	**EA**	**9,473.02**	**0.00**	**14,596.20**	**0.00**	**24,069.22**	**31,503.07**	**34,653.38**
			9,473.0211	*0.0000*	*14,596.2000*		*24,069.2211*	*31,503.0706*	*34,653.3777*
331XX010502 Power Connection/Distribution	**1.0000**	**EA**	**9,473.02**	**0.00**	**14,596.20**	**0.00**	**24,069.22**	**31,503.07**	**34,653.38**
			128.2738	*0.0000*	*124.2000*	*0.0000*	*252.4738*	*330.4511*	*363.4962*
RSM 015113500870 Temporary electrical power equipment (pro-rated per job), connections, office trailer, 60 amp	2.0000	EA	256.55	0.00	248.40	0.00	504.95	660.90	726.99

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			461.7857	*0.0000*	*793.8000*	*0.0000*	*1,255.5857*	*1,643.3771*	*1,807.7148*
RSM 015113500030 Temporary electrical power equipment (pro-rated per job), overhead feed, 3 uses, 100 amp	1.0000	EA	461.79	0.00	793.80	0.00	1,255.59	1,643.38	1,807.71
			1,443.0804	*0.0000*	*3,888.0000*	*0.0000*	*5,331.0804*	*6,977.6002*	*7,675.3602*
RSM 015113500240 Temporary electrical power equipment (pro-rated per job), transformers, 3 uses, 112.5 kVA	1.0000	EA	1,443.08	0.00	3,888.00	0.00	5,331.08	6,977.60	7,675.36
			7.2154	*0.0000*	*7.1280*	*0.0000*	*14.3434*	*18.7734*	*20.6507*
RSM 015113500420 Temporary electrical power equipment (pro-rated per job), feeder, EMT and aluminum wire, 100 amp (Note: Quantity approximated)	1,000.0000	LF	7,215.40	0.00	7,128.00	0.00	14,343.40	18,773.40	20,650.74
			48.1027	*0.0000*	*1,269.0000*	*0.0000*	*1,317.1027*	*1,723.8937*	*1,896.2831*
RSM 015113500560 Temporary electrical power equipment (pro-rated per job), temporary feeder cords, 100 amp, 3 uses, 100' long	2.0000	EA	96.21	0.00	2,538.00	0.00	2,634.21	3,447.79	3,792.57
ALT 3 - 331XX02 Monitoring,Samplng,Test,Analysis	**1.0000**	**LS**	**0.00**	**0.00**	**1,827.36**	**0.00**	**137,592.36**	**180,088.16**	**198,096.98**
			0.0000	*0.0000*	*0.0000*		*5,795.0000*	*7,584.8027*	*8,343.2830*
331XX0202 Radiation Monitoring	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**5,795.00**	**7,584.80**	**8,343.28**
			0.0000	*0.0000*	*0.0000*		*5,795.0000*	*7,584.8027*	*8,343.2830*
331XX020201 Area Monitoring	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**5,795.00**	**7,584.80**	**8,343.28**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*2,657.5000*	*3,478.2767*	*3,826.1043*
USR Rent Radiological Monitoring Equipment	2.0000	MO	0.00	0.00	0.00	0.00	5,315.00	6,956.55	7,652.21
(Note: Cost per bid results from a recent similar project. Refer to project notes for a list of equipment and quantities.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*240.0000*	*314.1247*	*345.5372*
USR Shipping for Radiological Monitoring Equipment (Note: Cost per bid results from a recent similar project. Cost is per delivery, each way.)	2.0000	EA	0.00	0.00	0.00	0.00	480.00	628.25	691.07
			0.0000	*0.0000*	*0.0000*		*23,000.0000*	*30,103.6174*	*33,113.9791*
331XX0203 Air Monitoring & Sampling	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**23,000.00**	**30,103.62**	**33,113.98**
			0.0000	*0.0000*	*0.0000*		*23,000.0000*	*30,103.6174*	*33,113.9791*
331XX020301 CAMP	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**23,000.00**	**30,103.62**	**33,113.98**
USR Camp Equipment Rental, Mobilization, and Weekly Reporting	1.0000	LS	0.00	0.00	0.00	0.00	23,000.00	30,103.62	33,113.98
(Note: Cost obtained from estimate for recent similar nearby project. Assumes 3 perimiter air monitoring stations (including 1 dust monitor, 1 PID, 1 datalogger and 1 radio), one meteorological tower, one computer and one telemetry system. Cost includes mobilization/setup by vendor, weekly summary reports and demobilization. The cost assumes a duration of three months.)									
			0.0000	*0.0000*	*38.8800*		*38.8800*	*50.8882*	*55.9770*
331XX0205 Sample Surface wt/Grdwtr/Liquid	**1.0000**	**EA**	**0.00**	**0.00**	**38.88**	**0.00**	**38.88**	**50.89**	**55.98**

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*38.8800*		*38.8800*	*50.8882*	*55.9770*
331XX020505 Sample Shipping and Handling	**1.0000**	**EA**	**0.00**	**0.00**	**38.88**	**0.00**	**38.88**	**50.89**	**55.98**
			0.0000	*0.0000*	*38.8800*	*0.0000*	*38.8800*	*50.8882*	*55.9770*
RSM 029110100230 Sample packaging & shipping, packaging, vials & bottles, 32 ounce HDPE bottle, case of 12	1.0000	EA	0.00	0.00	38.88	0.00	38.88	50.89	55.98
(Note: Labor for sample collection is accounted for elsewhere in the estimate; it is expected that sample collection will be performed by an on-site engineer, health and safety officer, environmental technician or otherwise.)									
			0.0000	*0.0000*	*1,555.2000*		*1,555.2000*	*2,035.5281*	*2,239.0809*
331XX0206 Sampling Soil and Sediment	**1.0000**	**EA**	**0.00**	**0.00**	**1,555.20**	**0.00**	**1,555.20**	**2,035.53**	**2,239.08**
			0.0000	*0.0000*	*1,555.2000*		*1,555.2000*	*2,035.5281*	*2,239.0809*
331XX020604 Sample Shipping and Handling	**1.0000**	**EA**	**0.00**	**0.00**	**1,555.20**	**0.00**	**1,555.20**	**2,035.53**	**2,239.08**
			0.0000	*0.0000*	*38.8800*	*0.0000*	*38.8800*	*50.8882*	*55.9770*
RSM 029110100230 Sample packaging & shipping, packaging, vials & bottles, 32 ounce HDPE bottle, case of 12	40.0000	EA	0.00	0.00	1,555.20	0.00	1,555.20	2,035.53	2,239.08
(Note: Assume 2 bottles per sample. Labor for sample collection is accounted for elsewhere in the estimate; it is expected that sample collection will be performed by an on-site engineer, health and safety officer, environmental technician or otherwise.)									
			0.0000	*0.0000*	*233.2800*		*233.2800*	*305.3292*	*335.8621*
331XX0208 Sampling Radioactve Contam Media	**1.0000**	**EA**	**0.00**	**0.00**	**233.28**	**0.00**	**233.28**	**305.33**	**335.86**
			0.0000	*0.0000*	*233.2800*		*233.2800*	*305.3292*	*335.8621*
331XX020808 Sample Shipping and Handling	**1.0000**	**EA**	**0.00**	**0.00**	**233.28**	**0.00**	**233.28**	**305.33**	**335.86**
			0.0000	*0.0000*	*38.8800*	*0.0000*	*38.8800*	*50.8882*	*55.9770*
RSM 029110100230 Sample packaging & shipping, packaging, vials & bottles, 32 ounce HDPE bottle, case of 12	6.0000	EA	0.00	0.00	233.28	0.00	233.28	305.33	335.86
(Note: Assume 2 bottles per sample. Labor for sample collection is accounted for elsewhere in the estimate; it is expected that sample collection will be performed by an on-site engineer, health and safety officer, environmental technician or otherwise.)									
			0.0000	*0.0000*	*0.0000*		*106,970.0000*	*140,007.9979*	*154,008.7977*
331XX0209 Laboratory Chemical Analysis	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**106,970.00**	**140,008.00**	**154,008.80**
			0.0000	*0.0000*	*0.0000*		*355.0000*	*464.6428*	*511.1071*
331XX020902 Gen Water Qual & Wastewtr Analys	**2.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**710.00**	**929.29**	**1,022.21**
(Note: Assume only 2 samples will be collected due to the relatively small volume)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*110.0000*	*143.9738*	*158.3712*
USR Ra-226 Analysis	2.0000	EA	0.00	0.00	0.00	0.00	220.00	287.95	316.74
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR Th-232 Analysis	2.0000	EA	0.00	0.00	0.00	0.00	160.00	209.42	230.36
(Note: Cost obtained from lab contract for similar project.)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR U-238 Analysis	2.0000	EA	0.00	0.00	0.00	0.00	160.00	209.42	230.36
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*85.0000*	*111.2525*	*122.3777*
USR PAH Analysis	2.0000	EA	0.00	0.00	0.00	0.00	170.00	222.50	244.76
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*		*385.0000*	*503.9084*	*554.2992*
331XX020907 Soil & Sediment Analysis	**240.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**92,400.00**	**120,938.01**	**133,031.81**
(Note: For approximately 40 individual excavations, with 6 samples per excavation.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*70.0000*	*91.6197*	*100.7817*
USR Ra-226 Analysis	240.0000	EA	0.00	0.00	0.00	0.00	16,800.00	21,988.73	24,187.60
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR Th-232 Analysis	240.0000	EA	0.00	0.00	0.00	0.00	19,200.00	25,129.98	27,642.97
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR U-238 Analysis	240.0000	EA	0.00	0.00	0.00	0.00	19,200.00	25,129.98	27,642.97
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*85.0000*	*111.2525*	*122.3777*
USR PAH Analysis	240.0000	EA	0.00	0.00	0.00	0.00	20,400.00	26,700.60	29,370.66
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*70.0000*	*91.6197*	*100.7817*
USR VOC Analysis	240.0000	EA	0.00	0.00	0.00	0.00	16,800.00	21,988.73	24,187.60
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*		*385.0000*	*503.9084*	*554.2992*
331XX020991 Contaminated Concrete Analysis	**36.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**13,860.00**	**18,140.70**	**19,954.77**
(Note: It is assumed that the cost for analysis of concrete chips is the same as for soil/sediment. Quantity assumes 12 samples per concrete slab,)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*70.0000*	*91.6197*	*100.7817*
USR Ra-226 Analysis	36.0000	EA	0.00	0.00	0.00	0.00	2,520.00	3,298.31	3,628.14
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR Th-232 Analysis	36.0000	EA	0.00	0.00	0.00	0.00	2,880.00	3,769.50	4,146.45
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR U-238 Analysis	36.0000	EA	0.00	0.00	0.00	0.00	2,880.00	3,769.50	4,146.45
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*85.0000*	*111.2525*	*122.3777*
USR PAH Analysis	36.0000	EA	0.00	0.00	0.00	0.00	3,060.00	4,005.09	4,405.60

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*70.0000*	*91.6197*	*100.7817*
USR VOC Analysis	36.0000	EA	0.00	0.00	0.00	0.00	2,520.00	3,298.31	3,628.14
(Note: Cost obtained from lab contract for similar project.)									
ALT 3 - 331XX03 Site Work	**1.0000**	**LS**	**64,384.25**	**29,066.14**	**194.40**	**0.00**	**93,644.79**	**135,648.94**	**149,213.83**
			15,657.7157	*8,664.3221*	*194.4000*		*24,516.4377*	*32,088.4114*	*35,297.2525*
331XX0301 Demolition and Removal of Asphalt Roadways	**1.0000**	**EA**	**15,657.72**	**8,664.32**	**194.40**	**0.00**	**24,516.44**	**32,088.41**	**35,297.25**
			0.6809	*0.2178*	*0.1296*		*1.0283*	*1.3459*	*1.4805*
331XX030190 Saw-cut asphalt roadway	**1,500.0000**	**LF**	**1,021.32**	**326.70**	**194.40**	**0.00**	**1,542.42**	**2,018.80**	**2,220.68**
			0.6809	*0.2178*	*0.1296*	*0.0000*	*1.0283*	*1.3459*	*1.4805*
RSM 024119250015 Selective demolition, saw cutting, asphalt, up to 3" deep	1,500.0000	LF	1,021.32	326.70	194.40	0.00	1,542.42	2,018.80	2,220.68
(Note: Quantity approximated based on aerial photo)									
			4.4353	*2.5266*	*0.0000*		*6.9618*	*9.1120*	*10.0232*
331XX030191 Asphalt road removal	**3,300.0000**	**CY**	**14,636.39**	**8,337.62**	**0.00**	**0.00**	**22,974.02**	**30,069.61**	**33,076.57**
			1.9449	*0.6451*	*0.0000*	*0.0000*	*2.5900*	*3.3899*	*3.7289*
RSM 312316425100 Excavating, bulk bank measure, sandy clay/loam, open site, 1 C.Y. capacity = 120 C.Y./hour, excavator, hydraulic, crawler mounted, excluding truck loading	3,300.0000	BCY	6,418.21	2,128.75	0.00	0.00	8,546.96	11,186.71	12,305.39
(Note: Crew output reduced to 90 because material being excavated is asphalt and gravel.)									
			1.9157	*1.4473*	*0.0000*	*0.0000*	*3.3630*	*4.4016*	*4.8418*
RSM 312323203626 Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min load/wait/unload, 16.5 C.Y. truck, cycle 0.5 mile, 20 MPH, excludes loading equipment	4,290.0000	LCY	8,218.19	6,208.87	0.00	0.00	14,427.06	18,882.89	20,771.18
(Note: Hauling from excavation site to temporary stockpiling area)									
			33,293.0302	*20,168.5391*	*0.0000*		*53,461.5693*	*83,055.0126*	*91,360.5139*
331XX0302 Clearing and Grubbing	**1.0000**	**EA**	**33,293.03**	**20,168.54**	**0.00**	**0.00**	**53,461.57**	**83,055.01**	**91,360.51**
			17,634.6331	*5,835.1298*	*0.0000*		*23,469.7629*	*36,461.3586*	*40,107.4945*
331XX030290 Tree removal	**1.0000**	**EA**	**17,634.63**	**5,835.13**	**0.00**	**0.00**	**23,469.76**	**36,461.36**	**40,107.49**
			1,513.6451	*1,385.5629*	*0.0000*	*0.0000*	*2,899.2080*	*4,504.0532*	*4,954.4585*
RSM 311110100250 Clearing & grubbing, trees to 12" diameter, grub stumps and remove	2.0000	ACR	3,027.29	2,771.13	0.00	0.00	5,798.42	9,008.11	9,908.92
			292.1469	*61.2801*	*0.0000*	*0.0000*	*353.4269*	*549.0650*	*603.9715*
HNC 311110107320 Tree removal, congested area, 12" to 24" diameter, tree removal, cutting and chipping	50.0000	EA	14,607.34	3,064.00	0.00	0.00	17,671.35	27,453.25	30,198.58
(Note: Quantity is approximated)									
			15,658.3972	*14,333.4093*	*0.0000*		*29,991.8065*	*46,593.6540*	*51,253.0194*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
331XX030291 Brush clearing	**1.0000**	**ACR**	**15,658.40**	**14,333.41**	**0.00**	**0.00**	**29,991.81**	**46,593.65**	**51,253.02**
			2,609.7329	*2,388.9016*	*0.0000*	*0.0000*	*4,998.6344*	*7,765.6090*	*8,542.1699*
RSM 311110100160 Clearing & grubbing, brush, including stumps	6.0000	ACR	15,658.40	14,333.41	0.00	0.00	29,991.81	46,593.65	51,253.02
			15,433.5049	*233.2781*	*0.0000*		*15,666.7830*	*20,505.5148*	*22,556.0663*
331XX0393 Survey	**1.0000**	**EA**	**15,433.50**	**233.28**	**0.00**	**0.00**	**15,666.78**	**20,505.51**	**22,556.07**
			907.8532	*13.7222*	*0.0000*	*0.0000*	*921.5755*	*1,206.2068*	*1,326.8274*
RSM 017123131100 Boundary & survey markers, crew for building layout, 2 person crew	17.0000	DAY	15,433.50	233.28	0.00	0.00	15,666.78	20,505.51	22,556.07
(Note: Assume surveyor will be on site daily during excavation phase to set up control points, locate and survey excavations, and locate any other key site features; and 5 additional days to complete final grade surveys)									
ALT 3 - 331XX08 Solids Collect And Containment	**1.0000**	**LS**	**80,869.00**	**50,566.06**	**8,100.00**	**0.00**	**156,410.06**	**204,717.77**	**225,189.54**
			13.7066	*8.5705*	*1.3729*		*26.5102*	*34.6979*	*38.1677*
331XX0801 Contaminated Soil Collection	**5,900.0000**	**BCY**	**80,869.00**	**50,566.06**	**8,100.00**	**0.00**	**156,410.06**	**204,717.77**	**225,189.54**
(Note: This includes the excavation of RAD/PAH and VOC-contaminated soils.)									
			2.9174	*0.9676*	*0.0000*		*3.8850*	*5.0849*	*5.5934*
331XX080102 Excavation	**5,900.0000**	**BCY**	**17,212.46**	**5,708.93**	**0.00**	**0.00**	**22,921.39**	**30,000.73**	**33,000.81**
			2.9174	*0.9676*	*0.0000*	*0.0000*	*3.8850*	*5.0849*	*5.5934*
RSM 312316425100 Excavating, bulk bank measure, sandy clay/loam, open site, 1 C.Y. capacity = 120 C.Y./hour, excavator, hydraulic, crawler mounted, excluding truck loading	5,900.0000	BCY	17,212.46	5,708.93	0.00	0.00	22,921.39	30,000.73	33,000.81
(Note: Crew output reduced to 60 to account for movement between excavations, equipment frisking, and waiting for transport trucks. Note that this item includes excavation of both radiological and VOC impacted soils.)									
			3.9464	*1.4473*	*1.0561*		*8.6498*	*11.3214*	*12.4535*
331XX080103 Hauling	**7,670.0000**	**LCY**	**30,268.52**	**11,100.70**	**8,100.00**	**0.00**	**66,344.22**	**86,834.83**	**95,518.32**
(Note: Hauling to temporary staging area from excavation site. Volume assumes a swell factor of 30%)									
			1.9157	*1.4473*	*0.0000*	*0.0000*	*3.3630*	*4.4016*	*4.8418*
RSM 312323203626 Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min load/wait/unload, 16.5 C.Y. truck, cycle 0.5 mile, 20 MPH, excludes loading equipment	7,670.0000	LCY	14,693.12	11,100.70	0.00	0.00	25,793.83	33,760.33	37,136.36
(Note: Hauling from excavation site to temporary stockpiling area. Assume a swell factor of 30%.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*450.0000*	*588.9838*	*647.8822*
USR Intermodal Shipping Container Rental	37.5000	MO	0.00	0.00	0.00	0.00	16,875.00	22,086.89	24,295.58
(Note: Cost per quote from Secur LLC. Quantity assumes 1 week roundtrip for a 25 ton truck.)									
			103.8360	*0.0000*	*54.0000*	*0.0000*	*157.8360*	*206.5841*	*227.2425*
USR Shipping container prep	150.0000	EA	15,575.40	0.00	8,100.00	0.00	23,675.40	30,987.61	34,086.37
(Note: User-created crew utilized due to lack of appropriate options in the Cost Book. Cost assumes two laborers for inspection of shipping containers and installation of specialty liners. Liner cost is per quote from Secur LLC. Assume 1/2 hour per truck)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			4.3531	*4.4011*	*0.0000*		*8.7542*	*11.4579*	*12.6037*
331XX080104 Stockpiling	**7,670.0000**	**LCY**	**33,388.02**	**33,756.42**	**0.00**	**0.00**	**67,144.44**	**87,882.20**	**96,670.42**
(Note: Temporary staging area for excavated material)									
			112.8696	*114.1150*	*0.0000*	*0.0000*	*226.9846*	*297.0895*	*326.7984*
RSM B10U Stockpile Management	247.4194	HR	27,926.13	28,234.27	0.00	0.00	56,160.39	73,505.69	80,856.26
(Note: Assume 1 loader with a spotter half-time for managing temporary stockpile. Quantity is based on the calculated extended duration for the cycle hauling item)									
			0.7121	*0.7200*	*0.0000*	*0.0000*	*1.4321*	*1.8744*	*2.0618*
HTW 312316133106 Load Truck for Transport to Disposal Facility, 5.5 CY wheel loader	7,670.0000	LCY	5,461.89	5,522.16	0.00	0.00	10,984.05	14,376.51	15,814.16
ALT 3 - 331XX09 Liq/Sed/Sludges Collect,Contain	**1.0000**	**LS**	**5,730.36**	**3,119.09**	**7,112.88**	**0.00**	**17,922.33**	**23,457.69**	**25,803.46**
			2,159.4379	*1,392.9879*	*7,112.8800*		*12,625.3058*	*16,524.6685*	*18,177.1353*
331XX0903 Waste Containment, Portable	**1.0000**	**EA**	**2,159.44**	**1,392.99**	**7,112.88**	**0.00**	**12,625.31**	**16,524.67**	**18,177.14**
			2,159.4379	*1,392.9879*	*7,112.8800*		*12,625.3058*	*16,524.6685*	*18,177.1353*
331XX090301 Bulk Liquid Containers/Roll-Offs	**1.0000**	**EA**	**2,159.44**	**1,392.99**	**7,112.88**	**0.00**	**12,625.31**	**16,524.67**	**18,177.14**
			626.0872	*266.0433*	*0.0000*	*0.0000*	*892.1305*	*1,167.6676*	*1,284.4343*
HTW 028610106152 Secondary containment and storage, storage systems, loading hazardous waste for shipment, load liquid or sludge into 5,000 gal. bulk tank truck	1.0000	EA	626.09	266.04	0.00	0.00	892.13	1,167.67	1,284.43
(Note: It is approximated that 1 gallon of water will need to be pumped for every cubic yard excavated, so for a total of 4,700 cy, this equals 4,700 gallons. Therefore only one load will be required)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*980.0000*	*1,282.6759*	*1,410.9435*
HTW 029110409118 Wastewater holding tanks, above ground, steel, closed, stationary, monthly rental, 21,000 gal	2.0000	MO	0.00	0.00	0.00	0.00	1,960.00	2,565.35	2,821.89
			1,384.5622	*1,105.7423*	*0.0000*	*0.0000*	*2,490.3046*	*3,259.4424*	*3,585.3867*
HTW 026510104315 Clean and rinse tank interior, high pressure water, 20,001 to 30,000 gallons	1.0000	EA	1,384.56	1,105.74	0.00	0.00	2,490.30	3,259.44	3,585.39
			74.3942	*10.6011*	*3,556.4400*	*0.0000*	*3,641.4354*	*4,766.1034*	*5,242.7137*
USR 221353203142 Wastewater holding tanks, above ground, saddle, f berglass, 200 gal	2.0000	MO	148.79	21.20	7,112.88	0.00	7,282.87	9,532.21	10,485.43
(Note: Pickup truck with 200 gallon tank for storing water pumped from excavations for transport to main storage tank. 1 truck, 1 laborer assume full time. Material cost is for the purchase price, so since the quantity is not 1, the material cost needs to be divided by the quantity to accurately reflect the purchase price.)									
			3,570.9236	*1,726.0991*	*0.0000*		*5,297.0227*	*6,933.0237*	*7,626.3260*
331XX0906 Pumping/Draining/Collection	**1.0000**	**EA**	**3,570.92**	**1,726.10**	**0.00**	**0.00**	**5,297.02**	**6,933.02**	**7,626.33**
			3,570.9236	*1,726.0991*	*0.0000*		*5,297.0227*	*6,933.0237*	*7,626.3260*
331XX090603 Dewatering	**1.0000**	**EA**	**3,570.92**	**1,726.10**	**0.00**	**0.00**	**5,297.02**	**6,933.02**	**7,626.33**

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			595.1539	*287.6832*	*0.0000*	*0.0000*	*882.8371*	*1,155.5039*	*1,271.0543*
RSM 312319201100 Dewatering, pumping 8 hours, attended 2 hrs per day, 6" centrifugal pump, includes 20 LF of suction hose and 250 LF of discharge hose	6.0000	DAY	3,570.92	1,726.10	0.00	0.00	5,297.02	6,933.02	7,626.33
(Note: It is assumed that dewatering will be required for half of the days that excavation is taking place. Approximately 11 total days of excavation are required, so pumping will be necessary for roughly 6 days.)									
ALT 3 - 331XX10 Drums/Tanks/Struct/Misc Removal	**1.0000**	**LS**	**21,441.68**	**8,189.59**	**0.00**	**0.00**	**29,631.27**	**38,782.97**	**42,661.27**
331XX1003 Structure Removal (Building 401 Slab)	**1.0000**	**LS**	**14,597.73**	**7,121.54**	**0.00**	**0.00**	**21,719.26**	**28,427.32**	**31,270.05**
331XX100302 Demolition	**1.0000**	**LS**	**9,962.17**	**4,698.38**	**0.00**	**0.00**	**14,660.55**	**19,188.51**	**21,107.36**
			0.5074	*0.2393*	*0.0000*	*0.0000*	*0.7467*	*0.9773*	*1.0750*
RSM 024116170400 Building footings and foundations demolition, floors, concrete slab on grade, plain concrete, 6" thick, excludes disposal costs and dump fees	19,635.0000	SF	9,962.17	4,698.38	0.00	0.00	14,660.55	19,188.51	21,107.36
(Note: Crew output reduced to 300 because slabs are assumed to be 12 inches thick. Quantity assumes 12 inch slabs. Building 401 Drains will be removed along with the concrete slabs, at no expected additional effort.)									
			4,635.5559	*2,423.1566*	*0.0000*		*7,058.7125*	*9,238.8166*	*10,162.6982*
331XX100390 Excavation, hauling, stockpiling and transport off-site	**1.0000**	**EA**	**4,635.56**	**2,423.16**	**0.00**	**0.00**	**7,058.71**	**9,238.82**	**10,162.70**
			3.5008	*1.1611*	*0.0000*	*0.0000*	*4.6620*	*6.1018*	*6.7120*
RSM 312316425100 Excavating, bulk bank measure, sandy clay/loam, open site, 1 C.Y. capacity = 120 C.Y./hour, excavator, hydraulic, crawler mounted, excluding truck loading	727.2222	BCY	2,545.89	844.41	0.00	0.00	3,390.29	4,437.40	4,881.14
(Note: Crew output reduced to 50 from 120 because material being excavated is reinforcecd concrete, and material needs to be transported to the temporary stockpile areas. Quantity is based on 19,635 square feet of foundation at an assumed 1 ft thick.)									
			1.9157	*1.4473*	*0.0000*	*0.0000*	*3.3630*	*4.4016*	*4.8418*
RSM 312323203626 Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min load/wait/unload, 16.5 C.Y. truck, cycle 0.5 mile, 20 MPH, excludes loading equipment	1,090.8333	LCY	2,089.67	1,578.75	0.00	0.00	3,668.42	4,801.42	5,281.56
(Note: Hauling from excavation site to temporary stockpiling area. Quantity is based on 19,635 square feet of foundation at an assumed 1 ft thick with a swell factor of 1.5 assumed)									
			136.8790	*21.3611*	*0.0000*		*158.2401*	*207.1130*	*227.8243*
331XX1091 Structure Removal (Tank Foundations)	**50.0000**	**CY**	**6,843.95**	**1,068.06**	**0.00**	**0.00**	**7,912.01**	**10,355.65**	**11,391.22**
331XX100302 Demolition	**1.0000**	**LS**	**6,622.19**	**941.73**	**0.00**	**0.00**	**7,563.91**	**9,900.05**	**10,890.06**
			132.4437	*18.8346*	*0.0000*	*0.0000*	*151.2783*	*198.0010*	*217.8011*
HNC 024113332110 Minor site demolition, concrete, unreinforced, 7" to 24" thick, remove with backhoe, excludes hauling	50.0000	CY	6,622.19	941.73	0.00	0.00	7,563.91	9,900.05	10,890.06

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
(Note: Removal of concrete tank foundations. Hydraulic hammer attachment added 1/4 time for breakdown of concrete pieces as needed. Quantity is approximated.)									
			4.4353	*2.5266*	*0.0000*		*6.9618*	*9.1120*	*10.0232*
331XX100390 Excavation, hauling, stockpiling and transport off-site	**50.0000**	**CY**	**221.76**	**126.33**	**0.00**	**0.00**	**348.09**	**455.60**	**501.16**
			1.9449	*0.6451*	*0.0000*	*0.0000*	*2.5900*	*3.3899*	*3.7289*
RSM 312316425100 Excavating, bulk bank measure, sandy clay/loam, open site, 1 C.Y. capacity = 120 C.Y./hour, excavator, hydraulic, crawler mounted, excluding truck loading	50.0000	BCY	97.25	32.25	0.00	0.00	129.50	169.50	186.45
(Note: Crew output reduced to 90 because material being excavated is reinforcecd concrete.)									
			1.9157	*1.4473*	*0.0000*	*0.0000*	*3.3630*	*4.4016*	*4.8418*
RSM 312323203626 Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min load/wait/unload, 16.5 C.Y. truck, cycle 0.5 mile, 20 MPH, excludes loading equipment	65.0000	LCY	124.52	94.07	0.00	0.00	218.59	286.10	314.71
(Note: Hauling from excavation site to temporary stockpiling area)									
			0.0000	*0.0000*	*0.0000*		*9,407,970.3889*	*12,313,649.6089*	*13,545,014.5697*
ALT 3 - 331XX18 Transport and Disposal - Radiological	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**9,407,970.39**	**12,313,649.61**	**13,545,014.57**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*497.0000*	*650.4999*	*715.5499*
USR Radiological Contaminated Soil Disposal	3,250.0000	LCY	0.00	0.00	0.00	0.00	1,615,250.00	2,114,124.70	2,325,537.16
(Note: Cost based on a contract for a similar project provided by WCS Texas Quantity assumes a swell factor of 30%.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*924.0000*	*1,209.3801*	*1,330.3181*
USR Radiological Contaminated Debris Disposal (concrete slabs)	1,454.4444	LCY	0.00	0.00	0.00	0.00	1,343,906.67	1,758,976.18	1,934,873.80
(Note: Cost based on a contract for a similar project provided by WCS Texas. Quantity assumes a swell factor of 1.5)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*924.0000*	*1,209.3801*	*1,330.3181*
USR Radiological Contaminated Debris Disposal (concrete dust and chips)	107.3503	LCY	0.00	0.00	0.00	0.00	99,191.69	129,827.33	142,810.06
(Note: Cost based on a contract for a similar project provided by WCS Texas. Assume swell factor of 1.3.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*924.0000*	*1,209.3801*	*1,330.3181*
USR Radiological Contaminated Debris Disposal (asphalt roadway)	4,290.0000	LCY	0.00	0.00	0.00	0.00	3,963,960.00	5,188,240.66	5,707,064.73
(Note: Cost based on a contract for a similar project provided by WCS Texas.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*200.0000*	*261.7706*	*287.9476*
USR Transport contaminated soil to Radiological Disposal Facility	3,750.0000	TON	0.00	0.00	0.00	0.00	750,000.00	981,639.70	1,079,803.67
(Note: Cost per quote from Secur LLC. Assumes 1.5 tons/CY.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*200.0000*	*261.7706*	*287.9476*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
USR Transport concrete chips and dust to Radiological Disposal Facility	123.8657	TON	0.00	0.00	0.00	0.00	24,773.15	32,424.41	35,666.85
(Note: Cost per quote from Secur LLC. Assumes 1.5 tons/CY. Assume a swell factor of 30%.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*200.0000*	*261.7706*	*287.9476*
USR Transport Contaminated Concrete to Radiological Disposal Facility	1,454.4444	TON	0.00	0.00	0.00	0.00	290,888.89	380,730.77	418,803.85
(Note: This item is for transporting radiologically contaminated concrete to the disposal facility. Cost per quote from Secur LLC. Assumes 2 tons/CY. Quantity is based on cycle hauling volume, assuming 2 tons per cy.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*200.0000*	*261.7706*	*287.9476*
USR Transport Contaminated Asphalt to Radiological Disposal Facility	6,600.0000	TON	0.00	0.00	0.00	0.00	1,320,000.00	1,727,685.87	1,900,454.45
(Note: This item is for transporting radiologically contaminated asphalt to the disposal facility. Cost per quote from Secur LLC. Assumes 2 tons/CY.)									
ALT 3 - 331XX19 Transport and Disposal - Non-Radiological	**1.0000**	**LS**	**0.00**	**0.00**	**0.00**	**0.00**	**526,756.00**	**689,446.13**	**758,390.75**
			0.0000	*0.0000*	*0.0000*		*5,789.0000*	*7,576.9496*	*8,334.6446*
331XX1990 Transport and Disposal - Non-Contaminated	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**5,789.00**	**7,576.95**	**8,334.64**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*55.0000*	*71.9869*	*79.1856*
USR Chipped tree and brush disposal	100.0000	TON	0.00	0.00	0.00	0.00	5,500.00	7,198.69	7,918.56
(Note: Cost per vendor quote - Triad Recycling, $55/ton Quantity assumes 1 ton per tree, and an additional 50 tons of brush, so 100 tons total)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*2.8900*	*3.7826*	*4.1608*
USR Hauling and Disposal of non-contaminated concrete tank foundations	100.0000	MI	0.00	0.00	0.00	0.00	289.00	378.26	416.08
(Note: Mileage assumes transport to Swift River in Tonawanda, NY (approximately 20 miles). Quantity assumes 50 cy or about 100 tons, 20 ton per load so 5 total trips (100 miles total). Cost reduced by 25% (from $3.85 to $2.89) since this item was for hazardous waste transport, and the item being estimated is just concrete and/or debris.)									
			0.0000	*0.0000*	*0.0000*		*520,200.0000*	*680,865.2942*	*748,951.8236*
331XX1991 Transport and Disposal - VOC-Contaminated Soil and Debris	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**520,200.00**	**680,865.29**	**748,951.82**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*53.0000*	*69.3692*	*76.3061*
USR VOC Contaminated Soil Disposal	5,100.0000	TON	0.00	0.00	0.00	0.00	270,300.00	353,782.95	389,161.24
(Note: Cost based on a quote from ESMI. Quantity assumes 1.5 ton/CY.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*49.0000*	*64.1338*	*70.5472*
USR Transport contaminated soil to Incineration facility	5,100.0000	TON	0.00	0.00	0.00	0.00	249,900.00	327,082.35	359,790.58
(Note: Transporation of VOC contaminated soils to Ft. Edward, NY per quote provided by ESMI. Assumes 1.5 ton/CY.)									
			0.0000	*0.0000*	*0.0000*		*767.0000*	*1,003.8902*	*1,104.2792*
331XX1992 Transport and Disposal - Water	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**767.00**	**1,003.89**	**1,104.28**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*0.1300*	*0.1702*	*0.1872*
USR Contaminated Water From Excavations - Transport and Disposal	5,900.0000	GAL	0.00	0.00	0.00	0.00	767.00	1,003.89	1,104.28

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
(Note: This item is for a 5,000-gallon tanker. It is assumed that a 21,000 gallon fractionalization tank will be used to temporarily store water that is pumped during various remediation alternatives. From there, water will be transferred to the tanker and transported to the nearby wastewater treatment plant. The total cost, based on a 2013 purchase order from Western New York Septic, escalated by 3% per year to 2016, would be $0.13 per gallon, before tax. Quantity assumes approximately 1 gal per cy excavated.)									
ALT 3 - 331XX20 Site Restoration	**1.0000**	**LS**	**112,769.24**	**56,442.75**	**1,138,890.53**	**0.00**	**1,308,102.52**	**1,712,113.82**	**1,883,325.20**
331XX2001 Earthwork	**1.0000**	**LS**	**14,017.85**	**15,162.23**	**371,155.39**	**0.00**	**400,335.47**	**523,980.25**	**576,378.28**
			1,984.6041	*2,006.5025*	*142,067.5200*		*146,058.6266*	*191,169.2614*	*210,286.1875*
331XX200103 Backfill	**1.0000**	**EA**	**1,984.60**	**2,006.50**	**142,067.52**	**0.00**	**146,058.63**	**191,169.26**	**210,286.19**
			0.3168	*0.3203*	*22.6800*	*0.0000*	*23.3171*	*30.5187*	*33.5706*
RSM 312323155080 Borrow, select granular fill, 5 C.Y. bucket, loading and/or spreading, front end loader, wheel mounted	6,264.0000	ECY	1,984.60	2,006.50	142,067.52	0.00	146,058.63	191,169.26	210,286.19
(Note: Quantity incorporates the volumes required to replace soils removed as well as half of the volume of concrete foundation excavated. So 5,900 cy soil + (727/2) cy concrete = 6,264 cy)									
			0.0000	*0.0000*	*105,535.8720*		*105,535.8720*	*138,130.9353*	*151,944.0288*
331XX200104 Borrow	**1.0000**	**EA**	**0.00**	**0.00**	**105,535.87**	**0.00**	**105,535.87**	**138,130.94**	**151,944.03**
			0.0000	*0.0000*	*12.9600*	*0.0000*	*12.9600*	*16.9627*	*18.6590*
USR Backfill Material including Delivery	8,143.2000	LCY	0.00	0.00	105,535.87	0.00	105,535.87	138,130.94	151,944.03
(Note: Assume a swell factor of 1.3)									
			3,334.8162	*1,983.2015*	*0.0000*		*5,318.0176*	*6,960.5029*	*7,656.5532*
331XX200107 Grading	**1.0000**	**EA**	**3,334.82**	**1,983.20**	**0.00**	**0.00**	**5,318.02**	**6,960.50**	**7,656.55**
			3,334.8162	*1,983.2015*	*0.0000*	*0.0000*	*5,318.0176*	*6,960.5029*	*7,656.5532*
RSM 312213200280 Rough grading sites, open, 75100-100000 S.F., grader	1.0000	EA	3,334.82	1,983.20	0.00	0.00	5,318.02	6,960.50	7,656.55
			1,087.7157	*659.8889*	*0.0000*		*1,747.6046*	*2,287.3574*	*2,516.0931*
331XX200108 Compaction	**1.0000**	**EA**	**1,087.72**	**659.89**	**0.00**	**0.00**	**1,747.60**	**2,287.36**	**2,516.09**
			0.1736	*0.1053*	*0.0000*	*0.0000*	*0.2790*	*0.3652*	*0.4017*
RSM 312323235060 Compaction, riding, vibrating roller, 2 passes, 12" lifts	6,264.0000	ECY	1,087.72	659.89	0.00	0.00	1,747.60	2,287.36	2,516.09
			2,054.0540	*4,894.6680*	*0.0000*		*6,948.7220*	*9,094.8551*	*10,004.3407*
331XX200113 Stockpiling	**1.0000**	**EA**	**2,054.05**	**4,894.67**	**0.00**	**0.00**	**6,948.72**	**9,094.86**	**10,004.34**
			0.2522	*0.6011*	*0.0000*	*0.0000*	*0.8533*	*1.1169*	*1.2286*
HNC 312213103020 Rough grading, open site, large area, 300 H.P., dozer	8,143.2000	LCY	2,054.05	4,894.67	0.00	0.00	6,948.72	9,094.86	10,004.34
(Note: This item is used for maintaining stockpiled fill material)									
			5,556.6576	*5,617.9704*	*123,552.0000*		*134,726.6279*	*176,337.3417*	*193,971.0759*
331XX200114 Topsoil	**1.0000**	**EA**	**5,556.66**	**5,617.97**	**123,552.00**	**0.00**	**134,726.63**	**176,337.34**	**193,971.08**
			0.3473	*0.3511*	*0.0000*	*0.0000*	*0.6984*	*0.9141*	*1.0055*
RSM 312323157080 Borrow, topsoil or loam, 5 C.Y. bucket, loading and/or spreading, front end loader, wheel mounted	16,000.0000	ECY	5,556.66	5,617.97	0.00	0.00	11,174.63	14,625.94	16,088.54

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
(Note: Material cost removed since it is accounted for under a separate item. Topsoil quantity is approximated based on aerial photos (approx. 96,000 sy), assuming 6" is placed over the entire area. 6" = 0.167 yd, so 96,000 sy x 0.167 yd = 16,000 cy)									
			0.0000	*0.0000*	*23.7600*	*0.0000*	*23.7600*	*31.0983*	*34.2082*
USR Topsoil Purchase and Delivery	5,200.0000	LCY	0.00	0.00	123,552.00	0.00	123,552.00	161,711.40	177,882.54
(Note: Since the majority of stripped topsoil can be re-used, it is assumed that only 25% of the topsoil placed needs to be purchased. Assume a swell factor of 1.3)									
			80,677.3136	*33,934.9982*	*585,258.3333*		*699,870.6451*	*916,027.7445*	*1,007,630.5190*
331XX2003 Permanent Features	**1.0000**	**EA**	**80,677.31**	**33,935.00**	**585,258.33**	**0.00**	**699,870.65**	**916,027.74**	**1,007,630.52**
			0.9075	*0.3817*	*6.5833*		*7.8726*	*10.3040*	*11.3344*
331XX200301 Road Replacement	**88,900.0000**	**SF**	**80,677.31**	**33,935.00**	**585,258.33**	**0.00**	**699,870.65**	**916,027.74**	**1,007,630.52**
			4.9905	*1.2719*	*75.6000*	*0.0000*	*81.8623*	*107.1457*	*117.8603*
RSM 321126132007 Plant mixed asphaltic base courses, for roadways and large paved areas, alternate method to figure base course, bituminous concrete, 8" thick	4,390.1235	TON	21,908.71	5,583.68	331,893.33	0.00	359,385.73	470,383.06	517,421.37
(Note: Quantity approximated based on aerial photos. Assume 2 ton/cy. 88,900 sf of pavement need to be replaced, at 8" thick this is approximately 2,200 cy)									
			1.5912	*0.4055*	*16.4700*	*0.0000*	*18.4667*	*24.1702*	*26.5872*
RSM 321216130200 Plant-mix asphalt paving, for highways and large paved areas, binder course, 4" thick, no hauling included	9,877.7778	SY	15,717.12	4,005.68	162,687.00	0.00	182,409.80	238,747.61	262,622.37
			1.1336	*0.3344*	*9.1800*	*0.0000*	*10.6480*	*13.9367*	*15.3304*
RSM 321216130380 Plant-mix asphalt paving, for highways and large paved areas, wearing course, 2" thick, no hauling included	9,877.7778	SY	11,197.59	3,303.47	90,678.00	0.00	105,179.06	137,663.92	151,430.31
			0.4515	*0.2123*	*0.0000*	*0.0000*	*0.6638*	*0.8688*	*0.9556*
RSM 312216100011 Fine grading, finish grading granular subbase for highway paving, +/- 1"	9,877.7778	SY	4,459.36	2,097.16	0.00	0.00	6,556.52	8,581.52	9,439.67
			5.9386	*4.1069*	*0.0000*	*0.0000*	*10.0454*	*13.1480*	*14.4628*
HNC 312323180555 Hauling, excavated or borrow material, loose cubic yards, 12 mile round trip @ base wide rate, 12 C.Y. truck, highway haulers, excludes loading	4,613.0000	LCY	27,394.54	18,945.00	0.00	0.00	46,339.54	60,651.64	66,716.81
(Note: This item is for hauling Asphalt from the plant. Distance is assumed. Productivity reduced by half to account for extra waiting time at the site. Quantity assumes 2 ton/cy for base, so 4,390/2 = 2,195 cy; 9,878 sy @ 4" thick binder = 1,098 cy; 9,878 sy @ 2" thick top = 549 cy; total = 3,842 cy, assume 20% compaction so total volume required = 4,610 cy.)									
			18,074.0808	*7,345.5234*	*182,476.8000*		*207,896.4042*	*272,105.8178*	*299,316.3996*
331XX2004 Revegetation And Planting	**1.0000**	**EA**	**18,074.08**	**7,345.52**	**182,476.80**	**0.00**	**207,896.40**	**272,105.82**	**299,316.40**
			18,074.0808	*7,345.5234*	*182,476.8000*		*207,896.4042*	*272,105.8178*	*299,316.3996*
331XX200401 Seeding/Mulch/Fertilizer	**1.0000**	**EA**	**18,074.08**	**7,345.52**	**182,476.80**	**0.00**	**207,896.40**	**272,105.82**	**299,316.40**
			0.1883	*0.0765*	*1.9008*	*0.0000*	*2.1656*	*2.8344*	*3.1179*
RSM 329219131100 Seeding, mechanical seeding hydro or air seeding for large areas, includes lime, fertilizer and seed with wood fiber mulch added	96,000.0000	SY	18,074.08	7,345.52	182,476.80	0.00	207,896.40	272,105.82	299,316.40
(Note: Quantity approximated based on aerial photos)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
ALT 3 - 331XX21 Demobilization	**1.0000**	**LS**	**26,277.56**	**5,191.00**	**17,037.00**	**0.00**	**48,505.56**	**63,486.65**	**69,835.31**
			15,469.9117	*5,180.0213*	*1,663.2000*		*22,313.1330*	*29,204.6095*	*32,125.0705*
331XX2101 Demob of Construction Equip & Fac	**1.0000**	**EA**	**15,469.91**	**5,180.02**	**1,663.20**	**0.00**	**22,313.13**	**29,204.61**	**32,125.07**
			0.0000	*0.0000*	*1,663.2000*		*1,663.2000*	*2,176.8842*	*2,394.5726*
331XX010190 Site Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**1,663.20**	**0.00**	**1,663.20**	**2,176.88**	**2,394.57**
			0.0000	*0.0000*	*475.2000*		*475.2000*	*621.9669*	*684.1636*
331XX010191 Office Trailers	**1.0000**	**EA**	**0.00**	**0.00**	**475.20**	**0.00**	**475.20**	**621.97**	**684.16**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Office trailer, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: assume 10 miles per haul, 2 trailers. double to account for demob)									
			0.0000	*0.0000*	*712.8000*		*712.8000*	*932.9504*	*1,026.2454*
331XX010192 Toilets	**1.0000**	**EA**	**0.00**	**0.00**	**712.80**	**0.00**	**712.80**	**932.95**	**1,026.25**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Portable toilet and hand wash, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: Assume same cost for delivering storage trailers - three toilets and two hand washes delivered on two trucks. Double to account for demob)									
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Portable hand wash station, delivery, add per mile	20.0000	MI	0.00	0.00	237.60	0.00	237.60	310.98	342.08
(Note: Assume same cost for delivering storage trailers - three delivered on one truck. Double to account for demob)									
			0.0000	*0.0000*	*475.2000*		*475.2000*	*621.9669*	*684.1636*
331XX010193 Storage Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**475.20**	**0.00**	**475.20**	**621.97**	**684.16**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Storage trailer, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: Assume same cost for delivering storage trailers - 2 deliveries double to account for demob)									
			15,469.9117	*5,180.0213*	*0.0000*		*20,649.9330*	*27,027.7253*	*29,730.4979*
331XX010191 Construction Equipment	**1.0000**	**EA**	**15,469.91**	**5,180.02**	**0.00**	**0.00**	**20,649.93**	**27,027.73**	**29,730.50**
			509.8944	*173.1983*	*0.0000*	*0.0000*	*683.0927*	*894.0678*	*983.4746*
RSM 015436501400 Mobilization or demobilization, delivery charge for equipment, hauled on 20-ton capacity towed trailer	20.0000	EA	10,197.89	3,463.97	0.00	0.00	13,661.85	17,881.36	19,669.49
(Note: Mobilization/demobilization of medium-sized equipment. 1 paver, 1 medium excavator, 3 medium FE loaders/backhoes/skidsteers, 3 rollers, 2 dozers)									
			540.2320	*191.5054*	*0.0000*	*0.0000*	*731.7374*	*957.7366*	*1,053.5102*
RSM 015436501500 Mobilization or demobilization, delivery charge for equipment, hauled on 40-ton capacity towed trailer	8.0000	EA	4,321.86	1,532.04	0.00	0.00	5,853.90	7,661.89	8,428.08
(Note: Mobilization/demobilization of heavy equipment. 1 grader, 2 large excavators, 1 large FE loader)									
			118.7710	*23.0016*	*0.0000*	*0.0000*	*141.7726*	*185.5595*	*204.1155*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
RSM 015436501200 Mobilization or demobilization, delivery charge for small equipment, placed in rear of, or towed by pickup truck (Note: Assume 4 loads each way for smaller equipment (saws, pumps, excavator attachments, etc.))	8.0000	EA	950.17	184.01	0.00	0.00	1,134.18	1,484.48	1,632.92
			9,473.0211	*0.0000*	*14,596.2000*		*24,069.2211*	*31,503.0706*	*34,653.3777*
331XX2102 Removal of Temporary Utilities	**1.0000**	**EA**	**9,473.02**	**0.00**	**14,596.20**	**0.00**	**24,069.22**	**31,503.07**	**34,653.38**
			9,473.0211	*0.0000*	*14,596.2000*		*24,069.2211*	*31,503.0706*	*34,653.3777*
331XX010502 Power Connection/Distribution	**1.0000**	**EA**	**9,473.02**	**0.00**	**14,596.20**	**0.00**	**24,069.22**	**31,503.07**	**34,653.38**
			128.2738	*0.0000*	*124.2000*	*0.0000*	*252.4738*	*330.4511*	*363.4962*
RSM 015113500870 Temporary electrical power equipment (pro-rated per job), connections, office trailer, 60 amp	2.0000	EA	256.55	0.00	248.40	0.00	504.95	660.90	726.99
			461.7857	*0.0000*	*793.8000*	*0.0000*	*1,255.5857*	*1,643.3771*	*1,807.7148*
RSM 015113500030 Temporary electrical power equipment (pro-rated per job), overhead feed, 3 uses, 100 amp	1.0000	EA	461.79	0.00	793.80	0.00	1,255.59	1,643.38	1,807.71
			1,443.0804	*0.0000*	*3,888.0000*	*0.0000*	*5,331.0804*	*6,977.6002*	*7,675.3602*
RSM 015113500240 Temporary electrical power equipment (pro-rated per job), transformers, 3 uses, 112.5 kVA	1.0000	EA	1,443.08	0.00	3,888.00	0.00	5,331.08	6,977.60	7,675.36
			7.2154	*0.0000*	*7.1280*	*0.0000*	*14.3434*	*18.7734*	*20.6507*
RSM 015113500420 Temporary electrical power equipment (pro-rated per job), feeder, EMT and aluminum wire, 100 amp (Note: Quantity approximated)	1,000.0000	LF	7,215.40	0.00	7,128.00	0.00	14,343.40	18,773.40	20,650.74
			48.1027	*0.0000*	*1,269.0000*	*0.0000*	*1,317.1027*	*1,723.8937*	*1,896.2831*
RSM 015113500560 Temporary electrical power equipment (pro-rated per job), temporary feeder cords, 100 amp, 3 uses, 100' long	2.0000	EA	96.21	0.00	2,538.00	0.00	2,634.21	3,447.79	3,792.57
			1,334.6250	*10.9816*	*777.6000*		*2,123.2067*	*2,778.9653*	*3,056.8618*
331XX0104 Deconstruct/Remove Temp Facilities	**1.0000**	**EA**	**1,334.63**	**10.98**	**777.60**	**0.00**	**2,123.21**	**2,778.97**	**3,056.86**
			1,334.6250	*10.9816*	*777.6000*		*2,123.2067*	*2,778.9653*	*3,056.8618*
331XX010430 Erosion Control	**1.0000**	**EA**	**1,334.63**	**10.98**	**777.60**	**0.00**	**2,123.21**	**2,778.97**	**3,056.86**
			1.3346	*0.0110*	*0.7776*	*0.0000*	*2.1232*	*2.7790*	*3.0569*
RSM 312514161000 Synthetic erosion control, silt fence, install and maintain, remove, 3' high (Note: Assume cost for removal is the same as for installation)	1,000.0000	LF	1,334.63	10.98	777.60	0.00	2,123.21	2,778.97	3,056.86
ALT 3 - 331XX22 Gen Requirements (Opt Breakout)	**1.0000**	**LS**	**252,039.32**	**0.00**	**8,709.65**	**0.00**	**261,798.97**	**342,656.35**	**376,921.99**
			226,704.6412	*0.0000*	*1,080.0000*		*227,784.6412*	*298,136.5950*	*327,950.2545*
331XX2207 Health & Safety	**1.0000**	**EA**	**226,704.64**	**0.00**	**1,080.00**	**0.00**	**227,784.64**	**298,136.60**	**327,950.25**
			198,573.4083	*0.0000*	*0.0000*		*198,573.4083*	*259,903.3873*	*285,893.7261*
331XX220702 Radiation Protection Tech (RPT)	**1.0000**	**EA**	**198,573.41**	**0.00**	**0.00**	**0.00**	**198,573.41**	**259,903.39**	**285,893.73**

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			150.4344	*0.0000*	*0.0000*	*0.0000*	*150.4344*	*196.8965*	*216.5862*
USR Rad-Technician crew	1,320.0000	HR	198,573.41	0.00	0.00	0.00	198,573.41	259,903.39	285,893.73
(Note: 2 technicians for duration of project (352 hours per month + 2 hr per day OT). Overtime assumed for daily setup and takedown of equipment and report generation.)									
			28,131.2328	*0.0000*	*0.0000*		*28,131.2328*	*36,819.6465*	*40,501.6112*
331XX220707 Site Safety & Health Officer	**1.0000**	**EA**	**28,131.23**	**0.00**	**0.00**	**0.00**	**28,131.23**	**36,819.65**	**40,501.61**
			42.6231	*0.0000*	*0.0000*	*0.0000*	*42.6231*	*55.7873*	*61.3661*
USR CAMP Monitor Labor	660.0000	HR	28,131.23	0.00	0.00	0.00	28,131.23	36,819.65	40,501.61
(Note: Full time for duration of project (3 months at 176 hr/month + 2 hr per day OT). Rate obtained from a similar nearby recent project. Overtime assumed for daily setup and takedown of equipment and report generation.)									
			0.0000	*0.0000*	*1,080.0000*		*1,080.0000*	*1,413.5612*	*1,554.9173*
331XX220716 Personal Protection Equipment	**1.0000**	**EA**	**0.00**	**0.00**	**1,080.00**	**0.00**	**1,080.00**	**1,413.56**	**1,554.92**
USR Personal Protective Equipment	1.0000	LS	0.00	0.00	1,080.00	0.00	1,080.00	1,413.56	1,554.92
(Note: Assume an allowance of $10,000 for PPE (gloves, eyewear, safety vests, ear plugs, boot covers, tyvek, etc.))									
			0.0000	*0.0000*	*1,393.2000*		*1,393.2000*	*1,823.4939*	*2,005.8433*
331XX2210 Project Utilities	**1.0000**	**EA**	**0.00**	**0.00**	**1,393.20**	**0.00**	**1,393.20**	**1,823.49**	**2,005.84**
			0.0000	*0.0000*	*91.8000*	*0.0000*	*91.8000*	*120.1527*	*132.1680*
RSM 015213400140 Field office expense, Internet	6.0000	MO	0.00	0.00	550.80	0.00	550.80	720.92	793.01
(Note: 2 hookups for 3 months)									
			0.0000	*0.0000*	*842.4000*		*842.4000*	*1,102.5777*	*1,212.8355*
331XX221002 Electrical Usage	**1.0000**	**EA**	**0.00**	**0.00**	**842.40**	**0.00**	**842.40**	**1,102.58**	**1,212.84**
			0.0000	*0.0000*	*0.1404*	*0.0000*	*0.1404*	*0.1838*	*0.2021*
HTW 015113800460 Electrical Charge Industrial Use	6,000.0000	KWH	0.00	0.00	842.40	0.00	842.40	1,102.58	1,212.84
(Note: Assume 2,000 kwH per month for 3 months)									
			25,334.6836	*0.0000*	*6,236.4492*		*32,621.1328*	*42,696.2652*	*46,965.8918*
331XX2208 Temp Const Facilities-Ownership	**1.0000**	**EA**	**25,334.68**	**0.00**	**6,236.45**	**0.00**	**32,621.13**	**42,696.27**	**46,965.89**
			0.0000	*0.0000*	*1,863.0000*		*1,863.0000*	*2,438.3930*	*2,682.2323*
331XX220801 Office Trailers and Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**1,863.00**	**0.00**	**1,863.00**	**2,438.39**	**2,682.23**
			0.0000	*0.0000*	*258.1200*	*0.0000*	*258.1200*	*337.8411*	*371.6252*
RSM 015213200350 Office trailer, furnished, rent per month, 32' x 8', excl. hookups	6.0000	EA	0.00	0.00	1,548.72	0.00	1,548.72	2,027.05	2,229.75
(Note: Two trailers for three months.)									
			0.0000	*0.0000*	*52.3800*	*0.0000*	*52.3800*	*68.5577*	*75.4135*
RSM 015213200700 Office trailer, excl. hookups, air conditioning, rent per month, add	6.0000	EA	0.00	0.00	314.28	0.00	314.28	411.35	452.48
(Note: Two trailers for three months.)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*1,814.4000*		*1,814.4000*	*2,374.7828*	*2,612.2610*
331XX220802 Office Furniture & Office Equip	**1.0000**	**EA**	**0.00**	**0.00**	**1,814.40**	**0.00**	**1,814.40**	**2,374.78**	**2,612.26**
			0.0000	*0.0000*	*216.0000*	*0.0000*	*216.0000*	*282.7122*	*310.9835*
RSM 015213400100 Field office expense, office equipment rental, average (Note: 2 offices for 3 months)	6.0000	MO	0.00	0.00	1,296.00	0.00	1,296.00	1,696.27	1,865.90
			0.0000	*0.0000*	*86.4000*	*0.0000*	*86.4000*	*113.0849*	*124.3934*
RSM 015213400120 Field office expense, office supplies, average (Note: Two offices for three months)	6.0000	MO	0.00	0.00	518.40	0.00	518.40	678.51	746.36
			0.0000	*0.0000*	*534.6000*		*534.6000*	*699.7128*	*769.6841*
331XX220803 Warehouse & Stor Trailers/Facil	**1.0000**	**EA**	**0.00**	**0.00**	**534.60**	**0.00**	**534.60**	**699.71**	**769.68**
			0.0000	*0.0000*	*89.1000*	*0.0000*	*89.1000*	*116.6188*	*128.2807*
RSM 015213201250 Storage boxes, rent per month, 20' x 8' (Note: Two boxes for three months.)	6.0000	EA	0.00	0.00	534.60	0.00	534.60	699.71	769.68
			0.0000	*0.0000*	*937.9800*		*1,987.9800*	*2,601.9734*	*2,862.1708*
331XX220808 Construction Portable Toilets	**1.0000**	**EA**	**0.00**	**0.00**	**937.98**	**0.00**	**1,987.98**	**2,601.97**	**2,862.17**
			0.0000	*0.0000*	*104.2200*	*0.0000*	*104.2200*	*136.4087*	*150.0495*
HNC 015213201400 Toilet, portable, chemical, rent per month (Note: 3 toilets for 3 months)	9.0000	MO	0.00	0.00	937.98	0.00	937.98	1,227.68	1,350.45
			0.0000	*0.0000*	*0.0000*	*0.0000*	*175.0000*	*229.0493*	*251.9542*
USR Portable Handwash Station (Note: Cost for rental $175/month based on a recent quote for a similar item. Included delivery. Assume 2 are required.)	6.0000	MO	0.00	0.00	0.00	0.00	1,050.00	1,374.30	1,511.73
			0.0000	*0.0000*	*1,086.4692*		*1,086.4692*	*1,422.0284*	*1,564.2312*
331XX220811 Decon Facilities for Personnel	**1.0000**	**EA**	**0.00**	**0.00**	**1,086.47**	**0.00**	**1,086.47**	**1,422.03**	**1,564.23**
			0.0000	*0.0000*	*362.1564*	*0.0000*	*362.1564*	*474.0095*	*521.4104*
HTW 019413205977 Decontamination kit in 3 gallon metal drum, 27 items	3.0000	EA	0.00	0.00	1,086.47	0.00	1,086.47	1,422.03	1,564.23
			25,334.6836	*0.0000*	*0.0000*		*25,334.6836*	*33,159.3748*	*36,475.3123*
331XX220812 Decon Facil for Const Equip/Veh	**1.0000**	**EA**	**25,334.68**	**0.00**	**0.00**	**0.00**	**25,334.68**	**33,159.37**	**36,475.31**
			664.9966	*0.0000*	*0.0000*	*0.0000*	*664.9966*	*870.3827*	*957.4210*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
HTW 019413103112 Spray washing, decontaminate heavy equipment, decontaminate heavy equipment	20.0000	EA	13,299.93	0.00	0.00	0.00	13,299.93	17,407.65	19,148.42
(Note: Assume decontamination of all equipment once during release from site. Approximate 20 pieces of equipment.)									
			300.8688	*0.0000*	*0.0000*	*0.0000*	*300.8688*	*393.7930*	*433.1723*
USR Release Surveys and Equipment Frisks	40.0000	EA	12,034.75	0.00	0.00	0.00	12,034.75	15,751.72	17,326.89
(Note: Assume 2 hour average per survey and/or frisk. These will need to be done during entry to and exit from site, so assuming 20 pieces of equipment, quantity is 40.)									
ALT 3 - 331XX90 Decon	**1.0000**	**LS**	**26,726.12**	**12,990.58**	**0.00**	**0.00**	**39,716.70**	**51,983.32**	**57,181.65**
			481.9479	*25.8979*	*0.0000*	*0.0000*	*507.8459*	*664.6956*	*731.1651*
USR Concrete Shaving	53.5100	MSF	25,789.03	1,385.80	0.00	0.00	27,174.83	35,567.86	39,124.65
(Note: Productivity approximated based on similar items in RS Means (090505200700), however, rather than crew A1a, the custom crew includes an operator, two laborers, a skid steer (with a shaver purchased separately) and a vacuum pickup system; productivity is therefore is assumed to be double (from 0.225 to 0.45). Purchase of shaver is under a separate item. This item excludes Building 401, which is to be removed.)									
			0.0000	*11,444.3890*	*0.0000*	*0.0000*	*11,444.3890*	*14,979.0221*	*16,476.9243*
USR Purchase Concrete Floor Shaver	1.0000	EA	0.00	11,444.39	0.00	0.00	11,444.39	14,979.02	16,476.92
(Note: Cost per Skidsteersolutions.com $10,295.00 + tax (8.875%) = $11,209)									
			11.3480	*1.9423*	*0.0000*	*0.0000*	*13.2904*	*17.3951*	*19.1346*
USR Transport concrete dust and chips to temporary stockpile area	82.5772	CY	937.09	160.39	0.00	0.00	1,097.48	1,436.44	1,580.08
(Note: Productivity assumes approximately 10 minutes per round trip using a skid steer (1 cy per trip). Quantity is approximated based on the surface area of concrete being decontamniated, at 1/2" thick.)									
			0.0000	*0.0000*	*0.0000*		*414,153.0000*	*414,153.0000*	*414,153.0000*
342XX ALT 3 - O&M	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**414,153.00**	**414,153.00**	**414,153.00**
USR Present Value for Long-Term O&M	1.0000	LS	0.00	0.00	0.00	0.00	414,153.00	414,153.00	414,153.00
(Note: Present value calculated per Chapter 4 of the USEPA Guide to Developing and Documenting Cost Estimates During the Feasibility Study, and additional guidance from USACE using a yearly cost of $13,460, discount rate of 3.25% and period of 1,000 years.)									
4 ALT 4 - Soil and GW Removal w/ Offsite Disposal; Remove Bldg 401 Foundation and Drains; Decon Foundations; and In-Situ VOC Treatment	**1.0000**	**LS**	**570,465.80**	**136,900.84**	**1,066,251.33**	**105,000.00**	**12,203,923.86**	**16,032,483.42**	**17,594,316.46**
331XX ALT 4 - CAPITAL COSTS	**1.0000**	**LS**	**570,465.80**	**136,900.84**	**1,066,251.33**	**105,000.00**	**11,789,770.86**	**15,618,330.42**	**17,180,163.46**
ALT 4 - 331XX01 Mobilize and Preparatory Work	**1.0000**	**LS**	**27,481.55**	**5,647.46**	**18,774.72**	**105,000.00**	**156,903.74**	**205,363.92**	**225,900.31**

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			15,469.9117	*5,180.0213*	*1,663.2000*		*22,313.1330*	*29,204.6095*	*32,125.0705*
331XX0101 Mob Construction Equip & Fac	**1.0000**	**EA**	**15,469.91**	**5,180.02**	**1,663.20**	**0.00**	**22,313.13**	**29,204.61**	**32,125.07**
			0.0000	*0.0000*	*1,663.2000*		*1,663.2000*	*2,176.8842*	*2,394.5726*
331XX010190 Site Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**1,663.20**	**0.00**	**1,663.20**	**2,176.88**	**2,394.57**
			0.0000	*0.0000*	*475.2000*		*475.2000*	*621.9669*	*684.1636*
331XX010191 Office Trailers	**1.0000**	**EA**	**0.00**	**0.00**	**475.20**	**0.00**	**475.20**	**621.97**	**684.16**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Office trailer, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: assume 10 miles per haul, 2 trailers. double to account for demob)									
			0.0000	*0.0000*	*712.8000*		*712.8000*	*932.9504*	*1,026.2454*
331XX010192 Toilets	**1.0000**	**EA**	**0.00**	**0.00**	**712.80**	**0.00**	**712.80**	**932.95**	**1,026.25**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Portable toilet and hand wash, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: Assume same cost for delivering storage trailers - three toilets and two hand washes delivered on two trucks. Double to account for demob)									
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Portable hand wash station, delivery, add per mile	20.0000	MI	0.00	0.00	237.60	0.00	237.60	310.98	342.08
(Note: Assume same cost for delivering storage trailers - three delivered on one truck. Double to account for demob)									
			0.0000	*0.0000*	*475.2000*		*475.2000*	*621.9669*	*684.1636*
331XX010193 Storage Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**475.20**	**0.00**	**475.20**	**621.97**	**684.16**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Storage trailer, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: Assume same cost for delivering storage trailers - 2 deliveries double to account for demob)									
			15,469.9117	*5,180.0213*	*0.0000*		*20,649.9330*	*27,027.7253*	*29,730.4979*
331XX010191 Construction Equipment	**1.0000**	**EA**	**15,469.91**	**5,180.02**	**0.00**	**0.00**	**20,649.93**	**27,027.73**	**29,730.50**
			509.8944	*173.1983*	*0.0000*	*0.0000*	*683.0927*	*894.0678*	*983.4746*
RSM 015436501400 Mobilization or demobilization, delivery charge for equipment, hauled on 20-ton capacity towed trailer	20.0000	EA	10,197.89	3,463.97	0.00	0.00	13,661.85	17,881.36	19,669.49
(Note: Mobilization/demobilization of medium-sized equipment. 1 paver, 1 medium excavator, 3 medium FE loaders/backhoes/skidsteers, 3 rollers, 2 dozers)									
			540.2320	*191.5054*	*0.0000*	*0.0000*	*731.7374*	*957.7366*	*1,053.5102*
RSM 015436501500 Mobilization or demobilization, delivery charge for equipment, hauled on 40-ton capacity towed trailer	8.0000	EA	4,321.86	1,532.04	0.00	0.00	5,853.90	7,661.89	8,428.08
(Note: Mobilization/demobilization of heavy equipment. 1 grader, 2 large excavators, 1 large FE loader)									
			118.7710	*23.0016*	*0.0000*	*0.0000*	*141.7726*	*185.5595*	*204.1155*
RSM 015436501200 Mobilization or demobilization, delivery charge for small equipment, placed in rear	8.0000	EA	950.17	184.01	0.00	0.00	1,134.18	1,484.48	1,632.92

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
of, or towed by pickup truck									
(Note: Assume 4 loads each way for smaller equipment (saws, pumps, excavator attachments, etc.))									
			0.0000	*0.0000*	*0.0000*		*105,000.0000*	*137,429.5577*	*151,172.5134*
331XX0103 Submittals/Implementation Plans	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**105,000.00**	**105,000.00**	**137,429.56**	**151,172.51**
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Community Air Monitoring Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Remedial Action Work Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Quality Control Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Sampling and Analysis Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Materials Handling/Transportation and Disposal Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Health and Safety Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Stormwater Pollution Prevention Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Community Participation Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*5,000.0000*	*5,000.0000*	*6,544.2647*	*7,198.6911*
USR Project Schedule	1.0000	EA	0.00	0.00	0.00	5,000.00	5,000.00	6,544.26	7,198.69
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by 75% for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
USR Site Access/Site Security Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Site Management/Long-term O&M Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			2,538.6206	*467.4417*	*2,515.3200*		*5,521.3824*	*7,226.6775*	*7,949.3452*
331XX0104 Setup/Construct Temp Facilities	**1.0000**	**EA**	**2,538.62**	**467.44**	**2,515.32**	**0.00**	**5,521.38**	**7,226.68**	**7,949.35**
			0.0000	*0.0000*	*1,089.7200*		*1,089.7200*	*1,426.2832*	*1,568.9115*
331XX010411 Barricades	**1.0000**	**EA**	**0.00**	**0.00**	**1,089.72**	**0.00**	**1,089.72**	**1,426.28**	**1,568.91**
			0.0000	*0.0000*	*114.4800*	*0.0000*	*114.4800*	*149.8375*	*164.8212*
RSM 015623100410 Barricades, PVC pipe barricade, break-a-way, buy, 3" diam. PVC, with 3 each 1' x 4' reflectorized panels	4.0000	EA	0.00	0.00	457.92	0.00	457.92	599.35	659.28
(Note: Quantity approximated - will be used to protect open excavations and active work areas)									
			0.0000	*0.0000*	*21.0600*	*0.0000*	*21.0600*	*27.5644*	*30.3209*
RSM 015623100850 Barricades, traffic cones, PVC, 28" high	30.0000	EA	0.00	0.00	631.80	0.00	631.80	826.93	909.63
(Note: Quantity approximated - will be used to protect open excavations and active work areas)									
			1,334.6250	*10.9816*	*777.6000*		*2,123.2067*	*2,778.9653*	*3,056.8618*
331XX010430 Erosion Control	**1.0000**	**EA**	**1,334.63**	**10.98**	**777.60**	**0.00**	**2,123.21**	**2,778.97**	**3,056.86**
			1.3346	*0.0110*	*0.7776*	*0.0000*	*2.1232*	*2.7790*	*3.0569*
RSM 312514161000 Synthetic erosion control, silt fence, install and maintain, remove, 3' high	1,000.0000	LF	1,334.63	10.98	777.60	0.00	2,123.21	2,778.97	3,056.86
(Note: Quantity approximated - will be used to protect temporary staging areas and other sensitive areas)									
			1,203.9956	*456.4601*	*648.0000*		*2,308.4557*	*3,021.4290*	*3,323.5719*
331XX010491 Temporary Staging Areas	**1.0000**	**EA**	**1,204.00**	**456.46**	**648.00**	**0.00**	**2,308.46**	**3,021.43**	**3,323.57**
			0.1204	*0.0456*	*0.0648*	*0.0000*	*0.2308*	*0.3021*	*0.3324*
USR Create Stockpile area	10,000.0000	SF	1,204.00	456.46	648.00	0.00	2,308.46	3,021.43	3,323.57
(Note: User-created crew utilized due to lack of appropriate options in the Cost Book. Assume 100 x 100 ft temporary staging area. Assume 1 half day to construct. Created using a loader for moving earth, and laborers for spotting and placing liner. Silt fence installation included under 10430 - Erosion Control Material cost for poly liner per Uline online - $0.5/sy or approx. $0.06/sf. Removal will be covered under general site restoration.)									
			9,473.0211	*0.0000*	*14,596.2000*		*24,069.2211*	*31,503.0706*	*34,653.3777*
331XX0105 Construct Temporary Utilities	**1.0000**	**EA**	**9,473.02**	**0.00**	**14,596.20**	**0.00**	**24,069.22**	**31,503.07**	**34,653.38**
			9,473.0211	*0.0000*	*14,596.2000*		*24,069.2211*	*31,503.0706*	*34,653.3777*
331XX010502 Power Connection/Distribution	**1.0000**	**EA**	**9,473.02**	**0.00**	**14,596.20**	**0.00**	**24,069.22**	**31,503.07**	**34,653.38**
			128.2738	*0.0000*	*124.2000*	*0.0000*	*252.4738*	*330.4511*	*363.4962*
RSM 015113500870 Temporary electrical power	2.0000	EA	256.55	0.00	248.40	0.00	504.95	660.90	726.99

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
equipment (pro-rated per job), connections, office trailer, 60 amp									
			461.7857	*0.0000*	*793.8000*	*0.0000*	*1,255.5857*	*1,643.3771*	*1,807.7148*
RSM 015113500030 Temporary electrical power equipment (pro-rated per job), overhead feed, 3 uses, 100 amp	1.0000	EA	461.79	0.00	793.80	0.00	1,255.59	1,643.38	1,807.71
			1,443.0804	*0.0000*	*3,888.0000*	*0.0000*	*5,331.0804*	*6,977.6002*	*7,675.3602*
RSM 015113500240 Temporary electrical power equipment (pro-rated per job), transformers, 3 uses, 112.5 kVA	1.0000	EA	1,443.08	0.00	3,888.00	0.00	5,331.08	6,977.60	7,675.36
			7.2154	*0.0000*	*7.1280*	*0.0000*	*14.3434*	*18.7734*	*20.6507*
RSM 015113500420 Temporary electrical power equipment (pro-rated per job), feeder, EMT and aluminum wire, 100 amp (Note: Quantity approximated)	1,000.0000	LF	7,215.40	0.00	7,128.00	0.00	14,343.40	18,773.40	20,650.74
			48.1027	*0.0000*	*1,269.0000*	*0.0000*	*1,317.1027*	*1,723.8937*	*1,896.2831*
RSM 015113500560 Temporary electrical power equipment (pro-rated per job), temporary feeder cords, 100 amp, 3 uses, 100' long	2.0000	EA	96.21	0.00	2,538.00	0.00	2,634.21	3,447.79	3,792.57
ALT 4 - 331XX02 Monitoring,Samplng,Test,Analysis	**1.0000**	**LS**	**0.00**	**0.00**	**1,827.36**	**0.00**	**140,249.86**	**183,566.44**	**201,923.08**
			0.0000	*0.0000*	*0.0000*		*8,452.5000*	*11,063.0794*	*12,169.3873*
331XX0202 Radiation Monitoring	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**8,452.50**	**11,063.08**	**12,169.39**
			0.0000	*0.0000*	*0.0000*		*8,452.5000*	*11,063.0794*	*12,169.3873*
331XX020201 Area Monitoring	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**8,452.50**	**11,063.08**	**12,169.39**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*2,657.5000*	*3,478.2767*	*3,826.1043*
USR Rent Radiological Monitoring Equipment	3.0000	MO	0.00	0.00	0.00	0.00	7,972.50	10,434.83	11,478.31
(Note: Cost per bid results from a recent similar project. Refer to project notes for a list of equipment and quantities.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*240.0000*	*314.1247*	*345.5372*
USR Shipping for Radiological Monitoring Equipment	2.0000	EA	0.00	0.00	0.00	0.00	480.00	628.25	691.07
(Note: Cost per bid results from a recent similar project. Cost is per delivery, each way.)									
			0.0000	*0.0000*	*0.0000*		*23,000.0000*	*30,103.6174*	*33,113.9791*
331XX0203 Air Monitoring & Sampling	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**23,000.00**	**30,103.62**	**33,113.98**
			0.0000	*0.0000*	*0.0000*		*23,000.0000*	*30,103.6174*	*33,113.9791*
331XX020301 CAMP	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**23,000.00**	**30,103.62**	**33,113.98**
USR Camp Equipment Rental, Mobilization, and Weekly Reporting	1.0000	LS	0.00	0.00	0.00	0.00	23,000.00	30,103.62	33,113.98
(Note: Cost obtained from estimate for recent similar nearby project. Assumes 3 perimiter air monitoring stations (including 1 dust monitor, 1 PID, 1 datalogger and 1 radio), one meteorological tower, one computer and one telemetry system. Cost includes mobilization/setup by vendor, weekly summary reports and demobilization. The cost assumes a duration of three months.)									
			0.0000	*0.0000*	*38.8800*		*38.8800*	*50.8882*	*55.9770*
331XX0205 Sample Surface wt/Grdwtr/Liquid	**1.0000**	**EA**	**0.00**	**0.00**	**38.88**	**0.00**	**38.88**	**50.89**	**55.98**

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*38.8800*		*38.8800*	*50.8882*	*55.9770*
331XX020505 Sample Shipping and Handling	**1.0000**	**EA**	**0.00**	**0.00**	**38.88**	**0.00**	**38.88**	**50.89**	**55.98**
			0.0000	*0.0000*	*38.8800*	*0.0000*	*38.8800*	*50.8882*	*55.9770*
RSM 029110100230 Sample packaging & shipping, packaging, vials & bottles, 32 ounce HDPE bottle, case of 12	1.0000	EA	0.00	0.00	38.88	0.00	38.88	50.89	55.98
(Note: Labor for sample collection is accounted for elsewhere in the estimate; it is expected that sample collection will be performed by an on-site engineer, health and safety officer, environmental technician or otherwise.)									
			0.0000	*0.0000*	*1,555.2000*		*1,555.2000*	*2,035.5281*	*2,239.0809*
331XX0206 Sampling Soil and Sediment	**1.0000**	**EA**	**0.00**	**0.00**	**1,555.20**	**0.00**	**1,555.20**	**2,035.53**	**2,239.08**
			0.0000	*0.0000*	*1,555.2000*		*1,555.2000*	*2,035.5281*	*2,239.0809*
331XX020604 Sample Shipping and Handling	**1.0000**	**EA**	**0.00**	**0.00**	**1,555.20**	**0.00**	**1,555.20**	**2,035.53**	**2,239.08**
			0.0000	*0.0000*	*38.8800*	*0.0000*	*38.8800*	*50.8882*	*55.9770*
RSM 029110100230 Sample packaging & shipping, packaging, vials & bottles, 32 ounce HDPE bottle, case of 12	40.0000	EA	0.00	0.00	1,555.20	0.00	1,555.20	2,035.53	2,239.08
(Note: Assume 2 bottles per sample. Labor for sample collection is accounted for elsewhere in the estimate; it is expected that sample collection will be performed by an on-site engineer, health and safety officer, environmental technician or otherwise.)									
			0.0000	*0.0000*	*233.2800*		*233.2800*	*305.3292*	*335.8621*
331XX0208 Sampling Radioactve Contam Media	**1.0000**	**EA**	**0.00**	**0.00**	**233.28**	**0.00**	**233.28**	**305.33**	**335.86**
			0.0000	*0.0000*	*233.2800*		*233.2800*	*305.3292*	*335.8621*
331XX020808 Sample Shipping and Handling	**1.0000**	**EA**	**0.00**	**0.00**	**233.28**	**0.00**	**233.28**	**305.33**	**335.86**
			0.0000	*0.0000*	*38.8800*	*0.0000*	*38.8800*	*50.8882*	*55.9770*
RSM 029110100230 Sample packaging & shipping, packaging, vials & bottles, 32 ounce HDPE bottle, case of 12	6.0000	EA	0.00	0.00	233.28	0.00	233.28	305.33	335.86
(Note: Assume 2 bottles per sample. Labor for sample collection is accounted for elsewhere in the estimate; it is expected that sample collection will be performed by an on-site engineer, health and safety officer, environmental technician or otherwise.)									
			0.0000	*0.0000*	*0.0000*		*106,970.0000*	*140,007.9979*	*154,008.7977*
331XX0209 Laboratory Chemical Analysis	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**106,970.00**	**140,008.00**	**154,008.80**
			0.0000	*0.0000*	*0.0000*		*355.0000*	*464.6428*	*511.1071*
331XX020902 Gen Water Qual & Wastewtr Analys	**2.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**710.00**	**929.29**	**1,022.21**
(Note: Assume only 2 samples will be collected due to the relatively small volume)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*110.0000*	*143.9738*	*158.3712*
USR Ra-226 Analysis	2.0000	EA	0.00	0.00	0.00	0.00	220.00	287.95	316.74
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR Th-232 Analysis	2.0000	EA	0.00	0.00	0.00	0.00	160.00	209.42	230.36
(Note: Cost obtained from lab contract for similar project.)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR U-238 Analysis	2.0000	EA	0.00	0.00	0.00	0.00	160.00	209.42	230.36
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*85.0000*	*111.2525*	*122.3777*
USR PAH Analysis	2.0000	EA	0.00	0.00	0.00	0.00	170.00	222.50	244.76
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*		*385.0000*	*503.9084*	*554.2992*
331XX020907 Soil & Sediment Analysis	**240.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**92,400.00**	**120,938.01**	**133,031.81**
(Note: For approximately 40 individual excavations, with 6 samples per excavation.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*70.0000*	*91.6197*	*100.7817*
USR Ra-226 Analysis	240.0000	EA	0.00	0.00	0.00	0.00	16,800.00	21,988.73	24,187.60
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR Th-232 Analysis	240.0000	EA	0.00	0.00	0.00	0.00	19,200.00	25,129.98	27,642.97
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR U-238 Analysis	240.0000	EA	0.00	0.00	0.00	0.00	19,200.00	25,129.98	27,642.97
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*85.0000*	*111.2525*	*122.3777*
USR PAH Analysis	240.0000	EA	0.00	0.00	0.00	0.00	20,400.00	26,700.60	29,370.66
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*70.0000*	*91.6197*	*100.7817*
USR VOC Analysis	240.0000	EA	0.00	0.00	0.00	0.00	16,800.00	21,988.73	24,187.60
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*		*385.0000*	*503.9084*	*554.2992*
331XX020991 Contaminated Concrete Analysis	**36.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**13,860.00**	**18,140.70**	**19,954.77**
(Note: It is assumed that the cost for analysis of concrete chips is the same as for soil/sediment. Quantity assumes 12 samples per concrete slab.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*70.0000*	*91.6197*	*100.7817*
USR Ra-226 Analysis	36.0000	EA	0.00	0.00	0.00	0.00	2,520.00	3,298.31	3,628.14
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR Th-232 Analysis	36.0000	EA	0.00	0.00	0.00	0.00	2,880.00	3,769.50	4,146.45
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR U-238 Analysis	36.0000	EA	0.00	0.00	0.00	0.00	2,880.00	3,769.50	4,146.45
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*85.0000*	*111.2525*	*122.3777*
USR PAH Analysis	36.0000	EA	0.00	0.00	0.00	0.00	3,060.00	4,005.09	4,405.60
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*70.0000*	*91.6197*	*100.7817*
USR VOC Analysis	36.0000	EA	0.00	0.00	0.00	0.00	2,520.00	3,298.31	3,628.14
(Note: Cost obtained from lab contract for similar project.)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
ALT 4 - 331XX03 Site Work	**1.0000**	**LS**	**64,384.25**	**29,066.14**	**194.40**	**0.00**	**93,644.79**	**135,648.94**	**149,213.83**
			15,657.7157	*8,664.3221*	*194.4000*		*24,516.4377*	*32,088.4114*	*35,297.2525*
331XX0301 Demolition and Removal of Asphalt Roadways	**1.0000**	**EA**	**15,657.72**	**8,664.32**	**194.40**	**0.00**	**24,516.44**	**32,088.41**	**35,297.25**
			1,021.3213	*326.6996*	*194.4000*		*1,542.4209*	*2,018.8021*	*2,220.6823*
331XX030190 Saw-cut asphalt roadway	**1.0000**	**LF**	**1,021.32**	**326.70**	**194.40**	**0.00**	**1,542.42**	**2,018.80**	**2,220.68**
			0.6809	*0.2178*	*0.1296*	*0.0000*	*1.0283*	*1.3459*	*1.4805*
RSM 024119250015 Selective demolition, saw cutting, asphalt, up to 3" deep (Note: Quantity approximated based on aerial photo)	1,500.0000	LF	1,021.32	326.70	194.40	0.00	1,542.42	2,018.80	2,220.68
			4.4353	*2.5266*	*0.0000*		*6.9618*	*9.1120*	*10.0232*
331XX030191 Asphalt road removal	**3,300.0000**	**CY**	**14,636.39**	**8,337.62**	**0.00**	**0.00**	**22,974.02**	**30,069.61**	**33,076.57**
			1.9449	*0.6451*	*0.0000*	*0.0000*	*2.5900*	*3.3899*	*3.7289*
RSM 312316425100 Excavating, bulk bank measure, sandy clay/loam, open site, 1 C.Y. capacity = 120 C.Y./hour, excavator, hydraulic, crawler mounted, excluding truck loading (Note: Crew output reduced to 90 because material being excavated is asphalt and gravel.)	3,300.0000	BCY	6,418.21	2,128.75	0.00	0.00	8,546.96	11,186.71	12,305.39
			1.9157	*1.4473*	*0.0000*	*0.0000*	*3.3630*	*4.4016*	*4.8418*
RSM 312323203626 Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min load/wait/unload, 16.5 C.Y. truck, cycle 0.5 mile, 20 MPH, excludes loading equipment (Note: Hauling from excavation site to temporary stockpiling area)	4,290.0000	LCY	8,218.19	6,208.87	0.00	0.00	14,427.06	18,882.89	20,771.18
			33,293.0302	*20,168.5391*	*0.0000*		*53,461.5693*	*83,055.0126*	*91,360.5139*
331XX0302 Clearing and Grubbing	**1.0000**	**EA**	**33,293.03**	**20,168.54**	**0.00**	**0.00**	**53,461.57**	**83,055.01**	**91,360.51**
			17,634.6331	*5,835.1298*	*0.0000*		*23,469.7629*	*36,461.3586*	*40,107.4945*
331XX030290 Tree removal	**1.0000**	**EA**	**17,634.63**	**5,835.13**	**0.00**	**0.00**	**23,469.76**	**36,461.36**	**40,107.49**
			1,513.6451	*1,385.5629*	*0.0000*	*0.0000*	*2,899.2080*	*4,504.0532*	*4,954.4585*
RSM 311110100250 Clearing & grubbing, trees to 12" diameter, grub stumps and remove	2.0000	ACR	3,027.29	2,771.13	0.00	0.00	5,798.42	9,008.11	9,908.92
			292.1469	*61.2801*	*0.0000*	*0.0000*	*353.4269*	*549.0650*	*603.9715*
HNC 311110107320 Tree removal, congested area, 12" to 24" diameter, tree removal, cutting and chipping (Note: Quantity is approximated)	50.0000	EA	14,607.34	3,064.00	0.00	0.00	17,671.35	27,453.25	30,198.58
			15,658.3972	*14,333.4093*	*0.0000*		*29,991.8065*	*46,593.6540*	*51,253.0194*
331XX030291 Brush clearing	**1.0000**	**ACR**	**15,658.40**	**14,333.41**	**0.00**	**0.00**	**29,991.81**	**46,593.65**	**51,253.02**
			2,609.7329	*2,388.9016*	*0.0000*	*0.0000*	*4,998.6344*	*7,765.6090*	*8,542.1699*
RSM 311110100160 Clearing & grubbing, brush, including stumps	6.0000	ACR	15,658.40	14,333.41	0.00	0.00	29,991.81	46,593.65	51,253.02

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			15,433.5049	*233.2781*	*0.0000*		*15,666.7830*	*20,505.5148*	*22,556.0663*
331XX0393 Survey	**1.0000**	**EA**	**15,433.50**	**233.28**	**0.00**	**0.00**	**15,666.78**	**20,505.51**	**22,556.07**
			907.8532	*13.7222*	*0.0000*	*0.0000*	*921.5755*	*1,206.2068*	*1,326.8274*
RSM 017123131100 Boundary & survey markers, crew for building layout, 2 person crew	17.0000	DAY	15,433.50	233.28	0.00	0.00	15,666.78	20,505.51	22,556.07
(Note: Assume surveyor will be on site daily during excavation phase to set up control points, locate and survey excavations, and locate any other key site features; and 5 additional days to complete final grade surveys)									
ALT 4 - 331XX08 Solids Collect And Containment	**1.0000**	**LS**	**43,242.18**	**21,426.30**	**8,100.00**	**0.00**	**89,643.47**	**117,330.12**	**129,063.14**
			17.2969	*8.5705*	*3.2400*		*35.8574*	*46.9320*	*51.6253*
331XX0801 Contaminated Soil Collection	**2,500.0000**	**BCY**	**43,242.18**	**21,426.30**	**8,100.00**	**0.00**	**89,643.47**	**117,330.12**	**129,063.14**
(Note: This includes the excavation of RAD/PAH-contaminated soils. The quantity includes 500 cy of soil from the Building 431/432 Trench (assuming 1/2 of the quantity removed will be soil).)									
			2.9174	*0.9676*	*0.0000*		*3.8850*	*5.0849*	*5.5934*
331XX080102 Excavation	**2,500.0000**	**BCY**	**7,293.42**	**2,419.04**	**0.00**	**0.00**	**9,712.46**	**12,712.18**	**13,983.39**
			2.9174	*0.9676*	*0.0000*	*0.0000*	*3.8850*	*5.0849*	*5.5934*
RSM 312316425100 Excavating, bulk bank measure, sandy clay/loam, open site, 1 C.Y. capacity = 120 C.Y./hour, excavator, hydraulic, crawler mounted, excluding truck loading	2,500.0000	BCY	7,293.42	2,419.04	0.00	0.00	9,712.46	12,712.18	13,983.39
(Note: Crew output reduced to 60 from 120 to account for movement between excavations, equipment frisking, and waiting for transport trucks.)									
			6.7081	*1.4473*	*2.4923*		*15.8400*	*20.7322*	*22.8054*
331XX080103 Hauling	**3,250.0000**	**LCY**	**21,801.30**	**4,703.69**	**8,100.00**	**0.00**	**51,479.98**	**67,379.73**	**74,117.70**
(Note: Hauling to temporary staging area from excavation site. Volume assumes a swell factor of 30%)									
			1.9157	*1.4473*	*0.0000*	*0.0000*	*3.3630*	*4.4016*	*4.8418*
RSM 312323203626 Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min load/wait/unload, 16.5 C.Y. truck, cycle 0.5 mile, 20 MPH, excludes loading equipment	3,250.0000	LCY	6,225.90	4,703.69	0.00	0.00	10,929.59	14,305.22	15,735.75
(Note: Hauling from excavation site to temporary stockpiling area. Assume a swell factor of 30%.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*450.0000*	*588.9838*	*647.8822*
USR Intermodal Shipping Container Rental	37.5000	MO	0.00	0.00	0.00	0.00	16,875.00	22,086.89	24,295.58
(Note: Cost per quote from Secur LLC. Quantity assumes 1 week roundtrip for a 25 ton truck, 4 trips per month per truck.)									
			103.8360	*0.0000*	*54.0000*	*0.0000*	*157.8360*	*206.5841*	*227.2425*
USR Shipping container prep	150.0000	EA	15,575.40	0.00	8,100.00	0.00	23,675.40	30,987.61	34,086.37
(Note: User-created crew utilized due to lack of appropriate options in the Cost Book. Cost assumes two laborers for inspection of shipping containers and installation of specialty liners. Liner cost is per quote from Secur LLC. Assume 1/2 hour per truck)									
			4.3531	*4.4011*	*0.0000*		*8.7542*	*11.4579*	*12.6037*
331XX080104 Stockpiling	**3,250.0000**	**LCY**	**14,147.46**	**14,303.57**	**0.00**	**0.00**	**28,451.03**	**37,238.22**	**40,962.04**
(Note: Temporary staging area for excavated material)									
			112.8696	*114.1150*	*0.0000*	*0.0000*	*226.9846*	*297.0895*	*326.7984*
RSM B10U Stockpile Management	104.8387	HR	11,833.10	11,963.67	0.00	0.00	23,796.78	31,146.48	34,261.13
(Note: Assume 1 loader with a spotter half-time for managing temporary stockpile. Quantity is based on the calculated extended duration for the cycle hauling item)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.7121	*0.7200*	*0.0000*	*0.0000*	*1.4321*	*1.8744*	*2.0618*
HTW 312316133106 Load Truck for Transport to Disposal Facility, 5.5 CY wheel loader	3,250.0000	LCY	2,314.36	2,339.90	0.00	0.00	4,654.26	6,091.74	6,700.91
(Note: Assume 1.3 swell factor)									
ALT 4 - 331XX09 Liq/Sed/Sludges Collect,Contain	**1.0000**	**LS**	**5,730.36**	**3,119.09**	**7,112.88**	**0.00**	**17,922.33**	**23,457.69**	**25,803.46**
			2,159.4379	*1,392.9879*	*7,112.8800*		*12,625.3058*	*16,524.6685*	*18,177.1353*
331XX0903 Waste Containment, Portable	**1.0000**	**EA**	**2,159.44**	**1,392.99**	**7,112.88**	**0.00**	**12,625.31**	**16,524.67**	**18,177.14**
			2,159.4379	*1,392.9879*	*7,112.8800*		*12,625.3058*	*16,524.6685*	*18,177.1353*
331XX090301 Bulk Liquid Containers/Roll-Offs	**1.0000**	**EA**	**2,159.44**	**1,392.99**	**7,112.88**	**0.00**	**12,625.31**	**16,524.67**	**18,177.14**
			626.0872	*266.0433*	*0.0000*	*0.0000*	*892.1305*	*1,167.6676*	*1,284.4343*
HTW 028610106152 Secondary containment and storage, storage systems, loading hazardous waste for shipment, load liquid or sludge into 5,000 gal. bulk tank truck	1.0000	EA	626.09	266.04	0.00	0.00	892.13	1,167.67	1,284.43
(Note: It is approximated that 1 gallon of water will need to be pumped for every cubic yard excavated, so for a total of 4,700 cy, this equals 4,700 gallons. Therefore only one load will be required)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*980.0000*	*1,282.6759*	*1,410.9435*
HTW 029110409118 Wastewater holding tanks, above ground, steel, closed, stationary, monthly rental, 21,000 gal	2.0000	MO	0.00	0.00	0.00	0.00	1,960.00	2,565.35	2,821.89
(Note: It is approximated that 1 gallon of water will need to be pumped for every cubic yard excavated, so for a total of 4,700 cy, this equals 4,700 gallons.)									
			1,384.5622	*1,105.7423*	*0.0000*	*0.0000*	*2,490.3046*	*3,259.4424*	*3,585.3867*
HTW 026510104315 Clean and rinse tank interior, high pressure water, 20,001 to 30,000 gallons	1.0000	EA	1,384.56	1,105.74	0.00	0.00	2,490.30	3,259.44	3,585.39
			74.3942	*10.6011*	*3,556.4400*	*0.0000*	*3,641.4354*	*4,766.1034*	*5,242.7137*
USR 221353203142 Wastewater holding tanks, above ground, saddle, f berglass, 200 gal	2.0000	MO	148.79	21.20	7,112.88	0.00	7,282.87	9,532.21	10,485.43
(Note: Pickup truck with 200 gallon tank for storing water pumped from excavations for transport to main storage tank. 1 truck, 1 laborer assume full time. Material cost is for the purchase price, so since the quantity is not 1, the material cost needs to be divided by the quantity to accurately reflect the purchase price.)									
			3,570.9236	*1,726.0991*	*0.0000*		*5,297.0227*	*6,933.0237*	*7,626.3260*
331XX0906 Pumping/Draining/Collection	**1.0000**	**EA**	**3,570.92**	**1,726.10**	**0.00**	**0.00**	**5,297.02**	**6,933.02**	**7,626.33**
			3,570.9236	*1,726.0991*	*0.0000*		*5,297.0227*	*6,933.0237*	*7,626.3260*
331XX090603 Dewatering	**1.0000**	**EA**	**3,570.92**	**1,726.10**	**0.00**	**0.00**	**5,297.02**	**6,933.02**	**7,626.33**
			595.1539	*287.6832*	*0.0000*	*0.0000*	*882.8371*	*1,155.5039*	*1,271.0543*
RSM 312319201100 Dewatering, pumping 8 hours, attended 2 hrs per day, 6" centrifugal pump, includes 20 LF of suction hose and 250 LF of discharge hose	6.0000	DAY	3,570.92	1,726.10	0.00	0.00	5,297.02	6,933.02	7,626.33
(Note: It is assumed that dewatering will be required for half of the days that excavation is taking place. Approximately 12 total days of excavation are required, so pumping will be necessary for roughly 6 days.)									
ALT 4 - 331XX10 Drums/Tanks/Struct/Misc Removal	**1.0000**	**LS**	**14,597.73**	**7,121.54**	**0.00**	**0.00**	**21,719.26**	**28,427.32**	**31,270.05**
331XX1003 Structure Removal (Building 401 Slab)	**1.0000**	**LS**	**14,597.73**	**7,121.54**	**0.00**	**0.00**	**21,719.26**	**28,427.32**	**31,270.05**
331XX100302 Demolition	**1.0000**	**LS**	**9,962.17**	**4,698.38**	**0.00**	**0.00**	**14,660.55**	**19,188.51**	**21,107.36**
			0.5074	*0.2393*	*0.0000*	*0.0000*	*0.7467*	*0.9773*	*1.0750*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
RSM 024116170400 Building footings and foundations demolition, floors, concrete slab on grade, plain concrete, 6" thick, excludes disposal costs and dump fees	19,635.0000	SF	9,962.17	4,698.38	0.00	0.00	14,660.55	19,188.51	21,107.36
(Note: Crew output reduced to 300 because slabs are assumed to be 12 inches thick. Quantity assumes 12 inch slabs. Building 401 Drains will be removed along with the concrete slabs, at no expected additional effort.)									
			4,635.5559	*2,423.1566*	*0.0000*		*7,058.7125*	*9,238.8166*	*10,162.6982*
331XX100390 Excavation, hauling, stockpiling and transport off-site	**1.0000**	**EA**	**4,635.56**	**2,423.16**	**0.00**	**0.00**	**7,058.71**	**9,238.82**	**10,162.70**
			3.5008	*1.1611*	*0.0000*	*0.0000*	*4.6620*	*6.1018*	*6.7120*
RSM 312316425100 Excavating, bulk bank measure, sandy clay/loam, open site, 1 C.Y. capacity = 120 C.Y./hour, excavator, hydraulic, crawler mounted, excluding truck loading	727.2222	BCY	2,545.89	844.41	0.00	0.00	3,390.29	4,437.40	4,881.14
(Note: Crew output reduced to 50 from 120 because material being excavated is reinforcecd concrete, and material needs to be transported to the temporary stockpile areas. Quantity is based on 19,635 square feet of foundation at an assumed 1 ft thick.)									
			1.9157	*1.4473*	*0.0000*	*0.0000*	*3.3630*	*4.4016*	*4.8418*
RSM 312323203626 Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min load/wait/unload, 16.5 C.Y. truck, cycle 0.5 mile, 20 MPH, excludes loading equipment	1,090.8333	LCY	2,089.67	1,578.75	0.00	0.00	3,668.42	4,801.42	5,281.56
(Note: Hauling from excavation site to temporary stockpiling area. Quantity is based on 19,635 square feet of foundation at an assumed 1 ft thick with a swell factor of 1.5 assumed)									
			0.0000	*0.0000*	*0.0000*		*711,800.0000*	*1,105,814.1151*	*1,216,395.5266*
ALT 4 - 331XX14 Thermal Treatment	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**711,800.00**	**1,105,814.12**	**1,216,395.53**
			0.0000	*0.0000*	*0.0000*		*711,800.0000*	*1,105,814.1151*	*1,216,395.5266*
331XX1492 In-Situ Thermal Treatment	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**711,800.00**	**1,105,814.12**	**1,216,395.53**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*82.0000*	*127.3908*	*140.1299*
USR Electrical Resistance Heating	3,400.0000	BCY	0.00	0.00	0.00	0.00	278,800.00	433,128.65	476,441.52
(Note: Cost for In-Situ Thermal Treatment per cost estimate prepared by CTI for a similar-sized site. This includes mobilization. Assume 1 year of treatment.)									
USR Off-gas treatment	1.0000	LS	0.00	0.00	0.00	0.00	433,000.00	672,685.46	739,954.01
(Note: Cost for treatment of effluent gasses during In-Situ Thermal Treatment per cost estimate prepared by CTI for a similar-sized site. Assume 1 year of treatment.)									
			0.0000	*0.0000*	*0.0000*		*9,035,220.3889*	*11,825,774.6792*	*13,008,352.1471*
ALT 4 - 331XX18 Transport and Disposal - Radiological	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**9,035,220.39**	**11,825,774.68**	**13,008,352.15**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*200.0000*	*261.7706*	*287.9476*
USR Transport contaminated soil to Radiological Disposal Facility	3,750.0000	TON	0.00	0.00	0.00	0.00	750,000.00	981,639.70	1,079,803.67
(Note: Cost per quote from Secur LLC. Assumes 1.5 tons/CY.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*200.0000*	*261.7706*	*287.9476*
USR Transport Contaminated Concrete to Radiological Disposal Facility	1,454.4444	TON	0.00	0.00	0.00	0.00	290,888.89	380,730.77	418,803.85
(Note: This item is for transporting radiologically contaminated concrete to the disposal facility. Cost per quote from Secur LLC. Assumes 2 tons/CY. Quantity is based on cycle hauling volume, assuming 2 tons per cy.)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*0.0000*	*0.0000*	*200.0000*	*261.7706*	*287.9476*
USR Transport concrete chips and dust to Radiological Disposal Facility	123.8657	TON	0.00	0.00	0.00	0.00	24,773.15	32,424.41	35,666.85
(Note: Cost per quote from Secur LLC. Assumes 1.5 tons/CY. Assume a swell factor of 30%.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*200.0000*	*261.7706*	*287.9476*
USR Transport Contaminated Asphalt to Radiological Disposal Facility	6,600.0000	TON	0.00	0.00	0.00	0.00	1,320,000.00	1,727,685.87	1,900,454.45
(Note: This item is for transporting radiologically contaminated asphalt to the disposal facility. Cost per quote from Secur LLC. Assumes 2 tons/CY.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*497.0000*	*650.4999*	*715.5499*
USR Radiological Contaminated Soil Disposal	2,500.0000	CY	0.00	0.00	0.00	0.00	1,242,500.00	1,626,249.77	1,788,874.74
(Note: Cost based on a contract for a similar project provided by WCS Texas Quantity assumes a swell factor of 30%.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*924.0000*	*1,209.3801*	*1,330.3181*
USR Radiological Contaminated Debris Disposal (asphalt roadway)	4,290.0000	LCY	0.00	0.00	0.00	0.00	3,963,960.00	5,188,240.66	5,707,064.73
(Note: Cost based on a contract for a similar project provided by WCS Texas.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*924.0000*	*1,209.3801*	*1,330.3181*
USR Radiological Contaminated Debris Disposal (concrete dust and chips)	107.3503	LCY	0.00	0.00	0.00	0.00	99,191.69	129,827.33	142,810.06
(Note: Cost based on a contract for a similar project provided by WCS Texas. Assume swell factor of 1.3.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*924.0000*	*1,209.3801*	*1,330.3181*
USR Radiological Contaminated Debris Disposal (concrete slabs)	1,454.4444	LCY	0.00	0.00	0.00	0.00	1,343,906.67	1,758,976.18	1,934,873.80
(Note: Cost based on a contract for a similar project provided by WCS Texas. Assume swell factor of 1.5.)									
ALT 4 - 331XX19 Transportation and Disposal - Non-Radiological	**1.0000**	**LS**	**0.00**	**0.00**	**0.00**	**0.00**	**5,825.00**	**7,624.07**	**8,386.48**
			0.0000	*0.0000*	*0.0000*		*5,500.0000*	*7,198.6911*	*7,918.5602*
331XX1990 Transport and Disposal - Non-Contaminated	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**5,500.00**	**7,198.69**	**7,918.56**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*55.0000*	*71.9869*	*79.1856*
USR Chipped tree and brush transport and disposal	100.0000	TON	0.00	0.00	0.00	0.00	5,500.00	7,198.69	7,918.56
(Note: Cost per vendor quote - Triad Recycling, $55/ton Quantity assumes 1 ton per tree, and an additional 50 tons of brush, so 100 tons total)									
			0.0000	*0.0000*	*0.0000*		*325.0000*	*425.3772*	*467.9149*
331XX1992 Transport and Disposal - Water	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**325.00**	**425.38**	**467.91**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*0.1300*	*0.1702*	*0.1872*
USR Contaminated Water From Excavations - Transport and Disposal	2,500.0000	GAL	0.00	0.00	0.00	0.00	325.00	425.38	467.91
(Note: This item is for a 5,000-gallon tanker. It is assumed that a 21,000 gallon fractionalization tank will be used to temporarily store water that is pumped during various remediation alternatives. From there, water will be transferred to the tanker and transported to the nearby wastewater treatment plant. The total cost, based on a 2013 purchase order from Western New York Septic, escalated by 3% per year to 2016, would be $0.13 per gallon, before tax. Quantity assumes approximately 1 gal per cy excavated.)									
ALT 4 - 331XX20 Site Restoration	**1.0000**	**LS**	**109,986.73**	**52,338.73**	**1,004,495.33**	**0.00**	**1,166,820.78**	**1,527,196.80**	**1,679,916.48**
			11,235.3330	*11,058.2079*	*236,760.1920*		*259,053.7329*	*339,063.2373*	*372,969.5611*
331XX2001 Earthwork	**1.0000**	**EA**	**11,235.33**	**11,058.21**	**236,760.19**	**0.00**	**259,053.73**	**339,063.24**	**372,969.56**
			907.3924	*917.4047*	*64,955.5200*		*66,780.3171*	*87,405.6137*	*96,146.1751*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
331XX200103 Backfill	**1.0000**	**EA**	**907.39**	**917.40**	**64,955.52**	**0.00**	**66,780.32**	**87,405.61**	**96,146.18**
			0.3168	*0.3203*	*22.6800*	*0.0000*	*23.3171*	*30.5187*	*33.5706*
RSM 312323155080 Borrow, select granular fill, 5 C.Y. bucket, loading and/or spreading, front end loader, wheel mounted	2,864.0000	ECY	907.39	917.40	64,955.52	0.00	66,780.32	87,405.61	96,146.18
(Note: Quantity incorporates the volumes required to replace soils removed as well as half of the volume of concrete foundation excavated. So 2,500 cy soil + (727/2) cy concrete = 2,864 cy)									
			0.0000	*0.0000*	*48,252.6720*		*48,252.6720*	*63,155.6511*	*69,471.2162*
331XX200104 Borrow	**1.0000**	**EA**	**0.00**	**0.00**	**48,252.67**	**0.00**	**48,252.67**	**63,155.65**	**69,471.22**
			0.0000	*0.0000*	*12.9600*	*0.0000*	*12.9600*	*16.9627*	*18.6590*
USR Backfill Material including Delivery	3,723.2000	LCY	0.00	0.00	48,252.67	0.00	48,252.67	63,155.65	69,471.22
(Note: Assume a swell factor of 1.3)									
			3,334.8162	*1,983.2015*	*0.0000*		*5,318.0176*	*6,960.5029*	*7,656.5532*
331XX200107 Grading	**1.0000**	**EA**	**3,334.82**	**1,983.20**	**0.00**	**0.00**	**5,318.02**	**6,960.50**	**7,656.55**
			3,334.8162	*1,983.2015*	*0.0000*	*0.0000*	*5,318.0176*	*6,960.5029*	*7,656.5532*
RSM 312213200280 Rough grading sites, open, 75100-100000 S.F., grader	1.0000	EA	3,334.82	1,983.20	0.00	0.00	5,318.02	6,960.50	7,656.55
			497.3209	*301.7116*	*0.0000*		*799.0325*	*1,045.8160*	*1,150.3976*
331XX200108 Compaction	**1.0000**	**EA**	**497.32**	**301.71**	**0.00**	**0.00**	**799.03**	**1,045.82**	**1,150.40**
			0.1736	*0.1053*	*0.0000*	*0.0000*	*0.2790*	*0.3652*	*0.4017*
RSM 312323235060 Compaction, riding, vibrating roller, 2 passes, 12" lifts	2,864.0000	ECY	497.32	301.71	0.00	0.00	799.03	1,045.82	1,150.40
			939.1460	*2,237.9197*	*0.0000*		*3,177.0657*	*4,158.3118*	*4,574.1430*
331XX200113 Stockpiling	**1.0000**	**EA**	**939.15**	**2,237.92**	**0.00**	**0.00**	**3,177.07**	**4,158.31**	**4,574.14**
			0.2522	*0.6011*	*0.0000*	*0.0000*	*0.8533*	*1.1169*	*1.2286*
HNC 312213103020 Rough grading, open site, large area, 300 H.P., dozer	3,723.2000	BCY	939.15	2,237.92	0.00	0.00	3,177.07	4,158.31	4,574.14
(Note: This item is used for maintaining stockpiled fill material)									
			5,556.6576	*5,617.9704*	*123,552.0000*		*134,726.6279*	*176,337.3417*	*193,971.0759*
331XX200114 Topsoil	**1.0000**	**EA**	**5,556.66**	**5,617.97**	**123,552.00**	**0.00**	**134,726.63**	**176,337.34**	**193,971.08**
			0.3473	*0.3511*	*0.0000*	*0.0000*	*0.6984*	*0.9141*	*1.0055*
RSM 312323157080 Borrow, topsoil or loam, 5 C.Y. bucket, loading and/or spreading, front end loader, wheel mounted	16,000.0000	ECY	5,556.66	5,617.97	0.00	0.00	11,174.63	14,625.94	16,088.54
(Note: Material cost removed since it is accounted for under a separate item. Topsoil quantity is approximated based on aerial photos (approx. 96,000 sy), assuming 6" is placed over the entire area. 6" = 0.167 yd, so 96,000 sy x 0.167 yd = 16,000 cy)									
			0.0000	*0.0000*	*23.7600*	*0.0000*	*23.7600*	*31.0983*	*34.2082*
USR Topsoil Purchase and Delivery	5,200.0000	LCY	0.00	0.00	123,552.00	0.00	123,552.00	161,711.40	177,882.54
(Note: Since the majority of stripped topsoil can be re-used, it is assumed that only 25% of the topsoil placed needs to be purchased. Assume a swell factor of 1.3)									
			80,677.3136	*33,934.9982*	*585,258.3333*		*699,870.6451*	*916,027.7445*	*1,007,630.5190*
331XX2003 Permanent Features	**1.0000**	**EA**	**80,677.31**	**33,935.00**	**585,258.33**	**0.00**	**699,870.65**	**916,027.74**	**1,007,630.52**
			0.9075	*0.3817*	*6.5833*		*7.8726*	*10.3040*	*11.3344*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
331XX200301 Road Replacement	**88,900.0000**	**SF**	**80,677.31**	**33,935.00**	**585,258.33**	**0.00**	**699,870.65**	**916,027.74**	**1,007,630.52**
			4.9905	*1.2719*	*75.6000*	*0.0000*	*81.8623*	*107.1457*	*117.8603*
RSM 321126132007 Plant mixed asphaltic base courses, for roadways and large paved areas, alternate method to figure base course, bituminous concrete, 8" thick	4,390.1235	TON	21,908.71	5,583.68	331,893.33	0.00	359,385.73	470,383.06	517,421.37
(Note: Quantity approximated based on aerial photos. Assume 2 ton/cy. 88,900 sf of pavement need to be replaced, at 8" thick this is approximately 2,200 cy)									
			1.5912	*0.4055*	*16.4700*	*0.0000*	*18.4667*	*24.1702*	*26.5872*
RSM 321216130200 Plant-mix asphalt paving, for highways and large paved areas, binder course, 4" thick, no hauling included	9,877.7778	SY	15,717.12	4,005.68	162,687.00	0.00	182,409.80	238,747.61	262,622.37
			1.1336	*0.3344*	*9.1800*	*0.0000*	*10.6480*	*13.9367*	*15.3304*
RSM 321216130380 Plant-mix asphalt paving, for highways and large paved areas, wearing course, 2" thick, no hauling included	9,877.7778	SY	11,197.59	3,303.47	90,678.00	0.00	105,179.06	137,663.92	151,430.31
			0.4515	*0.2123*	*0.0000*	*0.0000*	*0.6638*	*0.8688*	*0.9556*
RSM 312216100011 Fine grading, finish grading granular subbase for highway paving, +/- 1"	9,877.7778	SY	4,459.36	2,097.16	0.00	0.00	6,556.52	8,581.52	9,439.67
			5.9386	*4.1069*	*0.0000*	*0.0000*	*10.0454*	*13.1480*	*14.4628*
HNC 312323180555 Hauling, excavated or borrow material, loose cubic yards, 12 mile round trip @ base wide rate, 12 C.Y. truck, highway haulers, excludes loading	4,613.0000	LCY	27,394.54	18,945.00	0.00	0.00	46,339.54	60,651.64	66,716.81
(Note: This item is for hauling Asphalt from the plant. Distance is assumed. Productivity reduced by half to account for extra waiting time at the site. Quantity assumes 2 ton/cy for base, so 4,390/2 = 2,195 cy; 9,878 sy @ 4" thick binder = 1,098 cy; 9,878 sy @ 2" thick top = 549 cy; total = 3,842 cy, assume 20% compaction so total volume required = 4,610 cy.)									
			18,074.0808	*7,345.5234*	*182,476.8000*		*207,896.4042*	*272,105.8178*	*299,316.3996*
331XX2004 Revegetation And Planting	**1.0000**	**EA**	**18,074.08**	**7,345.52**	**182,476.80**	**0.00**	**207,896.40**	**272,105.82**	**299,316.40**
			18,074.0808	*7,345.5234*	*182,476.8000*		*207,896.4042*	*272,105.8178*	*299,316.3996*
331XX200401 Seeding/Mulch/Fertilizer	**1.0000**	**EA**	**18,074.08**	**7,345.52**	**182,476.80**	**0.00**	**207,896.40**	**272,105.82**	**299,316.40**
			0.1883	*0.0765*	*1.9008*	*0.0000*	*2.1656*	*2.8344*	*3.1179*
RSM 329219131100 Seeding, mechanical seeding hydro or air seeding for large areas, includes lime, fertilizer and seed with wood fiber mulch added	96,000.0000	SY	18,074.08	7,345.52	182,476.80	0.00	207,896.40	272,105.82	299,316.40
(Note: Quantity approximated based on aerial photos)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
ALT 4 - 331XX21 Demobilization	**1.0000**	**LS**	**26,277.56**	**5,191.00**	**17,037.00**	**0.00**	**48,505.56**	**63,486.65**	**69,835.31**
331XX2101 Demob of Construction Equip & Fac	**1.0000**	**EA**	*15,469.9117* **15,469.91**	*5,180.0213* **5,180.02**	*1,663.2000* **1,663.20**	**0.00**	*22,313.1330* **22,313.13**	*29,204.6095* **29,204.61**	*32,125.0705* **32,125.07**
331XX010190 Site Facilities	**1.0000**	**EA**	*0.0000* **0.00**	*0.0000* **0.00**	*1,663.2000* **1,663.20**	**0.00**	*1,663.2000* **1,663.20**	*2,176.8842* **2,176.88**	*2,394.5726* **2,394.57**
331XX010191 Office Trailers	**1.0000**	**EA**	*0.0000* **0.00**	*0.0000* **0.00**	*475.2000* **475.20**	**0.00**	*475.2000* **475.20**	*621.9669* **621.97**	*684.1636* **684.16**
RSM 015213200800 Office trailer, delivery, add per mile	40.0000	MI	*0.0000* 0.00	*0.0000* 0.00	*11.8800* 475.20	*0.0000* 0.00	*11.8800* 475.20	*15.5492* 621.97	*17.1041* 684.16
(Note: assume 10 miles per haul, 2 trailers. double to account for demob)									
331XX010192 Toilets	**1.0000**	**EA**	*0.0000* **0.00**	*0.0000* **0.00**	*712.8000* **712.80**	**0.00**	*712.8000* **712.80**	*932.9504* **932.95**	*1,026.2454* **1,026.25**
RSM 015213200800 Portable toilet and hand wash, delivery, add per mile	40.0000	MI	*0.0000* 0.00	*0.0000* 0.00	*11.8800* 475.20	*0.0000* 0.00	*11.8800* 475.20	*15.5492* 621.97	*17.1041* 684.16
(Note: Assume same cost for delivering storage trailers - three toilets and two hand washes delivered on two trucks. Double to account for demob)									
RSM 015213200800 Portable hand wash station, delivery, add per mile	20.0000	MI	*0.0000* 0.00	*0.0000* 0.00	*11.8800* 237.60	*0.0000* 0.00	*11.8800* 237.60	*15.5492* 310.98	*17.1041* 342.08
(Note: Assume same cost for delivering storage trailers - three delivered on one truck. Double to account for demob)									
331XX010193 Storage Facilities	**1.0000**	**EA**	*0.0000* **0.00**	*0.0000* **0.00**	*475.2000* **475.20**	**0.00**	*475.2000* **475.20**	*621.9669* **621.97**	*684.1636* **684.16**
RSM 015213200800 Storage trailer, delivery, add per mile	40.0000	MI	*0.0000* 0.00	*0.0000* 0.00	*11.8800* 475.20	*0.0000* 0.00	*11.8800* 475.20	*15.5492* 621.97	*17.1041* 684.16
(Note: Assume same cost for delivering storage trailers - 2 deliveries double to account for demob)									
331XX010191 Construction Equipment	**1.0000**	**EA**	*15,469.9117* **15,469.91**	*5,180.0213* **5,180.02**	*0.0000* **0.00**	**0.00**	*20,649.9330* **20,649.93**	*27,027.7253* **27,027.73**	*29,730.4979* **29,730.50**
RSM 015436501400 Mobilization or demobilization, delivery charge for equipment, hauled on 20-ton capacity towed trailer	20.0000	EA	*509.8944* 10,197.89	*173.1983* 3,463.97	*0.0000* 0.00	*0.0000* 0.00	*683.0927* 13,661.85	*894.0678* 17,881.36	*983.4746* 19,669.49
(Note: Mobilization/demobilization of medium-sized equipment. 1 paver, 1 medium excavator, 3 medium FE loaders/backhoes/skidsteers, 3 rollers, 2 dozers)									
RSM 015436501500 Mobilization or demobilization,	8.0000	EA	*540.2320* 4,321.86	*191.5054* 1,532.04	*0.0000* 0.00	*0.0000* 0.00	*731.7374* 5,853.90	*957.7366* 7,661.89	*1,053.5102* 8,428.08

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
delivery charge for equipment, hauled on 40-ton capacity towed trailer (Note: Mobilization/demobilization of heavy equipment. 1 grader, 2 large excavators, 1 large FE loader)									
			118.7710	*23.0016*	*0.0000*	*0.0000*	*141.7726*	*185.5595*	*204.1155*
RSM 015436501200 Mobilization or demobilization, delivery charge for small equipment, placed in rear of, or towed by pickup truck (Note: Assume 4 loads each way for smaller equipment (saws, pumps, excavator attachments, etc.))	8.0000	EA	950.17	184.01	0.00	0.00	1,134.18	1,484.48	1,632.92
			9,473.0211	*0.0000*	*14,596.2000*		*24,069.2211*	*31,503.0706*	*34,653.3777*
331XX2102 Removal of Temporary Utilities	**1.0000**	**EA**	**9,473.02**	**0.00**	**14,596.20**	**0.00**	**24,069.22**	**31,503.07**	**34,653.38**
			9,473.0211	*0.0000*	*14,596.2000*		*24,069.2211*	*31,503.0706*	*34,653.3777*
331XX010502 Power Connection/Distribution	**1.0000**	**EA**	**9,473.02**	**0.00**	**14,596.20**	**0.00**	**24,069.22**	**31,503.07**	**34,653.38**
			128.2738	*0.0000*	*124.2000*	*0.0000*	*252.4738*	*330.4511*	*363.4962*
RSM 015113500870 Temporary electrical power equipment (pro-rated per job), connections, office trailer, 60 amp	2.0000	EA	256.55	0.00	248.40	0.00	504.95	660.90	726.99
			461.7857	*0.0000*	*793.8000*	*0.0000*	*1,255.5857*	*1,643.3771*	*1,807.7148*
RSM 015113500030 Temporary electrical power equipment (pro-rated per job), overhead feed, 3 uses, 100 amp	1.0000	EA	461.79	0.00	793.80	0.00	1,255.59	1,643.38	1,807.71
			1,443.0804	*0.0000*	*3,888.0000*	*0.0000*	*5,331.0804*	*6,977.6002*	*7,675.3602*
RSM 015113500240 Temporary electrical power equipment (pro-rated per job), transformers, 3 uses, 112.5 kVA	1.0000	EA	1,443.08	0.00	3,888.00	0.00	5,331.08	6,977.60	7,675.36
			7.2154	*0.0000*	*7.1280*	*0.0000*	*14.3434*	*18.7734*	*20.6507*
RSM 015113500420 Temporary electrical power equipment (pro-rated per job), feeder, EMT and aluminum wire, 100 amp (Note: Quantity approximated)	1,000.0000	LF	7,215.40	0.00	7,128.00	0.00	14,343.40	18,773.40	20,650.74
			48.1027	*0.0000*	*1,269.0000*	*0.0000*	*1,317.1027*	*1,723.8937*	*1,896.2831*
RSM 015113500560 Temporary electrical power equipment (pro-rated per job), temporary feeder cords, 100 amp, 3 uses, 100' long	2.0000	EA	96.21	0.00	2,538.00	0.00	2,634.21	3,447.79	3,792.57
			1,334.6250	*10.9816*	*777.6000*		*2,123.2067*	*2,778.9653*	*3,056.8618*
331XX0104 Deconstruct/Remove Temp Facilities	**1.0000**	**EA**	**1,334.63**	**10.98**	**777.60**	**0.00**	**2,123.21**	**2,778.97**	**3,056.86**
			1,334.6250	*10.9816*	*777.6000*		*2,123.2067*	*2,778.9653*	*3,056.8618*
331XX010430 Erosion Control	**1.0000**	**EA**	**1,334.63**	**10.98**	**777.60**	**0.00**	**2,123.21**	**2,778.97**	**3,056.86**
			1.3346	*0.0110*	*0.7776*	*0.0000*	*2.1232*	*2.7790*	*3.0569*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
RSM 312514161000 Synthetic erosion control, silt fence, install and maintain, remove, 3' high	1,000.0000	LF	1,334.63	10.98	777.60	0.00	2,123.21	2,778.97	3,056.86
(Note: Assume cost for removal is the same as for installation)									
ALT 4 - 331XX22 Gen Requirements (Opt Breakout)	**1.0000**	**LS**	**252,039.32**	**0.00**	**8,709.65**	**0.00**	**261,798.97**	**342,656.35**	**376,921.99**
			226,704.6412	*0.0000*	*1,080.0000*		*227,784.6412*	*298,136.5950*	*327,950.2545*
331XX2207 Health & Safety	**1.0000**	**EA**	**226,704.64**	**0.00**	**1,080.00**	**0.00**	**227,784.64**	**298,136.60**	**327,950.25**
			198,573.4083	*0.0000*	*0.0000*		*198,573.4083*	*259,903.3873*	*285,893.7261*
331XX220702 Radiation Protection Tech (RPT)	**1.0000**	**EA**	**198,573.41**	**0.00**	**0.00**	**0.00**	**198,573.41**	**259,903.39**	**285,893.73**
			150.4344	*0.0000*	*0.0000*	*0.0000*	*150.4344*	*196.8965*	*216.5862*
USR Rad-Technician crew	1,320.0000	HR	198,573.41	0.00	0.00	0.00	198,573.41	259,903.39	285,893.73
(Note: 2 technicians for duration of project (352 hours per month + 2 hr per day OT). Overtime assumed for daily setup and takedown of equipment and report generation.)									
			28,131.2328	*0.0000*	*0.0000*		*28,131.2328*	*36,819.6465*	*40,501.6112*
331XX220707 Site Safety & Health Officer	**1.0000**	**EA**	**28,131.23**	**0.00**	**0.00**	**0.00**	**28,131.23**	**36,819.65**	**40,501.61**
			42.6231	*0.0000*	*0.0000*	*0.0000*	*42.6231*	*55.7873*	*61.3661*
USR CAMP Monitor Labor	660.0000	HR	28,131.23	0.00	0.00	0.00	28,131.23	36,819.65	40,501.61
(Note: Full time for duration of project (3 months at 176 hr/month + 2 hr per day OT). Rate obtained from a similar nearby recent project. Overtime assumed for daily setup and takedown of equipment and report generation.)									
			0.0000	*0.0000*	*1,080.0000*		*1,080.0000*	*1,413.5612*	*1,554.9173*
331XX220716 Personal Protection Equipment	**1.0000**	**EA**	**0.00**	**0.00**	**1,080.00**	**0.00**	**1,080.00**	**1,413.56**	**1,554.92**
USR Personal Protective Equipment	1.0000	LS	0.00	0.00	1,080.00	0.00	1,080.00	1,413.56	1,554.92
(Note: Assume an allowance of $10,000 for PPE (gloves, eyewear, safety vests, ear plugs, boot covers, tyvek, etc.))									
			0.0000	*0.0000*	*1,393.2000*		*1,393.2000*	*1,823.4939*	*2,005.8433*
331XX2210 Project Utilities	**1.0000**	**EA**	**0.00**	**0.00**	**1,393.20**	**0.00**	**1,393.20**	**1,823.49**	**2,005.84**
			0.0000	*0.0000*	*91.8000*	*0.0000*	*91.8000*	*120.1527*	*132.1680*
RSM 015213400140 Field office expense, Internet	6.0000	MO	0.00	0.00	550.80	0.00	550.80	720.92	793.01
(Note: 2 hookups for 3 months)									
			0.0000	*0.0000*	*842.4000*		*842.4000*	*1,102.5777*	*1,212.8355*
331XX221002 Electrical Usage	**1.0000**	**EA**	**0.00**	**0.00**	**842.40**	**0.00**	**842.40**	**1,102.58**	**1,212.84**
			0.0000	*0.0000*	*0.1404*	*0.0000*	*0.1404*	*0.1838*	*0.2021*
HTW 015113800460 Electrical Charge Industrial Use	6,000.0000	KWH	0.00	0.00	842.40	0.00	842.40	1,102.58	1,212.84
(Note: Assume 2,000 kwH per month for 3 months)									
			25,334.6836	*0.0000*	*6,236.4492*		*32,621.1328*	*42,696.2652*	*46,965.8918*
331XX2208 Temp Const Facilities-Ownership	**1.0000**	**EA**	**25,334.68**	**0.00**	**6,236.45**	**0.00**	**32,621.13**	**42,696.27**	**46,965.89**
			0.0000	*0.0000*	*1,863.0000*		*1,863.0000*	*2,438.3930*	*2,682.2323*
331XX220801 Office Trailers and Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**1,863.00**	**0.00**	**1,863.00**	**2,438.39**	**2,682.23**
			0.0000	*0.0000*	*258.1200*	*0.0000*	*258.1200*	*337.8411*	*371.6252*
RSM 015213200350 Office trailer, furnished, rent per month, 32' x 8', excl. hookups	6.0000	EA	0.00	0.00	1,548.72	0.00	1,548.72	2,027.05	2,229.75
(Note: Two trailers for three months.)									
			0.0000	*0.0000*	*52.3800*	*0.0000*	*52.3800*	*68.5577*	*75.4135*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
RSM 015213200700 Office trailer, excl. hookups, air conditioning, rent per month, add (Note: Two trailers for three months.)	6.0000	EA	0.00	0.00	314.28	0.00	314.28	411.35	452.48
			0.0000	*0.0000*	*1,814.4000*		*1,814.4000*	*2,374.7828*	*2,612.2610*
331XX220802 Office Furniture & Office Equip	**1.0000**	**EA**	**0.00**	**0.00**	**1,814.40**	**0.00**	**1,814.40**	**2,374.78**	**2,612.26**
			0.0000	*0.0000*	*216.0000*	*0.0000*	*216.0000*	*282.7122*	*310.9835*
RSM 015213400100 Field office expense, office equipment rental, average (Note: 2 offices for 3 months)	6.0000	MO	0.00	0.00	1,296.00	0.00	1,296.00	1,696.27	1,865.90
			0.0000	*0.0000*	*86.4000*	*0.0000*	*86.4000*	*113.0849*	*124.3934*
RSM 015213400120 Field office expense, office supplies, average (Note: Two offices for three months)	6.0000	MO	0.00	0.00	518.40	0.00	518.40	678.51	746.36
			0.0000	*0.0000*	*534.6000*		*534.6000*	*699.7128*	*769.6841*
331XX220803 Warehouse & Stor Trailers/Facil	**1.0000**	**EA**	**0.00**	**0.00**	**534.60**	**0.00**	**534.60**	**699.71**	**769.68**
			0.0000	*0.0000*	*89.1000*	*0.0000*	*89.1000*	*116.6188*	*128.2807*
RSM 015213201250 Storage boxes, rent per month, 20' x 8' (Note: Two boxes for three months.)	6.0000	EA	0.00	0.00	534.60	0.00	534.60	699.71	769.68
			0.0000	*0.0000*	*937.9800*		*1,987.9800*	*2,601.9734*	*2,862.1708*
331XX220808 Construction Portable Toilets	**1.0000**	**EA**	**0.00**	**0.00**	**937.98**	**0.00**	**1,987.98**	**2,601.97**	**2,862.17**
			0.0000	*0.0000*	*104.2200*	*0.0000*	*104.2200*	*136.4087*	*150.0495*
HNC 015213201400 Toilet, portable, chemical, rent per month (Note: 3 toilets for 3 months)	9.0000	MO	0.00	0.00	937.98	0.00	937.98	1,227.68	1,350.45
			0.0000	*0.0000*	*0.0000*	*0.0000*	*175.0000*	*229.0493*	*251.9542*
USR Portable Handwash Station (Note: Cost for rental $175/month based on a recent quote for a similar item. Included delivery. Assume 2 are required.)	6.0000	MO	0.00	0.00	0.00	0.00	1,050.00	1,374.30	1,511.73
			0.0000	*0.0000*	*1,086.4692*		*1,086.4692*	*1,422.0284*	*1,564.2312*
331XX220811 Decon Facilities for Personnel	**1.0000**	**EA**	**0.00**	**0.00**	**1,086.47**	**0.00**	**1,086.47**	**1,422.03**	**1,564.23**
			0.0000	*0.0000*	*362.1564*	*0.0000*	*362.1564*	*474.0095*	*521.4104*
HTW 019413205977 Decontamination kit in 3 gallon metal drum, 27 items	3.0000	EA	0.00	0.00	1,086.47	0.00	1,086.47	1,422.03	1,564.23
			25,334.6836	*0.0000*	*0.0000*		*25,334.6836*	*33,159.3748*	*36,475.3123*
331XX220812 Decon Facil for Const Equip/Veh	**1.0000**	**EA**	**25,334.68**	**0.00**	**0.00**	**0.00**	**25,334.68**	**33,159.37**	**36,475.31**
			664.9966	*0.0000*	*0.0000*	*0.0000*	*664.9966*	*870.3827*	*957.4210*
HTW 019413103112 Spray washing, decontaminate heavy equipment, decontaminate heavy equipment (Note: Assume decontamination of all equipment once during release from site. Approximate 20 pieces of equipment.)	20.0000	EA	13,299.93	0.00	0.00	0.00	13,299.93	17,407.65	19,148.42
			300.8688	*0.0000*	*0.0000*	*0.0000*	*300.8688*	*393.7930*	*433.1723*
USR Release Surveys and Equipment Frisks	40.0000	EA	12,034.75	0.00	0.00	0.00	12,034.75	15,751.72	17,326.89

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
(Note: Assume 2 hour average per survey and/or frisk. These will need to be done during entry to and exit from site, so assuming 20 pieces of equipment, quantity is 40.)									
ALT 4 - 331XX90 Decon	**1.0000**	**LS**	**26,726.12**	**12,990.58**	**0.00**	**0.00**	**39,716.70**	**51,983.32**	**57,181.65**
			481.9479	*25.8979*	*0.0000*	*0.0000*	*507.8459*	*664.6956*	*731.1651*
USR Concrete Shaving	53.5100	MSF	25,789.03	1,385.80	0.00	0.00	27,174.83	35,567.86	39,124.65
(Note: Productivity approximated based on similar items in RS Means (090505200700), however, rather than crew A1a, the custom crew includes an operator, two laborers, a skid steer (with a shaver purchased separately) and a vacuum pickup system; productivity is therefore is assumed to be double (from 0.225 to 0.45). Purchase of shaver is under a separate item. This item excludes Building 401, which is to be removed.)									
			0.0000	*11,444.3890*	*0.0000*	*0.0000*	*11,444.3890*	*14,979.0221*	*16,476.9243*
USR Purchase Concrete Floor Shaver	1.0000	EA	0.00	11,444.39	0.00	0.00	11,444.39	14,979.02	16,476.92
(Note: Cost per Skidsteersolutions.com $10,295.00 + tax (8.875%) = $11,209)									
			11.3480	*1.9423*	*0.0000*	*0.0000*	*13.2904*	*17.3951*	*19.1346*
USR Transport concrete dust and chips to temporary stockpile area	82.5772	CY	937.09	160.39	0.00	0.00	1,097.48	1,436.44	1,580.08
(Note: Productivity assumes approximately 10 minutes per round trip using a skid steer (1 cy per trip). Quantity is approximated based on the surface area of concrete being decontamniated, at 1/2" thick.)									
			0.0000	*0.0000*	*0.0000*		*414,153.0000*	*414,153.0000*	*414,153.0000*
342XX ALT 4 - O&M	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**414,153.00**	**414,153.00**	**414,153.00**
USR Present Value for Long-Term O&M	1.0000	LS	0.00	0.00	0.00	0.00	414,153.00	414,153.00	414,153.00
(Note: Present value calculated per Chapter 4 of the USEPA Guide to Developing and Documenting Cost Estimates During the Feasibility Study, and additional guidance from USACE using a yearly cost of $13,460, discount rate of 3.25% and period of 1,000 years.)									
5 ALT 5 - Soil and GW Removal w/ Offsite Disposal; Remove Bldg 401 Foundation and Drains; Decon Foundations; and Ex-Situ VOC Treatment	**1.0000**	**LS**	**577,309.75**	**137,968.89**	**1,071,651.33**	**105,000.00**	**13,916,712.87**	**18,400,387.19**	**20,199,010.60**
331XX ALT 5 - CAPITAL COSTS	**1.0000**	**LS**	**577,309.75**	**137,968.89**	**1,071,651.33**	**105,000.00**	**13,502,559.87**	**17,986,234.19**	**19,784,857.60**
ALT 5 - 331XX01 Mobilize and Preparatory Work	**1.0000**	**LS**	**27,481.55**	**5,647.46**	**18,774.72**	**105,000.00**	**156,903.74**	**205,363.92**	**225,900.31**
			15,469.9117	*5,180.0213*	*1,663.2000*		*22,313.1330*	*29,204.6095*	*32,125.0705*
331XX0101 Mob Construction Equip & Fac	**1.0000**	**EA**	**15,469.91**	**5,180.02**	**1,663.20**	**0.00**	**22,313.13**	**29,204.61**	**32,125.07**
			0.0000	*0.0000*	*1,663.2000*		*1,663.2000*	*2,176.8842*	*2,394.5726*
331XX010190 Site Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**1,663.20**	**0.00**	**1,663.20**	**2,176.88**	**2,394.57**
			0.0000	*0.0000*	*475.2000*		*475.2000*	*621.9669*	*684.1636*
331XX010191 Office Trailers	**1.0000**	**EA**	**0.00**	**0.00**	**475.20**	**0.00**	**475.20**	**621.97**	**684.16**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Office trailer, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: assume 10 miles per haul, 2 trailers. double to account for demob)									
			0.0000	*0.0000*	*712.8000*		*712.8000*	*932.9504*	*1,026.2454*
331XX010192 Toilets	**1.0000**	**EA**	**0.00**	**0.00**	**712.80**	**0.00**	**712.80**	**932.95**	**1,026.25**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Portable toilet and hand wash, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: Assume same cost for delivering storage trailers - three toilets and two hand washes delivered on two trucks. Double to account for demob)									
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
RSM 015213200800 Portable hand wash station, delivery, add per mile	20.0000	MI	0.00	0.00	237.60	0.00	237.60	310.98	342.08
(Note: Assume same cost for delivering storage trailers - three delivered on one truck. Double to account for demob)									
			0.0000	*0.0000*	*475.2000*		*475.2000*	*621.9669*	*684.1636*
331XX010193 Storage Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**475.20**	**0.00**	**475.20**	**621.97**	**684.16**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Storage trailer, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: Assume same cost for delivering storage trailers - 2 deliveries double to account for demob)									
			15,469.9117	*5,180.0213*	*0.0000*		*20,649.9330*	*27,027.7253*	*29,730.4979*
331XX010191 Construction Equipment	**1.0000**	**EA**	**15,469.91**	**5,180.02**	**0.00**	**0.00**	**20,649.93**	**27,027.73**	**29,730.50**
			509.8944	*173.1983*	*0.0000*	*0.0000*	*683.0927*	*894.0678*	*983.4746*
RSM 015436501400 Mobilization or demobilization, delivery charge for equipment, hauled on 20-ton capacity towed trailer	20.0000	EA	10,197.89	3,463.97	0.00	0.00	13,661.85	17,881.36	19,669.49
(Note: Mobilization/demobilization of medium-sized equipment. 1 paver, 1 medium excavator, 3 medium FE loaders/backhoes/skidsteers, 3 rollers, 2 dozers)									
			540.2320	*191.5054*	*0.0000*	*0.0000*	*731.7374*	*957.7366*	*1,053.5102*
RSM 015436501500 Mobilization or demobilization, delivery charge for equipment, hauled on 40-ton capacity towed trailer	8.0000	EA	4,321.86	1,532.04	0.00	0.00	5,853.90	7,661.89	8,428.08
(Note: Mobilization/demobilization of heavy equipment. 1 grader, 2 large excavators, 1 large FE loader)									
			118.7710	*23.0016*	*0.0000*	*0.0000*	*141.7726*	*185.5595*	*204.1155*
RSM 015436501200 Mobilization or demobilization, delivery charge for small equipment, placed in rear of, or towed by pickup truck	8.0000	EA	950.17	184.01	0.00	0.00	1,134.18	1,484.48	1,632.92
(Note: Assume 4 loads each way for smaller equipment (saws, pumps, excavator attachments, etc.))									
			0.0000	*0.0000*	*0.0000*		*105,000.0000*	*137,429.5577*	*151,172.5134*
331XX0103 Submittals/Implementation Plans	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**105,000.00**	**105,000.00**	**137,429.56**	**151,172.51**
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Community Air Monitoring Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Remedial Action Work Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Quality Control Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Sampling and Analysis Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Materials Handling/Transportation and Disposal Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Health and Safety Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Stormwater Pollution Prevention Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Community Participation Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*5,000.0000*	*5,000.0000*	*6,544.2647*	*7,198.6911*
USR Project Schedule	1.0000	EA	0.00	0.00	0.00	5,000.00	5,000.00	6,544.26	7,198.69
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by 75% for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Site Access/Site Security Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			0.0000	*0.0000*	*0.0000*	*10,000.0000*	*10,000.0000*	*13,088.5293*	*14,397.3822*
USR Site Management/Long-term O&M Plan	1.0000	EA	0.00	0.00	0.00	10,000.00	10,000.00	13,088.53	14,397.38
(Note: Cost is based on Feas bility Study Cost Estimate for the Interim Waste Containment Structure, provided by USACE. The cost was reduced by half for this task because the work is less complex.)									
			2,538.6206	*467.4417*	*2,515.3200*		*5,521.3824*	*7,226.6775*	*7,949.3452*
331XX0104 Setup/Construct Temp Facilities	**1.0000**	**EA**	**2,538.62**	**467.44**	**2,515.32**	**0.00**	**5,521.38**	**7,226.68**	**7,949.35**
			0.0000	*0.0000*	*1,089.7200*		*1,089.7200*	*1,426.2832*	*1,568.9115*
331XX010411 Barricades	**1.0000**	**EA**	**0.00**	**0.00**	**1,089.72**	**0.00**	**1,089.72**	**1,426.28**	**1,568.91**
			0.0000	*0.0000*	*114.4800*	*0.0000*	*114.4800*	*149.8375*	*164.8212*
RSM 015623100410 Barricades, PVC pipe barricade, break-a-way, buy, 3" diam. PVC, with 3 each 1' x 4' reflectorized panels	4.0000	EA	0.00	0.00	457.92	0.00	457.92	599.35	659.28
(Note: Quantity approximated - will be used to protect open excavations and active work areas)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*21.0600*	*0.0000*	*21.0600*	*27.5644*	*30.3209*
RSM 015623100850 Barricades, traffic cones, PVC, 28" high	30.0000	EA	0.00	0.00	631.80	0.00	631.80	826.93	909.63
(Note: Quantity approximated - will be used to protect open excavations and active work areas)									
			1,334.6250	*10.9816*	*777.6000*		*2,123.2067*	*2,778.9653*	*3,056.8618*
331XX010430 Erosion Control	**1.0000**	**EA**	**1,334.63**	**10.98**	**777.60**	**0.00**	**2,123.21**	**2,778.97**	**3,056.86**
			1.3346	*0.0110*	*0.7776*	*0.0000*	*2.1232*	*2.7790*	*3.0569*
RSM 312514161000 Synthetic erosion control, silt fence, install and maintain, remove, 3' high	1,000.0000	LF	1,334.63	10.98	777.60	0.00	2,123.21	2,778.97	3,056.86
(Note: Quantity approximated - will be used to protect temporary staging areas and other sensitive areas)									
			1,203.9956	*456.4601*	*648.0000*		*2,308.4557*	*3,021.4290*	*3,323.5719*
331XX010491 Temporary Staging Areas	**1.0000**	**EA**	**1,204.00**	**456.46**	**648.00**	**0.00**	**2,308.46**	**3,021.43**	**3,323.57**
			0.1204	*0.0456*	*0.0648*	*0.0000*	*0.2308*	*0.3021*	*0.3324*
USR Create Stockpile area	10,000.0000	SF	1,204.00	456.46	648.00	0.00	2,308.46	3,021.43	3,323.57
(Note: User-created crew utilized due to lack of appropriate options in the Cost Book. Assume 100 x 100 ft temporary staging area. Assume 1 half day to construct. Created using a loader for moving earth, and laborers for spotting and placing liner. Silt fence installation included under 10430 - Erosion Control Material cost for poly liner per Uline online - $0.5/sy or approx. $0.06/sf. Removal will be covered under general site restoration.)									
			9,473.0211	*0.0000*	*14,596.2000*		*24,069.2211*	*31,503.0706*	*34,653.3777*
331XX0105 Construct Temporary Utilities	**1.0000**	**EA**	**9,473.02**	**0.00**	**14,596.20**	**0.00**	**24,069.22**	**31,503.07**	**34,653.38**
			9,473.0211	*0.0000*	*14,596.2000*		*24,069.2211*	*31,503.0706*	*34,653.3777*
331XX010502 Power Connection/Distribution	**1.0000**	**EA**	**9,473.02**	**0.00**	**14,596.20**	**0.00**	**24,069.22**	**31,503.07**	**34,653.38**
			128.2738	*0.0000*	*124.2000*	*0.0000*	*252.4738*	*330.4511*	*363.4962*
RSM 015113500870 Temporary electrical power equipment (pro-rated per job), connections, office trailer, 60 amp	2.0000	EA	256.55	0.00	248.40	0.00	504.95	660.90	726.99
			461.7857	*0.0000*	*793.8000*	*0.0000*	*1,255.5857*	*1,643.3771*	*1,807.7148*
RSM 015113500030 Temporary electrical power equipment (pro-rated per job), overhead feed, 3 uses, 100 amp	1.0000	EA	461.79	0.00	793.80	0.00	1,255.59	1,643.38	1,807.71
			1,443.0804	*0.0000*	*3,888.0000*	*0.0000*	*5,331.0804*	*6,977.6002*	*7,675.3602*
RSM 015113500240 Temporary electrical power equipment (pro-rated per job), transformers, 3 uses, 112.5 kVA	1.0000	EA	1,443.08	0.00	3,888.00	0.00	5,331.08	6,977.60	7,675.36
			7.2154	*0.0000*	*7.1280*	*0.0000*	*14.3434*	*18.7734*	*20.6507*
RSM 015113500420 Temporary electrical power equipment (pro-rated per job), feeder, EMT and aluminum wire, 100 amp	1,000.0000	LF	7,215.40	0.00	7,128.00	0.00	14,343.40	18,773.40	20,650.74
(Note: Quantity approximated)									
			48.1027	*0.0000*	*1,269.0000*	*0.0000*	*1,317.1027*	*1,723.8937*	*1,896.2831*
RSM 015113500560 Temporary electrical power equipment (pro-rated per job), temporary feeder cords, 100 amp, 3 uses, 100' long	2.0000	EA	96.21	0.00	2,538.00	0.00	2,634.21	3,447.79	3,792.57
ALT 5 - 331XX02	**1.0000**	**LS**	**0.00**	**0.00**	**1,827.36**	**0.00**	**140,249.86**	**183,566.44**	**201,923.08**

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
Monitoring,Samplng,Test,Analysis									
			0.0000	*0.0000*	*0.0000*		*8,452.5000*	*11,063.0794*	*12,169.3873*
331XX0202 Radiation Monitoring	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**8,452.50**	**11,063.08**	**12,169.39**
			0.0000	*0.0000*	*0.0000*		*8,452.5000*	*11,063.0794*	*12,169.3873*
331XX020201 Area Monitoring	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**8,452.50**	**11,063.08**	**12,169.39**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*2,657.5000*	*3,478.2767*	*3,826.1043*
USR Rent Radiological Monitoring Equipment	3.0000	MO	0.00	0.00	0.00	0.00	7,972.50	10,434.83	11,478.31
(Note: Cost per bid results from a recent similar project. Refer to project notes for a list of equipment and quantities.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*240.0000*	*314.1247*	*345.5372*
USR Shipping for Radiological Monitoring Equipment	2.0000	EA	0.00	0.00	0.00	0.00	480.00	628.25	691.07
(Note: Cost per bid results from a recent similar project. Cost is per delivery, each way.)									
			0.0000	*0.0000*	*0.0000*		*23,000.0000*	*30,103.6174*	*33,113.9791*
331XX0203 Air Monitoring & Sampling	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**23,000.00**	**30,103.62**	**33,113.98**
			0.0000	*0.0000*	*0.0000*		*23,000.0000*	*30,103.6174*	*33,113.9791*
331XX020301 CAMP	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**23,000.00**	**30,103.62**	**33,113.98**
USR Camp Equipment Rental, Mobilization, and Weekly Reporting	1.0000	LS	0.00	0.00	0.00	0.00	23,000.00	30,103.62	33,113.98
(Note: Cost obtained from estimate for recent similar nearby project. Assumes 3 perimiter air monitoring stations (including 1 dust monitor, 1 PID, 1 datalogger and 1 radio), one meteorological tower, one computer and one telemetry system. Cost includes mobilization/setup by vendor, weekly summary reports and demobilization. The cost assumes a duration of three months.)									
			0.0000	*0.0000*	*38.8800*		*38.8800*	*50.8882*	*55.9770*
331XX0205 Sample Surface wt/Grdwtr/Liquid	**1.0000**	**EA**	**0.00**	**0.00**	**38.88**	**0.00**	**38.88**	**50.89**	**55.98**
			0.0000	*0.0000*	*38.8800*		*38.8800*	*50.8882*	*55.9770*
331XX020505 Sample Shipping and Handling	**1.0000**	**EA**	**0.00**	**0.00**	**38.88**	**0.00**	**38.88**	**50.89**	**55.98**
			0.0000	*0.0000*	*38.8800*	*0.0000*	*38.8800*	*50.8882*	*55.9770*
RSM 029110100230 Sample packaging & shipping, packaging, vials & bottles, 32 ounce HDPE bottle, case of 12	1.0000	EA	0.00	0.00	38.88	0.00	38.88	50.89	55.98
(Note: Labor for sample collection is accounted for elsewhere in the estimate; it is expected that sample collection will be performed by an on-site engineer, health and safety officer, environmental technician or otherwise.)									
			0.0000	*0.0000*	*1,555.2000*		*1,555.2000*	*2,035.5281*	*2,239.0809*
331XX0206 Sampling Soil and Sediment	**1.0000**	**EA**	**0.00**	**0.00**	**1,555.20**	**0.00**	**1,555.20**	**2,035.53**	**2,239.08**
			0.0000	*0.0000*	*1,555.2000*		*1,555.2000*	*2,035.5281*	*2,239.0809*
331XX020604 Sample Shipping and Handling	**1.0000**	**EA**	**0.00**	**0.00**	**1,555.20**	**0.00**	**1,555.20**	**2,035.53**	**2,239.08**
			0.0000	*0.0000*	*38.8800*	*0.0000*	*38.8800*	*50.8882*	*55.9770*
RSM 029110100230 Sample packaging & shipping, packaging, vials & bottles, 32 ounce HDPE bottle, case of 12	40.0000	EA	0.00	0.00	1,555.20	0.00	1,555.20	2,035.53	2,239.08
(Note: Assume 2 bottles per sample. Labor for sample collection is accounted for elsewhere in the estimate; it is expected that sample collection will be performed by an on-site engineer, health and safety officer, environmental technician or otherwise.)									
			0.0000	*0.0000*	*233.2800*		*233.2800*	*305.3292*	*335.8621*
331XX0208 Sampling Radioactve Contam Media	**1.0000**	**EA**	**0.00**	**0.00**	**233.28**	**0.00**	**233.28**	**305.33**	**335.86**

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*233.2800*		*233.2800*	*305.3292*	*335.8621*
331XX020808 Sample Shipping and Handling	**1.0000**	**EA**	**0.00**	**0.00**	**233.28**	**0.00**	**233.28**	**305.33**	**335.86**
			0.0000	*0.0000*	*38.8800*	*0.0000*	*38.8800*	*50.8882*	*55.9770*
RSM 029110100230 Sample packaging & shipping, packaging, vials & bottles, 32 ounce HDPE bottle, case of 12	6.0000	EA	0.00	0.00	233.28	0.00	233.28	305.33	335.86
(Note: Assume 2 bottles per sample. Labor for sample collection is accounted for elsewhere in the estimate; it is expected that sample collection will be performed by an on-site engineer, health and safety officer, environmental technician or otherwise.)									
			0.0000	*0.0000*	*0.0000*		*106,970.0000*	*140,007.9979*	*154,008.7977*
331XX0209 Laboratory Chemical Analysis	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**106,970.00**	**140,008.00**	**154,008.80**
			0.0000	*0.0000*	*0.0000*		*355.0000*	*464.6428*	*511.1071*
331XX020902 Gen Water Qual & Wastewtr Analys	**2.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**710.00**	**929.29**	**1,022.21**
(Note: Assume only 2 samples will be collected due to the relatively small volume)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*110.0000*	*143.9738*	*158.3712*
USR Ra-226 Analysis	2.0000	EA	0.00	0.00	0.00	0.00	220.00	287.95	316.74
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR Th-232 Analysis	2.0000	EA	0.00	0.00	0.00	0.00	160.00	209.42	230.36
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR U-238 Analysis	2.0000	EA	0.00	0.00	0.00	0.00	160.00	209.42	230.36
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*85.0000*	*111.2525*	*122.3777*
USR PAH Analysis	2.0000	EA	0.00	0.00	0.00	0.00	170.00	222.50	244.76
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*		*385.0000*	*503.9084*	*554.2992*
331XX020907 Soil & Sediment Analysis	**240.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**92,400.00**	**120,938.01**	**133,031.81**
(Note: For approximately 40 individual excavations, with 6 samples per excavation.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*70.0000*	*91.6197*	*100.7817*
USR Ra-226 Analysis	240.0000	EA	0.00	0.00	0.00	0.00	16,800.00	21,988.73	24,187.60
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR Th-232 Analysis	240.0000	EA	0.00	0.00	0.00	0.00	19,200.00	25,129.98	27,642.97
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR U-238 Analysis	240.0000	EA	0.00	0.00	0.00	0.00	19,200.00	25,129.98	27,642.97
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*85.0000*	*111.2525*	*122.3777*
USR PAH Analysis	240.0000	EA	0.00	0.00	0.00	0.00	20,400.00	26,700.60	29,370.66
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*70.0000*	*91.6197*	*100.7817*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
USR VOC Analysis	240.0000	EA	0.00	0.00	0.00	0.00	16,800.00	21,988.73	24,187.60
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*		*385.0000*	*503.9084*	*554.2992*
331XX020991 Contaminated Concrete Analysis	**36.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**13,860.00**	**18,140.70**	**19,954.77**
(Note: It is assumed that the cost for analysis of concrete chips is the same as for soil/sediment. Quantity assumes 12 samples per concrete slab.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*70.0000*	*91.6197*	*100.7817*
USR Ra-226 Analysis	36.0000	EA	0.00	0.00	0.00	0.00	2,520.00	3,298.31	3,628.14
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR Th-232 Analysis	36.0000	EA	0.00	0.00	0.00	0.00	2,880.00	3,769.50	4,146.45
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*80.0000*	*104.7082*	*115.1791*
USR U-238 Analysis	36.0000	EA	0.00	0.00	0.00	0.00	2,880.00	3,769.50	4,146.45
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*85.0000*	*111.2525*	*122.3777*
USR PAH Analysis	36.0000	EA	0.00	0.00	0.00	0.00	3,060.00	4,005.09	4,405.60
(Note: Cost obtained from lab contract for similar project.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*70.0000*	*91.6197*	*100.7817*
USR VOC Analysis	36.0000	EA	0.00	0.00	0.00	0.00	2,520.00	3,298.31	3,628.14
(Note: Cost obtained from lab contract for similar project.)									
ALT 5 - 331XX03 Site Work	**1.0000**	**LS**	**64,384.25**	**29,066.14**	**194.40**	**0.00**	**93,644.79**	**135,648.94**	**149,213.83**
			15,657.7157	*8,664.3221*	*194.4000*		*24,516.4377*	*32,088.4114*	*35,297.2525*
331XX0301 Demolition and Removal of Asphalt Roadways	**1.0000**	**EA**	**15,657.72**	**8,664.32**	**194.40**	**0.00**	**24,516.44**	**32,088.41**	**35,297.25**
			1,021.3213	*326.6996*	*194.4000*		*1,542.4209*	*2,018.8021*	*2,220.6823*
331XX030190 Saw-cut asphalt roadway	**1.0000**	**LF**	**1,021.32**	**326.70**	**194.40**	**0.00**	**1,542.42**	**2,018.80**	**2,220.68**
			0.6809	*0.2178*	*0.1296*	*0.0000*	*1.0283*	*1.3459*	*1.4805*
RSM 024119250015 Selective demolition, saw cutting, asphalt, up to 3" deep	1,500.0000	LF	1,021.32	326.70	194.40	0.00	1,542.42	2,018.80	2,220.68
(Note: Quantity approximated based on aerial photo)									
			4.4353	*2.5266*	*0.0000*		*6.9618*	*9.1120*	*10.0232*
331XX030191 Asphalt road removal	**3,300.0000**	**CY**	**14,636.39**	**8,337.62**	**0.00**	**0.00**	**22,974.02**	**30,069.61**	**33,076.57**
			1.9449	*0.6451*	*0.0000*	*0.0000*	*2.5900*	*3.3899*	*3.7289*
RSM 312316425100 Excavating, bulk bank measure, sandy clay/loam, open site, 1 C.Y. capacity = 120 C.Y./hour, excavator, hydraulic, crawler mounted, excluding truck loading	3,300.0000	BCY	6,418.21	2,128.75	0.00	0.00	8,546.96	11,186.71	12,305.39
(Note: Crew output reduced to 90 because material being excavated is asphalt and gravel.)									
			1.9157	*1.4473*	*0.0000*	*0.0000*	*3.3630*	*4.4016*	*4.8418*
RSM 312323203626 Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min	4,290.0000	LCY	8,218.19	6,208.87	0.00	0.00	14,427.06	18,882.89	20,771.18

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
load/wait/unload, 16.5 C.Y. truck, cycle 0.5 mile, 20 MPH, excludes loading equipment (Note: Hauling from excavation site to temporary stockpiling area)									
			33,293.0302	*20,168.5391*	*0.0000*		*53,461.5693*	*83,055.0126*	*91,360.5139*
331XX0302 Clearing and Grubbing	**1.0000**	**EA**	**33,293.03**	**20,168.54**	**0.00**	**0.00**	**53,461.57**	**83,055.01**	**91,360.51**
			17,634.6331	*5,835.1298*	*0.0000*		*23,469.7629*	*36,461.3586*	*40,107.4945*
331XX030290 Tree removal	**1.0000**	**EA**	**17,634.63**	**5,835.13**	**0.00**	**0.00**	**23,469.76**	**36,461.36**	**40,107.49**
			1,513.6451	*1,385.5629*	*0.0000*	*0.0000*	*2,899.2080*	*4,504.0532*	*4,954.4585*
RSM 311110100250 Clearing & grubbing, trees to 12" diameter, grub stumps and remove	2.0000	ACR	3,027.29	2,771.13	0.00	0.00	5,798.42	9,008.11	9,908.92
			292.1469	*61.2801*	*0.0000*	*0.0000*	*353.4269*	*549.0650*	*603.9715*
HNC 311110107320 Tree removal, congested area, 12" to 24" diameter, tree removal, cutting and chipping (Note: Quantity is approximated)	50.0000	EA	14,607.34	3,064.00	0.00	0.00	17,671.35	27,453.25	30,198.58
			15,658.3972	*14,333.4093*	*0.0000*		*29,991.8065*	*46,593.6540*	*51,253.0194*
331XX030291 Brush clearing	**1.0000**	**ACR**	**15,658.40**	**14,333.41**	**0.00**	**0.00**	**29,991.81**	**46,593.65**	**51,253.02**
			2,609.7329	*2,388.9016*	*0.0000*	*0.0000*	*4,998.6344*	*7,765.6090*	*8,542.1699*
RSM 311110100160 Clearing & grubbing, brush, including stumps	6.0000	ACR	15,658.40	14,333.41	0.00	0.00	29,991.81	46,593.65	51,253.02
			15,433.5049	*233.2781*	*0.0000*		*15,666.7830*	*20,505.5148*	*22,556.0663*
331XX0393 Survey	**1.0000**	**EA**	**15,433.50**	**233.28**	**0.00**	**0.00**	**15,666.78**	**20,505.51**	**22,556.07**
			907.8532	*13.7222*	*0.0000*	*0.0000*	*921.5755*	*1,206.2068*	*1,326.8274*
RSM 017123131100 Boundary & survey markers, crew for building layout, 2 person crew	17.0000	DAY	15,433.50	233.28	0.00	0.00	15,666.78	20,505.51	22,556.07
(Note: Assume surveyor will be on site daily during excavation phase to set up control points, locate and survey excavations, and locate any other key site features; and 5 additional days to complete final grade surveys)									
ALT 5 - 331XX08 Solids Collect And Containment	**1.0000**	**LS**	**43,242.18**	**21,426.30**	**8,100.00**	**0.00**	**89,643.47**	**117,330.12**	**129,063.14**
			17.2969	*8.5705*	*3.2400*		*35.8574*	*46.9320*	*51.6253*
331XX0801 Contaminated Soil Collection	**2,500.0000**	**BCY**	**43,242.18**	**21,426.30**	**8,100.00**	**0.00**	**89,643.47**	**117,330.12**	**129,063.14**
(Note: This includes the excavation of RAD/PAH-contaminated soils. The quantity includes 500 cy of soil from the Building 431/432 Trench (assuming 1/2 of the quantity removed will be soil).)									
			2.9174	*0.9676*	*0.0000*		*3.8850*	*5.0849*	*5.5934*
331XX080102 Excavation	**2,500.0000**	**BCY**	**7,293.42**	**2,419.04**	**0.00**	**0.00**	**9,712.46**	**12,712.18**	**13,983.39**
			2.9174	*0.9676*	*0.0000*	*0.0000*	*3.8850*	*5.0849*	*5.5934*
RSM 312316425100 Excavating, bulk bank measure, sandy clay/loam, open site, 1 C.Y. capacity = 120 C.Y./hour, excavator, hydraulic, crawler mounted, excluding truck loading	2,500.0000	BCY	7,293.42	2,419.04	0.00	0.00	9,712.46	12,712.18	13,983.39
(Note: Crew output reduced to 60 from 120 to account for movement between excavations, equipment frisking, and waiting for transport trucks.)									
			6.7081	*1.4473*	*2.4923*		*15.8400*	*20.7322*	*22.8054*
331XX080103 Hauling	**3,250.0000**	**LCY**	**21,801.30**	**4,703.69**	**8,100.00**	**0.00**	**51,479.98**	**67,379.73**	**74,117.70**
(Note: Hauling to temporary staging area from excavation site. Volume assumes a swell factor of 30%)									
			1.9157	*1.4473*	*0.0000*	*0.0000*	*3.3630*	*4.4016*	*4.8418*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
RSM 312323203626 Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min load/wait/unload, 16.5 C.Y. truck, cycle 0.5 mile, 20 MPH, excludes loading equipment	3,250.0000	LCY	6,225.90	4,703.69	0.00	0.00	10,929.59	14,305.22	15,735.75
(Note: Hauling from excavation site to temporary stockpiling area. Assume a swell factor of 30%.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*450.0000*	*588.9838*	*647.8822*
USR Intermodal Shipping Container Rental	37.5000	MO	0.00	0.00	0.00	0.00	16,875.00	22,086.89	24,295.58
(Note: Cost per quote from Secur LLC. Quantity assumes 1 week roundtrip for a 25 ton truck 4 trips per month per truck.)									
			103.8360	*0.0000*	*54.0000*	*0.0000*	*157.8360*	*206.5841*	*227.2425*
USR Shipping container prep	150.0000	EA	15,575.40	0.00	8,100.00	0.00	23,675.40	30,987.61	34,086.37
(Note: User-created crew utilized due to lack of appropriate options in the Cost Book. Cost assumes two laborers for inspection of shipping containers and installation of specialty liners. Liner cost is per quote from Secur LLC. Assume 1/2 hour per truck and 282 total truck loads.)									
			4.3531	*4.4011*	*0.0000*		*8.7542*	*11.4579*	*12.6037*
331XX080104 Stockpiling	**3,250.0000**	**LCY**	**14,147.46**	**14,303.57**	**0.00**	**0.00**	**28,451.03**	**37,238.22**	**40,962.04**
(Note: Temporary staging area for excavated material)									
			112.8696	*114.1150*	*0.0000*	*0.0000*	*226.9846*	*297.0895*	*326.7984*
RSM B10U Stockpile Management	104.8387	HR	11,833.10	11,963.67	0.00	0.00	23,796.78	31,146.48	34,261.13
(Note: Assume 1 loader with a spotter half-time for managing temporary stockpile. Quantity is based on the calculated extended duration for the cycle hauling item)									
			0.7121	*0.7200*	*0.0000*	*0.0000*	*1.4321*	*1.8744*	*2.0618*
HTW 312316133106 Load Truck for Transport to Disposal Facility, 5.5 CY wheel loader	3,250.0000	LCY	2,314.36	2,339.90	0.00	0.00	4,654.26	6,091.74	6,700.91
ALT 5 - 331XX09 Liq/Sed/Sludges Collect,Contain	**1.0000**	**LS**	**5,730.36**	**3,119.09**	**7,112.88**	**0.00**	**17,922.33**	**23,457.69**	**25,803.46**
			2,159.4379	*1,392.9879*	*7,112.8800*		*12,625.3058*	*16,524.6685*	*18,177.1353*
331XX0903 Waste Containment, Portable	**1.0000**	**EA**	**2,159.44**	**1,392.99**	**7,112.88**	**0.00**	**12,625.31**	**16,524.67**	**18,177.14**
			2,159.4379	*1,392.9879*	*7,112.8800*		*12,625.3058*	*16,524.6685*	*18,177.1353*
331XX090301 Bulk Liquid Containers/Roll-Offs	**1.0000**	**EA**	**2,159.44**	**1,392.99**	**7,112.88**	**0.00**	**12,625.31**	**16,524.67**	**18,177.14**
			626.0872	*266.0433*	*0.0000*	*0.0000*	*892.1305*	*1,167.6676*	*1,284.4343*
HTW 028610106152 Secondary containment and storage, storage systems, loading hazardous waste for shipment, load liquid or sludge into 5,000 gal. bulk tank truck	1.0000	EA	626.09	266.04	0.00	0.00	892.13	1,167.67	1,284.43
(Note: It is approximated that 1 gallon of water will need to be pumped for every cubic yard excavated, so for a total of 4,700 cy, this equals 4,700 gallons. Therefore only one load will be required)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*980.0000*	*1,282.6759*	*1,410.9435*
HTW 029110409118 Wastewater holding tanks, above ground, steel, closed, stationary, monthly rental, 21,000 gal	2.0000	MO	0.00	0.00	0.00	0.00	1,960.00	2,565.35	2,821.89
(Note: It is approximated that 1 gallon of water will need to be pumped for every cubic yard excavated, so for a total of 4,700 cy, this equals 4,700 gallons.)									
			1,384.5622	*1,105.7423*	*0.0000*	*0.0000*	*2,490.3046*	*3,259.4424*	*3,585.3867*
HTW 026510104315 Clean and rinse tank interior, high pressure water, 20,001 to 30,000 gallons	1.0000	EA	1,384.56	1,105.74	0.00	0.00	2,490.30	3,259.44	3,585.39
			74.3942	*10.6011*	*3,556.4400*	*0.0000*	*3,641.4354*	*4,766.1034*	*5,242.7137*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
USR 221353203142 Wastewater holding tanks, above ground, saddle, f berglass, 200 gal	2.0000	MO	148.79	21.20	7,112.88	0.00	7,282.87	9,532.21	10,485.43
(Note: Pickup truck with 200 gallon tank for storing water pumped from excavations for transport to main storage tank. 1 truck, 1 laborer assume full time. Material cost is for the purchase price, so since the quantity is not 1, the material cost needs to be divided by the quantity to accurately reflect the purchase price.)									
			3,570.9236	*1,726.0991*	*0.0000*		*5,297.0227*	*6,933.0237*	*7,626.3260*
331XX0906 Pumping/Draining/Collection	**1.0000**	**EA**	**3,570.92**	**1,726.10**	**0.00**	**0.00**	**5,297.02**	**6,933.02**	**7,626.33**
			3,570.9236	*1,726.0991*	*0.0000*		*5,297.0227*	*6,933.0237*	*7,626.3260*
331XX090603 Dewatering	**1.0000**	**EA**	**3,570.92**	**1,726.10**	**0.00**	**0.00**	**5,297.02**	**6,933.02**	**7,626.33**
			595.1539	*287.6832*	*0.0000*	*0.0000*	*882.8371*	*1,155.5039*	*1,271.0543*
RSM 312319201100 Dewatering, pumping 8 hours, attended 2 hrs per day, 6" centrifugal pump, includes 20 LF of suction hose and 250 LF of discharge hose	6.0000	DAY	3,570.92	1,726.10	0.00	0.00	5,297.02	6,933.02	7,626.33
(Note: It is assumed that dewatering will be required for half of the days that excavation is taking place. Approximately 12 total days of excavation are required, so pumping will be necessary for roughly 6 days.)									
ALT 5 - 331XX10 Drums/Tanks/Struct/Misc Removal	**1.0000**	**LS**	**21,441.68**	**8,189.59**	**0.00**	**0.00**	**29,631.27**	**38,782.97**	**42,661.27**
331XX1003 Structure Removal (Building 401 Slab)	**1.0000**	**LS**	**14,597.73**	**7,121.54**	**0.00**	**0.00**	**21,719.26**	**28,427.32**	**31,270.05**
331XX100302 Demolition	**1.0000**	**LS**	**9,962.17**	**4,698.38**	**0.00**	**0.00**	**14,660.55**	**19,188.51**	**21,107.36**
			0.5074	*0.2393*	*0.0000*	*0.0000*	*0.7467*	*0.9773*	*1.0750*
RSM 024116170400 Building footings and foundations demolition, floors, concrete slab on grade, plain concrete, 6" thick, excludes disposal costs and dump fees	19,635.0000	SF	9,962.17	4,698.38	0.00	0.00	14,660.55	19,188.51	21,107.36
(Note: Crew output reduced to 300 because slabs are assumed to be 12 inches thick. Quantity assumes 12 inch slabs. Building 401 Drains will be removed along with the concrete slabs, at no expected additional effort.)									
			4,635.5559	*2,423.1566*	*0.0000*		*7,058.7125*	*9,238.8166*	*10,162.6982*
331XX100390 Excavation, hauling, stockpiling and transport off-site	**1.0000**	**EA**	**4,635.56**	**2,423.16**	**0.00**	**0.00**	**7,058.71**	**9,238.82**	**10,162.70**
			3.5008	*1.1611*	*0.0000*	*0.0000*	*4.6620*	*6.1018*	*6.7120*
RSM 312316425100 Excavating, bulk bank measure, sandy clay/loam, open site, 1 C.Y. capacity = 120 C.Y./hour, excavator, hydraulic, crawler mounted, excluding truck loading	727.2222	BCY	2,545.89	844.41	0.00	0.00	3,390.29	4,437.40	4,881.14
(Note: Crew output reduced to 50 from 120 because material being excavated is reinforcecd concrete, and material needs to be transported to the temporary stockpile areas. Quantity is based on 19,635 square feet of foundation at an assumed 1 ft thick.)									
			1.9157	*1.4473*	*0.0000*	*0.0000*	*3.3630*	*4.4016*	*4.8418*
RSM 312323203626 Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min load/wait/unload, 16.5 C.Y. truck, cycle 0.5 mile, 20 MPH, excludes loading equipment	1,090.8333	LCY	2,089.67	1,578.75	0.00	0.00	3,668.42	4,801.42	5,281.56
(Note: Hauling from excavation site to temporary stockpiling area. Quantity is based on 19,635 square feet of foundation at an assumed 1 ft thick with a swell factor of 1.5 assumed)									
			136.8790	*21.3611*	*0.0000*		*158.2401*	*207.1130*	*227.8243*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
331XX1091 Structure Removal (Tank Foundations)	**50.0000**	**CY**	**6,843.95**	**1,068.06**	**0.00**	**0.00**	**7,912.01**	**10,355.65**	**11,391.22**
331XX100302 Demolition	**1.0000**	**LS**	**6,622.19**	**941.73**	**0.00**	**0.00**	**7,563.91**	**9,900.05**	**10,890.06**
			132.4437	*18.8346*	*0.0000*	*0.0000*	*151.2783*	*198.0010*	*217.8011*
HNC 024113332110 Minor site demolition, concrete, unreinforced, 7" to 24" thick, remove with backhoe, excludes hauling	50.0000	CY	6,622.19	941.73	0.00	0.00	7,563.91	9,900.05	10,890.06
(Note: Removal of concrete tank foundations. Hydraulic hammer attachment added 1/4 time for breakdown of concrete pieces as needed. Quantity is approximated.)									
			4.4353	*2.5266*	*0.0000*		*6.9618*	*9.1120*	*10.0232*
331XX100390 Excavation, hauling, stockpiling and transport off-site	**50.0000**	**CY**	**221.76**	**126.33**	**0.00**	**0.00**	**348.09**	**455.60**	**501.16**
			1.9449	*0.6451*	*0.0000*	*0.0000*	*2.5900*	*3.3899*	*3.7289*
RSM 312316425100 Excavating, bulk bank measure, sandy clay/loam, open site, 1 C.Y. capacity = 120 C.Y./hour, excavator, hydraulic, crawler mounted, excluding truck loading	50.0000	BCY	97.25	32.25	0.00	0.00	129.50	169.50	186.45
(Note: Crew output reduced to 90 because material being excavated is reinforcecd concrete.)									
			1.9157	*1.4473*	*0.0000*	*0.0000*	*3.3630*	*4.4016*	*4.8418*
RSM 312323203626 Cycle hauling(wait, load, travel, unload or dump & return) time per cycle, excavated or borrow, loose cubic yards, 30 min load/wait/unload, 16.5 C.Y. truck, cycle 0.5 mile, 20 MPH, excludes loading equipment	65.0000	LCY	124.52	94.07	0.00	0.00	218.59	286.10	314.71
(Note: Hauling from excavation site to temporary stockpiling area)									
ALT 5 - 331XX14 Thermal Treatment	**1.0000**	**LS**	**0.00**	**0.00**	**5,400.00**	**0.00**	**1,227,200.00**	**1,906,511.78**	**2,097,162.95**
			0.0000	*0.0000*	*5,400.0000*		*1,227,200.0000*	*1,906,511.7759*	*2,097,162.9534*
331XX1491 Ex-Situ Thermal Treatment	**1.0000**	**EA**	**0.00**	**0.00**	**5,400.00**	**0.00**	**1,227,200.00**	**1,906,511.78**	**2,097,162.95**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*232.0000*	*360.4227*	*396.4650*
USR Tevet	3,400.0000	BCY	0.00	0.00	0.00	0.00	788,800.00	1,225,437.16	1,347,980.88
(Note: Cost for Ex-Situ Treatment per federal roundtable on costing for thermal treatment. The cost includes excavation and backfill and mobilization. Assume 1 year of treatment.)									
USR Off-gas treatment	1.0000	LS	0.00	0.00	0.00	0.00	433,000.00	672,685.46	739,954.01
(Note: Cost for treatment of effluent gasses during Ex-Situ Thermal Treatment per cost estimate prepared by CTI for a similar-sized site. Assume 1 year of treatment.)									
USR Groundwater Polishing	1.0000	LS	0.00	0.00	5,400.00	0.00	5,400.00	8,389.15	9,228.06
(Note: This is an allowance for application of a chemical oxidation compound to exposed groundwater in order to enhance degredation of contamination in the groundwater. This will be applied while the excavation is open. Allowance covers only the material, since the application is simple.)									
			0.0000	*0.0000*	*0.0000*		*10,224,408.3889*	*13,382,246.8773*	*14,720,471.5650*
ALT 5 - 331XX18 Transport and Disposal - Radiological	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**10,224,408.39**	**13,382,246.88**	**14,720,471.57**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*200.0000*	*261.7706*	*287.9476*
USR Transport contaminated soil to Radiological Disposal Facility	3,750.0000	TON	0.00	0.00	0.00	0.00	750,000.00	981,639.70	1,079,803.67
(Note: Cost per quote from Secur LLC. Assumes 1.5 tons/CY.)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*0.0000*	*0.0000*	*200.0000*	*261.7706*	*287.9476*
USR Transport Contaminated Concrete to Disposal Facility	1,454.4444	TON	0.00	0.00	0.00	0.00	290,888.89	380,730.77	418,803.85
(Note: This item is for transporting radiologically contaminated concrete to the disposal facility. Cost per quote from Secur LLC. Assumes 2 tons/CY. Quantity is based on excavated volume, assuming 2 tons per cy.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*200.0000*	*261.7706*	*287.9476*
USR Transport concrete chips and dust to Radiological Disposal Facility	123.8657	TON	0.00	0.00	0.00	0.00	24,773.15	32,424.41	35,666.85
(Note: Cost per quote from Secur LLC. Assumes 1.5 tons/CY. Assume a swell factor of 30%.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*200.0000*	*261.7706*	*287.9476*
USR Transport Contaminated Asphalt to Radiological Disposal Facility	6,600.0000	TON	0.00	0.00	0.00	0.00	1,320,000.00	1,727,685.87	1,900,454.45
(Note: This item is for transporting radiologically contaminated asphalt to the disposal facility. Cost per quote from Secur LLC. Assumes 2 tons/CY.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*497.0000*	*650.4999*	*715.5499*
USR Radiological Contaminated Soil Disposal	2,500.0000	CY	0.00	0.00	0.00	0.00	1,242,500.00	1,626,249.77	1,788,874.74
(Note: Cost based on a contract for a similar project provided by WCS Texas Quantity assumes a swell factor of 30%.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*924.0000*	*1,209.3801*	*1,330.3181*
USR Radiological Contaminated Debris Disposal (asphalt roadway)	5,577.0000	LCY	0.00	0.00	0.00	0.00	5,153,148.00	6,744,712.86	7,419,184.14
(Note: Cost based on a contract for a similar project provided by WCS Texas. Assume swell factor of 1.3.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*924.0000*	*1,209.3801*	*1,330.3181*
USR Radiological Contaminated Debris Disposal (concrete dust and chips)	107.3503	LCY	0.00	0.00	0.00	0.00	99,191.69	129,827.33	142,810.06
(Note: Cost based on a contract for a similar project provided by WCS Texas. Assume swell factor of 1.3.)									
			0.0000	*0.0000*	*0.0000*	*0.0000*	*924.0000*	*1,209.3801*	*1,330.3181*
USR Radiological Contaminated Debris Disposal (concrete slabs)	1,454.4444	LCY	0.00	0.00	0.00	0.00	1,343,906.67	1,758,976.18	1,934,873.80
(Note: Cost based on a contract for a similar project provided by WCS Texas. Quantity assumes swell factor of 1.5.)									
ALT 5 - 331XX19 Transport and Disposal - Non-Radiological	**1.0000**	**LS**	**0.00**	**0.00**	**0.00**	**0.00**	**6,114.00**	**8,002.33**	**8,802.56**
			0.0000	*0.0000*	*0.0000*		*5,789.0000*	*7,576.9496*	*8,334.6446*
331XX1990 Transport and Disposal - Non-Contaminated	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**5,789.00**	**7,576.95**	**8,334.64**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*55.0000*	*71.9869*	*79.1856*
USR Chipped tree and brush transport and disposal	100.0000	TON	0.00	0.00	0.00	0.00	5,500.00	7,198.69	7,918.56
(Note: Cost per vendor quote - Triad Recycling, $55/ton Quantity assumes 1 ton per tree, and an additional 50 tons of brush, so 100 tons total)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			0.0000	*0.0000*	*0.0000*	*0.0000*	*2.8900*	*3.7826*	*4.1608*
USR Hauling and Disposal of non-contaminated concrete tank foundations	100.0000	MI	0.00	0.00	0.00	0.00	289.00	378.26	416.08
(Note: Mileage assumes transport to Swift River in Tonawanda, NY (approximately 20 miles). Quantity assumes 50 cy or about 100 tons, 20 ton per load so 5 total trips (100 miles total). Cost reduced by 25% (from $3.85 to $2.89) since this item was for hazardous waste transport, and the item being estimated is just concrete and/or debris.)									
			0.0000	*0.0000*	*0.0000*		*325.0000*	*425.3772*	*467.9149*
331XX1992 Transport and Disposal - Water	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**325.00**	**425.38**	**467.91**
			0.0000	*0.0000*	*0.0000*	*0.0000*	*0.1300*	*0.1702*	*0.1872*
USR Contaminated Water From Excavations - Transport and Disposal	2,500.0000	GAL	0.00	0.00	0.00	0.00	325.00	425.38	467.91
(Note: This item is for a 5,000-gallon tanker. It is assumed that a 21,000 gallon fractionalization tank will be used to temporarily store water that is pumped during various remediation alternatives. From there, water will be transferred to the tanker and transported to the nearby wastewater treatment plant. The total cost, based on a 2013 purchase order from Western New York Septic, escalated by 3% per year to 2016, would be $0.13 per gallon, before tax. Quantity assumes approximately 1 gal per cy excavated.)									
ALT 5 - 331XX20 Site Restoration	**1.0000**	**LS**	**109,986.73**	**52,338.73**	**1,004,495.33**	**0.00**	**1,166,820.78**	**1,527,196.80**	**1,679,916.48**
			11,235.3330	*11,058.2079*	*236,760.1920*		*259,053.7329*	*339,063.2373*	*372,969.5611*
331XX2001 Earthwork	**1.0000**	**EA**	**11,235.33**	**11,058.21**	**236,760.19**	**0.00**	**259,053.73**	**339,063.24**	**372,969.56**
			907.3924	*917.4047*	*64,955.5200*		*66,780.3171*	*87,405.6137*	*96,146.1751*
331XX200103 Backfill	**1.0000**	**EA**	**907.39**	**917.40**	**64,955.52**	**0.00**	**66,780.32**	**87,405.61**	**96,146.18**
			0.3168	*0.3203*	*22.6800*	*0.0000*	*23.3171*	*30.5187*	*33.5706*
RSM 312323155080 Borrow, select granular fill, 5 C.Y. bucket, loading and/or spreading, front end loader, wheel mounted	2,864.0000	ECY	907.39	917.40	64,955.52	0.00	66,780.32	87,405.61	96,146.18
(Note: Quantity incorporates the volumes required to replace soils removed as well as half of the volume of concrete foundation excavated. So 2,500 cy soil + (727/2) cy concrete = 2,864 cy)									
			0.0000	*0.0000*	*48,252.6720*		*48,252.6720*	*63,155.6511*	*69,471.2162*
331XX200104 Borrow	**1.0000**	**EA**	**0.00**	**0.00**	**48,252.67**	**0.00**	**48,252.67**	**63,155.65**	**69,471.22**
			0.0000	*0.0000*	*12.9600*	*0.0000*	*12.9600*	*16.9627*	*18.6590*
USR Backfill Material including Delivery (Note: Assume a swell factor of 1.3)	3,723.2000	LCY	0.00	0.00	48,252.67	0.00	48,252.67	63,155.65	69,471.22
			3,334.8162	*1,983.2015*	*0.0000*		*5,318.0176*	*6,960.5029*	*7,656.5532*
331XX200107 Grading	**1.0000**	**EA**	**3,334.82**	**1,983.20**	**0.00**	**0.00**	**5,318.02**	**6,960.50**	**7,656.55**
			3,334.8162	*1,983.2015*	*0.0000*	*0.0000*	*5,318.0176*	*6,960.5029*	*7,656.5532*
RSM 312213200280 Rough grading sites, open, 75100-100000 S.F., grader	1.0000	EA	3,334.82	1,983.20	0.00	0.00	5,318.02	6,960.50	7,656.55
			497.3209	*301.7116*	*0.0000*		*799.0325*	*1,045.8160*	*1,150.3976*
331XX200108 Compaction	**1.0000**	**EA**	**497.32**	**301.71**	**0.00**	**0.00**	**799.03**	**1,045.82**	**1,150.40**
			0.1736	*0.1053*	*0.0000*	*0.0000*	*0.2790*	*0.3652*	*0.4017*
RSM 312323235060 Compaction, riding, vibrating roller, 2 passes, 12" lifts	2,864.0000	ECY	497.32	301.71	0.00	0.00	799.03	1,045.82	1,150.40
			939.1460	*2,237.9197*	*0.0000*		*3,177.0657*	*4,158.3118*	*4,574.1430*
331XX200113 Stockpiling	**1.0000**	**EA**	**939.15**	**2,237.92**	**0.00**	**0.00**	**3,177.07**	**4,158.31**	**4,574.14**
			0.2522	*0.6011*	*0.0000*	*0.0000*	*0.8533*	*1.1169*	*1.2286*

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
HNC 312213103020 Rough grading, open site, large area, 300 H.P., dozer	3,723.2000	BCY	939.15	2,237.92	0.00	0.00	3,177.07	4,158.31	4,574.14
(Note: This item is used for maintaining stockpiled fill material)									
			5,556.6576	*5,617.9704*	*123,552.0000*		*134,726.6279*	*176,337.3417*	*193,971.0759*
331XX200114 Topsoil	**1.0000**	**EA**	**5,556.66**	**5,617.97**	**123,552.00**	**0.00**	**134,726.63**	**176,337.34**	**193,971.08**
			0.3473	*0.3511*	*0.0000*	*0.0000*	*0.6984*	*0.9141*	*1.0055*
RSM 312323157080 Borrow, topsoil or loam, 5 C.Y. bucket, loading and/or spreading, front end loader, wheel mounted	16,000.0000	ECY	5,556.66	5,617.97	0.00	0.00	11,174.63	14,625.94	16,088.54
(Note: Material cost removed since it is accounted for under a separate item. Topsoil quantity is approximated based on aerial photos (approx. 96,000 sy), assuming 6" is placed over the entire area. 6" = 0.167 yd, so 96,000 sy x 0.167 yd = 16,000 cy)									
			0.0000	*0.0000*	*23.7600*	*0.0000*	*23.7600*	*31.0983*	*34.2082*
USR Topsoil Purchase and Delivery	5,200.0000	LCY	0.00	0.00	123,552.00	0.00	123,552.00	161,711.40	177,882.54
(Note: Since the majority of stripped topsoil can be re-used, it is assumed that only 25% of the topsoil placed needs to be purchased. Assume a swell factor of 1.3)									
			80,677.3136	*33,934.9982*	*585,258.3333*		*699,870.6451*	*916,027.7445*	*1,007,630.5190*
331XX2003 Permanent Features	**1.0000**	**EA**	**80,677.31**	**33,935.00**	**585,258.33**	**0.00**	**699,870.65**	**916,027.74**	**1,007,630.52**
			0.9075	*0.3817*	*6.5833*		*7.8726*	*10.3040*	*11.3344*
331XX200301 Road Replacement	**88,900.0000**	**SF**	**80,677.31**	**33,935.00**	**585,258.33**	**0.00**	**699,870.65**	**916,027.74**	**1,007,630.52**
			4.9905	*1.2719*	*75.6000*	*0.0000*	*81.8623*	*107.1457*	*117.8603*
RSM 321126132007 Plant mixed asphaltic base courses, for roadways and large paved areas, alternate method to figure base course, bituminous concrete, 8" thick	4,390.1235	TON	21,908.71	5,583.68	331,893.33	0.00	359,385.73	470,383.06	517,421.37
(Note: Quantity approximated based on aerial photos. Assume 2 ton/cy. 88,900 sf of pavement need to be replaced, at 8" thick this is approximately 2,200 cy)									
			1.5912	*0.4055*	*16.4700*	*0.0000*	*18.4667*	*24.1702*	*26.5872*
RSM 321216130200 Plant-mix asphalt paving, for highways and large paved areas, binder course, 4" thick, no hauling included	9,877.7778	SY	15,717.12	4,005.68	162,687.00	0.00	182,409.80	238,747.61	262,622.37
			1.1336	*0.3344*	*9.1800*	*0.0000*	*10.6480*	*13.9367*	*15.3304*
RSM 321216130380 Plant-mix asphalt paving, for highways and large paved areas, wearing course, 2" thick, no hauling included	9,877.7778	SY	11,197.59	3,303.47	90,678.00	0.00	105,179.06	137,663.92	151,430.31
			0.4515	*0.2123*	*0.0000*	*0.0000*	*0.6638*	*0.8688*	*0.9556*
RSM 312216100011 Fine grading, finish grading granular subbase for highway paving, +/- 1"	9,877.7778	SY	4,459.36	2,097.16	0.00	0.00	6,556.52	8,581.52	9,439.67
			5.9386	*4.1069*	*0.0000*	*0.0000*	*10.0454*	*13.1480*	*14.4628*
HNC 312323180555 Hauling, excavated or borrow material, loose cubic yards, 12 mile round trip @ base wide rate, 12 C.Y. truck, highway haulers, excludes loading	4,613.0000	LCY	27,394.54	18,945.00	0.00	0.00	46,339.54	60,651.64	66,716.81
(Note: This item is for hauling Asphalt from the plant. Distance is assumed. Productivity reduced by half to account for extra waiting time at the site. Quantity assumes 2 ton/cy for base, so 4,390/2 = 2,195 cy; 9,878 sy @ 4" thick binder = 1,098 cy; 9,878 sy @ 2" thick top = 549 cy; total = 3,842 cy, assume 20% compaction so total volume required = 4,610 cy.)									
			18,074.0808	*7,345.5234*	*182,476.8000*		*207,896.4042*	*272,105.8178*	*299,316.3996*
331XX2004 Revegetation And Planting	**1.0000**	**EA**	**18,074.08**	**7,345.52**	**182,476.80**	**0.00**	**207,896.40**	**272,105.82**	**299,316.40**

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			18,074.0808	*7,345.5234*	*182,476.8000*		*207,896.4042*	*272,105.8178*	*299,316.3996*
331XX200401 Seeding/Mulch/Fertilizer	**1.0000**	**EA**	**18,074.08**	**7,345.52**	**182,476.80**	**0.00**	**207,896.40**	**272,105.82**	**299,316.40**
			0.1883	*0.0765*	*1.9008*	*0.0000*	*2.1656*	*2.8344*	*3.1179*
RSM 329219131100 Seeding, mechanical seeding hydro or air seeding for large areas, includes lime, fertilizer and seed with wood fiber mulch added	96,000.0000	SY	18,074.08	7,345.52	182,476.80	0.00	207,896.40	272,105.82	299,316.40
(Note: Quantity approximated based on aerial photos)									
ALT 5 - 331XX21 Demobilization	**1.0000**	**LS**	**26,277.56**	**5,191.00**	**17,037.00**	**0.00**	**48,505.56**	**63,486.65**	**69,835.31**
			15,469.9117	*5,180.0213*	*1,663.2000*		*22,313.1330*	*29,204.6095*	*32,125.0705*
331XX2101 Demob of Construction Equip & Fac	**1.0000**	**EA**	**15,469.91**	**5,180.02**	**1,663.20**	**0.00**	**22,313.13**	**29,204.61**	**32,125.07**
			0.0000	*0.0000*	*1,663.2000*		*1,663.2000*	*2,176.8842*	*2,394.5726*
331XX010190 Site Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**1,663.20**	**0.00**	**1,663.20**	**2,176.88**	**2,394.57**
			0.0000	*0.0000*	*475.2000*		*475.2000*	*621.9669*	*684.1636*
331XX010191 Office Trailers	**1.0000**	**EA**	**0.00**	**0.00**	**475.20**	**0.00**	**475.20**	**621.97**	**684.16**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Office trailer, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: assume 10 miles per haul, 2 trailers. double to account for demob)									
			0.0000	*0.0000*	*712.8000*		*712.8000*	*932.9504*	*1,026.2454*
331XX010192 Toilets	**1.0000**	**EA**	**0.00**	**0.00**	**712.80**	**0.00**	**712.80**	**932.95**	**1,026.25**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Portable toilet and hand wash, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: Assume same cost for delivering storage trailers - three toilets and two hand washes delivered on two trucks. Double to account for demob)									
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Portable hand wash station, delivery, add per mile	20.0000	MI	0.00	0.00	237.60	0.00	237.60	310.98	342.08
(Note: Assume same cost for delivering storage trailers - three delivered on one truck. Double to account for demob)									
			0.0000	*0.0000*	*475.2000*		*475.2000*	*621.9669*	*684.1636*
331XX010193 Storage Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**475.20**	**0.00**	**475.20**	**621.97**	**684.16**
			0.0000	*0.0000*	*11.8800*	*0.0000*	*11.8800*	*15.5492*	*17.1041*
RSM 015213200800 Storage trailer, delivery, add per mile	40.0000	MI	0.00	0.00	475.20	0.00	475.20	621.97	684.16
(Note: Assume same cost for delivering storage trailers - 2 deliveries double to account for demob)									
			15,469.9117	*5,180.0213*	*0.0000*		*20,649.9330*	*27,027.7253*	*29,730.4979*
331XX010191 Construction Equipment	**1.0000**	**EA**	**15,469.91**	**5,180.02**	**0.00**	**0.00**	**20,649.93**	**27,027.73**	**29,730.50**
			509.8944	*173.1983*	*0.0000*	*0.0000*	*683.0927*	*894.0678*	*983.4746*
RSM 015436501400 Mobilization or demobilization,	20.0000	EA	10,197.89	3,463.97	0.00	0.00	13,661.85	17,881.36	19,669.49

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
delivery charge for equipment, hauled on 20-ton capacity towed trailer (Note: Mobilization/demobilization of medium-sized equipment. 1 paver, 1 medium excavator, 3 medium FE loaders/backhoes/skidsteers, 3 rollers, 2 dozers)									
			540.2320	*191.5054*	*0.0000*	*0.0000*	*731.7374*	*957.7366*	*1,053.5102*
RSM 015436501500 Mobilization or demobilization, delivery charge for equipment, hauled on 40-ton capacity towed trailer (Note: Mobilization/demobilization of heavy equipment. 1 grader, 2 large excavators, 1 large FE loader)	8.0000	EA	4,321.86	1,532.04	0.00	0.00	5,853.90	7,661.89	8,428.08
			118.7710	*23.0016*	*0.0000*	*0.0000*	*141.7726*	*185.5595*	*204.1155*
RSM 015436501200 Mobilization or demobilization, delivery charge for small equipment, placed in rear of, or towed by pickup truck (Note: Assume 4 loads each way for smaller equipment (saws, pumps, excavator attachments, etc.))	8.0000	EA	950.17	184.01	0.00	0.00	1,134.18	1,484.48	1,632.92
			9,473.0211	*0.0000*	*14,596.2000*		*24,069.2211*	*31,503.0706*	*34,653.3777*
331XX2102 Removal of Temporary Utilities	**1.0000**	**EA**	**9,473.02**	**0.00**	**14,596.20**	**0.00**	**24,069.22**	**31,503.07**	**34,653.38**
			9,473.0211	*0.0000*	*14,596.2000*		*24,069.2211*	*31,503.0706*	*34,653.3777*
331XX010502 Power Connection/Distribution	**1.0000**	**EA**	**9,473.02**	**0.00**	**14,596.20**	**0.00**	**24,069.22**	**31,503.07**	**34,653.38**
			128.2738	*0.0000*	*124.2000*	*0.0000*	*252.4738*	*330.4511*	*363.4962*
RSM 015113500870 Temporary electrical power equipment (pro-rated per job), connections, office trailer, 60 amp	2.0000	EA	256.55	0.00	248.40	0.00	504.95	660.90	726.99
			461.7857	*0.0000*	*793.8000*	*0.0000*	*1,255.5857*	*1,643.3771*	*1,807.7148*
RSM 015113500030 Temporary electrical power equipment (pro-rated per job), overhead feed, 3 uses, 100 amp	1.0000	EA	461.79	0.00	793.80	0.00	1,255.59	1,643.38	1,807.71
			1,443.0804	*0.0000*	*3,888.0000*	*0.0000*	*5,331.0804*	*6,977.6002*	*7,675.3602*
RSM 015113500240 Temporary electrical power equipment (pro-rated per job), transformers, 3 uses, 112.5 kVA	1.0000	EA	1,443.08	0.00	3,888.00	0.00	5,331.08	6,977.60	7,675.36
			7.2154	*0.0000*	*7.1280*	*0.0000*	*14.3434*	*18.7734*	*20.6507*
RSM 015113500420 Temporary electrical power equipment (pro-rated per job), feeder, EMT and aluminum wire, 100 amp (Note: Quantity approximated)	1,000.0000	LF	7,215.40	0.00	7,128.00	0.00	14,343.40	18,773.40	20,650.74
			48.1027	*0.0000*	*1,269.0000*	*0.0000*	*1,317.1027*	*1,723.8937*	*1,896.2831*
RSM 015113500560 Temporary electrical power equipment (pro-rated per job), temporary feeder cords, 100 amp, 3 uses, 100' long	2.0000	EA	96.21	0.00	2,538.00	0.00	2,634.21	3,447.79	3,792.57
			1,334.6250	*10.9816*	*777.6000*		*2,123.2067*	*2,778.9653*	*3,056.8618*
331XX0104 Deconstruct/Remove Temp Facilities	**1.0000**	**EA**	**1,334.63**	**10.98**	**777.60**	**0.00**	**2,123.21**	**2,778.97**	**3,056.86**
			1,334.6250	*10.9816*	*777.6000*		*2,123.2067*	*2,778.9653*	*3,056.8618*
331XX010430 Erosion Control	**1.0000**	**EA**	**1,334.63**	**10.98**	**777.60**	**0.00**	**2,123.21**	**2,778.97**	**3,056.86**

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			1.3346	*0.0110*	*0.7776*	*0.0000*	*2.1232*	*2.7790*	*3.0569*
RSM 312514161000 Synthetic erosion control, silt fence, install and maintain, remove, 3' high	1,000.0000	LF	1,334.63	10.98	777.60	0.00	2,123.21	2,778.97	3,056.86
(Note: Assume cost for removal is the same as for installation)									
ALT 5 - 331XX22 Gen Requirements (Opt Breakout)	**1.0000**	**LS**	**252,039.32**	**0.00**	**8,709.65**	**0.00**	**261,798.97**	**342,656.35**	**376,921.99**
			226,704.6412	*0.0000*	*1,080.0000*		*227,784.6412*	*298,136.5950*	*327,950.2545*
331XX2207 Health & Safety	**1.0000**	**EA**	**226,704.64**	**0.00**	**1,080.00**	**0.00**	**227,784.64**	**298,136.60**	**327,950.25**
			198,573.4083	*0.0000*	*0.0000*		*198,573.4083*	*259,903.3873*	*285,893.7261*
331XX220702 Radiation Protection Tech (RPT)	**1.0000**	**EA**	**198,573.41**	**0.00**	**0.00**	**0.00**	**198,573.41**	**259,903.39**	**285,893.73**
			150.4344	*0.0000*	*0.0000*	*0.0000*	*150.4344*	*196.8965*	*216.5862*
USR Rad-Technician crew	1,320.0000	HR	198,573.41	0.00	0.00	0.00	198,573.41	259,903.39	285,893.73
(Note: 2 technicians for duration of project (352 hours per month + 2 hr per day OT). Overtime assumed for daily setup and takedown of equipment and report generation.)									
			28,131.2328	*0.0000*	*0.0000*		*28,131.2328*	*36,819.6465*	*40,501.6112*
331XX220707 Site Safety & Health Officer	**1.0000**	**EA**	**28,131.23**	**0.00**	**0.00**	**0.00**	**28,131.23**	**36,819.65**	**40,501.61**
			42.6231	*0.0000*	*0.0000*	*0.0000*	*42.6231*	*55.7873*	*61.3661*
USR CAMP Monitor Labor	660.0000	HR	28,131.23	0.00	0.00	0.00	28,131.23	36,819.65	40,501.61
(Note: Full time for duration of project (3 months at 176 hr/month + 2 hr per day OT). Rate obtained from a similar nearby recent project. Overtime assumed for daily setup and takedown of equipment and report generation.)									
			0.0000	*0.0000*	*1,080.0000*		*1,080.0000*	*1,413.5612*	*1,554.9173*
331XX220716 Personal Protection Equipment	**1.0000**	**EA**	**0.00**	**0.00**	**1,080.00**	**0.00**	**1,080.00**	**1,413.56**	**1,554.92**
USR Personal Protective Equipment	1.0000	LS	0.00	0.00	1,080.00	0.00	1,080.00	1,413.56	1,554.92
(Note: Assume an allowance of $10,000 for PPE (gloves, eyewear, safety vests, ear plugs, boot covers, tyvek, etc.))									
			0.0000	*0.0000*	*1,393.2000*		*1,393.2000*	*1,823.4939*	*2,005.8433*
331XX2210 Project Utilities	**1.0000**	**EA**	**0.00**	**0.00**	**1,393.20**	**0.00**	**1,393.20**	**1,823.49**	**2,005.84**
			0.0000	*0.0000*	*91.8000*	*0.0000*	*91.8000*	*120.1527*	*132.1680*
RSM 015213400140 Field office expense, Internet	6.0000	MO	0.00	0.00	550.80	0.00	550.80	720.92	793.01
(Note: 2 hookups for 3 months)									
			0.0000	*0.0000*	*842.4000*		*842.4000*	*1,102.5777*	*1,212.8355*
331XX221002 Electrical Usage	**1.0000**	**EA**	**0.00**	**0.00**	**842.40**	**0.00**	**842.40**	**1,102.58**	**1,212.84**
			0.0000	*0.0000*	*0.1404*	*0.0000*	*0.1404*	*0.1838*	*0.2021*
HTW 015113800460 Electrical Charge Industrial Use	6,000.0000	KWH	0.00	0.00	842.40	0.00	842.40	1,102.58	1,212.84
(Note: Assume 2,000 kwH per month for 3 months)									

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
			25,334.6836	*0.0000*	*6,236.4492*		*32,621.1328*	*42,696.2652*	*46,965.8918*
331XX2208 Temp Const Facilities-Ownership	**1.0000**	**EA**	**25,334.68**	**0.00**	**6,236.45**	**0.00**	**32,621.13**	**42,696.27**	**46,965.89**
			0.0000	*0.0000*	*1,863.0000*		*1,863.0000*	*2,438.3930*	*2,682.2323*
331XX220801 Office Trailers and Facilities	**1.0000**	**EA**	**0.00**	**0.00**	**1,863.00**	**0.00**	**1,863.00**	**2,438.39**	**2,682.23**
			0.0000	*0.0000*	*258.1200*	*0.0000*	*258.1200*	*337.8411*	*371.6252*
RSM 015213200350 Office trailer, furnished, rent per month, 32' x 8', excl. hookups (Note: Two trailers for three months.)	6.0000	EA	0.00	0.00	1,548.72	0.00	1,548.72	2,027.05	2,229.75
			0.0000	*0.0000*	*52.3800*	*0.0000*	*52.3800*	*68.5577*	*75.4135*
RSM 015213200700 Office trailer, excl. hookups, air conditioning, rent per month, add (Note: Two trailers for three months.)	6.0000	EA	0.00	0.00	314.28	0.00	314.28	411.35	452.48
			0.0000	*0.0000*	*1,814.4000*		*1,814.4000*	*2,374.7828*	*2,612.2610*
331XX220802 Office Furniture & Office Equip	**1.0000**	**EA**	**0.00**	**0.00**	**1,814.40**	**0.00**	**1,814.40**	**2,374.78**	**2,612.26**
			0.0000	*0.0000*	*216.0000*	*0.0000*	*216.0000*	*282.7122*	*310.9835*
RSM 015213400100 Field office expense, office equipment rental, average (Note: 2 offices for 3 months)	6.0000	MO	0.00	0.00	1,296.00	0.00	1,296.00	1,696.27	1,865.90
			0.0000	*0.0000*	*86.4000*	*0.0000*	*86.4000*	*113.0849*	*124.3934*
RSM 015213400120 Field office expense, office supplies, average (Note: Two offices for three months)	6.0000	MO	0.00	0.00	518.40	0.00	518.40	678.51	746.36
			0.0000	*0.0000*	*534.6000*		*534.6000*	*699.7128*	*769.6841*
331XX220803 Warehouse & Stor Trailers/Facil	**1.0000**	**EA**	**0.00**	**0.00**	**534.60**	**0.00**	**534.60**	**699.71**	**769.68**
			0.0000	*0.0000*	*89.1000*	*0.0000*	*89.1000*	*116.6188*	*128.2807*
RSM 015213201250 Storage boxes, rent per month, 20' x 8' (Note: Two boxes for three months.)	6.0000	EA	0.00	0.00	534.60	0.00	534.60	699.71	769.68
			0.0000	*0.0000*	*937.9800*		*1,987.9800*	*2,601.9734*	*2,862.1708*
331XX220808 Construction Portable Toilets	**1.0000**	**EA**	**0.00**	**0.00**	**937.98**	**0.00**	**1,987.98**	**2,601.97**	**2,862.17**
			0.0000	*0.0000*	*104.2200*	*0.0000*	*104.2200*	*136.4087*	*150.0495*
HNC 015213201400 Toilet, portable, chemical, rent per month (Note: 3 toilets for 3 months)	9.0000	MO	0.00	0.00	937.98	0.00	937.98	1,227.68	1,350.45
			0.0000	*0.0000*	*0.0000*	*0.0000*	*175.0000*	*229.0493*	*251.9542*
USR Portable Handwash Station (Note: Cost for rental $175/month based on a recent quote for a similar item. Included delivery. Assume 2 are required.)	6.0000	MO	0.00	0.00	0.00	0.00	1,050.00	1,374.30	1,511.73
			0.0000	*0.0000*	*1,086.4692*		*1,086.4692*	*1,422.0284*	*1,564.2312*
331XX220811 Decon Facilities for Personnel	**1.0000**	**EA**	**0.00**	**0.00**	**1,086.47**	**0.00**	**1,086.47**	**1,422.03**	**1,564.23**
			0.0000	*0.0000*	*362.1564*	*0.0000*	*362.1564*	*474.0095*	*521.4104*
HTW 019413205977 Decontamination kit in 3 gallon	3.0000	EA	0.00	0.00	1,086.47	0.00	1,086.47	1,422.03	1,564.23

Description	Quantity	UOM	DirectLabor	DirectEQ	DirectMatl	DirectUser1	DirectCost	ContractCost	ProjectCost
metal drum, 27 items									
			25,334.6836	*0.0000*	*0.0000*		*25,334.6836*	*33,159.3748*	*36,475.3123*
331XX220812 Decon Facil for Const Equip/Veh	**1.0000**	**EA**	**25,334.68**	**0.00**	**0.00**	**0.00**	**25,334.68**	**33,159.37**	**36,475.31**
			664.9966	*0.0000*	*0.0000*	*0.0000*	*664.9966*	*870.3827*	*957.4210*
HTW 019413103112 Spray washing, decontaminate heavy equipment, decontaminate heavy equipment	20.0000	EA	13,299.93	0.00	0.00	0.00	13,299.93	17,407.65	19,148.42
(Note: Assume decontamination of all equipment once during release from site. Approximate 20 pieces of equipment.)									
			300.8688	*0.0000*	*0.0000*	*0.0000*	*300.8688*	*393.7930*	*433.1723*
USR Release Surveys and Equipment Frisks	40.0000	EA	12,034.75	0.00	0.00	0.00	12,034.75	15,751.72	17,326.89
(Note: Assume 2 hour average per survey and/or frisk. These will need to be done during entry to and exit from site, so assuming 20 pieces of equipment, quantity is 40.)									
ALT 5 - 331XX90 Decon	**1.0000**	**LS**	**26,726.12**	**12,990.58**	**0.00**	**0.00**	**39,716.70**	**51,983.32**	**57,181.65**
			481.9479	*25.8979*	*0.0000*	*0.0000*	*507.8459*	*664.6956*	*731.1651*
USR Concrete Shaving	53.5100	MSF	25,789.03	1,385.80	0.00	0.00	27,174.83	35,567.86	39,124.65
(Note: Productivity approximated based on similar items in RS Means (090505200700), however, rather than crew A1a, the custom crew includes an operator, two laborers, a skid steer (with a shaver purchased separately) and a vacuum pickup system; productivity is therefore is assumed to be double (from 0.225 to 0.45). Purchase of shaver is under a separate item. This item excludes Building 401, which is to be removed.)									
			0.0000	*11,444.3890*	*0.0000*	*0.0000*	*11,444.3890*	*14,979.0221*	*16,476.9243*
USR Purchase Concrete Floor Shaver	1.0000	EA	0.00	11,444.39	0.00	0.00	11,444.39	14,979.02	16,476.92
(Note: Cost per Skidsteersolutions.com $10,295.00 + tax (8.875%) = $11,209)									
			11.3480	*1.9423*	*0.0000*	*0.0000*	*13.2904*	*17.3951*	*19.1346*
USR Transport concrete dust and chips to temporary stockpile area	82.5772	CY	937.09	160.39	0.00	0.00	1,097.48	1,436.44	1,580.08
(Note: Productivity assumes approximately 10 minutes per round trip using a skid steer (1 cy per trip). Quantity is approximated based on the surface area of concrete being decontamniated, at 1/2" thick.)									
			0.0000	*0.0000*	*0.0000*		*414,153.0000*	*414,153.0000*	*414,153.0000*
342XX ALT 5 - O&M	**1.0000**	**EA**	**0.00**	**0.00**	**0.00**	**0.00**	**414,153.00**	**414,153.00**	**414,153.00**
USR Present Value for Long-Term O&M	1.0000	LS	0.00	0.00	0.00	0.00	414,153.00	414,153.00	414,153.00
(Note: Present value calculated per Chapter 4 of the USEPA Guide to Developing and Documenting Cost Estimates During the Feasibility Study, and additional guidance from USACE using a yearly cost of $13,460, discount rate of 3.25% and period of 1,000 years.)									

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT B

VENDOR QUOTE BACKUP

THIS PAGE INTENTIONALLY LEFT BLANK

Niagara Falls Storage Site Vendor Quotes

Category	Item	Size/Spec	Unit Price	UOM	Source	Notes
MATERIALS						
	Clean Fill	Clean Fill (delivered)	$ 12.00	cy	Engineers estimate for similar nearby project	Lockport MGP
	Topsoil	Unscreened Topsoil (delivered)	$ 22.00	CY	Niagara Topsoil	
	6 mil poly sheeting	20' x 100' rolls	$ 0.50	SY	Uline online	
SUBCONTRACTS						
	Water Jetting	Based on 18" pipe, 100 to 120 lf/hr	$ 1,180.00	LS	RotoRooter	Tax not included
	Pipe Grouting	Based on 18" sewer and maybe 200 lf of drain in bldg 401	$ 15,000.00	LS	Nothnagle	
	Wastewater T&D	Excavation dewatering	$ 0.13	gal	2013 PO from Western NY Septic	Escalated 3% per year from 2013. Tax not included
	Lab Analysis	VOCs	$ 70.00	ea	Previous Contract with TestAmerica	
		PAHs	$ 85.00	ea	Previous Contract with TestAmerica	
		Ra-226 (Soil)	$ 70.00	ea	Previous Contract with TestAmerica	
		Ra-226 (water)	$ 110.00	ea	Previous Contract with TestAmerica	
		Th-232	$ 80.00	ea	Previous Contract with TestAmerica	
		U-238	$ 80.00	ea	Previous Contract with TestAmerica	
	CAMP	Labor	$ 34.00	hr	Recent nearby project experience	
		Equipment and Reporting				
	Rad Monitoring	Equipment Rental	$ 2,657.50	mo	Recent similar project	
		Equipment Delivery	$ 240.00	ea	Recent similar project	Per trip, each way.
		Technician Labor	$ 60.00	hr	Recent similar project	
	In-Situ Thermal Treatment	Electrical Resistance Heating (by TRS)	$ 82.00	cy	Unit Cost Provided by CTI	
	Ex-Situ Thermal Treatment	Tevet (by Hillside)	$ 232.00	cy	Unit Cost Provided by CTI	Concrete Removal also Required
	Off-Gas Treatment	Catalytic Thermal Oxidation	$ 433,000.00	LS	1-year cost provided by CTI	Assumes 1 year
	C&D Disposal	Clean broken concrete	$ 1.00	ton	Quote from Swift River	$20/ tandem load, assume 20 ton per load
		Brush, chipped trees, etc	$ 55.00	ton	Quote from Triad Recycling	
	Rad Transport	Intermodal Containers	$ 200.00	ton	Quote from Secur LLC	Quote was for $5,00 per shipment, 25 ton per shipment
		Shipping Container Rental	$ 450.00	mo	Quote from Secur LLC	
		Shipping Container Liners	$ 50.00	ea	Quote from Secur LLC	one liner per shipment
	Rad Disposal	Soil	$ 497.00	cy	Contract Costs from a similar nearby project, provided by Ken Grumski at WCS Texas	Assumes disposal by railcar, intermodal
		Debris	$ 924.00	cy	Contract Costs from a similar nearby project, provided by Ken Grumski at WCS Texas	Assumes disposal by railcar, intermodal
	VOC Transport	Impacted Soil	$ 49.00	ton	Quote from ESMI	Transport to Ft Edward, NY
	VOC Disposal	Impacted Soil	$ 53.00	ton	Quote from ESMI	

INVOICE

PLEASE REMIT TO:
AEROTEK ENVIRONMENTAL
P.O. BOX 198531
ATLANTA GA 30384-8531
UNITED STATES

[redacted]

AECOM INC
[redacted]

INVOICE AMOUNT DUE: USD 1,560.70

For Billing Inquiries Call Senga,Gloria at 866-466-0420 ext 410/579-6416 E-Mail: gsenga@aerotek.com

Contractor	Date	Type	Qty	Rate	Total
[redacted]		REG	40.00	33.65	1,346.00
		OVT	4.75	45.20	214.70

INVOICE TOTAL AMOUNT DUE: USD 1,560.70

Price Schedule
Year 5

CLIN #	Schedule of Services	Estimated Annual Quantity	Unit of Measure	Unit Price
	Class A LLW			
1001 *See Notes 6 and 9*	Baseline soil disposal rate: bulk in lined railcar	4,000	yd^3	$497.00
	Surcharges			
	Intermodal by railcar		yd^3	$0.00
	Soft side bags by railcar		yd^3	$52.00
1002 *See Note 9*	Baseline soil disposal rate: bulk in lined truck	4,000	yd^3	$448.00
	Surcharges			
	Intermodal by truck		yd^3	$37.00
	Soft side bags by truck		yd^3	$82.00
	Truck rolloff containers		yd^3	$37.00
	B-25 containers by truck		yd^3	$177.00
	Drums by truck		yd^3	$274.00
	Other containers by truck		yd^3	$274.00
1003 *See Notes 6, 7, 8 and 9*	Baseline debris disposal rate: bulk in lined railcar	3,700	yd^3	$924.00
	Surcharges			
	Intermodal by railcar		yd^3	$0.00
	Oversize		yd^3	$49.00
	Large components *(See Note 12)*		yd^3	$3,308.00
1004 *See Notes 7, 8 and 9*	Baseline debris disposal rate: bulk in lined truck	3,700	yd^3	$876.00
	Surcharges			
	Intermodal by truck		yd^3	$49.00
	Soft side bags by truck		yd^3	$95.00
	Truck rolloff containers		yd^3	$49.00
	B-25 containers by truck		yd^3	$233.00
	Drums by truck		yd^3	$417.00
	Other containers by truck		yd^3	$417.00
	Oversize		yd^3	$95.00
	Large components *(See Note 12)*		yd^3	$3,354.00
1005 *See Note 5*	Baseline depleted uranium converted product disposal rate: Cylinders delivered by railcar	15,000	yd^3	$1,571.00
1006 *See Note 5*	Baseline depleted uranium converted product disposal rate: Cylinders delivered by truck	15,000	yd^3	$1,672.00
	Class B LLW			
2001	Baseline soil disposal rate: container by truck	10	yd^3	$5,760.00
	Surcharges			
	Intermodal by truck		yd^3	$0.00
	B-25 containers by truck		yd^3	- $684.00
	Drums by truck		yd^3	$7,011.00

[redacted]

From: [redacted]
Sent: Wednesday, September 14, 2016 10:50 AM
To: [redacted]
Subject: Re: Niagara Falls Storage Site

[redacted] Sorry for the delay. The container has a capacity of 25 cubic yards and at least 40,000 pounds but that will be dictated based on type of truck and trailer or chassis used. The specifications for container are on previous spec sheet I sent you.

I gave you pricing by truck since you wanted worst case. If rail it could be $5,000 or so and would arrive either direct by rail or trucked from a rail terminal near by.

Please advise if you need any more clarifications.

[redacted]
SECUR LLC
[redacted]

Sent from my iPad

On Sep 12, 2016, at 7:13 AM, [redacted] wrote:

> [redacted]
>
> A couple questions:
>
> 1 – How much material can be transported in a container?
> 2 – Does this price assume transport to the site by rail, truck, or some combination of both? The disposal cost is going to be dependent on how it arrives at the facility.
>
> [redacted]
>
> [redacted]

From: [redacted]
Sent: Friday, September 09, 2016 4:05 PM
To: [redacted]
Subject: Re: Niagara Falls Storage Site

[redacted]

I checked with a few carriers for this and if you are looking for a worst case trucking price it will probably be around $8,500 per shipment. Each shipment would transport one intermodal container. The cost for the container use is $450.00 per month rental and you should use $50.00 for the liner you will want to instal in the container.

Hope this helps.

[redacted]

> On Sep 6, 2016, at 7:16 AM, [redacted] wrote:
>
> My apologies [redacted]
>
> It looks like the soil quantity, as I currently understand, would be closer to about 3,000 cy or roughly 4,500 tons.
>
> **From:** [redacted]
> **Sent:** Tuesday, September 06, 2016 9:56 AM
> **To:** [redacted]
> **Cc:** [redacted]
> **Subject:** Re: Niagara Falls Storage Site
>
> Hi [redacted]
>
> Yes we would want the containers lined and i will include the cost of the liner with the estimate. I will also provide truck prices so you have rail and truck for your study.
>
> Thanks
> [redacted]
>
>> On Sep 6, 2016, at 9:50 AM, [redacted] wrote:
>>
>> Hi [redacted]
>>
>> Thanks again for your help. The roll-offs in that document you sent are what I was envisioning. If these need to be lined, do you have a suggestion for a liner material? I would have to price out separately the cost for workers to install them in the boxes.

MEMO OF TELECON

	JOB NAME: *Niagara Falls Storage Site*
DATE 9-9-2016	
AECOM Representative [redacted]	Vendor Triad Recycling
Client or Other Tel No. [redacted]	
PURPOSE OF TELECON AND/OR EQUIPMENT INVOLVED	Vegetation Disposal Fee

Per phone conversation, the representative indicated that the tipping fee for brush, chipped trees, branches etc. is $55/ton.	**ACTION REQUIRED**

COPIES:

MEMO OF TELECON

JOB NAME: *Niagara Falls Storage Site*

DATE 9-9-2016

AECOM Representative [redacted]

Vendor Swift River Associates

Client or Other Tel No. [redacted]

PURPOSE OF TELECON AND/OR EQUIPMENT INVOLVED Concrete Disposal Fee

Per phone conversation, the representative indicated that the tipping fee for broken reinforced concrete (smaller than 3 ft dia) is $20 per tandem load. For a typical 20 ton load, this is $1/ton.	**ACTION REQUIRED**

COPIES:

URS Group, Inc.

Service Order Number: 288877

7650 West Courtney Campbell Causeway
Tampa, Florida 33607
Phone (813) 286-1711, 636-2496 fax

Vendor Name:	Western New York Septic	Order Date:	April 10, 2013
Vendor Number:	4006263	Project Number:	11176781.56520.00006
Address:	3045 Daniels Rd	Project Name:	NFSS Balance of Plant Field Investigation
	Wilson NY 14172	Prime Contract Number:	W912QR-12-D-0023
		TO/DO Number:	
Phone/Fax:	[redacted]	Project Location:	Lewiston NY
Contact:		Project Manager:	[redacted]

QUANTITY	DESCRIPTION/REQUIREMENTS	UNIT COST	EXTENDED COST
14,000	Transport IDW purge/development water	100.00	1,400.00
3,000	Disposal IDW purge/development water	10¢/GAL	300.00
	URS requires the services of a qualified Contractor to haul approximately 14,000 gallons of investigation-derived, non-hazardous wastewater from the NFSS located at 1397 Pletcher Road in Lewiston, New York to the Lockport Wastewater Treatment Plant located at 611 West Jackson Street in Lockport, New York. The Lockport Wastewater Treatment Plant has provided URS written documentation that the wastewater is acceptable at their facility.		11.6¢/GAL ASSUME 3% ESCAL. PER YR.
	The Contractor shall provide documentation of the transport and disposal (T&D) of the wastewater at the treatment plant through the use of USEPA non-hazardous waste manifests. The Contractor shall provide drafts of the waste manifests to URS, prior to T&D, for review and approval by the Client, the US Army Corps of Engineers.	1.6¢/GAL	12.7¢/GAL
	Taxes	136.00	$136.00
	Disposal fee (16.45 per 1,000 gallons)	664.00	$664.00
	URS will pay New York sales tax and the disposal fee		
	THIS IS A FIXED UNIT PRICED CONTRACT WITH A NOT TO EXCEED VALUE.		
		NOT-TO-EXCEED	$2,500.00

URS recognizes environmental stewardship as one of the cornerstones of our business. We're committed to using resources responsibly, preventing pollution, respecting ecological values and reducing the environmental footprint of our own operations and those of our clients. That being said, we pass on that challenge to our suppliers and subcontractors to do the same.

Please be sure to review the terms and conditions of this contract, and any client flow-down clauses that may specifically address green procurement and green-house-gas reduction requirements.

Period of performance: Effective date through 6/30/13.

This order is rated for national defense and you are required to follow all provisions of the Defense Priorities and Allocation System (15 CFR 700). This order is rated Not Rated.

BILL TO:
E-invoicing. You may sign up for this service through Transcepta (949-382-2841). The service is free through Jun 2010 but afterwards Transcepta will charge a monthly fee.

Lock box. You may submit paper invoices directly to URS at the following lockbox address: URS Group, Inc., P.O. Box 203970, Austin, TX 78720-1088. Hard copies of invoices must include the following information as they will be scanned and processed internally through URS for approval and payment. Failure to include this information will result in return of the invoice: (a) Subcontract number, (b) Project number, (c) Vendor number, and (d) Breakout of details supporting the amounts billed (i.e. description, quantity and unit prices)

This order is subject to the terms and conditions stated on the reverse of this subcontract order.

Western New York Septic		**URS GROUP, INC.**
Signature	Date	[redacted]
Printed Name		
Printed Title		

ESMI OF NY, LLC

304 TOWPATH ROAD, FORT EDWARD, NY 12828

PHONE: 1 (800) 511-3764 ~ FAX: (518)747-1181 ~ WWW.ESMIOFNY.COM

ESMI COMPANIES

CUSTOMER: AECOM.
257 West Genesee Street
Suite 400
Buffalo, New York 14202

Contact: [redacted]
Phone:

Site Information: Buffalo, NY
Services: The following Services shall be provided at the following rates:

Thermal Treatment and Recycling: 10,000 tons MGP Soils: $53.00 per ton.
Transportation: 49.00 per ton.

Transportation is non-union. (32 Ton minimum per truck. $95.00 per hour for time on site in excess of dock time allowance of 60 minutes. ESMI is not responsible for transporter delays or demurrage charges at project site. **Concrete and Brick need to be sized to less than eight inch minus. Size requirement for stone/rock less than 36" X 36."**

Other Services: Truck Liner Charge - $30.00 Each. (If Applicable)

HANDLING OF NON-CONFORMING WASTE MATERIALS:
Soils with moisture content in excess of 20% per ASTM Standard Test Method D 2216-10, will be subject to a surcharge of one dollar ($1) per ton per percent moisture content above 20%. No pure coal tar product, coal tar slag, and or coal tar chunks. MGP material should be blended accordingly. Price is quoted with BTU's less than 170 per pound. Material to be representative of the analytical provided.

Disposition of treated Materials. ESMI shall manage the treated materials as
*****Materials will become the property of ESMI of NY*****

PAYMENT TERMS: Customer shall pay ESMI of NY for services provided: Within Net 30 days following delivery of waste materials to ESMI of NY. **A 7.00% NY State Sales Tax is not included in the above pricing and will be added to the customer's Invoice, unless a properly executed Tax Exempt form is issued to ESMI of NY.**

Project acceptance is subject to the completion and review of our profile sheet, analytical testing results, and acceptance of the contract terms and conditions, and all documents incorporated by reference therein.

[redacted]

[redacted]

From: [redacted]
Sent: Friday, September 02, 2016 11:30 AM
To: [redacted]
Subject: RE: Sewer Grouting

I would budget $ 15,000.00 to grout up those sewer lines.

[redacted]

[redacted]

From: [redacted]
To: [redacted]
Cc: [redacted]
Subject: RE: Email
Date: Friday, September 09, 2016 9:24:28 AM
Attachments: TRS Example.pdf

[redacted]

If you are referring to my conversion from ton to CY I assumed in place at 1.5 Ton/CY. You could modify based on actual in place soil density if you like. The treatment rate assumes 1000 tons per week for duration purposes.

The in-situ treatment duration would likely be 3 months of heating and 7-9 months treatment. But the cost driver is energy density delivered and is driver by the cost of the electricity used. I have attached an estimate I had done for another small site so you can see the cost curve. This one is for a 10,000 SF site and the cost is $82/CY. I could have them run and actual quote if you like but I need the final area and assumed volumes from the USACE first.

[redacted]

From: [redacted]
Sent: Friday, September 09, 2016 8:05 AM
To: [redacted]
Subject: RE: Email

[redacted]

Is the ex-situ treatment cost per in-place cubic yard or excavated cubic yard?

From: [redacted]
Sent: Thursday, September 08, 2016 11:48 AM
To: [redacted]
Subject: RE: Email

[redacted]

If you want to eliminate competition the preferred vendors and technology would be TRS ERH for in-situ and the Hillside TEVET system for ex-situ.

Both are thermal desorption technologies. The off gas treatment could vary between carbon and thermal oxidation.

I can focus the text if you like.

Catalytic Thermal Oxidation for Off-Gas Treatment

The thermal treatment system to remove the PCE and daughter products from soil either in-situ or ex-situ would require off gas treatment by catalytic thermal oxidation to destroy the COCs on-site. This process requires off gas heating and pass through a catalyst to have 99% destruction. The treatment of chlorinated compounds results in the formation of acid gases requiring a scrubber with caustic neutralization of the waste stream. The capital cost of this off gas treatment is $250,000 with scrubber for a 500 scfm system in 2004 dollars with an operational cost of about $69,000 per year with 2004 fuel and electric costs (EPA-542-R-05-028, March 2006). In 2017 dollars this would represent the following:

- Capital Cost 2017 = $340,000 (rate 2.3% annual)
- Annual Operation Cost = $93,000 (rate 2.3% annual)

Assuming complete in 1 year ($433,000)

[redacted]

From: [redacted]
Sent: Wednesday, August 31, 2016 3:12 PM
To: [redacted]
Subject: Niagara Falls Storage Site - Analytical Lab Costs

[redacted]

Per the previous contract with TestAmerica, the costs for analysis of radiological materials are as follows:

VOCs: $70/sample
PAHs: $85/sample

Ra-226: Soil $70/sample, Water $110/sample
Th-232: $80/sample
U-238: $80/sample

[redacted]

AECOM
257 West Genesee Street, Suite 400, Buffalo, New York 14202
T: (716) 856-5636
www.aecom.com

[redacted]

From: [redacted]
Sent: Thursday, September 01, 2016 1:15 PM
To: [redacted]
Subject: Re: Niagara Falls project
Attachments: pic28836.jpg

Good Afternoon [redacted]
Its hard to say how many feet per hour because of the unknown nature of the pipe.
If relativity no issue we can clean a line this size 100 to 120' per hour.

We will bid on this, but for water jetting only and our bid for that would be between
$915.00 and $1180.00 + tax.

If you still wish to consider us for that portion of this bid, please accept this and let me know. The only other question I had was if this is a prevailing wage job.

Thank You,
[redacted]

[redacted]

[redacted]

From: [redacted]
Sent: Friday, September 09, 2016 2:56 PM
To: [redacted]
Subject: FW: NFSS Feasibility Study Cost Estimate

[redacted]

See Rad Tech rates below. Let me know if this works and/or if you need anything else.

[redacted]

AECOM
257 West Genesee Street
Suite 400
Buffalo, New York 14202, USA
T +1-716-856-5636
aecom.com

Built to deliver a better world

LinkedIn Twitter Facebook Instagram

From: [redacted]
Sent: Friday, September 09, 2016 2:55 PM
To: [redacted]
Subject: FW: NFSS Feasibility Study Cost Estimate

[redacted]

Does this work for you or do you need more costs?

[redacted]

From: [redacted]
Sent: Friday, September 09, 2016 2:53 PM
To: [redacted]
Subject: Re: NFSS Feasibility Study Cost Estimate

[redacted]

Use $60/hr.....A few exclusions ... No per diems....and the site has the rad instruments....(X tra costs if required)

Give me a call when you get a chance.

[redacted]

On Fri, Sep 9, 2016 at 1:27 PM, [redacted] wrote:

Radiological Monitoring Equipment Rentals

			MONTHLY RATES			
		Qty req'd	ERG Rate	ES Rate	Average Rate	TOTAL COST
Ludlum 2221 w/ rs232	digital scalar/ratemeter	2	$ 225.00	$ 240.00	$ 232.50	$ 465.00
Ludlum 44-10	2"NaI	2	$ 75.00	$ 35.00	$ 55.00	$ 110.00
Polyshield lead columinator		1	$ 50.00	$ -	$ 50.00	$ 50.00
Ludlum 2360	Dual channel scaler	2	$ 200.00	$ -	$ 200.00	$ 400.00
Ludlum 43-93	Alpha beta	2	$ 150.00	$ 105.00	$ 127.50	$ 255.00
Ludlum 2241	digital scalar/ratemeter	2	$ 150.00	$ 90.00	$ 120.00	$ 240.00
Ludlum 44-9	Pancake	2	$ 40.00	$ 25.00	$ 32.50	$ 65.00
Ludlum 19	Dose Rate	1	$ 100.00	$ 105.00	$ 102.50	$ 102.50
Ludlum 2929 W/ 43-10-1	Smear Counter	1	$ 275.00	$ 285.00	$ 280.00	$ 280.00
Alpha	Th-230	1	$ 100.00	$ 90.00	$ 95.00	$ 95.00
Beta	Tc-99	1	$ 100.00	$ 90.00	$ 95.00	$ 95.00
Gamma	CS-137	1	$ 100.00	$ 35.00	$ 67.50	$ 67.50
MSA Escort Elf	Lapel Air sampler	1	$ 200.00	$ 165.00	$ 182.50	$ 182.50
SS hand auger		1	$ 250.00	$ -	$ 250.00	$ 250.00
SHIPMENT** required for delivery and return					$ 240.00	
				TOTAL Per Month		$ 2,657.50

Niagara Topsoil

Quality Materials For Your Landscape, Garden & Commercial Property

716-479-0491

www.NiagaraTopsoil.com

2016 Product List

Topsoil

Screened ------------------------------$28/ Yd³

Unscreened -------------------------$18/ Yd³

55/TRUCK DELIV. ~#3.67/YD

~22/YD

Compost

Garden Compost---------------------$28/ Yd³
(Aged Manure, Screened)

Garden Blend------------------------$28/ Yd³
(Topsoil & Compost, Screened)

Mulch

Natural Brown------------------------$32/ Yd³

Midnight Black-----------------------$38/ Yd³

Autumn Red--------------------------$38/ Yd³

Decorative Stone

Product	Size	Price/ Yd³
#1 River Rock	½"	$52/ Yd³
#2 River Rock	1"	$52/ Yd³
#3 River Rock	2"-4"	$52/ Yd³
River Rock Tailings	2"-6"	$52/ Yd³

Quarry Products

Screenings------------------------------$45/ Yd³

1" Crusher Run -------------------------$41/ Yd³

2" Crusher Run -------------------------$41/ Yd³

#1 Washed Stone-----------------------$50/ Yd³

#2 Washed Stone-----------------------$50/ Yd³

Other

Sand ----------------------------------$52/ Yd³

Fill (type varies by availability)------------- Call

Delivery Amounts

Town/City	Delivery	Town/City	Delivery
Akron	$25	Lockport	$35
Alden	$45	Marilla	$55
Amherst	$25	N. Tonawanda	$45
Buffalo	$55	Newfane	$55
Cambria	$45	Newstead	$25
Cheektowaga	$45	Niagara	$55
Clarence	$25	Niagara Falls	$55
Depew	$45	Pendelton	$35
Elma	$55	Royalton	$35
Grand Island	$55	Somerset/Barker	$55
Hartland	$55	Tonawandas	$45
Kenmore	$45	West Seneca	$55
Lackawanna	$55	Wheatfield	$45
Lancaster	$45	Wilson	$55
Lewiston	$55	Porter/ Youngstown	$55

Visit www.niagaratopsoil.com for Product Pictures and More Information

- **All items are for delivery only**
- **Prices subject to change**
- **All orders are COD**
- **Some orders may require additional delivery charges.**

Niagara Topsoil will not be liable for damages to private property when delivery is required beyond curb line. The purchaser accepts responsibility for damage to all surfaces the vehicle travels over including driveways, sidewalks, curbs and grass. The purchaser also confirms there are no septic or underground tanks within the path of the delivery vehicle. It is the purchaser's responsibility to provide adequate roadways for safe and proper unloading. In addition, the purchaser will be responsible for all towing, recovery, repair and wait time costs for vehicles damaged or detained beyond the curb line

Trusted equipment from a trusted source.

CALL US! 866.966.2538
360.255.0603

SEARCH PRODUCTS

COLD PLANER CONCRETE SHAVER ATTACHMENT SERIES 1 | BRADCO

Ask a question

$10,295.00

Clear Poly Sheeting - 6 Mil, 20' x 100'

Enlarge

Economical protection from dust, dirt and moisture.

- Covers warehouse equipment, machinery, construction materials and skids.
- Replaces expensive drop cloths.
- Giant sheeting ideal cover for lumber, walls and scaffolding.

MODEL NO.	SIZE W x L	PRICE PER ROLL			LBS./ ROLL	ADD TO CART
		1	2	4+		
S-11180	20 x 100'	$119.00	$115.00	$110.00	58	1 ADD

Additional Info Email Page Add to Favorites Request a Catalog

[redacted]

From: [redacted]
Sent: Tuesday, September 20, 2016 2:58 PM
To: [redacted]
Subject: FW: Budget Estimate for Buffalo Program

For the camp cost.

From: [redacted]
Sent: Tuesday, September 20, 2016 12:16 PM
To: [redacted]
Cc: [redacted]
Subject: Budget Estimate for Buffalo Program

[redacted]

I have done a quick estimation as you requested for the Buffalo program (like Lockport) you are working on. This is a ballpark estimate and has not been presented to any management for approval.
The cost would be in the range of $18,000.00 - $23,000.00 making the assumptions listed below.

- You would supply the field technician
- Harvard would fabricate 3 PAM stations. Each station would contain 1 Dusttrak, 1 PID, 1 data logger, and 1 radio for transmission.
- Harvard would lease you 3 PAM units, 1 met tower, and a central computer for the telemetry system for a 3 month period. You would supply the trailer to house the computer and the internet.
- Harvard staff would travel to the site for mob/demob and 1 day training.
- Chelmsford office would produce a weekly summary report similar to the Lockport program and one final document at the completion of the 3 month program.
- Harvard staff would be available for technical support via telephone with no assumed extra trips to the site.
- At the conclusion of the program, Harvard will bring the equipment back to the Harvard facility and refurbish the units.

Again, this is a ball park estimate.

Let me know if you have any further questions or if you would like us to move forward with a formal budget estimate for your proposal.

[redacted]

[redacted]

Air Quality
[redacted]
AECOM
250 Apollo Drive
Chelmsford, MA 01824
T: (978)905-2427   F: (978)905-2101
www.aecom.com<http://www.aecom.com/>

ATTACHMENT C

LABOR RATE BACKUP

THIS PAGE INTENTIONALLY LEFT BLANK

```
NY170011 MOD  1  REVISED 03/03/17  NY11
******** THIS WAGE DETERMINATION WAS REPLACED ON 03/03/17********
General Decision Number: NY170011 02/17/2017

Superseded General Decision Number: NY20160011

State: New York

Construction Types: Heavy and Highway

County: Niagara County in New York.

HEAVY AND HIGHWAY CONSTRUCTION PROJECTS

Note: Under Executive Order (EO) 13658, an hourly minimum wage
of $10.20 for calendar year 2017 applies to all contracts
subject to the Davis-Bacon Act for which the contract is
awarded (and any solicitation was issued) on or after January
1, 2015. If this contract is covered by the EO, the contractor
must pay all workers in any classification listed on this wage
determination at least $10.20 (or the applicable wage rate
listed on this wage determination, if it is higher) for all
hours spent performing on the contract in calendar year 2017.
The EO minimum wage rate will be adjusted annually. Additional
information on contractor requirements and worker protections
under the EO is available at www.dol.gov/whd/govcontracts.


Modification Number     Publication Date
          0              01/06/2017
          1              02/17/2017

 BOIL0007-001 01/01/2013

                                  Rates          Fringes

BOILERMAKER......................$ 29.97           25.93
----------------------------------------------------------------
 BRNY0045-002 07/01/2016

                                  Rates          Fringes

Bricklayer, Stonemason...........$ 31.05           23.60
Marble mason.....................$ 31.40           22.75
Pointer, cleaner and caulker.....$ 31.05           23.60
Tile & Terrazzo Worker...........$ 31.40           22.75
Tile, Marble & Terrazzo
Finisher.........................$ 29.08           14.67
----------------------------------------------------------------
 CARP0276-015 07/01/2016

                                  Rates          Fringes

CARPENTER
     CARPENTER...................$ 33.14           23.41
     MILLWRIGHT..................$ 33.14           23.41
     PILEDRIVER..................$ 33.14           27.57
----------------------------------------------------------------
 ELEC0237-001 05/30/2016

                                  Rates          Fringes

Electricians:
     Cable Splicers..............$ 36.83           26.24
```

```
     Electricians...............$ 33.48           26.24
----------------------------------------------------------------
 ELEC1249-003 05/02/2016

                                  Rates          Fringes

ELECTRICIAN (LINE
CONSTRUCTION: LIGHTING AND
TRAFFIC SIGNAL Including any
and all Fiber Optic Cable
necessary for Traffic Signal
Systems, Traffic Monitoring
systems and Road Weather
information systems)
     Flagman....................$ 24.99    7.25%+21.75+a
     Groundman (Truck Driver)....$ 33.32    7.25%+21.75+a
     Groundman Truck Driver
     (tractor trailer unit)......$ 35.40    7.25%+21.75+a
     Lineman & Technician........$ 41.65    7.25%+21.75+a
     Mechanic....................$ 33.32    7.25%+21.75+a

FOOTNOTE:

  a.  New Year's Day, Memorial Day, Independence Day, Labor
  Day, Thanksgiving Day, Christmas Day, plus President's Day,
  Good Friday, Decoration Day, Election Day for the President
  of the United States and Election Day for the Governor of
  the State of New York, provided the employee works the day
  before or the day after the holiday.

----------------------------------------------------------------
 ELEC1249-004 05/02/2016

                                  Rates          Fringes

ELECTRICIAN (Line
Construction)
     Overhead and underground
     distribution and
     maintenance work and all
     overhead and underground
     transmission line work
     including any and all
     fiber optic ground wire,
     fiber optic shield wire or
     any other like product by
     any other name
     manufactured for the dual
     purpose of ground fault
     protection and fiber optic
     capabilities :
      Flagman...................$ 30.28    7.25%+21.75+a
      Groundman digging machine
      operator..................$ 45.41    7.25%+21.75+a
      Groundman truck driver
      (tractor trailer unit).....$ 42.89    7.25%+21.75+a
      Groundman Truck driver.....$ 40.37    7.25%+21.75+a
      Lineman and Technician.....$ 50.46    7.25%+21.75+a
      Mechanic..................$ 40.37    7.25%+21.75+a
     Substation:
      Cable Splicer.............$ 52.75    7.25%+21.75+a
      Flagman...................$ 28.77    7.25%+21.75+a
      Ground man truck driver....$ 38.36    7.25%+21.75+a
      Groundman digging machine
      operator..................$ 43.16    7.25%+21.75+a
```

```
      Groundman truck driver
      (tractor trailer unit).....$ 40.76    7.25%+21.75+a
      Lineman & Technician.......$ 47.95    7.25%+21.75+a
      Mechanic...................$ 38.36    7.25%+21.75+a
     Switching structures;
     railroad catenary
     installation and
     maintenance, third rail
     type underground fluid or
     gas filled transmission
     conduit and cable
     installations (including
     any and all fiber optic
     ground product by any
     other name manufactured
     for the dual purpose of
     ground fault protection
     and fiber optic
     capabilities), pipetype
     cable installation and
     maintenance jobs or
     projects, and maintenance
     bonding of rails; Pipetype
     cable installation
      Cable Splicer..............$ 54.20    7.25%+21.75+a
      Flagman....................$ 29.56    7.25%+21.75+a
      Groundman Digging Machine
      Operator...................$ 44.34    7.25%+21.75+a
      Groundman Truck Driver
      (tractor-trailer unit).....$ 41.88    7.25%+21.75+a
      Groundman Truck Driver.....$ 39.42    7.25%+21.75+a
      Lineman & Technician.......$ 49.27    7.25%+21.75+a
      Mechanic...................$ 39.42    7.25%+21.75+a

FOOTNOTE:

  a. PAID HOLIDAYS: New Year's Day, Presidents' Day, Memorial
  Day, Good Friday, Independence Day, Labor Day, Thanksgiving
  Day, Christmas Day, and Election Day for the President of
  the United States and Election Day for the Governor of New
  York State, provided the employee works two days before or
  two days after the holiday.

----------------------------------------------------------------
 ELEC1249-008 01/01/2014

                                  Rates          Fringes

ELECTRICIAN (Line
Construction)
     TELEPHONE, CATV
     FIBEROPTICS CABLE AND
     EQUIPMENT
      Cable splicer..............$ 29.12          3%+4.43
      Groundman..................$ 12.98          3%+4.43
      Installer Repairman-
      Teledata
      Lineman/Technician-
      Equipment Operator.........$ 27.64          3%+4.43
     Tree Trimmer................$ 22.41        8.30+3%+a

  a. New Year's Day, President's Day, Good Friday, Decoration
  Day, Independence Day, Labor Day, Veteran's Day,
  Thanksgiving Day, Day after Thanksgiving, Christmas Day.
```

ENGI0463-001 07/01/2016

```
                                  Rates          Fringes

Power Equipment Operator
     HEAVY AND HIGHWAY
     CONSTRUCTION
      GROUP A...................$ 36.29           28.10
      GROUP A1..................$ 39.29           28.10
      GROUP B...................$ 34.58           28.10
      Master Mechanic...........$ 38.06           28.10
```

Notes:
Hazardous Waste 3.00

ZONE PAY: crane boom premium for boom and jib 100-199 ft
(1.00 over group A)
crane boom premium for boom and jib 100-199 ft
(1.50 over group A)
crane boom premium for boom and jib 100-199 ft
(2.00 over group A)

GROUP A1: Backfillers, backhoes, automatic batch plant operator, black-top spreaders, bulldozers, CMI grading machines, cableways, clambuckets, combination hoe boom or shovel boomattached (except farm type crawler or rubber tired tractor unless used with hydraulic back-hoe), compressor (with paing breaker attached), concrete mixers (one yard and over), concrete planner, concrete pump (truck mounted), concrete spreader operator, crane work, cranes (overhead or bridge), crane operator (over 100, 200, 300 feet booms earn premiums as noted herein), derricks, draglines, Euclid type belt loaders, finishing machine operators, fork-lifts and hoists 9 when lifting material at an elevation higher than twenty-five feet), form puller, generator and compressor (power driven-when used simultaneously and for any make of portable concrete batching machine), graders, graders (with bulldozer blades), hoists (multiple drum with air compresor when used simultaneously for more than one purpose), hoists - single drum when used to hoist steel), hydraulic concrete joint hammers, hydraulic rock drill (Ingersoll-Rand LM 500 type), hydro-axe, Kolman Loaders, loaders (front & back - except small type), lubrication engineers, mechanic, pavement breaker (except hand operated pavement breakers), pile driving rigs, pipe pushing rigs, pipe pushing machines (mechanicl and hydraulic), post drivers (except truck mounted post drivers), reapir work on maintenance work under the supervision of a master mechanic, rollers (all) (on finish blacktop), scoopmobiles (all), scrapter (either double or single bowl), S-240 Lazer-Guided screed, shovels, snow-loader, steel erection, stone crushers (portable), stone spreaders (power driven), tractors use din conjunction with scraper wagons (all), tree bandit or similar chipper, tranchers (when excavation over six feet in depth), tunnel mucking machines, vibrators (self-propelled riding), welder

GROUP A2: crane boom premium for boom and jib 100-199 ft
(1.00 over group A)
GROUP A3: crane boom premium for boom and jib 100-199 ft
(1.50 over group A)
GROUP A4: crane boom premium for boom and jib 100-199 ft
(2.00 over group A)

GROUP B: air compresors (over 165 cu. ft), bobcat type skid loader, compressors when used in banks of two and not over three within a fifty foot radius and if fuel is stored, it would be stored within the same radius, concrete blowers, concrete pumps, conveyors, crawler or rubber tire tractor (small farm typewith blade or bucket not to exceed 0.5 yd capacity), earth drills (all), elevators (all), forklift while used to lift material not over 25 ft, gunnite machines, heaters (gasoline -use in banks of two and not over three within an area of one hudnred foot radius, highlift hoists while used to lift material not over 25 ft, material hoists, single drum hoist for hoisting materials other than steel, Latourneau turnatrailers, light and power systems 9 gas or diesel driven - temporary 25 KW capacity or over), Loaders 9 small front or back), locomotive, parts room - when a parts room is manned it shall be an engineer, pavement busters, pin pullser, post drivers 9 truck mounted), pug machine, pums over 4 Inches, (road rollers except on finish balcktop, road widener mounted on a loader, rolles (self propelled - not on finish blacktop and under 7 tons), scoopmobiles - when used as a station ary hoist, or one used to lift material not in excess of 25 feet, snow-go, stone crushers and winch hoists mounted on trucks, tractors, trenchers excavating up to 6 ft deep), trenchers on the back of a jeep, welding machines (for 2 but not over 3 gasoline or diesel driven), winch tractors

----

ENGI0463-002 07/01/2016

	Rates	Fringes
POWER EQUIPMENT OPERATOR: (TUNNEL AND SHAFT)		
GROUP A	$ 36.29	28.10
GROUP A1	$ 39.29	28.10
GROUP B	$ 34.58	28.10
GROUP C	$ 28.53	28.10
Master Mechanic	$ 38.06	28.10

NOTES: Hazmat premium 3.00

ZONE PAY:
Add $1.00 to GROUP A - long boom crane premium 100 ft - 199 ft
Add $1.50 to GROUP A- long boom crane premium 200 ft - 299 ft
Add $2.00 to GGROUP A - long boom crane premium 300 ft and over

FOOTNOTE:
a. PAID HOLIDAYS: New Year's Day; Memorial Day; Independence Day; Labor Day; Thanksgiving Day; Christmas Day provided employee works the day before and the day after the holiday.

TUNNEL AND SHAFT CLASSIFICATIONS

GROUP A1: Crane (underground), front end loader (tunnel and shaft), hoist (2 or 3 drum), maintenance engineer (tunnel and shaft), mining machine (mole and similar types), motor man, mucking machine, shovel, tripper/maintenance engineer (tunnel and shaft), tunnel shovel

GROUP B: automated central mix concrete plant, backhoe

```
  (topside), boring machine, compressors (4 or less,
  exceeding 2,000 C.F.M. combined capacity, but not to exceed
  5,000 C.F.M. with a distance not to exceed 1,500 feet),
  concrete pump, crane (topside, front end loader (topside),
  Grayco epoxy machine, hoist (2 or 3 drum -- topside),
  maintenance engineer (topside), maintenance grease man,
  personnel hoist, pump crete, shotcrete machine, shovel
  (topside)

  GROUP C:  comrpessors (4 not to exceed 2,000 C.F.M. combined
  capacity or 3 or less with more than 1,200 C.F.M. but not
  to exceed 2,000 C.F.M. with a distance for compressors),
  dust collectors, generators, pumps, welding machines (4 of
  any type or combination) with a distance not to exceed
  1,500 feet; conveyor, electric pump used inconjunction with
  well point system grout pump over 5 cubic feet
  (manufacturer's rating), hydro-blaster, motorized form
  carrier, truck crane oiler, well point

  GROUP D:  Compressors (3 or less not to exceed 1,200 C.F.M.
  combined capacity with a distance not to exceed 1,500 feet;
  comrpessors (any size but subject to other provisions for
  compressors), dust collectors, generators, pumps, welding
  machines (three or less of any type or combination) with a
  distance not to exceed 1,500 feet; fireman, grease man,

----------------------------------------------------------------
 IRON0009-003 05/02/2016

                                  Rates          Fringes

Ironworkers:
     IRONWORKER..................$ 30.22           24.28
     SHEETER.....................$ 33.12           24.28
----------------------------------------------------------------
* LABO0091-002 07/01/2016

                                  Rates          Fringes

LABORER
     COMPRESSED AIR
      GROUP 1....................$ 26.00         34.41+a
      GROUP 2....................$ 29.90         34.41+a
      GROUP 3....................$ 31.20         34.41+a
      GROUP 4....................$ 32.50         34.41+a
      GROUP 5....................$ 33.80         34.41+a
      GROUP 6....................$ 35.10         34.41+a
     HEAVY & HIGHWAY
     CLASSIFICATIONS
      GROUP 1....................$ 26.00         34.16+a
      GROUP 2....................$ 26.30         34.16+a
      GROUP 3....................$ 26.50         34.16+a
      GROUP 4....................$ 26.60         34.16+a
      GROUP 5....................$ 26.85         34.16+a
      GROUP 6....................$ 27.00         34.16+a
      GROUP 7....................$ 28.00         34.16+a
      GROUP 8....................$ 28.60         34.16+a
      GROUP 9....................$ 31.00         34.16+a
     TUNNEL FREE AIR
     CONSTRUCTION
      GROUP 1....................$ 32.50         34.41+a
      GROUP 2....................$ 26.59         34.41+a
      GROUP 3....................$ 33.80         34.41+a
      GROUP 4:...................$ 35.10         34.41+a
      GROUP 5:...................$ 46.59         34.41+a
```

LABORERS CLASSIFICATIONS

GROUP 1: Common Laborers, Multi-Trade Tender, Decontamination of all Machines, Horizontal Directional Drill/Locator; All terrain Vehicles with Attachments/All wheel or Track Types

GROUP 2: Potman, Pipelayers, Pavement Breakers or Busters, Jackhammer Operators; Barco Rammers; Chain Saw; Powder Monkey; Black Top Rakers; Scalers; Drill Tenders; Mortar Mixers; Concrete Polishing Machine; Operation & Maintenance of all Robotic Remote Systems in Hazardous Environment; Men Working from Swinging Scaffold Bo'sns Chair, suspended cage or bucket; All Other Operators of Mechanical Tools, Including Vibrators Regardless of Type of Power and Boat Men; Operation of All Types of Video Machinery Used in the Inspection of Pipe; Work in Caissons below 8 feet; Concrete Motor Buggy

GROUP 3: Respirator Required for Busting

GROUP 4: Form Setter; Road Finisher; Gunnite Nozzleman; Sandblasters; Burning Torch; Concrete Saw Operators; Utility Pile Driver; Tree Topper; Grout Machine and Grout Pump Operator

GROUP 5: Laser Beam Operator

GROUP 6: Welders; Wagon Drill & Air Track Drill; Self Contained Drill; Respirator Required due to Atmospheric Conditions (Excluding Respirators Required for Hazardous Waste & Toxic Materials, Asbestos Abatement or Lead Abatement)

GROUP 7: Chemical Waste - Men Working with Hazardous Waste & Toxic Materials or in Areas of Radioactive Material & Asbestos; The Removal of Asbestos from Roofs, Ceilings, Pipes, Walls, Boilers etc., and All Machinery, & the Recovering of Same; Removal of Lead

GROUP 8: Grade Checker & Blaster

GROUP 9: Supplied Air Respirators

For TUNNEL FREE AIR CLASSIFICATIONS

GROUP 1: General Laborer; Mole Nipper (one per shift); Top Laborer

GROUP 2: Tenders for Divers

GROUP 3: Tunnel Workers; Miners; Drill Runners; Conveyor Men; Powder Carriers; Chuck Tenders; Trackmen; Nippers; Burners; Brake Men; Derail Men; Cable Men; Hosemen; Grout Men; Gravel Men; Form Men; Bottom Bell; Top Bell; Signal Men; Movers; Shaft Men; Tunnel Laborers

GROUP 4: Blasters; Welders; Steel Erectors; Piledrivers; Riggers; Ironmen

GROUP 5: Divers

For COMPRESSED AIR CLASSIFICATIONS

GROUP 1: Top Laborers

GROUP 2: Top Bell; Signal Men; Shaft Men; Outside Man; Lock Tender; Gauge Tender; Outside Muck Lock Tender

GROUP 3: Top Nipper

GROUP 4: Bottom Bell; Mole Nippers per Working Shaft per Shift up to and Including Two Moles

GROUP 5: All Tunnel Workers Including Miners; Drill Runners; Ironmen; Muck Men; Inside Mucklock Tender; Pumpmen; Hydrualic Men; Shield Drivers; Monorail Operators; Motormen; Conveyor Men; Powdermen; Pan Men; Chuck Tenders; Track Men; Nippers; Brakemen; Derail Men; Cable Men; Hose Men; Grout Men; Gravel Men; Tunnel Laborers

GROUP 6: Blasters; Mucking Machine Operators

FOOTNOTE: a. PAID HOLIDAYS: New Years Day, Memorial Day, Independence Day Labor Day, Thanksgiving Day, Christmas Day, and Election Day

----

PAIN0004-002 05/01/2016

TOWNSHIPS OF HARTLAND, LOCKPORT NORTH TONAWANDA, NEWFANE, PENDLETON, ROYALTON, SOMERSET and the eastern halves of CAMBRIA and WILSON

	Rates	Fringes
Painters: (HEAVY & HIGHWAY CONSTRUCTION)		
HEAVY & HIGHWAY CONSTRUCTION		
BRIDGES....................	$ 38.00	25.25
PAINTERS		
BRUSH & ROLLER.............	$ 25.95	22.44
DRYWALL/TAPING.............	$ 26.45	22.44
WALLCOVERING...............	$ 26.20	22.44

PAIN0004-005 05/01/2016

TOWNSHIPS OF LEWISTON, NIAGARA FALLS, PORTER, WHEATFIELD and the western halves of CAMBRIA and WILSON

	Rates	Fringes
Painters:		
HEAVY & HIGHWAY CONSTRUCTION		
Bridge Painting............	$ 38.00	25.25
Lead Abatement..............	$ 25.43	15.30
Painters....................	$ 24.68	15.30
Spraying, Paperhangers, Sand-Blasting, Swinging scaffold....................	$ 24.93	15.30
Tapers......................	$ 25.18	15.30

```
 PAIN0004-011 05/01/2016

                                  Rates          Fringes

GLAZIER..........................$ 26.25          19.42
----------------------------------------------------------------
 PLAS0111-002 07/01/2016

                                  Rates          Fringes

CEMENT FINISHER..................$ 30.00          29.07
----------------------------------------------------------------
 PLUM0022-005 05/02/2016

                                  Rates          Fringes

Plumber and Steamfitter
     ZONE 1......................$ 34.30          23.40
----------------------------------------------------------------
 ROOF0074-002 06/01/2011

                                  Rates          Fringes

Roofers:
     Composition.................$ 25.00          16.18
     Slate & Tile................$ 25.15          16.18
----------------------------------------------------------------
 SFNY0669-001 04/01/2016

                                  Rates          Fringes

SPRINKLER FITTER.................$ 32.66          21.42
----------------------------------------------------------------
 SHEE0071-002 05/15/2011

                                  Rates          Fringes

Sheet metal worker...............$ 31.50          17.45
----------------------------------------------------------------
 TEAM0449-003 07/01/2015

Heavy & Highway

                                  Rates          Fringes

Truck drivers: (Includes
Single Axle Dump and
Off-Highway Dump Trucks).........$ 35.15        5.00+a+b

  Work on a hazardous waste site then additional $2.00 per
  hour.

FOOTNOTE: a. Pension $49.00 per day

  b. Paid Holidays: New Years Day, Memorial Day, Independence
  Day, Labor Day, Thanksgiving Day, Christmas Day provided
  the employee has worked the working day before and after
  the holiday

----------------------------------------------------------------
 TEAM0449-006 07/01/2015

Heavy & Highway

                                  Rates          Fringes
```

```
Truck drivers: (Dump Truck
Only, Excludes Single Axle
Dump and Off-Highway Dump
Trucks).........................$ 18.95          3.17+a

  FOOTNOTE: a. Paid Holidays: New Years Day, Memorial Day,
  Independence Day, Labor Day, Thanksgiving Day, Christmas
  Day provided the employee has worked the working day before
  and after the holiday

----------------------------------------------------------------

WELDERS - Receive rate prescribed for craft performing
operation to which welding is incidental.

================================================================
```

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year. Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at www.dol.gov/whd/govcontracts.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (ii)).

The body of each wage determination lists the classification and wage rates that have been found to be prevailing for the cited type(s) of construction in the area covered by the wage determination. The classifications are listed in alphabetical order of "identifiers" that indicate whether the particular rate is a union rate (current union negotiated rate for local), a survey rate (weighted average rate) or a union average rate (weighted union average rate).

Union Rate Identifiers

A four letter classification abbreviation identifier enclosed in dotted lines beginning with characters other than "SU" or "UAVG" denotes that the union classification and rate were prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2014. PLUM is an abbreviation identifier of the union which prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. 07/01/2014 is the effective date of the most current negotiated rate, which in this example is July 1, 2014.

Union prevailing wage rates are updated to reflect all rate changes in the collective bargaining agreement (CBA) governing this classification and rate.

Survey Rate Identifiers

Classifications listed under the "SU" identifier indicate that no one rate prevailed for this classification in the survey and the published rate is derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As this weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SULA2012-007 5/13/2014. SU indicates the rates are survey rates based on a weighted average calculation of rates and are not majority rates. LA indicates the State of Louisiana. 2012 is the year of survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. 5/13/2014 indicates the survey completion date for the classifications and rates under that identifier.

Survey wage rates are not updated and remain in effect until a new survey is conducted.

Union Average Rate Identifiers

Classification(s) listed under the UAVG identifier indicate that no single majority rate prevailed for those classifications; however, 100% of the data reported for the classifications was union data. EXAMPLE: UAVG-OH-0010 08/29/2014. UAVG indicates that the rate is a weighted union average rate. OH indicates the state. The next number, 0010 in the example, is an internal number used in producing the wage determination. 08/29/2014 indicates the survey completion date for the classifications and rates under that identifier.

A UAVG rate will be updated once a year, usually in January of each year, to reflect a weighted average of the current negotiated/CBA rate of the union locals from which the rate is based.

WAGE DETERMINATION APPEALS PROCESS

1.) Has there been an initial decision in the matter? This can be:

* an existing published wage determination
* a survey underlying a wage determination
* a Wage and Hour Division letter setting forth a position on a wage determination matter
* a conformance (additional classification and rate) ruling

On survey related matters, initial contact, including requests for summaries of surveys, should be with the Wage and Hour Regional Office for the area in which the survey was conducted because those Regional Offices have responsibility for the

Davis-Bacon survey program. If the response from this initial contact is not satisfactory, then the process described in 2.) and 3.) should be followed.

With regard to any other matter not yet ripe for the formal process described here, initial contact should be with the Branch of Construction Wage Determinations. Write to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2.) If the answer to the question in 1.) is yes, then an interested party (those affected by the action) can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Write to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and by any information (wage payment data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3.) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

4.) All decisions by the Administrative Review Board are final.

==

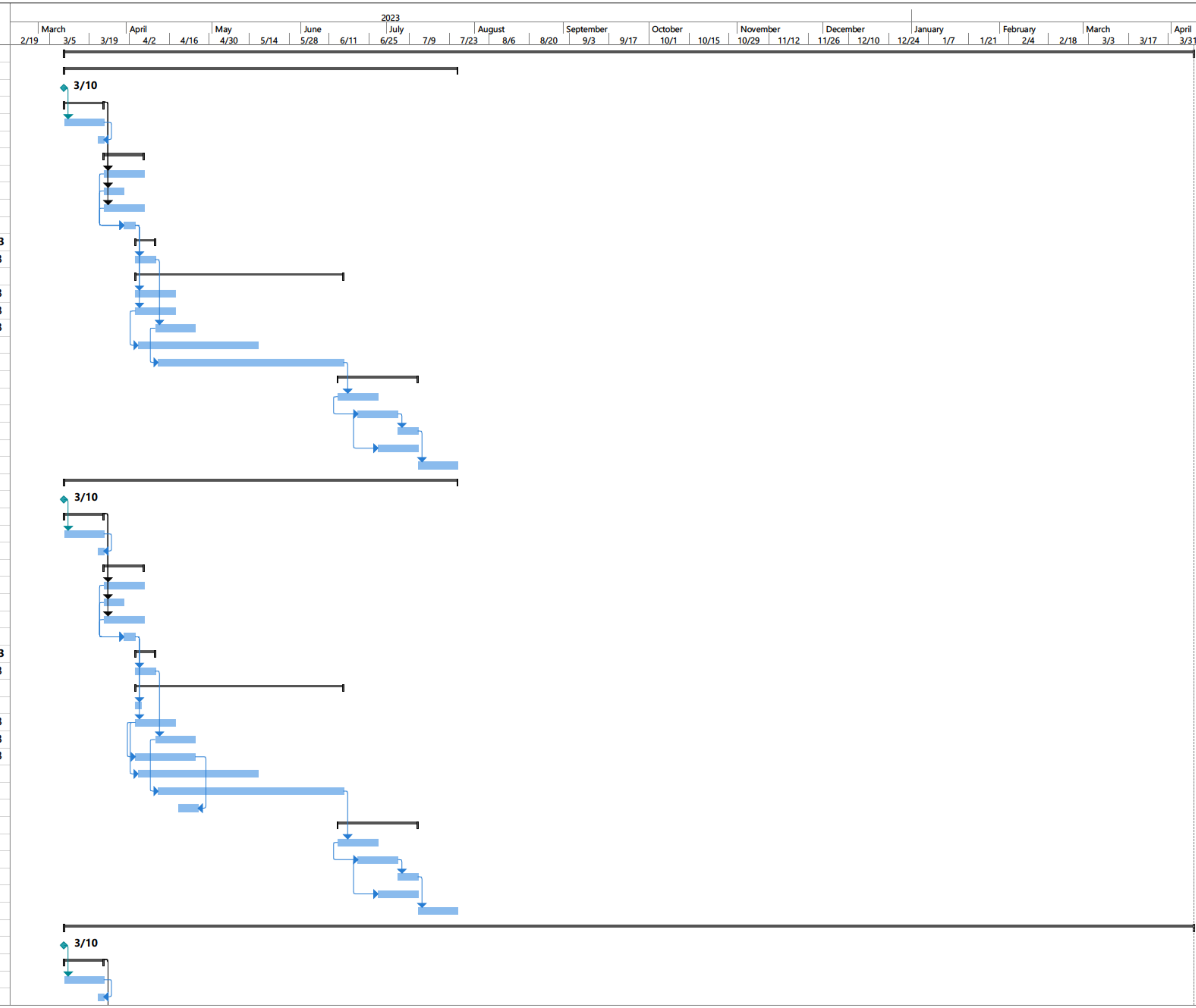
END OF GENERAL DECISION

ATTACHMENT D

SCHEDULE

THIS PAGE INTENTIONALLY LEFT BLANK

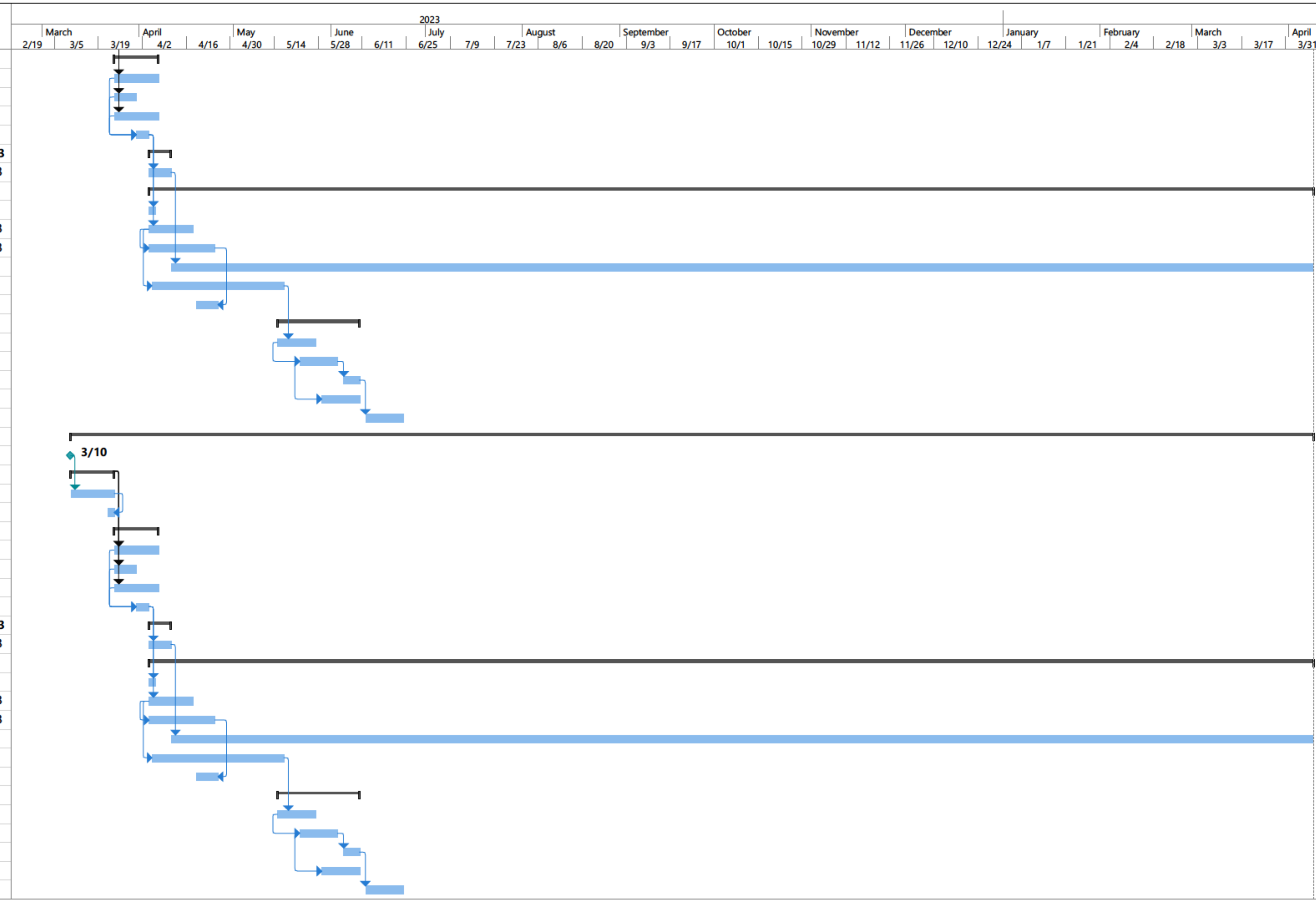
ID	Task Name	Duration	Start	Finish
1	**Niagara Falls Storage Site Remediation**	**282 days**	**Fri 3/10/23**	**Mon 4/8/24**
2	**Alternative 2**	**98 days**	**Fri 3/10/23**	**Tue 7/25/23**
3	Construction Notice to Proceed	0 days	Fri 3/10/23	Fri 3/10/23
4	**Mobilization**	**10 days**	**Fri 3/10/23**	**Thu 3/23/23**
5	Temporary Facilities	10 days	Fri 3/10/23	Thu 3/23/23
6	E&S Controls	2 days	Wed 3/22/23	Thu 3/23/23
7	**Site Work**	**10 days**	**Fri 3/24/23**	**Thu 4/6/23**
8	Clearing and Grubbing	10 days	Fri 3/24/23	Thu 4/6/23
9	Tree Removal	5 days	Fri 3/24/23	Thu 3/30/23
10	Road Removal	10 days	Fri 3/24/23	Thu 4/6/23
11	Staging/Stockpiling Areas	2 days	Fri 3/31/23	Mon 4/3/23
12	**Structure Removal**	**5 days**	**Tue 4/4/23**	**Mon 4/10/23**
13	Tank Foundation Removal	5 days	Tue 4/4/23	Mon 4/10/23
14	**Remedial Work**	**53 days**	**Tue 4/4/23**	**Thu 6/15/23**
15	Remove Building Foundations	10 days	Tue 4/4/23	Mon 4/17/23
16	Excavation and Stockpiling (Radiological)	10 days	Tue 4/4/23	Mon 4/17/23
17	Excavation and Stockpiling (VOC)	10 days	Tue 4/11/23	Mon 4/24/23
18	Transport and Dispose Radiological Material	30 days	Wed 4/5/23	Tue 5/16/23
19	Transport and Dispose VOC Material	47 days	Wed 4/12/23	Thu 6/15/23
20	**Restoration**	**20 days**	**Wed 6/14/23**	**Tue 7/11/23**
21	Backfill/Grade	10 days	Wed 6/14/23	Tue 6/27/23
22	Place Topsoil	10 days	Wed 6/21/23	Tue 7/4/23
23	Seeding	5 days	Wed 7/5/23	Tue 7/11/23
24	Asphalt Road Replacement	10 days	Wed 6/28/23	Tue 7/11/23
25	Demobilization	10 days	Wed 7/12/23	Tue 7/25/23
26	**Alternative 3**	**98 days**	**Fri 3/10/23**	**Tue 7/25/23**
27	Construction Notice to Proceed	0 days	Fri 3/10/23	Fri 3/10/23
28	**Mobilization**	**10 days**	**Fri 3/10/23**	**Thu 3/23/23**
29	Temporary Facilities	10 days	Fri 3/10/23	Thu 3/23/23
30	E&S Controls	2 days	Wed 3/22/23	Thu 3/23/23
31	**Site Work**	**10 days**	**Fri 3/24/23**	**Thu 4/6/23**
32	Clearing and Grubbing	10 days	Fri 3/24/23	Thu 4/6/23
33	Tree Removal	5 days	Fri 3/24/23	Thu 3/30/23
34	Road Removal	10 days	Fri 3/24/23	Thu 4/6/23
35	Staging/Stockpiling Areas	2 days	Fri 3/31/23	Mon 4/3/23
36	**Structure Removal**	**5 days**	**Tue 4/4/23**	**Mon 4/10/23**
37	Tank Foundation Removal	5 days	Tue 4/4/23	Mon 4/10/23
38	**Remedial Work**	**53 days**	**Tue 4/4/23**	**Thu 6/15/23**
39	Remove Building 401 Foundation	2 days	Tue 4/4/23	Wed 4/5/23
40	Excavation and Stockpiling (Radiological)	10 days	Tue 4/4/23	Mon 4/17/23
41	Excavation and Stockpiling (VOC)	10 days	Tue 4/11/23	Mon 4/24/23
42	Foundation Decontamination	15 days	Tue 4/4/23	Mon 4/24/23
43	Transport and Dispose Radiological Material	30 days	Wed 4/5/23	Tue 5/16/23
44	Transport and Dispose VOC Material	47 days	Wed 4/12/23	Thu 6/15/23
45	Transport Concrete Chips and Dust	5 days	Wed 4/19/23	Tue 4/25/23
46	**Restoration**	**20 days**	**Wed 6/14/23**	**Tue 7/11/23**
47	Backfill/Grade	10 days	Wed 6/14/23	Tue 6/27/23
48	Place Topsoil	10 days	Wed 6/21/23	Tue 7/4/23
49	Seeding	5 days	Wed 7/5/23	Tue 7/11/23
50	Asphalt Road Replacement	10 days	Wed 6/28/23	Tue 7/11/23
51	Demobilization	10 days	Wed 7/12/23	Tue 7/25/23
52	**Alternative 4**	**282 days**	**Fri 3/10/23**	**Mon 4/8/24**
53	Construction Notice to Proceed	0 days	Fri 3/10/23	Fri 3/10/23
54	**Mobilization**	**10 days**	**Fri 3/10/23**	**Thu 3/23/23**
55	Temporary Facilities	10 days	Fri 3/10/23	Thu 3/23/23
56	E&S Controls	2 days	Wed 3/22/23	Thu 3/23/23



Project: FS Construction Schedule
Date: Tue 3/14/17

Task	Summary	Inactive Milestone	Duration-only	Start-only	External Milestone	Manual Progress					
Split	Project Summary	Inactive Summary	Manual Summary Rollup	Finish-only	Deadline						
Milestone	Inactive Task	Manual Task	Manual Summary	External Tasks	Progress						

ID	Task Name	Duration	Start	Finish
57	**Site Work**	**10 days**	**Fri 3/24/23**	**Thu 4/6/23**
58	Clearing and Grubbing	10 days	Fri 3/24/23	Thu 4/6/23
59	Tree Removal	5 days	Fri 3/24/23	Thu 3/30/23
60	Road Removal	10 days	Fri 3/24/23	Thu 4/6/23
61	Staging/Stockpiling Areas	2 days	Fri 3/31/23	Mon 4/3/23
62	**Structure Removal**	**5 days**	**Tue 4/4/23**	**Mon 4/10/23**
63	Tank Foundation Removal	5 days	Tue 4/4/23	Mon 4/10/23
64	**Remedial Work**	**265 days**	**Tue 4/4/23**	**Mon 4/8/24**
65	Remove Building 401 Foundation	2 days	Tue 4/4/23	Wed 4/5/23
66	Excavation and Stockpiling (Radiological)	10 days	Tue 4/4/23	Mon 4/17/23
67	Foundation Decontamination	15 days	Tue 4/4/23	Mon 4/24/23
68	In-Situ Thermal Treatment	260 days	Tue 4/11/23	Mon 4/8/24
69	Transport and Dispose Radiological Material	30 days	Wed 4/5/23	Tue 5/16/23
70	Transport Concrete Chips and Dust	5 days	Wed 4/19/23	Tue 4/25/23
71	**Restoration**	**20 days**	**Mon 5/15/23**	**Fri 6/9/23**
72	Backfill/Grade	10 days	Mon 5/15/23	Fri 5/26/23
73	Place Topsoil	10 days	Mon 5/22/23	Fri 6/2/23
74	Seeding	5 days	Mon 6/5/23	Fri 6/9/23
75	Asphalt Road Replacement	10 days	Mon 5/29/23	Fri 6/9/23
76	Demobilization	10 days	Mon 6/12/23	Fri 6/23/23
77	**Alternative 5**	**282 days**	**Fri 3/10/23**	**Mon 4/8/24**
78	Construction Notice to Proceed	0 days	Fri 3/10/23	Fri 3/10/23
79	**Mobilization**	**10 days**	**Fri 3/10/23**	**Thu 3/23/23**
80	Temporary Facilities	10 days	Fri 3/10/23	Thu 3/23/23
81	E&S Controls	2 days	Wed 3/22/23	Thu 3/23/23
82	**Site Work**	**10 days**	**Fri 3/24/23**	**Thu 4/6/23**
83	Clearing and Grubbing	10 days	Fri 3/24/23	Thu 4/6/23
84	Tree Removal	5 days	Fri 3/24/23	Thu 3/30/23
85	Road Removal	10 days	Fri 3/24/23	Thu 4/6/23
86	Staging/Stockpiling Areas	2 days	Fri 3/31/23	Mon 4/3/23
87	**Structure Removal**	**5 days**	**Tue 4/4/23**	**Mon 4/10/23**
88	Tank Foundation Removal	5 days	Tue 4/4/23	Mon 4/10/23
89	**Remedial Work**	**265 days**	**Tue 4/4/23**	**Mon 4/8/24**
90	Remove Building 401 Foundation	2 days	Tue 4/4/23	Wed 4/5/23
91	Excavation and Stockpiling (Radiological)	10 days	Tue 4/4/23	Mon 4/17/23
92	Foundation Decontamination	15 days	Tue 4/4/23	Mon 4/24/23
93	Ex-Situ Thermal Treatment	260 days	Tue 4/11/23	Mon 4/8/24
94	Transport and Dispose Radiological Material	30 days	Wed 4/5/23	Tue 5/16/23
95	Transport Concrete Chips and Dust	5 days	Wed 4/19/23	Tue 4/25/23
96	**Restoration**	**20 days**	**Mon 5/15/23**	**Fri 6/9/23**
97	Backfill/Grade	10 days	Mon 5/15/23	Fri 5/26/23
98	Place Topsoil	10 days	Mon 5/22/23	Fri 6/2/23
99	Seeding	5 days	Mon 6/5/23	Fri 6/9/23
100	Asphalt Road Replacement	10 days	Mon 5/29/23	Fri 6/9/23
101	Demobilization	10 days	Mon 6/12/23	Fri 6/23/23



Project: FS Construction Schedule
Date: Tue 3/14/17

Task		Summary		Inactive Milestone		Duration-only		Start-only		External Milestone		Manual Progress	
Split		Project Summary		Inactive Summary		Manual Summary Rollup		Finish-only		Deadline			
Milestone		Inactive Task		Manual Task		Manual Summary		External Tasks		Progress			

ATTACHMENT E

BREAKDOWN OF O&M COSTS

THIS PAGE INTENTIONALLY LEFT BLANK

ATTACHMENT E
BREAKDOWN OF O&M COSTS

Task	Name	Amount
1	TASK 1 - Quarterly Site Visits (four per year)	$ 2,266.56
2	TASK 2 - Annual Supervision and Administration	$ 2,480.18
3	TASK 3 - 5-year Review Report (Average per year)	$ 8,713.22
	Total	$ 13,459.96

Long-Term O&M Cost Summary

Personnel Category	Project Role		Rate	Hours per Year	Annual Cost[1]
Program Manager	Program Manager	[redacted]	$ 259.70	1.0	$ 259.70
Project Manager	Project Manager		$ 144.85	18.4	$ 2,665.24
Certified Industrial Hygenist	Certified Industrial Hygenist		$ 278.70	1.6	$ 445.92
Certified Safety Professional	Certified Safety Professional		$ 142.00	0.0	$ -
Chemist Senior	Chemist Senior		$ 109.12	3.2	$ 349.18
Chemist Junior	Chemist Junior		$ 91.81	0.0	$ -
Civil Engineer Junior	Civil Engineer Junior		$ 108.67	0.0	$ -
Cost Estimator	Cost Estimator		$ 94.28	0.0	$ -
Cost Estimator	Cost Estimator		$ 80.46	0.0	$ -
Designer Senior	GIS Manager		$ 131.37	0.0	$ -
Draftsman Senior	Draftsman Senior		$ 77.32	0.0	$ -
Draftsman Junior	Draftsman Junior		$ 64.39	9.6	$ 618.14
Environmental Engineer Senior	Environmental Engineer Senior		$ 125.98	19.2	$ 2,418.82
Environmental Engineer Junior	Environmental Engineer Junior		$ 77.54	0.0	$ -
Environmental Engineer Junior	Environmental Technician		$ 64.12	24.0	$ 1,538.88
Geologist Senior	ITR Officer		$ 115.07	6.4	$ 736.45
Geologist Senior	H&S Officer		$ 107.10	0.0	$ -
Geologist Junior	Junior Geologist		$ 55.40	0.0	$ -
Geologist Junior	Junior Geologist		$ 70.83	35.2	$ 2,493.22
Healh Physicist (Radiological)	Sr. Health Physicist		$ 195.00	0.0	$ -
Sr CADD Operator	Sr CADD Operator		$ 120.02	0.0	$ -
Jr CADD Operator	Jr CADD Operator		$ 90.91	9.6	$ 872.74
Project Administrator	Project Administrator		$ 82.71	8.0	$ 661.68
Project Administrator	Project Administrator		$ 79.34	0.0	$ -
Regulatory Specialist	Regulatory Specialist		$ -	0.0	$ -
Clerk	Clerk		$ 50.00	8.0	$ 400.00
Subtotal				144.2	$ 13,459.96
Total Annual Labor[1]					**$ 13,459.96**

1 - The total annual cost assumes that the cost for 5-year review is distributed evenly, with 20% of its total cost applied each year

TASK 1 - Quarterly Site Visits

Personnel Category	Project Role		Rate	Hours per Year	Annual Cost1
Program Manager	Program Manager	[redacted]	$ 259 70		$ -
Project Manager	Project Manager		$ 144 85		$ -
Certified Industrial Hygenist	Certified Industrial Hygenist		$ 278 70		$ -
Certified Safety Professional	Certified Safety Professional		$ 142 00		$ -
Chemist Senior	Chemist Senior		$ 109 12		$ -
Chemist Junior	Chemist Junior		$ 91 81		$ -
Civil Engineer Junior	Civil Engineer Junior		$ 108 67		$ -
Cost Estimator	Cost Estimator		$ 94 28		$ -
Cost Estimator	Cost Estimator		$ 80 46		$ -
Designer Senior	GIS Manager		$ 131 37		$ -
Draftsman Senior	Draftsman Senior		$ 77 32		$ -
Draftsman Junior	Draftsman Junior		$ 64 39		$ -
Environmental Engineer Senior	Environmental Engineer Senior		$ 125 98		$ -
Environmental Engineer Junior	Environmental Engineer Junior		$ 77 54		$ -
Environmental Engineer Junior	Environmental Technician		$ 64 12		$ -
Geologist Senior	ITR Officer		$ 115 07		$ -
Geologist Senior	H&S Officer		$ 107 10		$ -
Geologist Junior	Junior Geologist		$ 55 40		$ -
Geologist Junior	Junior Geologist		$ 70 83	32	$ 2,266 56
Healh Physicist (Radiological)	Sr Health Physicist		$ 195 00		$ -
Sr CADD Operator	Sr CADD Operator		$ 120 02		$ -
Jr CADD Operator	Jr CADD Operator		$ 90 91		$ -
Project Administrator	Project Administrator		$ 82 71		$ -
Project Administrator	Project Administrator		$ 79 34		$ -
Regulatory Specialist	Regulatory Specialist		$ -		$ -
Clerk	Clerk		$ 50 00		$ -
Subtotal				**32**	**$ 2,266.56**

TASK 2 - Annual Supervision and Administration

Personnel Category	Project Role		Rate	Hours per Year	Annual Cost1
Program Manager	Program Manager	[redacted]	$ 259 70	1	$ 259 70
Project Manager	Project Manager		$ 144 85	8	$ 1,158 80
Certified Industrial Hygenist	Certified Industrial Hygenist		$ 278 70		$ -
Certified Safety Professional	Certified Safety Professional		$ 142 00		$ -
Chemist Senior	Chemist Senior		$ 109 12		$ -
Chemist Junior	Chemist Junior		$ 91 81		$ -
Civil Engineer Junior	Civil Engineer Junior		$ 108 67		$ -
Cost Estimator	Cost Estimator		$ 94 28		$ -
Cost Estimator	Cost Estimator		$ 80 46		$ -
Designer Senior	GIS Manager		$ 131 37		$ -
Draftsman Senior	Draftsman Senior		$ 77 32		$ -
Draftsman Junior	Draftsman Junior		$ 64 39		$ -
Environmental Engineer Senior	Environmental Engineer Senior		$ 125 98		$ -
Environmental Engineer Junior	Environmental Engineer Junior		$ 77 54		$ -
Environmental Engineer Junior	Environmental Technician		$ 64 12		$ -
Geologist Senior	ITR Officer		$ 115 07		$ -
Geologist Senior	H&S Officer		$ 107 10		$ -
Geologist Junior	Junior Geologist		$ 55 40		$ -
Geologist Junior	Junior Geologist		$ 70 83		$ -
Healh Physicist (Radiological)	Sr Health Physicist		$ 195 00		$ -
Sr CADD Operator	Sr CADD Operator		$ 120 02		$ -
Jr CADD Operator	Jr CADD Operator		$ 90 91		$ -
Project Administrator	Project Administrator		$ 82 71	8	$ 661 68
Project Administrator	Project Administrator		$ 79 34		$ -
Regulatory Specialist	Regulatory Specialist		$ -		$ -
Clerk	Clerk		$ 50 00	8	$ 400 00
Subtotal				**25**	**$ 2,480.18**

TASK 3 - Five-Year Review Report

Personnel Category	Project Role		Rate	Total Hours	5-year Cost
Program Manager	Program Manager	[redacted]	$ 259 70		$ -
Project Manager	Project Manager	[redacted]	$ 144 85	52	$ 7,532 20
Certified Industrial Hygenist	Certified Industrial Hygenist	[redacted]	$ 278 70	8	$ 2,229 60
Certified Safety Professional	Certified Safety Professional	[redacted]	$ 142 00		$ -
Chemist Senior	Chemist Senior	[redacted]	$ 109 12	16	$ 1,745 92
Chemist Junior	Chemist Junior	[redacted]	$ 91 81		$ -
Civil Engineer Junior	Civil Engineer Junior	[redacted]	$ 108 67		$ -
Cost Estimator	Cost Estimator	[redacted]	$ 94 28		$ -
Cost Estimator	Cost Estimator	[redacted]	$ 80 46		$ -
Designer Senior	GIS Manager	[redacted]	$ 131 37		$ -
Draftsman Senior	Draftsman Senior	[redacted]	$ 77 32		$ -
Draftsman Junior	Draftsman Junior	[redacted]	$ 64 39	48	$ 3,090 72
Environmental Engineer Senior	Environmental Engineer Senior	[redacted]	$ 125 98	96	$ 12,094 08
Environmental Engineer Junior	Environmental Engineer Junior	[redacted]	$ 77 54		$ -
Environmental Engineer Junior	Environmental Technician	[redacted]	$ 64 12	120	$ 7,694 40
Geologist Senior	ITR Officer	[redacted]	$ 115 07	32	$ 3,682 24
Geologist Senior	H&S Officer	[redacted]	$ 107 10		$ -
Geologist Junior	Junior Geologist	[redacted]	$ 55 40		$ -
Geologist Junior	Junior Geologist	[redacted]	$ 70 83	16	$ 1,133 28
Healh Physicist (Radiological)	Sr Health Physicist	[redacted]	$ 195 00		$ -
Sr CADD Operator	Sr CADD Operator	[redacted]	$ 120 02		$ -
Jr CADD Operator	Jr CADD Operator	[redacted]	$ 90 91	48	$ 4,363 68
Project Administrator	Project Administrator	[redacted]	$ 82 71		$ -
Project Administrator	Project Administrator	[redacted]	$ 79 34		$ -
Regulatory Specialist	Regulatory Specialist	[redacted]	$ -		$ -
Clerk	Clerk	[redacted]	$ 50 00		$ -
Subtotal				**436**	**$ 43,566.12**

ATTACHMENT F

ABBREVIATED RISK ANALYSIS FORMS

THIS PAGE INTENTIONALLY LEFT BLANK

Abbreviated Risk Analysis

Project (less than $40M): **NFSS FS BOP & GW OUs**

Project Development Stage/Alternative: **Feasibility (Alternatives)**

Risk Category: **Moderate Risk: Typical Project Construction Type**

Alternative: **Alt 2**

Meeting Date: **16-Oct-17**

Total Estimated Construction Contract Cost = **$ 21,649,386**

	CWWBS	Feature of Work	Contract Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ -		0.00%	$ -	$ -
1		33101 Mob & Preparatory Work / 33121 Demobilization	$ 268,851		15.93%	$ 42,841	$ 311,691
2		33102 Monitoring, Sampling, Testing, & Analysis	$ 180,088		18.67%	$ 33,619	$ 213,707
3		33103 Site Work	$ 135,649		7.00%	$ 9,495	$ 145,144
4		33108 Soilds Collection and Containment	$ 204,718		35.33%	$ 72,322	$ 277,039
5		33109 Liquids/Sediments/Sludges Collection & Contain.	$ 23,458		16.56%	$ 3,884	$ 27,342
6		33110 Drums/Tanks/Structures/Misc. Demo. & Removal	$ 116,254		35.33%	$ 41,070	$ 157,324
7		33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	$ 18,611,973		52.52%	$ 9,774,387	$ 28,386,359.91
8		33120 Site Restoration	$ 1,765,740		56.59%	$ 999,317	$ 2,765,056.36
9		33122 General Requirements	$ 342,656		30.04%	$ 102,923	$ 445,579.00
10			$ -		0.00%	$ -	$ -
11					0.00%	$ -	$ -
12	All Other	**Remaining Construction Items**	$ -	*0.0%*	0.00%	$ -	$ -
13	30 PLANNING, ENGINEERING, AND DESIGN	**Planning, Engineering, & Design**	$ 1,082,469	5.0%	9.04%	$ 97,814	$ 1,180,283
14	31 CONSTRUCTION MANAGEMENT	**Construction Management**	$ 1,082,469	5.0%	21.59%	$ 233,757	$ 1,316,226
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					$ -	

Totals				
Real Estate	$ -	0.00%	$ -	$ -
Total Construction Estimate	$ 21,649,386	51.18%	$ 11,079,857	$ 32,729,243
Total Planning, Engineering & Design	$ 1,082,469	9.04%	$ 97,814	$ 1,180,283
Total Construction Management	$ 1,082,469	21.59%	$ 233,757	$ 1,316,226
Total Excluding Real Estate	**$ 23,814,325**	**48%**	**$ 11,411,427**	**$ 35,225,752**

	Base	50%	80%
Confidence Level Range Estimate ($000's)	$23,814k	$30,661k	$35,226k

* 50% based on base is at 5% CL.

Fixed Dollar Risk Add: (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate.	

NFSS FS BOP & GW OUs Alt 2
Feasibility (Alternatives)
Abbreviated Risk Analysis

Risk Evaluation

WBS	Potential Risk Areas	Project Management & Scope Growth	Acquisition Strategy	Construction Elements	Specialty Construction or Fabrication	Technical Design & Quantities	Cost Estimate Assumptions	External Project Risks	Cost in Thousands
01 LANDS AND DAMAGES	Real Estate								$0
0	33101 Mob & Preparatory Work / 33121 Demobilization	0	0	3	0	0	1	0	$269
0	33102 Monitoring, Sampling, Testing, & Analysis	0	0	2	0	2	2	0	$180
0	33103 Site Work	0	0	0	0	0	0	0	$136
0	33108 Soilds Collection and Containment	0	0	4	0	4	0	0	$205
0	33109 Liquids/Sediments/Sludges Collection & Contain.	0	0	2	0	2	1	0	$23
0	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	0	0	4	0	4	0	0	$116
0	33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	0	0	4	0	4	4	0	$18,612
0	33120 Site Restoration	0	0	3	0	3	5	0	$1,766
0	33122 General Requirements	0	0	3	0	3	3	0	$343
0		0	0	0	0	0	0	0	$0
0		0	0	0	0	0	0	0	$0
All Other	Remaining Construction Items	0	0	0	0	0	0	0	$0
30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	0	0	0	0	0	1	0	$1,082
31 CONSTRUCTION MANAGEMENT	Construction Management	0	0	3	0	3	0	0	$1,082
									$23,814
Risk		$ -	$ -	$ 4,399	$ -	$ 3,130	$ 3,882	$ -	$11,411
Fixed Dollar Risk Allocation		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$0
	Risk	$ -	$ -	$ 4,399	$ -	$ 3,130	$ 3,882	$ -	$11,411
								Total	$35,226

NFSS FS BOP & GW OUs Alt 2

Feasibility (Alternatives)

Abbreviated Risk Analysis

Meeting Date: 16-Oct-17

Risk Level

	Negligible	Marginal	Moderate	Significant	Critical
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Project Management & Scope Growth					Maximum Project Growth	75%
PS-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-2	33102 Monitoring, Sampling, Testing, & Analysis	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-3	33103 Site Work	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-4	33108 Soilds Collection and Containment	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-5	33109 Liquids/Sediments/Sludges Collection & Contain.	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-7	33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-8	33120 Site Restoration	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-9	33122 General Requirements	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-10				Negligible	Unlikely	0
PS-11				Negligible	Unlikely	0
PS-12	Remaining Construction Items			Negligible	Unlikely	0
PS-13	Planning, Engineering, & Design	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-14	Construction Management	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
Acquisition Strategy					Maximum Project Growth	30%

AS-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-2	33102 Monitoring, Sampling, Testing, & Analysis	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-3	33103 Site Work	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-4	33108 Soilds Collection and Containment	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-5	33109 Liquids/Sediments/Sludges Collection & Contain.	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-7	33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-8	33120 Site Restoration	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-9	33122 General Requirements	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-10				Negligible	Unlikely	0
AS-11				Negligible	Unlikely	0
AS-12	Remaining Construction Items			Negligible	Unlikely	0
AS-13	Planning, Engineering, & Design	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-14	Construction Management	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
Construction Elements					**Maximum Project Growth**	**25%**
CON-1	33101 Mob & Preparatory Work / 33121 Demobilization	On-site laboratory may be needed, including ELAP accreditation. Depending on scheduling, may be concurrent with IWCS RA.	Likely significant impact anticipated, dependent upon contract type selected.	Moderate	Likely	3
CE-2	33102 Monitoring, Sampling, Testing, & Analysis	On-site laboratory may be needed, including ELAP accreditation. Depending on scheduling, may be concurrent with IWCS RA.	Costs for on-site laboratory likely to be marginally higher than off-site analysis.	Marginal	Likely	2
CE-3	33103 Site Work	No concers identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
CE-4	33108 Soilds Collection and Containment	Deep excavations require benching/sloping that could cause impacts to site work. Base estiamte did not include benching/sloping.	Potentiial for increased volumes for off-site disposal. Increased water management could cause scjhedule delay.	Moderate	Very LIKELY	4
CE-5	33109 Liquids/Sediments/Sludges Collection & Contain.	Seasonal considerations may impact work and cause greater water management issues. Drainage ditch used by Modern Landfill would need to be diverted.	Standard work, minimal impact anticipated.	Negligible	Very LIKELY	2
CE-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	Concern raised over slab thickness assumptiions.	Actual slab thicknesses/footings may be greater than those assumed in the cost estimate, resulting in increased work required for removal.	Moderate	Very LIKELY	4

CE-7	33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	Assumptions on slab thickness may cause changes to potential volume disposal.	Potentiial for increased volumes for off-site disposal.	Moderate	Very LIKELY	4
CE-8	33120 Site Restoration	Seasonal considerations may impact work and cause greater water management issues.	Standard work, minimal impact anticipated.	Moderate	Likely	3
CE-9	33122 General Requirements	Additional site work duration would cause impacts.	Addittional site work duration would cause impacts.	Moderate	Likely	3
CE-10				Negligible	Unlikely	0
CE-11				Negligible	Unlikely	0
CE-12	Remaining Construction Items			Negligible	Unlikely	0
CE-13	Planning, Engineering, & Design	No concerns identified.	Standard work, minimal impact anticipated.	Marginal	Unlikely	0
CE-14	Construction Management	Additional site work durations would cause impacts.	Additional site work durations would cause impacts.	Moderate	Likely	3
Specialty Construction or Fabrication				**Maximum Project Growth**		**65%**
SC-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-2	33102 Monitoring, Sampling, Testing, & Analysis	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-3	33103 Site Work	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-4	33108 Soilds Collection and Containment	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-5	33109 Liquids/Sediments/Sludges Collection & Contain.	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-7	33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-8	33120 Site Restoration	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-9	33122 General Requirements	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-10				Negligible	Unlikely	0
SC-11				Negligible	Unlikely	0
SC-12	Remaining Construction Items			Negligible	Unlikely	0

SC-13	Planning, Engineering, & Design	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-14	Construction Management	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
Technical Design & Quantities					**Maximum Project Growth**	**30%**
T-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
T-2	33102 Monitoring, Sampling, Testing, & Analysis	Concern raised over effect of additional excavation.	Additional excavation and site work would increase sampling quantities.	Marginal	Likely	2
T-3	33103 Site Work	No concerns identified.	Standard site work, couold cause impacts.	Negligible	Unlikely	0
T-4	33108 Soilds Collection and Containment	Concern raised over potential for deeper excavations.	Benching and sloping for deeper excavations, and chasing contamination off-site would cause impacts.	Moderate	Very LIKELY	4
T-5	33109 Liquids/Sediments/Sludges Collection & Contain.	Concern raised over impact of seasonal considerations (precipitation).	Seasonal considerations may impact work and caused greater water management issues.	Marginal	Likely	2
T-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	Concern raised over slab thickness assumptiions.	Actual slab thicknesses/footings may be greater than those assumed in the cost estimate, resulting in increased work required for removal.	Moderate	Very LIKELY	4
T-7	33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	Concern raised over assumed volumes in cost estimate.	Assumptions in cost estimate lack full volumes associated with benching and sloping, slab volumes, and other additional factors.	Moderate	Very LIKELY	4
T-8	33120 Site Restoration	Concern raised over potential need for additional backfill.	Additional backfill may be required for deeper excavations with benching and sloping and slab removal. Possibility for offset reusing site materials.	Moderate	Likely	3
T-9	33122 General Requirements	Concern raised over schedule impacts of additioanl site work.	Additional site work duration would cauise schedule impacts.	Moderate	Likely	3
T-10				Negligible	Unlikely	0
T-11				Negligible	Unlikely	0
T-12	Remaining Construction Items			Negligible	Unlikely	0
T-13	Planning, Engineering, & Design	No concerns identified.	Minimal impact to design from increased quantities.	Negligible	Unlikely	0
T-14	Construction Management	Concern raised over schedule impacts of increased quantities.	Impacts could be caused from increased quantities and longer duration.	Moderate	Likely	3
Cost Estimate Assumptions					**Maximum Project Growth**	**35%**
EST-1	33101 Mob & Preparatory Work / 33121 Demobilization	Mobilization of on-site laboratory not considered.	Standard mobilization, on-site laboratory could result in additional costs.	Negligible	Likely	1
EST-2	33102 Monitoring, Sampling, Testing, & Analysis	On-site laboratory could result in changes to analysis and packaging/shipping costs.	On-site laboratory could result in different costs.	Marginal	Likely	2
EST-3	33103 Site Work	Revised quantities could result in cost changes.	Many quantities are still uncertain, but assumptions made with regard to cost should not have significant impacts.	Marginal	Unlikely	0

EST-4	33108 Soilds Collection and Containment	Quotes obtained for uncommon cost items. Other cots based on past experience.	Reliable quotes and project experience used to price this feature.	Marginal	Unlikely	0
EST-5	33109 Liquids/Sediments/Sludges Collection & Contain.	Quantity assumptios were made. Refinement of quantities could result in changes to cost.	Uncertainty of quantities and actual implementation of work could result in cost changes.	Negligible	Likely	1
EST-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	Common tasks based on cost book, with adjustments made based on experience.	Common tasks with well-defined quantities. Adjustments made based on experience.	Negligible	Unlikely	0
EST-7	33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	Quotes obtained from industry experts and based on similar nearby projects for some items - should be reliable. Revisions to quantities may result in cost changes. If the method/equipment used for T&D is different than what was assumed for estimating purposes, then significant cost impacts could be incurred.	Quotes are expected to be reliable, however quantity changes could have significant impacts. These impacts are accounted for under Technical Design & Quantities. If the method/equipment used for T&D is different than what was assumed for estimating purposes, then significant cost impacts could be incurred.	Significant	Likely	4
EST-8	33120 Site Restoration	Quotes for materials can be highly variable based on season, vendor, contractor, etc. Quantities are mostly assumed, and may require revisions.	Material quotes can vary, quantities are not certain.	Significant	Very LIKELY	5
EST-9	33122 General Requirements	Durations/overtime assumptions made but can be variable depending on project schedule. Many costs are duration-based, however, and can be significantly impacted by schedule changes.	Schedule can have significant impacts on general requirements.	Marginal	Very LIKELY	3
EST-10				Negligible	Unlikely	0
EST-11				Negligible	Unlikely	0
EST-12	Remaining Construction Items			Negligible	Unlikely	0
EST-13	Planning, Engineering, & Design	Estimate assumes PED will be performed in-house by USACE. $1.5M/year assumption based on past CELRB FUSRAP projects.	PED cost assumption of 5% of construction costs is consistent with assumption of $1.5M/year for USACE in-house S&A and CM costs commonly used in FUSRAP RA cost estimates.	Marginal	Possible	1
EST-14	Construction Management	CUES estimated the labor rates and hours necessary for annual supervision and administration based on past project experience.	Changes to the construction approach are not expected to have a drastic effect on the personnel or amount of hours required to complete the annual supervision and administration tasks.	Negligible	Possible	0
External Project Risks				**Maximum Project Growth**		**40%**
EX-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-2	33102 Monitoring, Sampling, Testing, & Analysis	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-3	33103 Site Work	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-4	33108 Soilds Collection and Containment	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-5	33109 Liquids/Sediments/Sludges Collection & Contain.	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0

EX-7	33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-8	33120 Site Restoration	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-9	33122 General Requirements	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-10				Negligible	Unlikely	0
EX-11				Negligible	Unlikely	0
EX-12	Remaining Construction Items			Negligible	Unlikely	0
EX-13	Planning, Engineering, & Design	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-14	Construction Management	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0

Abbreviated Risk Analysis

NFSS FS BOP & GW OUs

Feasibility (Alternatives)

Alternative 2

Meeting Date: 16-Oct-17

PDT Members

Note: PDT involvement is commensurate with project size and involvement.

Represents	Name
Project Management:	[redacted]
Project Engineer:	
SP-PM Team Leader:	
SP-PM Support	
TD-EH Team Leader:	
Health Physicist:	
Health Physicist:	
RTS:	
Chemist:	
Hydrogeologist:	
Cost Engineering:	
Cost Engineering:	
A-E Project Manager:	
A-E Cost Estimator:	

NFSS FS BOP & GW OUs - ALT 2 CAPITAL COSTS

WBS Number			DESCRIPTION
33XXX			HTRW CONSTRUCTION ACTIVITIES
331XX			HTRW REMEDIAL ACTION (CONSTRUCTION)
01			MOBILIZATION AND PREPARATORY WORK
01	01		MOBILIZATION OF CONSTRUCTION EQUIPMENT AND FACILITIES
01	01	90	SITE FACILITIES
01	01	91	OFFICE TRAILERS
01	01	92	TOILETS
01	01	93	STORAGE FACILITIES
01	01	91	CONSTRUCTION EQUIPMENT
01	03		SUBMITTALS/IMPLEMENTATION PLANS
01	04		SETUP/CONSTRUCT TEMPORARY FACILITIES
01	04	11	BARRICADES
01	04	30	EROSION CONTROL
01	04	91	TEMPORARY STAGING AREAS
01	05		CONSTRUCT TEMPORARY UTILITIES
01	05	02	POWER CONNECTION/DISTRIBUTION
02			MONITORING, SAMPLING, TESTING, AND ANALYSIS
02	02		RADIATION MONITORING
02	02	01	AREA MONITORING
02	03		AIR MONITORING AND SAMPLING
02	03	01	CAMP
02	05		SAMPLING SURFACE WATER/GROUNDWATER/LIQUID WASTE
02	05	05	SAMPLE SHIPPING AND HANDLING
02	06		SAMPLING SOIL AND SEDIMENT
02	06	04	SAMPLE SHIPPING AND HANDLING
02	08		SAMPLING RADIOACTIVE CONTAMINATED MEDIA
02	08	08	SAMPLE SHIPPING AND HANDLING
02	09		LABORATORY CHEMICAL ANALYSIS
02	09	02	GENERAL WATER QUALITY AND WASTEWATER ANALYSIS
02	09	07	SOIL AND SEDIMENT ANALYSIS
02	09	91	CONTAMINATED CONCRETE ANALYSIS
03			SITEWORK
03	01		DEMOLITION (and Removal of Asphalt Roadways)
03	01	90	SAW-CUT ASPHALT ROADWAY
03	01	91	ASPHALT ROAD REMOVAL
03	02		CLEARING AND GRUBBING
03	02	90	TREE REMOVAL AND DISPOSAL
03	02	91	BRUSH CLEARING AND DISPOSAL
03	93		SURVEY
08			SOLIDS COLLECTION AND CONTAINMENT
08	01		CONTAMINATED SOIL COLLECTION
08	01	02	EXCAVATION
08	01	03	HAULING
08	01	04	STOCKPILING
09			LIQUIDS/SEDIMENTS/SLUDGES/COLLECTION AND CONTAINMENT
09	03		WASTE CONTAINMENT, PORTABLE (FURNISH/FILL)
09	03	01	BULK LIQUID CONTAINERS/ROLL-OFFS
09	06		PUMPING/DRAINING/COLLECTION
09	06	03	COLLECTION (Dewatering)
10			DRUMS/TANKS/STRUCTURES/MISCELLANEOUS DEMOLITION AND REMOVAL
10	03		STRUCTURE REMOVAL (Building 401 Slab)
10	03	02	DEMOLITION
10	03	90	EXCAVATION, HAULING, STOCKPILING AND TRANSPORT OFF-SITE
10	91		STRUCTURE REMOVAL (Tank Foundations)
10	03	90	EXCAVATION, HAULING, STOCKPILING AND TRANSPORT OFF-SITE
18			TRANSPORT and DISPOSAL - Radiological
19			TRANSPORT and DISPOSAL - Non-Radiological
19	90		Transport and Disposal - Non-Contaminaated
19	91		Transport and Disposal - VOC-Contaminated Soil and Debris
19	92		Transport and Disposal - Water
20			SITE RESTORATION
20	01		EARTHWORK
20	01	03	BACKFILL
20	01	04	BORROW
20	01	07	GRADING
20	01	08	COMPACTION
20	01	13	STOCKPILING
20	01	14	TOPSOIL
20	03		PERMANENT FEATURES
20	03	01	ROAD REPLACEMENT
20	04		REVEGETATION AND PLANTING
20	04	01	SEEDING/MULCH/FERTILIZER
21			DEMOBILIZATION
21	01		DEMOBILIZATION OF CONSTRUCTION EQUIPMENT AND FACILITIES
01	01	90	SITE FACILITIES
01	01	91	OFFICE TRAILERS
01	01	92	TOILETS
01	01	93	STORAGE FACILITIES
01	01	91	CONSTRUCTION EQUIPMENT
21	02		REMOVAL OF TEMPORARY UTILITIES
01	05	02	POWER CONNECTION/DISTRIBUTION
01	04		DECONSTRUCT/REMOVE TEMP FACILITIES
01	04	30	EROSION CONTROL
22			GENERAL REQUIREMENTS
22	07		HEALTH & SAFETY
22	07	02	RADIATION PROTECTION TECHNOLOGIST (RPT)
22	07	07	SITE SAFETY & HEALTH OFFICER
22	07	16	PERSONAL PROTECTION EQUIPMENT
22	10		PROJECT UTILITIES
22	10	02	ELECTRICAL USAGE
22	08		TEMPORARY CONSTRUCTION FACILITIES - OWNERSHIP
22	08	01	OFFICE TRAILERS AND FACILITIES
22	08	02	OFFICE FURNITURE AND OFFICE EQUIPMENT
22	08	03	WAREHOUSE AND STORAGE TRAILERS AND FACILITIES
22	08	08	CONSTRUCTION PORTABLE TOILETS
22	08	11	DECONTAMINATION FACILITIES FOR PERSONNEL
22	08	12	DECONTAMINATION FACILITIES FOR CONSTRUCTION EQUIPMENT AND VEHICLES

Abbreviated Risk Analysis

Project (less than $40M): **NFSS FS BOP & GW OUs**

Project Development Stage/Alternative: **Feasibility (Alternatives)**

Risk Category: **Moderate Risk: Typical Project Construction Type**

Alternative: **Alt 3**

Meeting Date: **16-Oct-17**

Total Estimated Construction Contract Cost = $ 15,961,395

	CWWBS	Feature of Work	Contract Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ -		0.00%	$ -	$ -
1		33101 Mob & Preparatory Work / 33121 Demobilization	$ 268,851		15.93%	$ 42,841	$ 311,691
2		33102 Monitoring, Sampling, Testing, & Analysis	$ 180,088		18.67%	$ 33,619	$ 213,707
3		33103 Site Work	$ 135,649		7.00%	$ 9,495	$ 145,144
4		33108 Soilds Collection and Containment	$ 204,718		35.33%	$ 72,322	$ 277,039
5		33109 Liquids/Sediments/Sludges Collection & Contain.	$ 23,458		16.56%	$ 3,884	$ 27,342
6		33110 Drums/Tanks/Structures/Misc. Demo. & Removal	$ 38,783		21.59%	$ 8,375	$ 47,158
7		33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	$ 13,003,096		38.78%	$ 5,043,112	$ 18,046,208 07
8		33120 Site Restoration	$ 1,712,114		56.59%	$ 968,967	$ 2,681,080.95
9		33122 General Requirements	$ 342,656		30.04%	$ 102,923	$ 445,579.00
10		33190 Decon	$ 51,983		11.15%	$ 5,794	$ 57,777 37
11					0.00%	$ -	$ -
12	All Other	**Remaining Construction Items**	$ -	*0.0%*	0.00%	$ -	$ -
13	30 PLANNING, ENGINEERING, AND DESIGN	**Planning, Engineering, & Design**	$ 798,070	5.0%	9.04%	$ 72,115	$ 870,185
14	31 CONSTRUCTION MANAGEMENT	**Construction Management**	$ 798,070	5.0%	21.59%	$ 172,341	$ 970,411
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					$ -	

Totals	Contract Cost	% Contingency	$ Contingency	Total
Real Estate	$ -	0.00%	$ -	$ -
Total Construction Estimate	$ 15,961,395	39.42%	$ 6,291,332	$ 22,252,727
Total Planning, Engineering & Design	$ 798,070	9.04%	$ 72,115	$ 870,185
Total Construction Management	$ 798,070	21.59%	$ 172,341	$ 970,411
Total Excluding Real Estate	**$ 17,557,535**	**37%**	**$ 6,535,788**	**$ 24,093,323**

	Base	50%	80%
Confidence Level Range Estimate ($000's)	$17,558k	$21,479k	$24,093k

* 50% based on base is at 5% CL.

Fixed Dollar Risk Add: (Allows for additional risk to be added to he risk analsyis. Must include justification. Does not allocate to Real Estate.	

NFSS FS BOP & GW OUs Alt 3
Feasibility (Alternatives)
Abbreviated Risk Analysis

Risk Evaluation

WBS	Potential Risk Areas	Project Management & Scope Growth	Acquisition Strategy	Construction Elements	Specialty Construction or Fabrication	Technical Design & Quantities	Cost Estimate Assumptions	External Project Risks	Cost in Thousands
01 LANDS AND DAMAGES	Real Estate								$0
0	33101 Mob & Preparatory Work / 33121 Demobilization	0	0	3	0	0	1	0	$269
0	33102 Monitoring, Sampling, Testing, & Analysis	0	0	2	0	2	2	0	$180
0	33103 Site Work	0	0	0	0	0	0	0	$136
0	33108 Soilds Collection and Containment	0	0	4	0	4	0	0	$205
0	33109 Liquids/Sediments/Sludges Collection & Contain.	0	0	2	0	2	1	0	$23
0	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	0	0	3	0	3	0	0	$39
0	33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	0	0	3	0	3	4	0	$13,003
0	33120 Site Restoration	0	0	3	0	3	5	0	$1,712
0	33122 General Requirements	0	0	3	0	3	3	0	$343
0	33190 Decon	0	0	0	0	0	2	0	$52
0		0	0	0	0	0	0	0	$0
All Other	Remaining Construction Items	0	0	0	0	0	0	0	$0
30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	0	0	0	0	0	1	0	$798
31 CONSTRUCTION MANAGEMENT	Construction Management	0	0	3	0	3	0	0	$798
									$17,558
Risk		$ -	$ -	$ 2,378	$ -	$ 1,262	$ 2,895	$ -	$6,536
Fixed Dollar Risk Allocation		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$0
	Risk	$ -	$ -	$ 2,378	$ -	$ 1,262	$ 2,895	$ -	$6,536
								Total	$24,093

NFSS FS BOP & GW OUs Alt 3

Feasibility (Alternatives)
Abbreviated Risk Analysis
Meeting Date: 16-Oct-17

Risk Level

	Negligible	Marginal	Moderate	Significant	Critical
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Project Management & Scope Growth					Maximum Project Growth	75%
PS-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-2	33102 Monitoring, Sampling, Testing, & Analysis	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-3	33103 Site Work	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-4	33108 Soilds Collection and Containment	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-5	33109 Liquids/Sediments/Sludges Collection & Contain.	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-7	33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-8	33120 Site Restoration	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-9	33122 General Requirements	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-10	33190 Decon	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-11				Negligible	Unlikely	0
PS-12	Remaining Construction Items			Negligible	Unlikely	0
PS-13	Planning, Engineering, & Design	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-14	Construction Management	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
Acquisition Strategy					Maximum Project Growth	30%

AS-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-2	33102 Monitoring, Sampling, Testing, & Analysis	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-3	33103 Site Work	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-4	33108 Soilds Collection and Containment	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-5	33109 Liquids/Sediments/Sludges Collection & Contain.	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-7	33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-8	33120 Site Restoration	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-9	33122 General Requirements	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-10	33190 Decon	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-11				Negligible	Unlikely	0
AS-12	Remaining Construction Items			Negligible	Unlikely	0
AS-13	Planning, Engineering, & Design	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-14	Construction Management	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
Construction Elements				**Maximum Project Growth**		**25%**
CON-1	33101 Mob & Preparatory Work / 33121 Demobilization	On-site laboratory may be needed, including ELAP accreditation. Depending on scheduling, may be concurrent with IWCS RA.	Likely significant impact anticipated, dependent upon contract type selected.	Moderate	Likely	3
CE-2	33102 Monitoring, Sampling, Testing, & Analysis	On-site laboratory may be needed, including ELAP accreditation. Depending on scheduling, may be concurrent with IWCS RA.	Costs for on-site laboratory likely to be marginally higher than off-site analysis.	Marginal	Likely	2
CE-3	33103 Site Work	No concers identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
CE-4	33108 Soilds Collection and Containment	Deep excavations require benching/sloping that could cause impacts to site work. Base estiamte did not include benching/sloping.	Potentiial for increased volumes for off-site disposal. Increased water management could cause scjhedule delay.	Moderate	Very LIKELY	4
CE-5	33109 Liquids/Sediments/Sludges Collection & Contain.	Seasonal considerations may impact work and cause greater water management issues. Drainage ditch used by Modern Landfill would need to be diverted.	Standard work, minimal impact anticipated.	Negligible	Very LIKELY	2
CE-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	Concern raised over slab thickness assumptiions.	Actual slab thicknesses/footings may be greater than those assumed in the cost estimate, resulting in increased work required for removal.	Marginal	Very LIKELY	3

CE-7	33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	Assumptions on slab thickness may cause changes to potential volume disposal.	Potential for increased volumes for off-site disposal.	Marginal	Very LIKELY	3
CE-8	33120 Site Restoration	Seasonal considerations may impact work and cause greater water management issues.	Standard work, minimal impact anticipated.	Moderate	Likely	3
CE-9	33122 General Requirements	No concerns identified.	Standard work, minimal impact anticipated.	Moderate	Likely	3
CE-10	33190 Decon	No concerns identified.	Standard work, minimal impact anticipated.	Marginal	Unlikely	0
CE-11				Negligible	Unlikely	0
CE-12	Remaining Construction Items			Negligible	Unlikely	0
CE-13	Planning, Engineering, & Design	No concerns identified.	Minimal impact to design from increased quantities.	Negligible	Unlikely	0
CE-14	Construction Management	Additional site work durations would cause impacts.	Additional site work duration would cauise schedule impacts.	Moderate	Likely	3
Specialty Construction or Fabrication					**Maximum Project Growth**	**65%**
SC-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-2	33102 Monitoring, Sampling, Testing, & Analysis	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-3	33103 Site Work	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-4	33108 Soilds Collection and Containment	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-5	33109 Liquids/Sediments/Sludges Collection & Contain.	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-7	33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-8	33120 Site Restoration	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-9	33122 General Requirements	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-10	33190 Decon	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-11				Negligible	Unlikely	0
SC-12	Remaining Construction Items			Negligible	Unlikely	0

SC-13	Planning, Engineering, & Design	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
SC-14	Construction Management	No concerns identified.	No anticipated need for specialty construction or fabrication.	Marginal	Unlikely	0
Technical Design & Quantities					Maximum Project Growth	30%
T-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
T-2	33102 Monitoring, Sampling, Testing, & Analysis	Concern raised over effect of additional excavation.	Additional excavation and site work would increase sampling quantities.	Marginal	Likely	2
T-3	33103 Site Work	No concerns identified.	Standard site work, couold cause impacts.	Negligible	Unlikely	0
T-4	33108 Soilds Collection and Containment	Concern raised over potential for deeper excavations.	Benching and sloping for deeper excavations, and chasing contamination off-site would cause impacts.	Moderate	Very LIKELY	4
T-5	33109 Liquids/Sediments/Sludges Collection & Contain.	Concern raised over impact of seasonal considerations (precipitation).	Seasonal considerations may impact work and caused greater water management issues.	Marginal	Likely	2
T-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	Concern raised over slab thickness assumptiions.	Actual slab thicknesses/footings may be greater than those assumed in the cost estimate, resulting in increased work required for removal.	Marginal	Very LIKELY	3
T-7	33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	Concern raised over assumed volumes in cost estimate.	Assumptions in cost estimate lack full volumes associated with benching and sloping, slab volumes, and other additional factors.	Marginal	Very LIKELY	3
T-8	33120 Site Restoration	Concern raised over potential need for additional backfill.	Additional backfill may be required for deeper excavations with benching and sloping and slab removal. Possibility for offset reusing site materials.	Moderate	Likely	3
T-9	33122 General Requirements	Concern raised over schedule impacts of additioanl site work.	Additional site work duration would cauise schedule impacts.	Moderate	Likely	3
T-10	33190 Decon	No concerns identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
T-11				Negligible	Unlikely	0
T-12	Remaining Construction Items			Negligible	Unlikely	0
T-13	Planning, Engineering, & Design	No concerns identified.	Minimal impact to design from increased quantities.	Negligible	Unlikely	0
T-14	Construction Management	Concern raised over schedule impacts of increased quantities.	Impacts could be caused from increased quantities and longer duration.	Moderate	Likely	3
Cost Estimate Assumptions					Maximum Project Growth	35%
EST-1	33101 Mob & Preparatory Work / 33121 Demobilization	Mobilization of on-site laboratory not considered.	Standard mobilization, on-site laboratory could result in additional costs.	Negligible	Likely	1
EST-2	33102 Monitoring, Sampling, Testing, & Analysis	On-site laboratory could result in changes to analysis and packaging/shipping costs.	On-site laboratory could result in different costs.	Marginal	Likely	2
EST-3	33103 Site Work	Revised quantities could result in cost changes.	Many quantities are still uncertain, but assumptions made with regard to cost should not have significant impacts.	Marginal	Unlikely	0

EST-4	33108 Soilds Collection and Containment	Quotes obtained for uncommon cost items. Other cots based on past experience.	Reliable quotes and project experience used to price this feature.	Marginal	Unlikely	0
EST-5	33109 Liquids/Sediments/Sludges Collection & Contain.	Quantity assumptios were made. Refinement of quantities could result in changes to cost.	Uncertainty of quantities and actual implementation of work could result in cost changes.	Negligible	Likely	1
EST-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	Common tasks based on cost book, with adjustments made based on experience.	Common tasks with well-defined quantities. Adjustments made based on experience.	Negligible	Unlikely	0
EST-7	33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	Quotes obtained from industry experts and based on similar nearby projects for some items - should be reliable. Revisions to quantities may result in cost changes. If the method/equipment used for T&D is different than what was assumed for estimating purposes, then significant cost impacts could be incurred.	Quotes are expected to be reliable, however quantity changes could have significant impacts. These impacts are accounted for under Technical Design & Quantities. If the method/equipment used for T&D is different than what was assumed for estimating purposes, then significant cost impacts could be incurred.	Significant	Likely	4
EST-8	33120 Site Restoration	Quotes for materials can be highly variable based on season, vendor, contractor, etc. Quantities are mostly assumed, and may require revisions.	Material quotes can vary, quantities are not certain.	Significant	Very LIKELY	5
EST-9	33122 General Requirements	Durations/overtime assumptions made but can be variable depending on project schedule. Many costs are duration-based, however, and can be significantly impacted by schedule changes.	Schedule can have significant impacts on general requirements.	Marginal	Very LIKELY	3
EST-10	33190 Decon	Only quote obtained is for concrete shaver purchase. Uncommon work item, productivity was assumed. No critical cost items. However, quantities and productivity were assumed.	This work feature is not a significant cost relative to the project, however there is uncertainty in the quantity and production rates.	Marginal	Likely	2
EST-11				Negligible	Unlikely	0
EST-12	Remaining Construction Items			Negligible	Unlikely	0
EST-13	Planning, Engineering, & Design	Estimate assumes PED will be performed in-house by USACE. \$1.5M/year assumption based on past CELRB FUSRAP projects.	PED cost assumption of 5% of construction costs is consistent with assumption of \$1.5M/year for USACE in-house S&A and CM costs commonly used in FUSRAP RA cost estimates.	Marginal	Possible	1
EST-14	Construction Management	CUES estimated the labor rates and hours necessary for annual supervision and administration based on past project experience.	Changes to the construction approach are not expected to have a drastic effect on the personnel or amount of hours required to complete the annual supervision and administration tasks.	Negligible	Possible	0
External Project Risks					**Maximum Project Growth**	**40%**
EX-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-2	33102 Monitoring, Sampling, Testing, & Analysis	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-3	33103 Site Work	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-4	33108 Soilds Collection and Containment	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-5	33109 Liquids/Sediments/Sludges Collection & Contain.	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0

EX-7	33118 T & D (Radiological) / 33119 T & D (Non-Radiological)	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-8	33120 Site Restoration	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-9	33122 General Requirements	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-10	33190 Decon	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-11				Negligible	Unlikely	0
EX-12	Remaining Construction Items			Negligible	Unlikely	0
EX-13	Planning, Engineering, & Design	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-14	Construction Management	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0

Abbreviated Risk Analysis

NFSS FS BOP & GW OUs

Feasibility (Alternatives)

Alternative 3

Meeting Date: 16-Oct-17

PDT Members

Note: PDT involvement is commensurate with project size and involvement.

Represents	Name
Project Management:	[redacted]
Project Engineer:	
SP-PM Team Leader:	
SP-PM Support	
TD-EH Team Leader:	
Health Physicist:	
Health Physicist:	
RTS:	
Chemist:	
Hydrogeologist:	
Cost Engineering:	
Cost Engineering:	
A-E Project Manager:	
A-E Cost Estimator:	

NFSS FS BOP & GW OUs - ALT 3 CAPITAL COSTS

WBS Number			DESCRIPTION
33XXX			HTRW CONSTRUCTION ACTIVITIES
331XX			HTRW REMEDIAL ACTION (CONSTRUCTION)
01			MOBILIZATION AND PREPARATORY WORK
01	01		MOBILIZATION OF CONSTRUCTION EQUIPMENT AND FACILITIES
01	01	90	SITE FACILITIES
01	01	91	OFFICE TRAILERS
01	01	92	TOILETS
01	01	93	STORAGE FACILITIES
01	01	91	CONSTRUCTION EQUIPMENT
01	03		SUBMITTALS/IMPLEMENTATION PLANS
01	04		SETUP/CONSTRUCT TEMPORARY FACILITIES
01	04	11	BARRICADES
01	04	30	EROSION CONTROL
01	04	91	TEMPORARY STAGING AREAS
01	05		CONSTRUCT TEMPORARY UTILITIES
01	05	02	POWER CONNECTION/DISTRIBUTION
02			MONITORING, SAMPLING, TESTING, AND ANALYSIS
02	02		RADIATION MONITORING
02	02	01	AREA MONITORING
02	03		AIR MONITORING AND SAMPLING
02	03	01	CAMP
02	05		SAMPLING SURFACE WATER/GROUNDWATER/LIQUID WASTE
02	05	05	SAMPLE SHIPPING AND HANDLING
02	06		SAMPLING SOIL AND SEDIMENT
02	06	04	SAMPLE SHIPPING AND HANDLING
02	08		SAMPLING RADIOACTIVE CONTAMINATED MEDIA
02	08	08	SAMPLE SHIPPING AND HANDLING
02	09		LABORATORY CHEMICAL ANALYSIS
02	09	02	GENERAL WATER QUALITY AND WASTEWATER ANALYSIS
02	09	07	SOIL AND SEDIMENT ANALYSIS
02	09	91	CONTAMINATED CONCRETE ANALYSIS
03			SITEWORK
03	01		DEMOLITION (and Removal of Asphalt Roadways)
03	01	90	SAW-CUT ASPHALT ROADWAY
03	01	91	ASPHALT ROAD REMOVAL
03	02		CLEARING AND GRUBBING
03	02	90	TREE REMOVAL AND DISPOSAL
03	02	91	BRUSH CLEARING AND DISPOSAL
03	93		SURVEY
08			SOLIDS COLLECTION AND CONTAINMENT
08	01		CONTAMINATED SOIL COLLECTION
08	01	02	EXCAVATION
08	01	03	HAULING
08	01	04	STOCKPILING
09			LIQUIDS/SEDIMENTS/SLUDGES/COLLECTION AND CONTAINMENT
09	03		WASTE CONTAINMENT, PORTABLE (FURNISH/FILL)
09	03	01	BULK LIQUID CONTAINERS/ROLL-OFFS
09	06		PUMPING/DRAINING/COLLECTION
09	06	03	COLLECTION (Dewatering)
10			DRUMS/TANKS/STRUCTURES/MISCELLANEOUS DEMOLITION AND REMOVAL
10	03		STRUCTURE REMOVAL (Building 401 Slab)
10	03	02	DEMOLITION
10	03	90	EXCAVATION, HAULING, STOCKPILING AND TRANSPORT OFF-SITE
10	91		STRUCTURE REMOVAL (Tank Foundations)
10	03	90	EXCAVATION, HAULING, STOCKPILING AND TRANSPORT OFF-SITE
18			TRANSPORT and DISPOSAL - Radiological
19			TRANSPORT and DISPOSAL - Non-Radiological
19	90		Transport and Disposal - Non-Contaminaated
19	91		Transport and Disposal - VOC-Contaminated Soil and Debris
19	92		Transport and Disposal - Water
20			SITE RESTORATION
20	01		EARTHWORK
20	01	03	BACKFILL
20	01	04	BORROW
20	01	07	GRADING
20	01	08	COMPACTION
20	01	13	STOCKPILING
20	01	14	TOPSOIL
20	03		PERMANENT FEATURES
20	03	01	ROAD REPLACEMENT
20	04		REVEGETATION AND PLANTING
20	04	01	SEEDING/MULCH/FERTILIZER
21			DEMOBILIZATION
21	01		DEMOBILIZATION OF CONSTRUCTION EQUIPMENT AND FACILITIES
01	01	90	SITE FACILITIES
01	01	91	OFFICE TRAILERS
01	01	92	TOILETS
01	01	93	STORAGE FACILITIES
01	01	91	CONSTRUCTION EQUIPMENT
21	02		REMOVAL OF TEMPORARY UTILITIES
01	05	02	POWER CONNECTION/DISTRIBUTION
01	04		DECONSTRUCT/REMOVE TEMP FACILITIES
01	04	30	EROSION CONTROL
22			GENERAL REQUIREMENTS
22	07		HEALTH & SAFETY
22	07	02	RADIATION PROTECTION TECHNOLOGIST (RPT)
22	07	07	SITE SAFETY & HEALTH OFFICER
22	07	16	PERSONAL PROTECTION EQUIPMENT
22	10		PROJECT UTILITIES
22	10	02	ELECTRICAL USAGE
22	08		TEMPORARY CONSTRUCTION FACILITIES - OWNERSHIP
22	08	01	OFFICE TRAILERS AND FACILITIES
22	08	02	OFFICE FURNITURE AND OFFICE EQUIPMENT
22	08	03	WAREHOUSE AND STORAGE TRAILERS AND FACILITIES
22	08	08	CONSTRUCTION PORTABLE TOILETS
22	08	11	DECONTAMINATION FACILITIES FOR PERSONNEL
22	08	12	DECONTAMINATION FACILITIES FOR CONSTRUCTION EQUIPMENT AND VEHICLES
90			DECON

Abbreviated Risk Analysis

Project (less than $40M): **NFSS FS BOP & GW OUs**

Alternative: **Alt 4**

Project Development Stage/Alternative: **Feasibility (Alternatives)**

Risk Category: **Moderate Risk: Typical Project Construction Type**

Meeting Date: **16-Oct-17**

Total Estimated Construction Contract Cost = $ 15,618,330

	CWWBS	Feature of Work	Contract Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ -		0.00%	$ -	$ -
1		33101 Mob & Preparatory Work / 33121 Demobilization	$ 268,851		15.93%	$ 42,841	$ 311,691
2		33102 Monitoring, Sampling, Testing, & Analysis	$ 183,566		18.67%	$ 34,268	$ 217,835
3		33103 Site Work	$ 135,649		7.00%	$ 9,495	$ 145,144
4		33108 Soilds Collection and Containment	$ 117,330		21.59%	$ 25,337	$ 142,667
5		33109 Liquids/Sediments/Sludges Collection & Contain.	$ 23,458		16.56%	$ 3,884	$ 27,342
6		33110 Drums/Tanks/Structures/Misc. Demo. & Removal	$ 28,427		14.52%	$ 4,128	$ 32,556
7		33114 Thermal Treatment (In-Situ)	$ 1,105,814		23.98%	$ 265,161	$ 1,370,975.12
8		33118 T & D - Radiological / 33119 T & D - Non-Radiological	$ 11,833,399		31.71%	$ 3,752,502	$ 15,585,900.79
9		33120 Site Restoration	$ 1,527,197		52.80%	$ 806,310	$ 2,333,506.44
10		33122 General Requirements	$ 342,656		30.04%	$ 102,923	$ 445,579.00
11		33190 Decon	$ 51,983		11.15%	$ 5,794	$ 57,777.37
12	All Other	Remaining Construction Items	$ -	0.0%	0.00%	$ -	$ -
13	30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	$ 780,917	5.0%	9.04%	$ 70,565	$ 851,481
14	31 CONSTRUCTION MANAGEMENT	Construction Management	$ 780,917	5.0%	21.59%	$ 168,637	$ 949,554
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					$ -	

Totals	Contract Cost	% Contingency	$ Contingency	Total
Real Estate	$ -	0.00%	$ -	$ -
Total Construc ion Estimate	$ 15,618,330	32.35%	$ 5,052,643	$ 20,670,974
Total Planning, Engineering & Design	$ 780,917	9.04%	$ 70,565	$ 851,481
Total Construction Management	$ 780,917	21.59%	$ 168,637	$ 949,554
Total Excluding Real Estate	**$ 17,180,163**	**31%**	**$ 5,291,845**	**$ 22,472,009**

	Base	50%	80%
Confidence Level Range Estimate ($000's)	$17,180k	$20,355k	$22,472k

* 50% based on base is at 5% CL.

Fixed Dollar Risk Add: (Allows for additional risk to be added to the risk analsyis. Must include jus ification. Does not allocate to Real Estate.	

NFSS FS BOP & GW OUs Alt 4
Feasibility (Alternatives)
Abbreviated Risk Analysis

Risk Evaluation

WBS	Potential Risk Areas	Project Management & Scope Growth	Acquisition Strategy	Construction Elements	Specialty Construction or Fabrication	Technical Design & Quantities	Cost Estimate Assumptions	External Project Risks	Cost in Thousands
01 LANDS AND DAMAGES	Real Estate								$0
0	33101 Mob & Preparatory Work / 33121 Demobilization	0	0	3	0	0	1	0	$269
0	33102 Monitoring, Sampling, Testing, & Analysis	0	0	2	0	2	2	0	$184
0	33103 Site Work	0	0	0	0	0	0	0	$136
0	33108 Soilds Collection and Containment	0	0	3	0	3	0	0	$117
0	33109 Liquids/Sediments/Sludges Collection & Contain.	0	0	2	0	2	1	0	$23
0	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	0	0	2	0	2	0	0	$28
0	33114 Thermal Treatment (In-Situ)	0	0	2	2	2	2	0	$1,106
0	33118 T & D - Radiological / 33119 T & D - Non-Radiological	0	0	2	0	2	4	0	$11,833
0	33120 Site Restoration	0	0	3	0	2	5	0	$1,527
0	33122 General Requirements	0	0	3	0	3	3	0	$343
0	33190 Decon	0	0	0	0	0	2	0	$52
All Other	Remaining Construction Items	0	0	0	0	0	0	0	$0
30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	0	0	0	0	0	1	0	$781
31 CONSTRUCTION MANAGEMENT	Construction Management	0	0	3	0	3	0	0	$781
									$17,180
Risk		$ -	$ -	$ 1,890	$ 59	$ 669	$ 2,675	$ -	$5,292
Fixed Dollar Risk Allocation		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$0
	Risk	$ -	$ -	$ 1,890	$ 59	$ 669	$ 2,675	$ -	$5,292
								Total	$22,472

NFSS FS BOP & GW OUs Alt 4

Feasibility (Alternatives)

Abbreviated Risk Analysis

Meeting Date: 16-Oct-17

Risk Level

	Negligible	Marginal	Moderate	Significant	Critical
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Project Management & Scope Growth					**Maximum Project Growth**	**75%**
PS-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-2	33102 Monitoring, Sampling, Testing, & Analysis	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-3	33103 Site Work	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-4	33108 Soilds Collection and Containment	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-5	33109 Liquids/Sediments/Sludges Collection & Contain.	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-7	33114 Thermal Treatment (In-Situ)	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-8	33118 T & D - Radiological / 33119 T & D - Non-Radiological	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-9	33120 Site Restoration	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-10	33122 General Requirements	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-11	33190 Decon	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-12	Remaining Construction Items			Negligible	Unlikely	0
PS-13	Planning, Engineering, & Design	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-14	Construction Management	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
Acquisition Strategy					**Maximum Project Growth**	**30%**

AS-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-2	33102 Monitoring, Sampling, Testing, & Analysis	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-3	33103 Site Work	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-4	33108 Soilds Collection and Containment	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-5	33109 Liquids/Sediments/Sludges Collection & Contain.	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-7	33114 Thermal Treatment (In-Situ)	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-8	33118 T & D - Radiological / 33119 T & D - Non-Radiological	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-9	33120 Site Restoration	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-10	33122 General Requirements	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-11	33190 Decon	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-12	Remaining Construction Items			Negligible	Unlikely	0
AS-13	Planning, Engineering, & Design	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-14	Construction Management	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
Construction Elements				**Maximum Project Growth**		**25%**
CON-1	33101 Mob & Preparatory Work / 33121 Demobilization	On-site laboratory may be needed, including ELAP accreditation. Depending on scheduling, may be concurrent with IWCS RA.	Likely significant impact anticipated, dependent upon contract type selected.	Moderate	Likely	3
CE-2	33102 Monitoring, Sampling, Testing, & Analysis	On-site laboratory may be needed, including ELAP accreditation. Depending on scheduling, may be concurrent with IWCS RA.	Costs for on-site laboratory likely to be marginally higher than off-site analysis.	Marginal	Likely	2
CE-3	33103 Site Work	No concers identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
CE-4	33108 Soilds Collection and Containment	Deep excavations require benching/sloping that could cause impacts to site work. Base estiamte did not include benching/sloping.	Potentiial for increased volumes for off-site disposal. Increased water management could cause scjhedule delay.	Marginal	Very LIKELY	3
CE-5	33109 Liquids/Sediments/Sludges Collection & Contain.	Seasonal considerations may impact work and cause greater water management issues. Drainage ditch used by Modern Landfill would need to be diverted.	Standard work, minimal impact anticipated.	Negligible	Very LIKELY	2
CE-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	Concern raised over slab thickness assumptiions.	Actual slab thicknesses/footings may be greater than those assumed in the cost estimate, resulting in increased work required for removal.	Marginal	Likely	2
CE-7	33114 Thermal Treatment (In-Situ)	Concern raised over duration of in-situ thermal treatment.	In-situ thermal treatment is well established technology. Treatment time may vary significantly from assumptions.	Moderate	Possible	2

CE-8	33118 T & D - Radiological / 33119 T & D - Non-Radiological	Assumptions on slab thickness may cause changes to potential volume disposal.	Potential for increased volumes for off-site disposal.	Marginal	Likely	2
CE-9	33120 Site Restoration	Seasonal considerations may impact work and cause greater water management issues.	Standard work, minimal impact anticipated.	Moderate	Likely	3
CE-10	33122 General Requirements	No concerns identified.	Standard work, minimal impact anticipated.	Moderate	Likely	3
CE-11	33190 Decon	No concerns identified.	Standard work, minimal impact anticipated.	Marginal	Unlikely	0
CE-12	Remaining Construction Items			Negligible	Unlikely	0
CE-13	Planning, Engineering, & Design	No concerns identified.	Minimal impact to design from increased quantities.	Marginal	Unlikely	0
CE-14	Construction Management	Additional site work durations would cause impacts.	Additional site work duration would cause schedule impacts.	Moderate	Likely	3
Specialty Construction or Fabrication				**Maximum Project Growth**		**65%**
SC-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-2	33102 Monitoring, Sampling, Testing, & Analysis	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-3	33103 Site Work	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-4	33108 Soilds Collection and Containment	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-5	33109 Liquids/Sediments/Sludges Collection & Contain.	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-7	33114 Thermal Treatment (In-Situ)	Concern raised over duration of in-situ thermal treatment.	In-situ thermal treatment is well established technology. Treatment time may vary significantly from assumptions.	Moderate	Possible	2
SC-8	33118 T & D - Radiological / 33119 T & D - Non-Radiological	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-9	33120 Site Restoration	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-10	33122 General Requirements	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-11	33190 Decon	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-12	Remaining Construction Items			Negligible	Unlikely	0
SC-13	Planning, Engineering, & Design	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-14	Construction Management	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0

Technical Design & Quantities

Maximum Project Growth **30%**

T-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
T-2	33102 Monitoring, Sampling, Testing, & Analysis	Concern raised over effect of additional excavation.	Additional excavation and site work would increase sampling quantities.	Marginal	Likely	2
T-3	33103 Site Work	No concerns identified.	Standard site work, couold cause impacts.	Negligible	Unlikely	0
T-4	33108 Soilds Collection and Containment	Concern raised over potential for deeper excavations.	Benching and sloping for deeper excavations, and chasing contamination off-site would cause impacts.	Marginal	Very LIKELY	3
T-5	33109 Liquids/Sediments/Sludges Collection & Contain.	Concern raised over impact of seasonal considerations (precipitation).	Seasonal considerations may impact work and caused greater water management issues.	Marginal	Likely	2
T-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	Concern raised over slab thickness assumptiions.	Actual slab thicknesses/footings may be greater than those assumed in the cost estimate, resulting in increased work required for removal.	Marginal	Likely	2
T-7	33114 Thermal Treatment (In-Situ)	Concern raised over duration of in-situ thermal treatment.	In-situ thermal treatment is well established technology. Treatment time may vary significantly from assumptions.	Moderate	Possible	2
T-8	33118 T & D - Radiological / 33119 T & D - Non-Radiological	Concern raised over assumed volumes in cost estimate.	Assumptions in cost estimate lack full volumes associated with benching and sloping, slab volumes, and other additional factors.	Marginal	Likely	2
T-9	33120 Site Restoration	Concern raised over potential need for additional backfill.	Additional backfill may be required for deeper excavations with benching and sloping and slab removal. Possibility for offset reusing site materials.	Marginal	Likely	2
T-10	33122 General Requirements	Concern raised over schedule impacts of additioanl site work.	Additional site work duration would cauise schedule impacts.	Moderate	Likely	3
T-11	33190 Decon	No concerns identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
T-12	Remaining Construction Items			Negligible	Unlikely	0
T-13	Planning, Engineering, & Design	No concerns identified.	Minimal impact to design from increased quantities.	Negligible	Unlikely	0
T-14	Construction Management	Concern raised over schedule impacts of increased quantities.	Impacts could be caused from increased quantities and longer duration.	Moderate	Likely	3

Cost Estimate Assumptions

Maximum Project Growth **35%**

EST-1	33101 Mob & Preparatory Work / 33121 Demobilization	Mobilization of on-site laboratory not considered.	Standard mobilization, on-site laboratory could result in additional costs.	Negligible	Likely	1
EST-2	33102 Monitoring, Sampling, Testing, & Analysis	On-site laboratory could result in changes to analysis and packaging/shipping costs.	On-site laboratory could result in different costs.	Marginal	Likely	2
EST-3	33103 Site Work	Revised quantities could result in cost changes.	Many quantities are still uncertain, but assumptions made with regard to cost should not have significant impacts.	Marginal	Unlikely	0
EST-4	33108 Soilds Collection and Containment	Quotes obtained for uncommon cost items. Other cots based on past experience.	Reliable quotes and project experience used to price this feature.	Marginal	Unlikely	0
EST-5	33109 Liquids/Sediments/Sludges Collection & Contain.	Quantity assumptios were made. Refinement of quantities could result in changes to cost.	Uncertainty of quantities and actual implementation of work could result in cost changes.	Negligible	Likely	1
EST-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	Common tasks based on cost book, with adjustments made based on experience.	Common tasks with well-defined quantities. Adjustments made based on experience.	Negligible	Unlikely	0

EST-7	33114 Thermal Treatment (In-Situ)	Quote provided by a source familiar with this work. The duration required for this work could be impacted by the effectiveness of the remedy.	The duration of the work could be impacted depending on the effectiveness of the technology.	Significant	Unlikely	2
EST-8	33118 T & D - Radiological / 33119 T & D - Non-Radiological	Quotes obtained from industry experts and based on similar nearby projects for some items - should be reliable. Revisions to quantities may result in cost changes. If the method/equipment used for T&D is different than what was assumed for estimating purposes, then significant cost impacts could be incurred.	Quotes are expected to be reliable, however quantity changes could have significant impacts. These impacts are accounted for under Technical Design & Quantities. If the method/equipment used for T&D is different than what was assumed for estimating purposes, then significant cost impacts could be incurred.	Significant	Likely	4
EST-9	33120 Site Restoration	Quotes for materials can be highly variable based on season, vendor, contractor, etc. Quantities are mostly assumed, and may require revisions.	Material quotes can vary, quantities are not certain.	Significant	Very LIKELY	5
EST-10	33122 General Requirements	Durations/overtime assumptions made but can be variable depending on project schedule. Many costs are duration-based, however, and can be significantly impacted by schedule changes.	Schedule can have significant impacts on general requirements.	Marginal	Very LIKELY	3
EST-11	33190 Decon	Only quote obtained is for concrete shaver purchase. Uncommon work item, productivity was assumed. No critical cost items. However, quantities and productivity were assumed.	This work feature is not a significant cost relative to the project, however there is uncertainty in the quantity and production rates.	Marginal	Likely	2
EST-12	Remaining Construction Items			Negligible	Unlikely	0
EST-13	Planning, Engineering, & Design	Estimate assumes PED will be performed in-house by USACE. \$1.5M/year assumption based on past CELRB FUSRAP projects.	PED cost assumption of 5% of construction costs is consistent with assumption of \$1.5M/year for USACE in-house S&A and CM costs commonly used in FUSRAP RA cost estimates.	Marginal	Possible	1
EST-14	Construction Management	CUES estimated the labor rates and hours necessary for annual supervision and administration based on past project experience.	Changes to the construction approach are not expected to have a drastic effect on the personnel or amount of hours required to complete the annual supervision and administration tasks.	Negligible	Possible	0
External Project Risks				**Maximum Project Growth**		**40%**
EX-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-2	33102 Monitoring, Sampling, Testing, & Analysis	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-3	33103 Site Work	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-4	33108 Soilds Collection and Containment	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-5	33109 Liquids/Sediments/Sludges Collection & Contain.	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-7	33114 Thermal Treatment (In-Situ)	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-8	33118 T & D - Radiological / 33119 T & D - Non-Radiological	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-9	33120 Site Restoration	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0

EX-10	33122 General Requirements	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-11	33190 Decon			Negligible	Unlikely	0
EX-12	Remaining Construction Items			Negligible	Unlikely	0
EX-13	Planning, Engineering, & Design	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-14	Construction Management	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0

Abbreviated Risk Analysis

NFSS FS BOP & GW OUs

Feasibility (Alternatives)

Alternative 4

Meeting Date: 16-Oct-17

PDT Members

Note: PDT involvement is commensurate with project size and involvement.

Represents	Name
Project Management:	[redacted]
Project Engineer:	
SP-PM Team Leader:	
SP-PM Support	
TD-EH Team Leader:	
Health Physicist:	
Health Physicist:	
RTS:	
Chemist:	
Hydrogeologist:	
Cost Engineering:	
Cost Engineering:	
A-E Project Manager:	
A-E Cost Estimator:	

NFSS FS BOP & GW OUs - ALT 4 CAPITAL COSTS

WBS Number			DESCRIPTION
33XXX			HTRW CONSTRUCTION ACTIVITIES
331XX			HTRW REMEDIAL ACTION (CONSTRUCTION)
01			MOBILIZATION AND PREPARATORY WORK
01	01		MOBILIZATION OF CONSTRUCTION EQUIPMENT AND FACILITIES
01	01	90	SITE FACILITIES
01	01	91	OFFICE TRAILERS
01	01	92	TOILETS
01	01	93	STORAGE FACILITIES
01	01	91	CONSTRUCTION EQUIPMENT
01	03		SUBMITTALS/IMPLEMENTATION PLANS
01	04		SETUP/CONSTRUCT TEMPORARY FACILITIES
01	04	11	BARRICADES
01	04	30	EROSION CONTROL
01	04	91	TEMPORARY STAGING AREAS
01	05		CONSTRUCT TEMPORARY UTILITIES
01	05	02	POWER CONNECTION/DISTRIBUTION
02			MONITORING, SAMPLING, TESTING, AND ANALYSIS
02	02		RADIATION MONITORING
02	02	01	AREA MONITORING
02	03		AIR MONITORING AND SAMPLING
02	03	01	CAMP
02	05		SAMPLING SURFACE WATER/GROUNDWATER/LIQUID WASTE
02	05	05	SAMPLE SHIPPING AND HANDLING
02	06		SAMPLING SOIL AND SEDIMENT
02	06	04	SAMPLE SHIPPING AND HANDLING
02	08		SAMPLING RADIOACTIVE CONTAMINATED MEDIA
02	08	08	SAMPLE SHIPPING AND HANDLING
02	09		LABORATORY CHEMICAL ANALYSIS
02	09	02	GENERAL WATER QUALITY AND WASTEWATER ANALYSIS
02	09	07	SOIL AND SEDIMENT ANALYSIS
02	09	91	CONTAMINATED CONCRETE ANALYSIS
03			SITEWORK
03	01		DEMOLITION (and Removal of Asphalt Roadways)
03	01	90	SAW-CUT ASPHALT ROADWAY
03	01	91	ASPHALT ROAD REMOVAL
03	02		CLEARING AND GRUBBING
03	02	90	TREE REMOVAL AND DISPOSAL
03	02	91	BRUSH CLEARING AND DISPOSAL
03	93		SURVEY
08			SOLIDS COLLECTION AND CONTAINMENT
08	01		CONTAMINATED SOIL COLLECTION
08	01	02	EXCAVATION
08	01	03	HAULING
08	01	04	STOCKPILING
09			LIQUIDS/SEDIMENTS/SLUDGES/COLLECTION AND CONTAINMENT
09	03		WASTE CONTAINMENT, PORTABLE (FURNISH/FILL)
09	03	01	BULK LIQUID CONTAINERS/ROLL-OFFS
09	06		PUMPING/DRAINING/COLLECTION
09	06	03	COLLECTION (Dewatering)
10			DRUMS/TANKS/STRUCTURES/MISCELLANEOUS DEMOLITION AND REMOVAL
10	03		STRUCTURE REMOVAL (Building 401 Slab)
10	03	02	DEMOLITION
10	03	90	EXCAVATION, HAULING, STOCKPILING AND TRANSPORT OFF-SITE
14			THERMAL TREATMENT
14	92		IN-SITU THERMAL TREAMENT
18			TRANSPORT and DISPOSAL - Radiological
19			TRANSPORT and DISPOSAL - Non-Radiological
19	90		Transport and Disposal - Non-Contaminaated
19	92		Transport and Disposal - Water
20			SITE RESTORATION
20	01		EARTHWORK
20	01	03	BACKFILL
20	01	04	BORROW
20	01	07	GRADING
20	01	08	COMPACTION
20	01	13	STOCKPILING
20	01	14	TOPSOIL
20	03		PERMANENT FEATURES
20	03	01	ROAD REPLACEMENT
20	04		REVEGETATION AND PLANTING
20	04	01	SEEDING/MULCH/FERTILIZER
21			DEMOBILIZATION
21	01		DEMOBILIZATION OF CONSTRUCTION EQUIPMENT AND FACILITIES
01	01	90	SITE FACILITIES
01	01	91	OFFICE TRAILERS
01	01	92	TOILETS
01	01	93	STORAGE FACILITIES
01	01	91	CONSTRUCTION EQUIPMENT
21	02		REMOVAL OF TEMPORARY UTILITIES
01	05	02	POWER CONNECTION/DISTRIBUTION
01	04		DECONSTRUCT/REMOVE TEMP FACILITIES
01	04	30	EROSION CONTROL
22			GENERAL REQUIREMENTS
22	07		HEALTH & SAFETY
22	07	02	RADIATION PROTECTION TECHNOLOGIST (RPT)
22	07	07	SITE SAFETY & HEALTH OFFICER
22	07	16	PERSONAL PROTECTION EQUIPMENT
22	10		PROJECT UTILITIES
22	10	02	ELECTRICAL USAGE
22	08		TEMPORARY CONSTRUCTION FACILITIES - OWNERSHIP
22	08	01	OFFICE TRAILERS AND FACILITIES
22	08	02	OFFICE FURNITURE AND OFFICE EQUIPMENT
22	08	03	WAREHOUSE AND STORAGE TRAILERS AND FACILITIES
22	08	08	CONSTRUCTION PORTABLE TOILETS
22	08	11	DECONTAMINATION FACILITIES FOR PERSONNEL
22	08	12	DECONTAMINATION FACILITIES FOR CONSTRUCTION EQUIPMENT AND VEHICLES
90			DECON

Abbreviated Risk Analysis

Project (less than $40M): **NFSS FS BOP & GW OUs**

Alternative: **Alt 5**

Project Development Stage/Alternative: **Feasibility (Alternatives)**

Risk Category: **Moderate Risk: Typical Project Construction Type**

Meeting Date: **16-Oct-17**

Total Estimated Construction Contract Cost = **$ 17,986,234**

	CWWBS	Feature of Work	Contract Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ -		0.00%	$ -	$ -
1		33101 Mob & Preparatory Work / 33121 Demobilization	$ 268,851		15.93%	$ 42,841	$ 311,691
2		33102 Monitoring, Sampling, Testing, & Analysis	$ 183,566		18.67%	$ 34,268	$ 217,835
3		33103 Site Work	$ 135,649		7.00%	$ 9,495	$ 145,144
4		33108 Soilds Collection and Containment	$ 117,330		21.59%	$ 25,337	$ 142,667
5		33109 Liquids/Sediments/Sludges Collection & Contain.	$ 23,458		16.56%	$ 3,884	$ 27,342
6		33110 Drums/Tanks/Structures/Misc. Demo. & Removal	$ 38,783		21.59%	$ 8,375	$ 47,158
7		33114 Thermal Treatment (Ex-Situ)	$ 1,906,512		27.78%	$ 529,570	$ 2,436,081.28
8		33118 T & D - Radiological / 33119 T & D - Non-Radiological	$ 13,390,249		38.78%	$ 5,193,266	$ 18,583,514.89
9		33120 Site Restoration	$ 1,527,197		52.80%	$ 806,310	$ 2,333,506.44
10		33122 General Requirements	$ 342,656		30.04%	$ 102,923	$ 445,579.00
11		33190 Decon	$ 51,983		11.15%	$ 5,794	$ 57,777.37
12	All Other	**Remaining Construction Items**	$ -	*0.0%*	0.00%	$ -	$ -
13	30 PLANNING, ENGINEERING, AND DESIGN	**Planning, Engineering, & Design**	$ 899,312	5.0%	9.04%	$ 81,263	$ 980,575
14	31 CONSTRUCTION MANAGEMENT	**Construction Management**	$ 899,312	5.0%	21.59%	$ 194,204	$ 1,093,516
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					$ -	

Totals				
Real Estate	$ -	0.00%	$ -	$ -
Total Construction Estimate	$ 17,986,234	37.60%	$ 6,762,062	$ 24,748,296
Total Planning, Engineering & Design	$ 899,312	9.04%	$ 81,263	$ 980,575
Total Construction Management	$ 899,312	21.59%	$ 194,204	$ 1,093,516
Total Excluding Real Estate	**$ 19,784,858**	**36%**	**$ 7,037,530**	**$ 26,822,388**

	Base	50%	80%
Confidence Level Range Estimate ($000's)	$19,785k	$24,007k	$26,822k

* 50% based on base is at 5% CL.

Fixed Dollar Risk Add: (Allows for additional risk to be added to the risk analysis. Must include justification. Does not allocate to Real Estate.	

NFSS FS BOP & GW OUs Alt 5
Feasibility (Alternatives)
Abbreviated Risk Analysis

Risk Evaluation

WBS	Potential Risk Areas	Project Management & Scope Growth	Acquisition Strategy	Construction Elements	Specialty Construction or Fabrication	Technical Design & Quantities	Cost Estimate Assumptions	External Project Risks	Cost in Thousands
01 LANDS AND DAMAGES	**Real Estate**								$0
0	**33101 Mob & Preparatory Work / 33121 Demobilization**	0	0	3	0	0	1	0	$269
0	33102 Monitoring, Sampling, Testing, & Analysis	0	0	2	0	2	2	0	$184
0	33103 Site Work	0	0	0	0	0	0	0	$136
0	33108 Soilds Collection and Containment	0	0	3	0	3	0	0	$117
0	33109 Liquids/Sediments/Sludges Collection & Contain.	0	0	2	0	2	1	0	$23
0	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	0	0	3	0	3	0	0	$39
0	**33114 Thermal Treatment (Ex-Situ)**	0	0	2	2	3	2	0	$1,907
0	**33118 T & D - Radiological / 33119 T & D - Non-Radiological**	0	0	3	0	3	4	0	$13,390
0	**33120 Site Restoration**	0	0	3	0	2	5	0	$1,527
0	**33122 General Requirements**	0	0	3	0	3	3	0	$343
0	**33190 Decon**	0	0	0	0	0	2	0	$52
All Other	Remaining Construction Items	0	0	0	0	0	0	0	$0
30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	0	0	0	0	0	1	0	$899
31 CONSTRUCTION MANAGEMENT	Construction Management	0	0	3	0	3	0	0	$899
									$19,785
Risk		$ -	$ -	$ 2,606	$ 101	$ 1,352	$ 2,978	$ -	**$7,038**
Fixed Dollar Risk Allocation		$ -	$ -	$ -	$ -	$ -	$ -	$ -	**$0**
	Risk	$ -	$ -	$ 2,606	$ 101	$ 1,352	$ 2,978	$ -	**$7,038**
								Total	**$26,822**

NFSS FS BOP & GW OUs Alt 5

Feasibility (Alternatives)
Abbreviated Risk Analysis
Meeting Date: 16-Oct-17

Risk Level

	Negligible	Marginal	Moderate	Significant	Critical
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Project Management & Scope Growth				**Maximum Project Growth**		**75%**
PS-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-2	33102 Monitoring, Sampling, Testing, & Analysis	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-3	33103 Site Work	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-4	33108 Soilds Collection and Containment	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-5	33109 Liquids/Sediments/Sludges Collection & Contain.	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-7	33114 Thermal Treatment (Ex-Situ)	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-8	33118 T & D - Radiological / 33119 T & D - Non-Radiological	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-9	33120 Site Restoration	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-10	33122 General Requirements	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-11	33190 Decon	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-12	Remaining Construction tems			Negligible	Unlikely	0
PS-13	Planning, Engineering, & Design	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-14	Construction Management	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
Acquisition Strategy				**Maximum Project Growth**		**30%**

AS-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-2	33102 Monitoring, Sampling, Testing, & Analysis	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-3	33103 Site Work	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-4	33108 Soilds Collection and Containment	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-5	33109 Liquids/Sediments/Sludges Collection & Contain.	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-7	33114 Thermal Treatment (Ex-Situ)	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-8	33118 T & D - Radiological / 33119 T & D - Non-Radiological	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-9	33120 Site Restoration	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-10	33122 General Requirements	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-11	33190 Decon	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-12	Remaining Construction tems			Negligible	Unlikely	0
AS-13	Planning, Engineering, & Design	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-14	Construction Management	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
Construction Elements				Maximum Project Growth		25%
CON-1	33101 Mob & Preparatory Work / 33121 Demobilization	On-site laboratory may be needed, including ELAP accreditation. Depending on scheduling, may be concurrent with IWCS RA.	Likely significant impact anticipated, dependent upon contract type selected.	Moderate	Likely	3
CE-2	33102 Monitoring, Sampling, Testing, & Analysis	On-site laboratory may be needed, including ELAP accreditation. Depending on scheduling, may be concurrent with IWCS RA.	Costs for on-site laboratory likely to be marginally higher than off-site analysis.	Marginal	Likely	2
CE-3	33103 Site Work	No concers identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
CE-4	33108 Soilds Collection and Containment	Deep excavations require benching/sloping that could cause impacts to site work. Base estiamte did not include benching/sloping.	Potentiial for increased volumes for off-site disposal. Increased water management could cause scjhedule delay.	Marginal	Very LIKELY	3
CE-5	33109 Liquids/Sediments/Sludges Collection & Contain.	Seasonal considerations may impact work and cause greater water management issues. Drainage ditch used by Modern Landfill would need to be diverted.	Standard work, minimal impact anticipated.	Negligible	Very LIKELY	2
CE-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	Concern raised over slab thickness assumptiions.	Actual slab thicknesses/footings may be greater than those assumed in the cost estimate, resulting in increased work required for removal.	Marginal	Very LIKELY	3

CE-7	33114 Thermal Treatment (Ex-Situ)	Concern raised over duration of ex-situ thermal treatment.	Ex-situ thermal treatment is well established technology. Treatment time may vary significantly from assumptions.	Moderate	Possible	2
CE-8	33118 T & D - Radiological / 33119 T & D - Non-Radiological	Assumptions on slab thickness may cause changes to potential volume disposal.	Potential for increased volumes for off-site disposal.	Moderate	Likely	3
CE-9	33120 Site Restoration	Seasonal considerations may impact work and cause greater water management issues.	Standard work, minimal impact anticipated.	Moderate	Likely	3
CE-10	33122 General Requirements	No concerns identified.	Standard work, minimal impact anticipated.	Moderate	Likely	3
CE-11	33190 Decon	No concerns identified.	Standard work, minimal impact anticipated.	Marginal	Unlikely	0
CE-12	Remaining Construction tems			Negligible	Unlikely	0
CE-13	Planning, Engineering, & Design	No concerns identified.	Minimal impact to design from increased quantities.	Marginal	Unlikely	0
CE-14	Construction Management	Additional site work durations would cause impacts.	Additional site work duration would cauise schedule impacts.	Moderate	Likely	3
Specialty Construction or Fabrication				**Maximum Project Growth**		**65%**
SC-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-2	33102 Monitoring, Sampling, Testing, & Analysis	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-3	33103 Site Work	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-4	33108 Soilds Collection and Containment	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-5	33109 Liquids/Sediments/Sludges Collection & Contain.	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-7	33114 Thermal Treatment (Ex-Situ)	Concern raised over duration of ex-situ thermal treatment.	Ex-situ thermal treatment is well established technology. Treatment time may vary significantly from assumptions.	Moderate	Possible	2
SC-8	33118 T & D - Radiological / 33119 T & D - Non-Radiological	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-9	33120 Site Restoration	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-10	33122 General Requirements	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-11	33190 Decon	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-12	Remaining Construction tems			Negligible	Unlikely	0

SC-13	Planning, Engineering, & Design	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-14	Construction Management	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
Technical Design & Quantities				**Maximum Project Growth**		**30%**
T-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
T-2	33102 Monitoring, Sampling, Testing, & Analysis	Concern raised over effect of additional excavation.	Additional excavation and site work would increase sampling quantities.	Marginal	Likely	2
T-3	33103 Site Work	No concerns identified.	Standard site work, couold cause impacts.	Negligible	Unlikely	0
T-4	33108 Soilds Collection and Containment	Concern raised over potential for deeper excavations.	Benching and sloping for deeper excavations, and chasing contamination off-site would cause impacts.	Marginal	Very LIKELY	3
T-5	33109 Liquids/Sediments/Sludges Collection & Contain.	Concern raised over impact of seasonal considerations (precipitation).	Seasonal considerations may impact work and caused greater water management issues.	Marginal	Likely	2
T-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	Concern raised over slab thickness assumptiions.	Actual slab thicknesses/footings may be greater than those assumed in the cost estimate, resulting in increased work required for removal.	Marginal	Very LIKELY	3
T-7	33114 Thermal Treatment (Ex-Situ)	Concern raised over soil volume and duration of ex-situ thermal treatment.	In-situ thermal treatment is well established technology. Soil volume and treatment time may vary significantly from assumptions.	Significant	Possible	3
T-8	33118 T & D - Radiological / 33119 T & D - Non-Radiological	Concern raised over assumed volumes in cost estimate.	Assumptions in cost estimate lack full volumes associated with benching and sloping, slab volumes, and other additional factors.	Moderate	Likely	3
T-9	33120 Site Restoration	Concern raised over potential need for additional backfill.	Additional backfill may be required for deeper excavations with benching and sloping and slab removal. Possibility for offset reusing site materials.	Marginal	Likely	2
T-10	33122 General Requirements	Concern raised over schedule impacts of additioanl site work.	Additional site work duration would cauise schedule impacts.	Moderate	Likely	3
T-11	33190 Decon	No concerns identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
T-12	Remaining Construction tems			Negligible	Unlikely	0
T-13	Planning, Engineering, & Design	No concerns identified.	Minimal impact to design from increased quantities.	Negligible	Unlikely	0
T-14	Construction Management	Concern raised over schedule impacts of increased quantities.	Impacts could be caused from increased quantities and longer duration.	Moderate	Likely	3
Cost Estimate Assumptions				**Maximum Project Growth**		**35%**
EST-1	33101 Mob & Preparatory Work / 33121 Demobilization	Mobilization of on-site laboratory not considered.	Standard mobilization, on-site laboratory could result in additional costs.	Negligible	Likely	1
EST-2	33102 Monitoring, Sampling, Testing, & Analysis	On-site laboratory could result in changes to analysis and packaging/shipping costs.	On-site laboratory could result in different costs.	Marginal	Likely	2
EST-3	33103 Site Work	Revised quantities could result in cost changes.	Many quantities are still uncertain, but assumptions made with regard to cost should not have significant impacts.	Marginal	Unlikely	0
EST-4	33108 Soilds Collection and Containment	Quotes obtained for uncommon cost items. Other cots based on past experience.	Reliable quotes and project experience used to price this feature.	Marginal	Unlikely	0

EST-5	33109 Liquids/Sediments/Sludges Collection & Contain.	Quantity assumptios were made. Refinement of quantities could result in changes to cost.	Uncertainty of quantities and actual implementation of work could result in cost changes.	Negligible	Likely	1
EST-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	Common tasks based on cost book, with adjustments made based on experience.	Common tasks with well-defined quantities. Adjustments made based on experience.	Negligible	Unlikely	0
EST-7	33114 Thermal Treatment (Ex-Situ)	Quote provided by a source familiar with this work. The duration required for this work could be impacted by the effectiveness of the remedy.	The duration of the work could be impacted depending on the effectiveness of the technology.	Significant	Unlikely	2
EST-8	33118 T & D - Radiological / 33119 T & D - Non-Radiological	Quotes obtained from industry experts and based on similar nearby projects for some items - should be reliable. Revisions to quantities may result in cost changes. If the method/equipment used for T&D is different than what was assumed for estimating purposes, then significant cost impacts could be incurred.	Quotes are expected to be reliable, however quantity changes could have significant impacts. These impacts are accounted for under Technical Design & Quantities. If the method/equipment used for T&D is different than what was assumed for estimating purposes, then significant cost impacts could be incurred.	Significant	Likely	4
EST-9	33120 Site Restoration	Quotes for materials can be highly variable based on season, vendor, contractor, etc. Quantities are mostly assumed, and may require revisions.	Material quotes can vary, quantities are not certain.	Significant	Very LIKELY	5
EST-10	33122 General Requirements	Durations/overtime assumptions made but can be variable depending on project schedule. Many costs are duration-based, however, and can be significantly impacted by schedule changes.	Schedule can have significant impacts on general requirements.	Marginal	Very LIKELY	3
EST-11	33190 Decon	Only quote obtained is for concrete shaver purchase. Uncommon work item, productivity was assumed. No critical cost items. However, quantities and productivity were assumed.	This work feature is not a significant cost relative to the project, however there is uncertainty in the quantity and production rates.	Marginal	Likely	2
EST-12	Remaining Construction tems			Negligible	Unlikely	0
EST-13	Planning, Engineering, & Design	Estimate assumes PED will be performed in-house by USACE. $1.5M/year assumption based on past CELRB FUSRAP projects.	PED cost assumption of 5% of construction costs is consistent with assumption of $1.5M/year for USACE in-house S&A and CM costs commonly used in FUSRAP RA cost estimates.	Marginal	Possible	1
EST-14	Construction Management	CUES estimated the labor rates and hours necessary for annual supervision and administration based on past project experience.	Changes to the construction approach are not expected to have a drastic effect on the personnel or amount of hours required to complete the annual supervision and	Negligible	Unlikely	0
External Project Risks				**Maximum Project Growth**		**40%**
EX-1	33101 Mob & Preparatory Work / 33121 Demobilization	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-2	33102 Monitoring, Sampling, Testing, & Analysis	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-3	33103 Site Work	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-4	33108 Soilds Collection and Containment	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-5	33109 Liquids/Sediments/Sludges Collection & Contain.	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-6	33110 Drums/Tanks/Structures/Misc. Demo. & Removal	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-7	33114 Thermal Treatment (Ex-Situ)	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-8	33118 T & D - Radiological / 33119 T & D - Non-Radiological	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0

EX-9	33120 Site Restoration	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	**0**
EX-10	33122 General Requirements	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	**0**
EX-11	33190 Decon			Negligible	Unlikely	**0**
EX-12	Remaining Construction tems			Negligible	Unlikely	**0**
EX-13	Planning, Engineering, & Design	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	**0**
EX-14	Construction Management	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	**0**

Abbreviated Risk Analysis

NFSS FS BOP & GW OUs

Feasibility (Alternatives)

Alternative 5

Meeting Date: 16-Oct-17

PDT Members

Note: PDT involvement is commensurate with project size and involvement.

Represents	Name
Project Management:	[redacted]
Project Engineer:	
SP-PM Team Leader:	
SP-PM Support	
TD-EH Team Leader:	
Health Physicist:	
Health Physicist:	
RTS:	
Chemist:	
Hydrogeologist:	
Cost Engineering:	
Cost Engineering:	
A-E Project Manager:	
A-E Cost Estimator:	

NFSS FS BOP & GW OUs - ALT 5 CAPITAL COSTS

WBS Number	DESCRIPTION
33XXX	HTRW CONSTRUCTION ACTIVITIES
331XX	HTRW REMEDIAL ACTION (CONSTRUCTION)
01	MOBILIZATION AND PREPARATORY WORK
01 01	MOBILIZATION OF CONSTRUCTION EQUIPMENT AND FACILITIES
01 01 90	SITE FACILITIES
01 01 91	OFFICE TRAILERS
01 01 92	TOILETS
01 01 93	STORAGE FACILITIES
01 01 91	CONSTRUCTION EQUIPMENT
01 03	SUBMITTALS/IMPLEMENTATION PLANS
01 04	SETUP/CONSTRUCT TEMPORARY FACILITIES
01 04 11	BARRICADES
01 04 30	EROSION CONTROL
01 04 91	TEMPORARY STAGING AREAS
01 05	CONSTRUCT TEMPORARY UTILITIES
01 05 02	POWER CONNECTION/DISTRIBUTION
02	MONITORING, SAMPLING, TESTING, AND ANALYSIS
02 02	RADIATION MONITORING
02 02 01	AREA MONITORING
02 03	AIR MONITORING AND SAMPLING
02 03 01	CAMP
02 05	SAMPLING SURFACE WATER/GROUNDWATER/LIQUID WASTE
02 05 05	SAMPLE SHIPPING AND HANDLING
02 06	SAMPLING SOIL AND SEDIMENT
02 06 04	SAMPLE SHIPPING AND HANDLING
02 08	SAMPLING RADIOACTIVE CONTAMINATED MEDIA
02 08 08	SAMPLE SHIPPING AND HANDLING
02 09	LABORATORY CHEMICAL ANALYSIS
02 09 02	GENERAL WATER QUALITY AND WASTEWATER ANALYSIS
02 09 07	SOIL AND SEDIMENT ANALYSIS
02 09 91	CONTAMINATED CONCRETE ANALYSIS
03	SITEWORK
03 01	DEMOLITION (and Removal of Asphalt Roadways)
03 01 90	SAW-CUT ASPHALT ROADWAY
03 01 91	ASPHALT ROAD REMOVAL
03 02	CLEARING AND GRUBBING
03 02 90	TREE REMOVAL AND DISPOSAL
03 02 91	BRUSH CLEARING AND DISPOSAL
03 93	SURVEY
08	SOLIDS COLLECTION AND CONTAINMENT
08 01	CONTAMINATED SOIL COLLECTION
08 01 02	EXCAVATION
08 01 03	HAULING
08 01 04	STOCKPILING
09	LIQUIDS/SEDIMENTS/SLUDGES/COLLECTION AND CONTAINMENT
09 03	WASTE CONTAINMENT, PORTABLE (FURNISH/FILL)
09 03 01	BULK LIQUID CONTAINERS/ROLL-OFFS
09 06	PUMPING/DRAINING/COLLECTION
09 06 03	COLLECTION (Dewatering)
10	DRUMS/TANKS/STRUCTURES/MISCELLANEOUS DEMOLITION AND REMOVAL
10 03	STRUCTURE REMOVAL (Building 401 Slab)
10 03 02	DEMOLITION
10 03 90	EXCAVATION, HAULING, STOCKPILING AND TRANSPORT OFF-SITE
10 91	STRUCTURE REMOVAL (Tank Foundations)
10 03 02	DEMOLITION
10 03 90	EXCAVATION, HAULING, STOCKPILING AND TRANSPORT OFF-SITE
14	THERMAL TREATMENT
14 91	EX-SITU THERMAL TREAMENT
18	TRANSPORT and DISPOSAL - Radiological
19	TRANSPORT and DISPOSAL - Non-Radiological
19 90	Transport and Disposal - Non-Contaminated
19 92	Transport and Disposal - Water
20	SITE RESTORATION
20 01	EARTHWORK
20 01 03	BACKFILL
20 01 04	BORROW
20 01 07	GRADING
20 01 08	COMPACTION
20 01 13	STOCKPILING
20 01 14	TOPSOIL
20 03	PERMANENT FEATURES
20 03 01	ROAD REPLACEMENT
20 04	REVEGETATION AND PLANTING
20 04 01	SEEDING/MULCH/FERTILIZER
21	DEMOBILIZATION
21 01	DEMOBILIZATION OF CONSTRUCTION EQUIPMENT AND FACILITIES
01 01 90	SITE FACILITIES
01 01 91	OFFICE TRAILERS
01 01 92	TOILETS
01 01 93	STORAGE FACILITIES
01 01 91	CONSTRUCTION EQUIPMENT
21 02	REMOVAL OF TEMPORARY UTILITIES
01 05 02	POWER CONNECTION/DISTRIBUTION
01 04	DECONSTRUCT/REMOVE TEMP FACILITIES
01 04 30	EROSION CONTROL
22	GENERAL REQUIREMENTS
22 07	HEALTH & SAFETY
22 07 02	RADIATION PROTECTION TECHNOLOGIST (RPT)
22 07 07	SITE SAFETY & HEALTH OFFICER
22 07 16	PERSONAL PROTECTION EQUIPMENT
22 10	PROJECT UTILITIES
22 10 02	ELECTRICAL USAGE
22 08	TEMPORARY CONSTRUCTION FACILITIES - OWNERSHIP
22 08 01	OFFICE TRAILERS AND FACILITIES
22 08 02	OFFICE FURNITURE AND OFFICE EQUIPMENT
22 08 03	WAREHOUSE AND STORAGE TRAILERS AND FACILITIES
22 08 08	CONSTRUCTION PORTABLE TOILETS
22 08 11	DECONTAMINATION FACILITIES FOR PERSONNEL
22 08 12	DECONTAMINATION FACILITIES FOR CONSTRUCTION EQUIPMENT AND VEHICLES
90	DECON

Abbreviated Risk Analysis

Project (less than $40M): **NFSS FS BOP & GW OUs O&M**

Project Development Stage/Alternative: **Feasibility (Alternatives)**

Risk Category: **Low Risk: Typical Construction, Simple**

Alternative: **Alts. 2, 3, 4 & 5**

Meeting Date: **16-Oct-17**

Total Estimated O&M Contract Cost = $ 479,764

	CWWBS	Feature of Work	Contract Cost		% Contingency	$ Contingency	Total
	01 LANDS AND DAMAGES	Real Estate	$ -		0.00%	$ -	$ -
1		34202 Quarterly Site Visits (four per year)	$69,740.31		7.00%	$ 4,882	$ 74,622
2		34202 5-year Review Report	$268,099.08		7.00%	$ 18,767	$ 286,866
3		34203 Chain Link Fence/Gate Repairs	$65,611.08		10.62%	$ 6,970	$ 72,582
4		34222 Supervision and Administration	$76,313.23		7.00%	$ 5,342	$ 81,655
5					0.00%	$ -	$ -
6					0.00%	$ -	$ -
7					0.00%	$ -	$ -
8					0.00%	$ -	$ -
9					0.00%	$ -	$ -
10			$ -		0.00%	$ -	$ -
11					0.00%	$ -	$ -
12	All Other	**Remaining Construction Items**	$ -	*0.0%*	0.00%	$ -	$ -
13	30 PLANNING, ENGINEERING, AND DESIGN	**Planning, Engineering, & Design**			0.00%	$ -	$ -
14	31 CONSTRUCTION MANAGEMENT	**Construction Management**			0.00%	$ -	$ -
XX	FIXED DOLLAR RISK ADD (EQUALLY DISPERSED TO ALL, MUST INCLUDE JUSTIFICATION SEE BELOW)					$ -	

Totals	Contract Cost	% Contingency	$ Contingency	Total
Real Estate	$ -	0.00%	$ -	$ -
Total O&M Estimate	$ 479,764	7.50%	$ 35,961	$ 515,725
Total Planning, Engineering & Design	$ -	0.00%	$ -	$ -
Total Construction Management	$ -	0.00%	$ -	$ -
Total Excluding Real Estate	$ 479,764	7%	$ 35,961	$ 515,725

	Base	50%	80%
Confidence Level Range Estimate ($000's)	$480k	$502k	$516k

* 50% based on base is at 5% CL.

Fixed Dollar Risk Add: (Allows for additional risk to be added to the risk analsyis. Must include justification. Does not allocate to Real Estate.)

NFSS FS BOP & GW OUs O&M Alts. 2, 3, 4 & 5
Feasibility (Alternatives)
Abbreviated Risk Analysis

Risk Evaluation

WBS	Potential Risk Areas	Project Management & Scope Growth	Acquisition Strategy	Construction Elements	Specialty Construction or Fabrication	Technical Design & Quantities	Cost Estimate Assumptions	External Project Risks	Cost in Thousands
01 LANDS AND DAMAGES	Real Estate								$0
0	34202 Quarterly Site Visits (four per year)	0	0	0	0	0	0	0	$70
0	34202 5-year Review Report	0	0	0	0	0	0	0	$268
0	34203 Chain Link Fence/Gate Repairs	0	0	0	0	0	2	0	$66
0	34222 Supervision and Administration	0	0	0	0	0	0	0	$76
0	0	0	0	0	0	0	0	0	$0
0	0	0	0	0	0	0	0	0	$0
0	0	0	0	0	0	0	0	0	$0
0	0	0	0	0	0	0	0	0	$0
0	0	0	0	0	0	0	0	0	$0
0	0	0	0	0	0	0	0	0	$0
0		0	0	0	0	0	0	0	$0
All Other	Remaining Construction Items	0	0	0	0	0	0	0	$0
30 PLANNING, ENGINEERING, AND DESIGN	Planning, Engineering, & Design	0	0	0	0	0	0	0	$0
31 CONSTRUCTION MANAGEMENT	Construction Management	0	0	0	0	0	0	0	$0
									$480
Risk		$ -	$ -	$ 34	$ -	$ -	$ 2	$ -	$36
Fixed Dollar Risk Allocation		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$0
	Risk	$ -	$ -	$ 34	$ -	$ -	$ 2	$ -	$36
								Total	$516

NFSS FS BOP & GW OUs O&M Alts. 2, 3, 4 & 5

Feasibility (Alternatives)

Abbreviated Risk Analysis

Meeting Date: 16-Oct-17

Risk Level

	Negligible	Marginal	Moderate	Significant	Critical
Very Likely	2	3	4	5	5
Likely	1	2	3	4	5
Possible	0	1	2	3	4
Unlikely	0	0	1	2	3

Risk Register

Risk Element	Feature of Work	Concerns	PDT Discussions & Conclusions (Include logic & justification for choice of Likelihood & Impact)	Impact	Likelihood	Risk Level
Project Management & Scope Growth					Maximum Project Growth	40%
PS-1	34202 Quarterly Site Visits (four per year)	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-2	34202 5-year Review Report	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-3	34203 Chain Link Fence/Gate Repairs	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-4	34222 Supervision and Administration	No concerns identified.	Project is well defined, minimal PM or scope growth is anticipated.	Negligible	Unlikely	0
PS-5	0			Negligible	Unlikely	0
PS-6	0			Negligible	Unlikely	0
PS-7	0			Negligible	Unlikely	0
PS-8	0			Negligible	Unlikely	0
PS-9	0			Negligible	Unlikely	0
PS-10	0			Negligible	Unlikely	0
PS-11				Negligible	Unlikely	0
PS-12	Remaining Construction Items			Negligible	Unlikely	0
PS-13	Planning, Engineering, & Design			Negligible	Unlikely	0
PS-14	Construction Management			Negligible	Unlikely	0
Acquisition Strategy					Maximum Project Growth	30%

AS-1	34202 Quarterly Site Visits (four per year)	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-2	34202 5-year Review Report	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-3	34203 Chain Link Fence/Gate Repairs	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-4	34222 Supervision and Administration	No concerns identified.	No concerns due to acquisition strategy.	Negligible	Unlikely	0
AS-5	0			Negligible	Unlikely	0
AS-6	0			Negligible	Unlikely	0
AS-7	0			Negligible	Unlikely	0
AS-8	0			Negligible	Unlikely	0
AS-9	0			Negligible	Unlikely	0
AS-10	0			Negligible	Unlikely	0
AS-11				Negligible	Unlikely	0
AS-12	Remaining Construction Items			Negligible	Unlikely	0
AS-13	Planning, Engineering, & Design			Negligible	Unlikely	0
AS-14	Construction Management			Negligible	Unlikely	0
Construction Elements				**Maximum Project Growth**		**15%**
CON-1	34202 Quarterly Site Visits (four per year)	No concerns identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
CE-2	34202 5-year Review Report	No concerns identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
CE-3	34203 Chain Link Fence/Gate Repairs	No concerns identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
CE-4	34222 Supervision and Administration	No concerns identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
CE-5	0			Negligible	Unlikely	0
CE-6	0			Negligible	Unlikely	0

CE-7	0			Negligible	Unlikely	0
CE-8	0			Negligible	Unlikely	0
CE-9	0			Negligible	Unlikely	0
CE-10	0			Negligible	Unlikely	0
CE-11				Negligible	Unlikely	0
CE-12	Remaining Construction Items			Negligible	Unlikely	0
CE-13	Planning, Engineering, & Design			Negligible	Unlikely	0
CE-14	Construction Management			Negligible	Unlikely	0
Specialty Construction or Fabrication				**Maximum Project Growth**		**50%**
SC-1	34202 Quarterly Site Visits (four per year)	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-2	34202 5-year Review Report	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-3	34203 Chain Link Fence/Gate Repairs	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-4	34222 Supervision and Administration	No concerns identified.	No anticipated need for specialty construction or fabrication.	Negligible	Unlikely	0
SC-5	0			Negligible	Unlikely	0
SC-6	0			Negligible	Unlikely	0
SC-7	0			Negligible	Unlikely	0
SC-8	0			Negligible	Unlikely	0
SC-9	0			Negligible	Unlikely	0
SC-10	0			Negligible	Unlikely	0
SC-11				Negligible	Unlikely	0
SC-12	Remaining Construction Items			Negligible	Unlikely	0

SC-13	Planning, Engineering, & Design			Negligible	Unlikely	0
SC-14	Construction Management			Negligible	Unlikely	0
Technical Design & Quantities				Maximum Project Growth		20%
T-1	34202 Quarterly Site Visits (four per year)	No concerns identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
T-2	34202 5-year Review Report	No concerns identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
T-3	34203 Chain Link Fence/Gate Repairs	No concerns identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
T-4	34222 Supervision and Administration	No concerns identified.	Standard work, minimal impact anticipated.	Negligible	Unlikely	0
T-5	0			Negligible	Unlikely	0
T-6	0			Negligible	Unlikely	0
T-7	0			Negligible	Unlikely	0
T-8	0			Negligible	Unlikely	0
T-9	0			Negligible	Unlikely	0
T-10	0			Negligible	Unlikely	0
T-11				Negligible	Unlikely	0
T-12	Remaining Construction Items			Negligible	Unlikely	0
T-13	Planning, Engineering, & Design			Negligible	Unlikely	0
T-14	Construction Management			Negligible	Unlikely	0
Cost Estimate Assumptions				Maximum Project Growth		25%
EST-1	34202 Quarterly Site Visits (four per year)	Costs were developed based on project experience, no quotes obtained	Minimal work is required for a quarterly site visit.	Negligible	Unlikely	0
EST-2	34202 5-year Review Report	Labor was estimated based on project experience. Revisions to crew makeup and labor hours could be required.	The crew makeup and number of labor hours may be subject to revisions.	Marginal	Unlikely	0
EST-3	34203 Chain Link Fence/Gate Repairs	Assumptions were made for required crew but no overtime is expected and no productivity adjustments were made.	Quantity was assumed.	Marginal	Likely	2

EST-4	34222 Supervision and Administration	CUES estimated the labor rates and hous necessary for annual supervision and admninistration based on past project experience.	Canges to the construction approach are not expected to have a drastic effect on the personnel or amount of hours required to complete the annual supervision and administration tasks.	Negligible	Unlikely	0
EST-5	0			Negligible	Unlikely	0
EST-6	0			Negligible	Unlikely	0
EST-7	0			Negligible	Unlikely	0
EST-8	0			Negligible	Unlikely	0
EST-9	0			Negligible	Unlikely	0
EST-10	0			Negligible	Unlikely	0
EST-11				Negligible	Unlikely	0
EST-12	Remaining Construction Items			Negligible	Unlikely	0
EST-13	Planning, Engineering, & Design			Negligible	Unlikely	0
EST-14	Construction Management			Negligible	Unlikely	0
External Project Risks				**Maximum Project Growth**		**20%**
EX-1	34202 Quarterly Site Visits (four per year)	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-2	34202 5-year Review Report	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-3	34203 Chain Link Fence/Gate Repairs	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-4	34222 Supervision and Administration	No concerns identified.	External Project Risks not likely to impact project.	Negligible	Unlikely	0
EX-5	0			Negligible	Unlikely	0
EX-6	0			Negligible	Unlikely	0
EX-7	0			Negligible	Unlikely	0
EX-8	0			Negligible	Unlikely	0
EX-9	0			Negligible	Unlikely	0

EX-10	0			Negligible	Unlikely	0
EX-11				Negligible	Unlikely	0
EX-12	Remaining Construction Items			Negligible	Unlikely	0
EX-13	Planning, Engineering, & Design			Negligible	Unlikely	0
EX-14	Construction Management			Negligible	Unlikely	0

Abbreviated Risk Analysis

NFSS FS BOP & GW OUs O&M

Feasibility (Alternatives)

Operations & Maintenance

Meeting Date: 16-Oct-17

PDT Members

Note: PDT involvement is commensurate with project size and involvement.

Represents	Name
Project Management:	[redacted]
Project Engineer:	
SP-PM Team Leader:	
SP-PM Support	
TD-EH Team Leader:	
Health Physicist:	
Health Physicist:	
RTS:	
Chemist:	
Hydrogeologist:	
Cost Engineering:	
Cost Engineering:	
A-E Project Manager:	
A-E Cost Estimator:	

NFSS FS BOP & GW OUs - O&M COSTS

WBS Number		DESCRIPTION
34XXX		HTRW POST CONSTRUCTION AND FINANCIAL CLOSEOUT ACTIVITIES
342XX		HTRW OPERATION AND MAINTENANCE (POST CONSTRUCTION)
02		MONITORING, SAMPLING, TESTING, and ANALYSIS
02	90	QUARTERLY SITE VISITS (four per year)
02	91	5-YEAR REVIEW REPORT
03		SITEWORK
03	05	CHAIN LINK FENCE/GATE REPAIRS
22		GENERAL REQUIREMENTS
22	01	SUPERVISION and ADMINISTRATION