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Feasibility Study Report

Former Guterl Specialty Steel Corporation
Formerly Utilized Sites Remedial Action Program Site

Lockport, New York

Prepared for:

U.S. Army Corps of Engineers
Buffalo District

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Table of Contents

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (continued)

LIST OF APPENDICES

ACRONYMS AND ABBREVIATIONS

µg/L	micrograms per liter
ac	acre(s)
AEC	Atomic Energy Commission
AGI	American Geosciences, Inc.
ALARA	as low as reasonably achievable
ARAR	Applicable or Relevant and Appropriate Requirement
ATI	Allegheny Technologies Incorporated
BAASS	Bayesian Approaches for Adaptive Spatial Sampling
bgs	below ground surface
BRA	baseline risk assessment
C&D	construction and dismantlement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CSM	conceptual site model
$CaCO_3$	Calcite
$Ca(UO_2)_2(PO_4)_2 \cdot nH_2O$	Autunite
CB&I	CB&I Federal Services LLC
cm^2	square centimeters
CO_2	carbon dioxide
COC	constituent of concern
COPC	constituent of potential concern
CWQG	Canadian water quality guideline
CWS	community water system
DCGL	derived concentration guideline level
DGA	Data Gap Analysis
DGI	Data Gap Investigation
DO	dissolved oxygen
DOE	U.S. Department of Energy
dpm	disintegrations per minute
Eh	redox potential
EPA	Environmental Protection Agency
EU	exposure unit
FBDU	Ford, Bacon and Davis Utah, Inc.
Fe(II)	ferrous iron
Fe(III)	ferric iron
FS	feasibility study
ft	foot/feet
ft^2	square feet
FUSRAP	Formerly Utilized Sites Remedial Action Program
GIS	geographic information systems
gpm	gallons per minute
GRA	general response action
Guterl Site	Guterl Specialty Steel Corporation Site

ACRONYMS AND ABBREVIATIONS (continued)

ha	hectare
HEPA	high efficiency particulate air
HHRA	human health risk assessment
kg	kilogram
L/day	liters per day
LF	linear feet
LARW	low-activity radioactive waste
LM	linear meter
L/min	liters per minute
LTM	long-term management
LUC	land use controls
LUCIP	Land Use Control Implementation Plan
m	meter
m^2	square meter
m^3	cubic meter
MARSAME	Multi-Agency Radiation Survey and Assessment of Materials and Equipment Manual
MARSSIM	Multi-Agency Radiation Survey and Site Investigation Manual
MCL	maximum contaminant level
MED	Manhattan Engineer District
mg/L	milligrams per liter
mg/kg	milligrams per kilogram
MNA	monitored natural attenuation
mrem/yr	millirems per year
msl	mean sea level
NCDOH	Niagara County Department of Health
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NLO	National Lead of Ohio
NRC	Nuclear Regulatory Commission
NYCRR	New York Code of Rules and Regulations
NYSDEC	New York State Department of Environmental Conservation
NTNCWS	nontransient noncommunity water system
O&M	operation and maintenance
ORISE	Oak Ridge Institute for Science and Education
ORP	oxidation reduction potential
PA	preliminary assessment
PACM	potential asbestos-containing material
PCB	polychlorinated biphenyls
pCi/g	picocuries per gram
pCi/L	picocuries per liter
pH	hydrogen ion potential
POTW	publicly owned treatment works
PP	proposed plan

ACRONYMS AND ABBREVIATIONS (continued)

PPE	personal protective equipment
PRB	permeable reactive barrier
PRG	preliminary remediation goal(s)
PRG-CW	preliminary remediation goal - construction worker
PRG-GW	preliminary remediation goal - groundwater
Ra	radium
^{226}Ra	radium-226
^{228}Ra	radium-228
RAO	remedial action objective
RCRA	Resource Conservation and Recovery Act
redox	oxidation reduction
RESRAD	RESidual RADioactivity
RI	remedial investigation
ROD	record of decision
S^{2-}	sulfide
SI	site inspection
Simonds	Simonds Saw and Steel Company
Site	Guterl Specialty Steel Corporation Site
SLERA	Screening Level Ecological Risk Assessment
SOR	sum-of-ratios
TCLP	toxicity characteristic leaching procedure
TDS	total dissolved solids
TEDE	total effective dose equivalent
TWS	transient water system
Th	thorium
^{228}Th	thorium-228
^{230}Th	thorium-230
^{232}Th	thorium-232
UIQSM	unimportant quantities of source material
U	uranium
^{234}U	uranium-234
^{235}U	uranium-235
^{238}U	uranium-238
U.S.	United States
$U(SiO_4)_{1-x}(OH)_{4x}$	coffinite
U(IV)	uranium +4 or tetravalent uranium
U(VI)	uranium +6 or hexavalent uranium
UO_2	uraninite
UO_2^{2+}	uranyl
$UO_2(CO_3)_2^{2-}$	uranyl dicarbonate ion
$UO_2(CO_3)_3^{4-}$	uranyl tri-carbonate ion
USACE	U.S. Army Corps of Engineers
USC	United States Code

ACRONYMS AND ABBREVIATIONS (continued)

UU/UE	unlimited use/unrestricted exposure
VOC	volatile organic compound
WAC	waste acceptance criteria
yd^3	cubic yards

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	264.172	gallons
cubic inches	16.3870	cubic centimeters	cubic centimeters	0.061023	cubic inches
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	28,349,523	micrograms	micrograms	3.527396E-08	ounces
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

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EXECUTIVE SUMMARY

This executive summary provides an overview of the *Feasibility Study* (FS) *Report for the Former Guterl Specialty Steel Corporation* (previously known as the Simonds Saw and Steel Company) Formerly Utilized Sites Remedial Action Program (FUSRAP) Site, in Lockport, New York. The U.S. Army Corps of Engineers (USACE) prepared the FS to serve as a principal source of information for decision making at the Guterl Site in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended, 42 United States Code 9601 et seq., and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300. The FS presents the identification, development, and detailed analysis of remedial alternatives to address FUSRAP-related constituents of concern (COCs) on the Guterl Site. Site documentation may be found in the administrative record file for this project on the project website at: https://www.lrb.usace.army.mil/Missions/HTRW/FUSRAP/Guterl-Steel-Site/Guterl-Admin-Record/; at the Lockport Public Library, 23 East Avenue, Lockport, New York 14094; and by appointment by calling 1-800-833-6390, at the USACE Public Information Center, 1776 Niagara Street, Buffalo, New York 14207.

ES.1 PROJECT BACKGROUND

The Guterl Site is located in the City of Lockport, New York, approximately 32 kilometers (20 miles) northeast of Buffalo, New York. From 1948 to 1952, the Guterl Site was used by Simonds Saw and Steel (referred here within as “Simonds”) to process uranium metal and, to a lesser extent, thorium metal for the New York Operations Office of the Atomic Energy Commission (AEC). The AEC is the predecessor to the U.S. Department of Energy (DOE) and Nuclear Regulatory Commission. Simonds continued the work from 1952 to 1956 under a subcontract to National Lead of Ohio.

In 1966, Simonds was acquired by the Wallace-Murray Corporation (Delaware Secretary of State, 1966). The Wallace-Murray Corporation continued to operate the plant as a specialty steel mill until 1978, when the Guterl Specialty Steel Corporation acquired the property (Niagara County Clerk’s Department, 1978).

In 1982, the Guterl Specialty Steel Corporation filed for Chapter 11 bankruptcy protection in the U.S. Bankruptcy Court for the Western District of Pennsylvania (this was changed to a Chapter 7 bankruptcy in 1990). In 1984, using industrial development bonds received through the Niagara County Industrial Development Agency, the Allegheny Ludlum Corporation purchased the Guterl Specialty Steel Corporation assets at an auction (U.S. Bankruptcy Court, 1984). The purchase included all of the Guterl Specialty Steel Corporation property, with the exception of 3.6-ha (hectare) (nine acres [ac] of land, later known as the Excised Area, and equipment utilized during AEC-related operations at the Guterl Site. As a result, the Excised Area and equipment therein remains under ownership of Guterl Specialty Steel Corporation (a Chapter 7 bankrupt corporation).

In 1996, the Allegheny Ludlum Corporation merged with Teledyne Incorporated to form Allegheny Technologies Incorporated (ATI). The Guterl Site, with the exception of the Excised

Area and equipment within the excised area buildings, is currently owned and operated by ATI under the name ATI Specialty Materials. In May 2000, the DOE declared the Guterl Site eligible for FUSRAP.

The approximately 28-hectare (ha) (70-ac) site is bordered by Ohio Street on the south and east, residential and commercial properties to the north, and New York State Route 93 on the west. The Erie Canal is south-southeast of the Guterl Site boundary. For FS purposes the Guterl Site is grouped into two areas:

- The 24.5-ha (60.6-ac) ATI Specialty Materials (formerly Allegheny Ludlum Corporation) property. This includes four buildings constructed after AEC activities ended. Building 24 is owned and actively used by ATI. This area includes a 3.5-ha (8.6-ac) inactive hazardous waste disposal site, owned by ATI Specialty Materials, in the northwest corner of the site. This area is classified as a New York State Department of Environmental Conservation (NYSDEC) inactive hazardous waste disposal site (NYSDEC, 2003).
- The 3.6-ha (9-ac) excised property (also referred to as the "Excised Area") owned by Guterl Specialty Steel. This includes nine buildings (the buildings are numbered 1, 2, 3, 4/9, 5, 6, 8, and 35) that existed during the AEC activities. They are in the southeast corner of the site.

The Guterl Site is zoned for industrial use, as shown in the Niagara County land use map (Figure 1-2), and is anticipated to remain so in the future.

During the remedial investigation (RI) performed in 2007 and a follow-up data gap investigation performed in 2011, the USACE investigated the on-site buildings, surface and subsurface soil, on-site surface water and sediment, and on-site and off-site groundwater. In addition, the USACE collected seeps, surface water, and sediment samples from the Erie Canal. The results of the investigations confirmed the presence of FUSRAP-related contaminants in several of the buildings, soil, groundwater, and seeps that posed a potential human health risk if exposure were to occur.

ES.2 MEDIA AND CONSTITUENTS OF CONCERN

The FUSRAP-related COCs were identified for the Guterl Site in the human health risk assessment prepared as part of the RI. By media, the COCs for soil and buildings include thorium (^{232}Th) and uranium (^{234}U, ^{235}U, and ^{238}U); the COC for groundwater is limited to total uranium. Thorium and radium are not COCs for groundwater because the RI concluded these analytes are at background levels in groundwater. No potential ecological risks were found.

ES.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The identification of applicable or relevant and appropriate requirements (ARARs) is an integral part of the FS process. Section 3.3 and Appendix K contain the detailed evaluation of all potential ARARs.

As a result of this evaluation, USACE identified the following federal regulations as ARARs for the Guterl Site:

- 10 CFR 20, Subpart E: Radiological Criteria for License Termination
    - Section 20.1402: Radiological Criteria for License Termination: radiological criteria under unrestricted conditions

- 40 CFR 141 National Primary Drinking Water Regulations
    - Section 141.66: Maximum Contaminant Levels (MCLs) for Radionuclides

ES.4 SPECIFIC REMEDIAL ACTION OBJECTIVES

The remedial action objectives (RAOs) developed in this FS address soil, building materials and contents, as well as groundwater. The RAOs for the Guterl Site will provide for long-term protection of human health and the environment. To provide this protection, USACE developed media-specific ARAR-based preliminary remediation goals (PRGs). These objectives are based on the media of concern, COCs, exposure routes, receptors, and to define an acceptable contaminant concentration for the long-term protection of receptors. The PRGs and soil background concentrations are discussed in detail in Section 3.5. The RAOs developed for the site are as follows:

- Prevent exposure to uranium and ^{232}Th in soil and buildings; and uranium in groundwater; such that a construction worker does not receive a total effective dose exceeding 25 mrem/yr above background from all pathways.
- Prevent human ingestion of groundwater that exceeds the uranium MCL of 30 micrograms per liter (µg/L).

Preliminary Remediation Goals (PRGs) for Radionuclides in Soils

COC	Chemical Abstract Services Registry Number	Weighted Average Site Background Concentration	PRG-CW Construction Worker	PRG-GW Groundwater Protection
^{232}Th[a]	7440-29-1	0.644 pCi/g	6.6 pCi/g	Not separately defined[d]
^{238}U[b]	7440-61-1	0.74 pCi/g	23 pCi/g	3.66 pCi/g
Total U[c]	N/A	N/A	69 mg/kg	11 mg/kg

Notes: Values represent minimum of Residual RADioactivity (RESRAD) calculated PRG at Years 0 or 1,000 (year of peak dose per nuclide group). Based on 10 CFR 20.
N/A: Not Applicable
Total U: total uranium
mg/kg: milligrams per kilogram
pCi/g: picocurie(s) per gram (amount of radioactivity)

[a] PRGs for ^{232}Th include ^{228}Ra and ^{228}Th contribution to dose at time zero.
[b] A conversion factor of 0.333 was used to convert uranium mass to ^{238}U activity.

[c] PRG for Total U includes contribution to dose from ^{234}U, ^{235}U, and ^{238}U, assuming natural abundance of uranium isotopes (in ratio of ^{234}U: ^{235}U: ^{238}U, 1:0.046:1).

[d] Removal of soil that exceeds the ^{238}U PRG-GW will include the removal of the collocated soil with activity concentrations that exceed the ^{232}Th soil PRG-CW.

The USACE Buffalo District developed project-specific derived concentration guideline levels (DCGLs) for the buildings (Appendix H). These DCGLs are the measured surface contamination concentrations in disintegrations per minute per 100 square centimeters (cm^2) that will result in 25 mrem/yr dose limit to the critical group (i.e., the construction worker). The DCGLs are in Table 3-2a and discussed in detail in Section 3.5.3.

Project-Specific Derived Concentration Guideline Levels

	DCGL[a]	
	Total[b]	**Removable**
Alpha (α) dpm/100 cm^2	2,391	240
Beta (β) dpm/100 cm^2	2,515	252

[a] DCGLs are derived in Appendix H. dpm: disintegrations per minute.

[b] Fixed plus removable contamination (as measured by a static measurement or scan).

ES.5 REMEDIAL ALTERNATIVES

The USACE identified media-specific alternatives for soil, buildings, and groundwater by combining general response actions (GRAs), technology types, and process options retained from the screening processes. The media-specific alternatives were then combined to develop site-wide alternatives that consider all media at the site. The alternatives should ensure adequate protection of human health and the environment, achieve RAOs, meet ARARs, and preferably permanently and significantly reduce the volume, toxicity, and/or mobility of site-related contaminants, as appropriate. The following three site-wide alternatives were identified in this FS to be carried forward for consideration.

Site-Wide Alternative 1—No Action

Under this alternative, no action would be taken for buildings, soil, or groundwater/seeps impacted at the site. Since no actions are taken, it is not considered protective of human health and the environment. However, the no-action alternative is carried over as a baseline for comparison to the other alternatives, as required by the NCP [40 CFR §300.430(e)(6)]. The groundwater model developed for this FS predicts it will take more than 1,000 years for the uranium concentrations in groundwater to reach the MCL.

Site-Wide Alternative 2—Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35; Complete Soil Removal to Soil PRG—GW and Off-Site Disposal; Monitored Natural Attenuation with Environmental Monitoring

Under this alternative, Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35 would be dismantled. The dismantlement of Building 24 and the remediation of underlying soils will be conducted at the time of the site-wide remedial action with property owner permission to dismantle the building.

All buildings except Building 24 are available for dismantlement and removal upon commencement of the remedial action. Building 24 is currently owned and utilized by ATI and the dismantlement of Building 24 and the remediation of underlying soils is intended to occur at the time of the site-wide remedial action with property owner's consent. If Building 24 is not available or the property owner does not consent to its dismantlement at the time of the site-wide remedial action the inaccessible underlying soil and Building 24 would remain while the other buildings and contaminated soil are removed. If Building 24 becomes available prior to the completion of the site-wide remedial action then it would be dismantled and underlying soil removed at that time. Soils impacted above the soil PRG-GW (11 milligrams per kilogram [mg/kg] total uranium [equivalent to 3.66 pCi/g ^{238}U] and 6.6 pCi/g for ^{232}Th), a soil cleanup level developed to protect continued impacts to groundwater above the MCL for uranium, would be removed. Building materials and impacted soils would then be disposed of off site. Uranium in groundwater would be addressed through monitored natural attenuation (MNA). The groundwater model predicts that the concentrations in the groundwater below the site will achieve the MCL in approximately 120 years. Environmental monitoring would be used to document the performance of this alternative, which includes collecting groundwater and seep samples.

Site-Wide Alternative 3—Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35; Complete Soil Removal to the Soil PRG-GW and Off-Site Disposal; Groundwater Recovery Using Extraction Wells and a Rubblized Trench with *Ex Situ* Treatment, with Environmental Monitoring

Under this alternative, the dismantlement of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35, as well as limited decontamination of the building material/contents would be performed. All buildings except Building 24 are available for dismantlement and removal upon commencement of the remedial action. Building 24 is currently utilized by ATI and the dismantlement of Building 24 and the remediation of underlying soils is intended to occur at the time of the site-wide remedial action with property owner's consent. If Building 24 is not available or the property owner does not consent to its dismantlement at the time of the site-wide remedial action the inaccessible underlying soil and Building 24 would remain while the other buildings and contaminated soil are removed and the groundwater treatment and recovery system is installed. If Building 24 becomes available prior to the completion of the site-wide remedial action then it would be dismantled and underlying soil removed at that time. Soils impacted above the soil PRG-GW (11 milligrams per kilogram [mg/kg] total uranium and 6.6 pCi/g for ^{232}Th) would be removed. Building materials and impacted soils would then be disposed of off site. Uranium in groundwater would be addressed through groundwater recovery using a series of vertical extraction wells and a rubblized trench along the southern excised property boundary combined with *ex situ* treatment and off-site disposal. The groundwater model predicts it will take approximately 30 years for the uranium concentrations in groundwater to achieve the MCL. Environmental monitoring would be used to document the performance of this alternative, which includes collecting groundwater and seep samples.

Site-Wide Alternative 4—Decontamination of Building 1; Dismantlement and Off-Site Disposal of Buildings 2, 3, 4/9, 5, 6, 8, and 24; Complete Soil Removal to the Soil PRG-CW and Off-Site Disposal; Monitored Natural Attenuation with Environmental Monitoring

Under this alternative, Building 1, which has limited portions of the structure impacted, will be decontaminated and not dismantled. Buildings 2, 3, 4/9, 5, 6, 8, and 24 would be dismantled, and limited decontamination of the buildings/contents would be performed. Building 1 would be decontaminated and all interior contents and materials above the DCGLs would be disposed off site. The soil underlying Building 1 and Building 35 are not above the soil PRG-CW, therefore the buildings will not be dismantled and no underlying soil will be excavated. Additionally, the contents and surfaces of Building 35 are not above the DCGLs; therefore, Building 35 is not addressed under this alternative. All buildings except Building 24 are available for dismantlement and removal upon commencement of the remedial action. Building 24 is currently utilized by ATI and the dismantlement of Building 24 and the remediation of underlying soils is intended to occur at the time of the site-wide remedial action with property owner's consent. If Building 24 is not available or the property owner does not consent to its dismantlement at the time of the site-wide remedial action the inaccessible underlying soil and Building 24 would remain while the other buildings and contaminated soil are removed. If Building 24 becomes available prior to the completion of the site-wide remedial action then it would be dismantled and underlying soil removed at that time. Soils impacted above the Soil PRG-CW (23 pCi/g for ^{238}U and 6.6 pCi/g for ^{232}Th), a soil cleanup level developed to be protective of the construction worker, would be removed. Building materials and impacted soils would then be disposed off site. Uranium in groundwater would be addressed through MNA. The groundwater model developed for this FS predicts that the groundwater concentrations in the groundwater below the site will achieve the MCL in approximately 660 years. Environmental monitoring would be used to document the performance of this alternative, which includes collection of groundwater and seep samples.

ES.6 COMPARISON OF REMEDIAL ALTERNATIVES

These alternatives are compared against the nine evaluation criteria specified in the NCP. These nine criteria are grouped into three categories: threshold, balancing, and modifying criteria. The threshold criteria include overall protection of human health and the environment and compliance with ARARs. The balancing criteria include long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; short-term effectiveness; implementability; and cost. The modifying criteria include state acceptance and community acceptance. The modifying criteria are not evaluated in this FS, but will be evaluated after we receive state and public comments on the preferred alternative in the upcoming proposed plan (PP). A summary of the analysis of each alternative against the threshold and balancing criteria is presented in Table ES-1.

ES.7 NEXT STEPS

Based on the results of the FS, USACE will develop a PP that will identify the preferred remedy to address FUSRAP-related COCs at the Guterl Site. Public input on the preferred alternative is paramount in the selection process, and USACE will invite the public to comment. Based on comments received, USACE will decide to progress with the preferred alternative, modify the preferred alternative, or select another alternative before continuing. Responses to public comments will be included in the record of decision (ROD), where the final remedy will be selected, presented, and formalized.

Table ES-1: Comparison of Site-Wide Remedial Alternatives at the Guterl Site

NCP Evaluation Criteria	Site-Wide Alternative 1	Site-Wide Alternative 2	Site-Wide Alternative 3	Site-Wide Alternative 4
Threshold Criteria				
Overall Protection of Human Health and the Environment	Not Protective	Protective	Protective	Protective
Compliance with ARARs	Not Compliant	Compliant	Compliant	Compliant
Balancing Criteria				
Long-term Effectiveness and Permanence	Low	High	High	Moderate
Reduction in Toxicity, Mobility, and Volume Through Treatment	Low	Low	Moderate	Low
Short-term Effectiveness	High	Moderate	Moderate	Moderate
Implementability	High	Moderate	Low	High
Cost				
Capital Cost (non-discounted)	$0	$180.9 M	$189.3 M	$104.4 M
Present Worth Operations and Maintenance Cost	$0	$5.2 M	$16.3 M	$5.2 M
Total Present Worth Cost	$0	$186.1 M	$205.6 M	$109.7 M

Note:

- *High* represents a favorable rating for the specific criteria whereas *Low* represents the least favorable rating.
- Present Worth discount rate used is 3.5%.
- M=million
- Site-Wide Alternative 1–No Action
- Site-Wide Alternative 2–Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35; Complete Soil Removal to Soil PRG-GW and Off-Site Disposal; Monitored Natural Attenuation with Environmental Monitoring.
- Site-Wide Alternative 3–Dismantlement and Off-site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35; Complete Soil Removal to the Soil PRG-GW and Off-Site Disposal; Groundwater Recovery Using Extraction Wells and a Rubblized Trench with *Ex Situ* Treatment, with Environmental Monitoring.
- Site-Wide Alternative 4–Decontamination of Building 1; Dismantlement and Off-Site Disposal of Buildings 2, 3, 4/9, 5, 6, 8, and 24; Complete Soil Removal to the Soil PRG-CW and Off-Site Disposal; Monitored Natural Attenuation with Environmental Monitoring.

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1.0 INTRODUCTION

CB&I Federal Services LLC (CB&I), working in collaboration and under contract (Contract Number W912QR-08-D-0013, Delivery Order No. DN03) with the United States (U.S.) Army Corps of Engineers (USACE) Buffalo District, prepared this *feasibility study* (FS) for the former Guterl Specialty Steel Corporation Formerly Utilized Sites Remedial Action Program (FUSRAP) Site (previously known as the Simonds Saw and Steel Company [Simonds]).

FUSRAP was initiated in 1974 to identify, investigate, and if necessary, clean up or control sites throughout the United States that had been contaminated as a result of the nation's early atomic weapons and energy programs during the 1940s, 1950s, and 1960s. Activities conducted by the Manhattan Engineer District from 1942 through 1946 and the Atomic Energy Commission (AEC) from 1947 through 1975 are eligible for FUSRAP. The Manhattan Engineer District and AEC were both predecessors of the DOE. The DOE declared the Guterl Site eligible for FUSRAP in May 2000 because the facility was used for foundry work on uranium and thorium metal in support of the AEC.

The Energy and Water Development Appropriations Act for Fiscal Year 1998 Public Law 105-62, signed October 13, 1997, transferred responsibility for the administration and execution of FUSRAP from the DOE to USACE. USACE executes FUSRAP in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended, Title 42 of the United States Code (USC), Chapter 103, and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), Title 40 of the Code of Federal Regulations (CFR), Part 300 (40 CFR 300). The USACE Buffalo District is the lead federal agency responsible for CERCLA actions at the Guterl Site.

1.1 PURPOSE AND SCOPE OF THE FEASIBILITY STUDY REPORT

The purpose of this FS is to document the rationale and procedures to identify, develop, screen, and evaluate a range of remedial alternatives to address impacted media from historic AEC activities at the Guterl Site. The remedial alternative evaluations are based on the nature and extent of contamination and site-specific conditions as documented in the *Remedial Investigation (RI) Report* (USACE, 2010), *Data Gap Investigation Technical Memorandum* (USACE, 2012b), and *Supplemental Sampling Technical Memorandum* (USACE, 2013).

This FS, developed in accordance with the U.S. Environmental Protection Agency (EPA) *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA*, is organized as follows:

- ***Section 1.0 – Introduction*** provides the purpose, scope, and organization of this report.
- ***Section 2.0 – Background Information*** summarizes site background information and previous investigations and results.
- ***Section 3.0 – Identification and Screening of Technologies*** introduces the remedial action objectives (RAOs) and general response actions (GRAs) for this FS. This section also presents the initial identification and screening of technology types, and process options under consideration for site remediation.

- ***Section 4.0 – Development of Remedial Alternatives*** combines the technology/process options remaining from the screening performed in Section 3.0 to provide alternatives for remediation to address the RAOs.
- ***Section 5.0 – Detailed Analysis of Alternatives*** evaluates remedial action alternatives developed in Section 4.0 according to seven of the nine remedy selection criteria specified in the NCP.
- ***Section 6.0 – Comparison of Alternatives*** compares the alternatives against each other with respect to the threshold criteria and primary balancing factors.
- ***Section 7.0 – Conclusions*** provides the conclusions for this FS based on the development, detail analysis and comparison of alternatives.
- ***Section 8.0 – References*** lists the applicable references cited in this FS.

2.0 BACKGROUND INFORMATION

This section summarizes the physical characteristics of the Guterl Site, site history, and previous investigations and results.

2.1 SITE DESCRIPTION

The Guterl Site is located in the City of Lockport, Niagara County, New York, approximately 32 kilometers (20 miles) northeast of Buffalo, New York. The approximately 28-hectare (ha) (70-acre [ac]) site is bordered by Ohio Street on the south and east, residential and commercial properties to the north near New York State Route 31 (West Avenue), and New York State Route 93 on the west (Figure 1-1). To the west-southwest of New York State Route 93, there is an active dolostone quarry. The Erie Canal is south-southeast past the Guterl Site boundary. For remediation management purposes the Guterl Site is combined into two areas:

- The 24.5 ha (60.6 ac) property currently owned and operated by ATI Specialty Materials (formerly Allegheny Ludlum Corporation). This area includes a 3.5 ha (8.6 ac) inactive hazardous waste disposal site in the northwest corner of the site owned by ATI Specialty Materials.[1]
- The 3.6 ha (9 ac) excised property (known as the "Excised Area") in the southeast corner of the site owned by Guterl Specialty Steel.

ATI Specialty Materials operates an active specialty materials manufacturing facility in the southwest portion of the 24.5-ha (60.6-ac) ATI Specialty Materials property. The 3.5-ha (8.6-ac) inactive hazardous waste disposal site (NYSDEC site #932032) is no longer operated as a waste disposal area (since 1981). The 3.6-ha (9-ac) Excised Area that contains the buildings once used to roll uranium metal is abandoned with chain link security fence surrounding the inactive buildings.

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[1] The remedial investigation for the Guterl Site also considered a 1.76-acre parcel immediately north of the inactive hazardous disposal site. This parcel, known as the Lombardi property, was not carried forward into the feasibility study because it was determined not to be impacted by FUSRAP-related material above RI screening levels.

As shown in Figure 1-1, there are currently 14 buildings located on the Guterl Site; nine abandoned buildings in the Excised Area (Buildings 1, 2, 3, 4/9, 5, 6, 8, and 35) and five buildings owned by ATI Specialty Materials (Buildings 14, 17, 24, 37, and 47).

Topography at the Guterl Site is relatively flat, with a relief of approximately 7.7 meters (m) (25 ft) from the north side of the site at New York State Route 31 (elevation 189 m [620 ft]) to the south side of the Guterl Site at New York State Route 93 (elevation 181 m [595 ft]).

The vegetated areas on the Guterl Site contain herbaceous, scrub/shrub, and woodland habitats. The northern portion of the Guterl Site contains large swaths of old fields and is currently strewn with construction debris (e.g., concrete, wood, etc.). In the southwest portion of the Guterl Site there are limited wooded and scrub/shrub area habitats. Other small habitats of unmanaged open areas occur randomly in the eastern portion of the Guterl Site around the abandoned buildings and a rail spur.

The Guterl Site is not located in a 1% or a 0.2% floodplain and no New York State or federally regulated wetlands have been identified at the Guterl Site. Unregulated, isolated, seasonal wetlands were noted within the Guterl Site and vary from scrub/shrub and forested wetlands to small, ephemeral wet depressional areas. The Guterl Site does not contain any ponds or streams and has no visible natural connection to other surface water bodies, including the Erie Canal south-southeast of the Guterl Site. A culvert pipe connects the eastern and western drainage ditches along the New York State Route 93 Bypass in the southwestern corner of the site, although the culvert did not appear to be functioning properly at the time of the RI, as evidenced by ponded water on both sides of the culvert pipe.

Characterization data collected during the RI and the data gap investigation (DGI) were used to develop a revised conceptual site model (CSM) of the Guterl Site. The CSM is a nonnumeric model that consolidates the geologic, hydrologic, analytical, and surface water data into a unified interpretation. Individual elements used to develop the CSM of the Guterl Site are discussed in detail in Section 2.1.4 (Site Geology), Section 2.1.6 (Site Hydrogeology), Section 2.1.7 (Surface Water), and Section 2.4 (Nature and Extent of Contamination). In addition to the on-site data, off-site features (such as the Erie Canal and the quarry) influencing contaminant fate and transport on the Guterl Site were included in the CSM. The CSM is presented graphically in Figure 2-8.

2.1.1 CURRENT AND POTENTIAL FUTURE LAND USE

Land use near the Guterl Site is mixed, consisting of private residences, small farms, and light industries as shown in Figure 1-2. The Guterl Site is currently zoned for industrial use, as shown in the Niagara County land use map (Figure 1-2), and is anticipated to remain so in the future. Land use around the site can be described as:

- To the north of the Excised Area, along Simonds Street, land use includes light industrial/warehouse operations.
- To the east of the former railroad right-of-way is a New York State Department of Transportation maintenance yard (abuts northern half of parcel) and private residences (abut southern half of parcel).

- To the west of the former railroad right-of-way, land use consists of light industry (concrete batch plant operations and warehousing).
- To the west of the operating facility, west-southwest of the New York State Route 93 bypass, there is an active dolostone quarry.
- To the south-southeast, unused open space and the Erie Canal separates the Guterl Site from private farmlands.

2.1.2 SITE BUILDINGS

This section discusses the current conditions and structural integrity of the buildings at the Guterl Site that are included in this FS. Buildings on the Guterl FUSRAP site are not sequentially numbered but are divided into the Excised Area and the active ATI property. Buildings 1, 2, 3, 4/9, 5, 6, 8, and 35, are located in the Excised Area and are abandoned. Building 24 is located on the property of ATI Specialty Materials and is actively used. The buildings that are part of the FUSRAP site are Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35. Buildings 14, 17, 37, and 47 are on the property of ATI Specialty Materials and an active part of the ATI Specialty Materials facility, but are not included in this FS. Figure 1-1 is the site plan that identifies the buildings and boundaries.

Building 14 first appears in aerial photographs in 1958, after AEC operations ceased. Building 14 was not used during AEC operations and therefore not included as part of this study. Buildings 37 and 47 existed during AEC operations, but were not surveyed in the Oak Ridge Institute for Science and Education (ORISE) 1999 investigation. The building use history and exterior screening suggested the presence of AEC-related constituents was unlikely; therefore Buildings 37 and 47 are not included in the USACE FS.

2.1.2.1 BUILDING DESCRIPTION

2.1.2.1.1 Building 1

Building 1 was originally built in 1913 and has a floor area of approximately 820 square meters (m^2) (8,800 square feet [ft^2]). The building is constructed of masonry exterior walls with a metal interior frame system. The main floor is constructed of thin gauge steel over trusses; in some places plywood has been used to bridge weak areas of the floor. Building 1 contains a flooded, lower level/basement; the basement walls extend several feet above grade, thus creating an elevated main floor to the building as compared to the other buildings on the Guterl Site. Vehicle access ramps to the basement are located on the east side (southern third) and the north end of the building.

2.1.2.1.2 Building 2

Building 2 was originally built in 1914 and has a floor area of approximately 6,400 m^2 (68,900 ft^2). The building is constructed of masonry exterior walls with a metal interior frame system. Floor materials include soil, concrete, and brick. Building 2 is subdivided into three large segments: south, center, and north. The north end contains several large chemical vats formerly used in non-AEC manufacturing processes. There are smaller rooms (offices, lockers, laboratories) located on the lateral walls of each segment. A trolley rail connecting Building 3 with Building 2 is located through the west side of the center section. Building 2 also contains boilers, furnaces, silos, benches, as well as miscellaneous wood, metal, and paper debris.

2.1.2.1.3 Building 3

Building 3 was built in 1920 and has a floor area of approximately 6,300 m^2 (67,400 ft^2). Building additions occurred in 1946 and 1951. The building is constructed of masonry exterior walls with a metal interior frame system. Floor materials include dirt, concrete, and brick. A trolley rail connecting Building 3 with Building 2 is located through the east side of the center section. There is a small room subdivided off the south end of the building that may have been used for secure storage or as supervisory offices. The south end, west side, of Building 3 is fully open to Building 4/9; i.e., there is no wall separating the direct connection to the adjoining building. The same condition exists for adjoining Building 6 and Building 8, located at about the midpoint of the west side of Building 3. There are several large floor trenches present within the building, some of which were covered with plywood or thin gauge steel. Several furnaces and associated exhaust stacks remain; the stacks are typically severely deteriorated, up to and including complete collapse. Building 3 also contains steel cylinders, hoods, grinders, cabinets, as well as miscellaneous wood, metal, and paper debris.

2.1.2.1.4 Buildings 4/9

Buildings 4 and 9 are commonly referred to together because there is no internal partitioning between the buildings; i.e., the entire complex appears to be a single, large building. Available records indicate an original construction date of 1920 for Building 4, with construction of an addition in 1951. Building 9 was built in 1918 with an addition dated 1951. The combined Building 4/9 complex has a floor area of approximately 3,400 m^2 (47,400 ft^2). The building is constructed of masonry exterior walls with a metal interior frame system. Floor materials include dirt, concrete, and brick. The roof is of a “saw tooth” design, with vertical panels of glass – many of which have fallen into disrepair and the roof is no longer weatherproof. The east end of the building is completely open to Building 3. A rail car accessibly loading dock exists at the west end of the building. Several furnaces and associated exhaust stacks remain; the stacks are typically severely deteriorated, up to and including complete collapse. Building 4/9 also contains fume hoods, steel equipment, an overhead crane, saws, an electrical transformer, as well as miscellaneous wood, metal, and paper debris. Due to the availability of light, soil, and moisture, portions of the building contain ferns and moss.

2.1.2.1.5 Building 5

Available records indicate Building 5 was constructed in 1918 with a floor area of approximately 350 m^2 (3,770 ft^2). The building is constructed of a metal frame system. The building is located in an alcove with limited lateral clearance created by Building 4/9 (south), Building 3 (east), and

Building 6 (north). The floor of the building consists of a suspended steel grate walkway along the center aisle of the building; a subfloor area of unknown dimensions exists below the walkway.

2.1.2.1.6 Building 6

Building 6 was built in 1918 and has a floor area of approximately 1,400 m^2 (15,090 ft^2). Building 6 was one of two main buildings (along with Building 8) used to process AEC materials. The building is constructed of masonry exterior walls with a metal interior frame system. Floor materials include soil, concrete, brick, and metal plate. The roof is of a “saw tooth” design, with vertical panels of glass – many of which have fallen into disrepair and the roof is no longer weatherproof. The east end of the building is open to Building 3. The north side of the building is open to Building 8. The building contains numerous items of machinery, including furnaces and a rolling mill.

2.1.2.1.7 Building 8

Building 8 was built in 1918 and has a floor area of approximately 2,600 m^2 (27,880 ft^2). Building 8 was one of two main buildings (along with Building 6) used to process AEC materials. The building is constructed of masonry exterior walls with a metal interior frame system. Floor materials include soil, concrete, brick, and metal plate. The roof is of a “saw tooth” design, with vertical panels of glass—many of which have fallen into disrepair and the roof is no longer weatherproof. A loading dock exists at the west end of the building. The east end of the building is open to Building 3. The south side of the building is open to Building 6. The building contains numerous items of machinery, including furnaces, rolling mills, and cooling beds.

2.1.2.1.8 Building 17

Building 17 is located outside of the Excised Area and is considered to be part of the active facility of ATI Specialty Materials. Building 17 is pictured in aerial photos beginning in 1938 and historical records indicate that a metallurgy laboratory was formerly housed in the second floor of the building. The laboratory was found to be present but abandoned at the time of the RI. The first floor is used as office space by ATI Specialty Materials.

2.1.2.1.9 Building 24

Building 24 is not part of the Excised Area but is included in this FS because the southwest portion of the building was constructed in 1941 and was used during the time AEC support operations were being performed. A small addition was built in 1951 onto the north end of the original 1941 structure. The addition of what is currently the southeast portion of the building was completed in 1959; this addition “squared off” the 1941-1951 footprint, extending Building 24 from Building 8 to the north end of the 1951 addition. A final northern addition was completed in 1966 that matched the full width of the then-existing building. The building has been subdivided into southwest, southeast, and northern evaluation areas to account for the possible effects of building construction and use over time.

Building 24 is an active warehouse facility for ATI Specialty Materials. The floor of the building is wall-to-wall concrete with periodically-spaced, shallow, concrete-lined trenches covered with steel grate. The windows, walls, and roof are well-maintained.

2.1.2.1.10 Building 35

Building 35 was built in 1950 and has a floor area of approximately 305 m^2 (3,280 ft^2). The building is constructed of masonry exterior walls with a metal interior frame system. The floor consists of wall-to-wall concrete. Building 35 contains shelves, an overhead crane, and miscellaneous debris.

2.1.2.2 STRUCTURAL INTEGRITY

As part of the RI, a structural survey of the Excised Area buildings was conducted in February 2006 for the purpose of assessing whether the buildings were sufficiently stable for RI-related investigations without undue risk to personnel. The assessment determined that the structural condition of the buildings was sufficient for RI-related investigations to proceed. The 2006 inspection confirmed the findings of a structural inspection USACE conducted in October 2000 as part of the preliminary assessment (PA)/site inspection (SI).

The USACE conducted a structural survey (USACE, 2013a) on November 5, 2013 to evaluate shoring requirements for potential remedial action activities. The survey concluded that Building 24 may have to be shored with precautions taken to protect the foundation if the adjacent building (Building 8) is deconstructed. The survey also determined that shoring and foundation protection may be necessary if soil excavation were to be conducted beneath Building 35 if the building was not planned to be dismantled.

2.1.3 REGIONAL GEOLOGY

The Guterl Site is located in the Erie-Ontario lowlands physiographic province. Unconsolidated glacial deposits of till and lacustrine clay, silt, and sand overlie gently dipping sedimentary rocks throughout the area. The bedrock of this region is predominantly limestone, dolostone, and shale. Middle Silurian epoch dolomite and limestone formations of the Lockport Group directly underlie the glacial sediments in the area of the Guterl Site. Dolomite, shale, and limestone formations of the Clinton Group underlie the Lockport Group.

The uppermost bedrock formation underlying the Guterl Site has been identified as the Goat Island Dolostone Formation of the Lockport Group (NYSDEC, 2000). The Goat Island Dolostone is generally a light olive-gray to brownish-gray, medium to fine crystalline, thick to massive bedded dolostone with a sugary texture. Stratigraphically below the Goat Island Formation is the Gasport Formation of the Lockport Group. The Gasport Formation contains dolomitic limestone of blue to gray color, generally coarsely crystalline but with some fine crystalline layers. Bedding is massive with discontinuous shale partings and stylolites are common. This unit is underlain by the very finely crystalline, medium to dark gray in color DeCew Dolostone of the Clinton Group. The Rochester Shale of the Clinton Group, a dark bluish to brownish gray, calcareous shale with atypical argillaceous limestone layers, underlies the DeCew Dolostone (Tesmer and Bastedo, 1981; Brett et al., 1995).

2.1.4 SITE GEOLOGY

The subsurface lithology beneath the Guterl Site consists of unconsolidated soil and shallow weathered bedrock; both derived from glaciolacustrine deposits, glacial till and fill material. These layers are underlain by fractured dolomite, with the degree of fracturing decreasing with depth. The dolomite grades into a more competent shaly dolomite and eventually is underlain by shale bedrock. Native soils consist of silts and clays with varying amounts of sand and bedrock fragments and are less permeable as compared to the fill material. The fill material, where encountered, has been described as coal fragments, apparent ash and coke fragments, and brick or crushed stone. For discussion purposes in this document, these unconsolidated materials will be named the overburden soil. The overburden thickness in borings completed in 2011 ranged from 0.5 to 2.3 m (1.7 to 7.6 ft). The overburden is 4 to 5 m (13 to 15 ft) thick in the western area of the property and a location north of the north fence.

Underlying the overburden soil was a medium gray to light gray shallow weathered dolomite bedrock containing numerous horizontal fractures. Vugs, calcite-filled vugs, and voids were also found generally in the upper 8 to 9 m (25 to 30 ft) of bedrock. The fracture density in dolostone decreased with depth between 8 to 20 m (25 to 65 ft) below ground surface (bgs), which corresponds to the first main fracture zone that commonly lies about 10-11 m (~35 ft) bgs. Vertical and angled fractures were also identified. Many of the fractures were noted to be weathered and/or clay filled.

The lower portion of the bedrock, starting at depths of 6 to 8 m (20 to 25 ft) below the overburden and shallow weathered bedrock interface, is not weathered and has distinct fractures; however, the fracture density is lower than that in the shallow weathered bedrock and decreases with depth. This zone is called the first main fracture zone, and extends to a depth of approximately 12 m (40 ft) below the bottom of the shallow weathered bedrock. The first main fracture zone is underlain by shaly dolostone, and is estimated to be 6 to 9 m (20 to 30 ft) thick with few to no fractures. The shaly dolostone in turn is underlain by Rochester Shale.

Correspondingly, the rock quality designation increases with depth; it is a rough measure of the degree of jointing or fracture in a rock mass. A rock quality designation value of 80% was used to demarcate the boundary between the shallow weathered dolostone and the less fractured dolostone, which occurs at 8 to 9 m (25 to 30 ft) bgs (first main fracture zone). Dark gray shaly dolostone was encountered at depths of approximately 18 to 20 m (60 to 65 ft) bgs. The shaly dolostone is believed to transition into the Rochester Shale Formation at depths greater than 24 m (80 ft) bgs. The Rochester Shale formation was not encountered in the boreholes that were drilled to depths of 24 m (80 ft) bgs during the DGI.

The stratigraphic order at the site, starting from ground surface is summarized as follows:

- Overburden soil
- Shallow weathered bedrock (shallow groundwater)
- First main fracture zone (deep groundwater)
- Shaly dolostone (no monitoring wells installed)
- Rochester Shale (no monitoring wells installed)

Geologic cross sections were constructed using subsurface information from well installations on the Guterl Site. A cross section, which extends from the northwest corner of the Guterl Site and extends across the site boundary to the Erie Canal (northwest to southeast traverse), is shown on Figure 2-1.

2.1.5 REGIONAL HYDROGEOLOGY

Hydrogeologic studies completed in the Niagara Falls area provide regional information on the characteristics of fracturing and groundwater flow within rocks of the Lockport Group. The major water-bearing units in the Niagara region are in the bedrock above the Rochester Shale. Groundwater flow within the Lockport Group occurs primarily in secondary porosity features, such as weathered horizontal and vertical near-surface fractures, bedding planes, and regional vertical joints patterns (Olcott 1995, Eckhardt et al. 2006). The bedding planes, which transmit most of the water in the Lockport Group, are relatively continuous fracture planes parallel to the natural layering of the rock. The upper 3 to 8 m (10 to 25 ft) of this unit can be heavily weathered and often contain abundant bedding planes and vertical fractures enlarged by dissolution and glacial scour (Miller and Kappel 1987, Yager and Kappel 1987).

In the Niagara Falls area, weathered bedrock surface and horizontal fracture zones near stratigraphic contacts in the Lockport Group have been identified as principal water-bearing zones. Closely spaced horizontal fractures that are connected by high-angle vertical fractures have been observed. Hydraulic conductivity values in the literature vary between 0.001 to 170 m/day (1.2E-05 to 0.2 centimeters per second or 0.003 to 570 ft/day) and constant-head injection tests range from 0.06 to 60 m/day (6.9E-04 to 0.07 centimeters per second or 0.2 to 200 ft/day). The Lockport Dolomite produces well yields that vary up to 379 liters per minute (100 gallons per minute), with average rates of 114 liters per minute (30 gallons per minute) (Olcott 1995). The higher rates are derived from the upper part of the aquifer (shallow bedrock), whereas lower zones are less productive and average 27 liters per minute (seven gallons per minute). This is reflected in site permeability data and the distribution of the uranium plume dominantly in the upper productive zone. An over-pressured natural gas reservoir, which underlies the Lockport Group, restricts vertical flow of groundwater (Tepper, et.al., 1991; Yager, 1993).

2.1.6 SITE HYDROGEOLOGY

A portion of the precipitation that falls in the area as rain and snow infiltrates the ground and recharges the groundwater system before either discharging to the Erie Canal or migrating to the lower Lockport dolostone overlying the Rochester Shale Formation, where the groundwater flow direction has not been determined. The remainder of the precipitation is lost to the atmosphere through the processes of evaporation and transpiration through vegetation, or is surface water runoff towards the Erie Canal. Poor stormwater management promotes standing water and higher infiltration at the site. The infiltrating water moves vertically through the unsaturated overburden soil and weathered rock and then recharges the shallow groundwater.

Ground surface and the top of bedrock elevation are highest in the northern area of the Guterl Site and slope unevenly southward towards the Erie Canal. The groundwater table is fairly shallow and depths to water in the shallow bedrock wells during the August 2011 gauging event ranged from 1 to 3 m (3 to 10.5 ft) in the shallow weathered bedrock. Figure 2-2 represents the shallow groundwater wells at the site.

Water levels in the deep bedrock wells (first main fracture zone) are more variable than in the shallow bedrock and ranged from and to 0.2 to 10.8 m (0.6 to 35.4 ft) in the first main fracture zone of the dolostone. The shallow bedrock potentiometric surface map shows a generally southward flow direction with the highest groundwater elevations in the northern area of the Guterl Site (Figure 2-2). The groundwater flow directions are either towards the quarry or to the southeast towards the Erie Canal. The deep groundwater shows a similar pattern to the shallow groundwater. Figure 2-3 represents the deep groundwater wells at the site.

Monitoring wells have not been installed in the underlying shaly dolostone or Rochester Shale. Hydraulic conductivity values obtained for the shallow bedrock wells range from 8.5 x 10^{-6} cm/sec (0.024 ft/day) at MW-705D to 7.7 x 10^{-2} cm/sec (218 ft/day) at MW-3. Hydraulic conductivity values obtained for the deep bedrock wells range from 3.2 x 10^{-7} cm/sec (0.0009 ft/day at MW-711DD to 1.5 x 10^{-2} cm/sec (41.4 ft/day) at MW-712DD. The geometric mean hydraulic conductivities for shallow and deep wells are 3.5 x 10^{-3} cm/sec and 3.5 x 10^{-4} cm/sec (10 ft/day and 1 ft/day), respectively.

The site-specific hydraulic conductivity of the shallow bedrock zone reflects regional values noted in Section 2.1.5, which indicates the upper water-bearing zone of the Lockport Dolostone underlying the site can sustain well yields coincident with potable aquifer uses. This condition is verified using specific-yield estimations for a simulated production well, as described in Dricoll 1986. This method indicates that a 0.3 m (1.0 foot) diameter water well pumped for 365 days via a 15foot (4.6 m) deep well screen in the upper bedrock that has average hydraulic conductivity and specific yield (~0.1 based on bedrock coring logs of rock quality) would produce approximately 10 gallons per minute for domestic use, thus an exploitable groundwater resource.

Groundwater potentiometric surface maps prepared using the August 2011 gauging data are presented as Figures 2-2 and 2-3. Shallow bedrock groundwater elevation data from wells screened within the upper 7 m (23 ft) of bedrock were used to generate the map shown on Figure 2-2. Figure 2-3 presents potentiometric surface contours using data from the deep monitoring wells screened within the 9 to 12 m (29 to 40 ft) interval (deep bedrock wells). A groundwater divide oriented northwest to southeast originates in the northwestern area of the Guterl Site. West of the divide, the groundwater flow direction is towards the quarry. South and east of the divide, groundwater flow is to the southeast towards the canal. Vertical hydraulic gradients exist at some locations; at most locations the gradients show a slight downward flow component or are near-coincident (magnitude less than 0.003 m/m [0.01 ft/ft] is considered near-coincident).

2.1.6.1 GROUNDWATER SEEPS

Groundwater discharges, via seeps, to the Erie Canal. The seeps are located on the northern wall of the canal as shown in Figure 2-2. The elevations of the seeps are higher than the elevation of the base of the shallow weathered bedrock, indicating that groundwater from the shallow weathered bedrock may be discharging to the surface as seeps. From mid-November through April, the canal is not navigable and the water elevation in the canal is 3 to 3.7 m (10 to 12 ft) lower than the elevation during the May through mid-November navigation season. The movement of deep groundwater in the canal area has not been determined, yet the geologic logging of deep borings does not indicate viable water-bearing zones in the deeper bedrock. During the DGI, supplemental sampling and yearly environmental monitoring events, six general seep locations were identified. One of the off-site locations, near a former pump station, contains multiple seeps as shown in Figure 2-4. Seasonal variation in the number of seeps and discharge volume has been observed.

Access to the seeps is accomplished by boat during the navigable season. Pedestrian access to the area is difficult due to the steep terrain. During the nonnavigable season a "horse path," along the northern wall of the canal, is the only access point to the seeps. This path must be accessed through private property, located south of the Guterl Site. Due to their remote location, incidental exposure to the seeps is not anticipated.

2.1.7 SURFACE WATER

The Guterl Site does not contain surface water bodies such as ponds or streams, and there are no visible surface drainages that connect the site to the Erie Canal south-southeast of the site. Temporary surface water has been observed at the Guterl Site as stormwater runoff and as standing or ponded water resulting from undeveloped stormwater drainage patterns. Stormwater runoff is observed to move as sheet flow from topographic highs to topographic lows. Areas of standing water are seasonally influenced and are subject to evaporation or infiltration. More specific information regarding the Erie Canal is provided in the following section.

2.1.7.1 THE ERIE CANAL

The Erie Canal is approximately 90 m (300 ft) southeast of Ohio Street at the Guterl Site (Figure 1-1). The surface water elevation of the Erie Canal immediately south of the Guterl Site fluctuates by several feet due to seasonal control of the navigable water level (i.e., water elevation is lowered in winter and raised in summer), its location relative to the Lockport Locks to the northeast, and its confluence with Tonawanda Creek to the southwest (Tonawanda Creek provides the headwaters for the Erie Canal). During the normal navigational season from April through mid-November, the water elevation in the Erie Canal is 172.4 m (565.7 ft) above mean sea level (msl), as determined from the gauge reading at Lock 35, which is located approximately 2.82 km (1.75 miles) downstream of the Guterl Site. The canal bottom is 3.0 to 3.7 m (10 to 12 ft) below the water surface, at elevation 169.4 to 168.8 m (555.7 to 553.7 ft msl). From mid-November through April, the canal is not navigable and has an average of 0.6 m (2 ft) of water (Rick Manns, Erie Canal Corp., Telecommunication, September 2011).

In the area of the Guterl Site, the Erie Canal flows from west to east (i.e., from the Niagara River toward Lockport). From April 20 through November 20 the average flow is 0.6 m (2 ft) per second. From November 20 through April 20, the lower Erie Canal is dewatered (below the Lockport Locks between the bulkhead in Pendleton, New York, and the Genesee River) and there is no measurable flow. As a result, the flow from the west (i.e., in the area of the Guterl Site) through the Lockport Locks is also negligible.

2.1.8 CURRENT AND POTENTIAL FUTURE GROUNDWATER USE

The shallow groundwater flow is generally towards the southeast, towards the Erie Canal. No records indicate that groundwater is currently used in the area downgradient of the site. No functioning groundwater wells were identified in a well survey performed by the Niagara County Department of Health within a half-mile radius of the site (see Appendix C); it was confirmed the City of Lockport public water supplies the area. City of Lockport personnel informed USACE that the city has not received any requests for water well permits for new wells in the area. They also confirmed that when the public water supply was installed, the public was not given the option of retaining well water.

Groundwater discharges into surface waters of the Erie Canal via seeps on the cliff face of the escarpment, as shown in Figure 2-2. Since the groundwater seep locations are inaccessible, there is no current or reasonably anticipated future human exposure to the seep water.

Surface water from the Erie Canal may be used as an emergency back-up drinking water supply by the City of Lockport. The water intake is located downgradient of the Guterl Site, on the southern wall of the Erie Canal. The City of Lockport has indicated in recent discussions that water from the canal has not been used as a drinking water supply since 1997, and that its use in the future is very unlikely. Sections 2.4.5.1 and 2.4.6 of this FS, discuss the surface water sample results taken from the Erie Canal are below the MCL for drinking water.

To further determine the potential future usability of groundwater for drinking water purposes, an assessment of potability of the groundwater at the Guterl Site was considered using the following:

- Federal guidelines (Guidelines for Ground-Water Classification Under the U.S. EPA Ground-Water Protection Strategy [U.S. EPA, 1986]), which define "nonpotable," or Class III, groundwater aquifers as those that:
  - Contain more than 10,000 milligrams per liter (mg/L) total dissolved solids (TDS).
  - Yield less than 570 liters per day (L/day) (150 gallons per day [gpd]).
  - Are so contaminated by naturally occurring conditions (e.g., salinity) or broad-scale human activity not related to a specific contaminant source that cleanup is not practicable using treatment methods reasonably employed in public water-supply systems.
- New York Code of Rules and Regulations (NYCRR), which classifies all fresh groundwater as Class GA, for which potable water supply is the best usage (6 NYCRR 701.15). New York State classifies Class GSB saline groundwater, which is not usable for drinking water purposes, as that which has:
  - Chloride concentrations in excess of 1,000 mg/L.
  - TDS concentrations in excess of 2,000 mg/L.

As demonstrated in the following sections, which compare site data with the federal guidance and state regulations discussed above, groundwater at the Guterl Site is considered a potential source of drinking water for the purposes of this FS.

2.1.8.1 YIELD

Aquifer characterization conducted during the RI and supplemental sampling program included testing to estimate the *in situ* hydraulic conductivity of the shallow and deep bedrock aquifers. Two methods of slug testing were conducted—manual falling and rising head tests and pneumatic head tests. The slug tests were performed at 43 individual monitoring wells, 33 of which were shallow bedrock wells and 10 were deep bedrock wells.

The *in situ* hydraulic conductivity values for the shallow bedrock wells range from 0.0003 m/day (0.0009 ft/day) to 66.53 m/day (218.27 ft/day) with an average value of 8.21 m/day (26.93 ft/day). Hydraulic conductivity values for the deep bedrock wells range from 0.003 m/day (0.011 ft/day) to 12.6 m/day (41.4 ft/day) with an average value of 2.52 m/day (8.27 ft/day). In the shallow bedrock aquifer, the largest hydraulic conductivities were measured at monitoring wells MW-3, MW-9, and MW-711D (Figure 2-2) with values of 33.65 m/day (110.4 ft/day), 36.11 m/day (118.48 ft/day), and 66.52 m/day (218.27 ft/day), respectively. Monitoring wells MW-3 and MW-9 are in the eastern part of the Guterl Site (within the Excised Area) and MW-711D is south of the site boundary. In the deep bedrock aquifer, the largest hydraulic conductivity value was estimated at monitoring well MW-712DD (Figure 2-3) with a hydraulic conductivity of 12.62 m/day (41.4 ft/day). Monitoring well MW-712DD is located along the southeastern boundary of the site.

Site data indicate that shallow and deep groundwater at the Guterl Site is potentially capable of yielding rates greater than 570 L/day (150 gallons per day), specifically in areas with the highest measured hydraulic conductivity values. Based upon the federal guidelines discussed above, this would indicate that groundwater at the Guterl Site can be classified as a Class II B aquifer, a potential source of drinking water.

2.1.8.2 TOTAL DISSOLVED SOLIDS

The TDS data collected during the RI and supplemental sampling program indicate that groundwater at the Guterl Site in general exhibits moderate salinity. In the shallow bedrock aquifer the average TDS concentration was calculated at each monitoring well location; the concentrations range from 317 mg/L to 4,183 mg/L. In the shallow bedrock aquifer at MW-26, there was one detected TDS concentration of 13,000 mg/L, exceeding the 10,000 mg/L U.S. EPA Class III value. However, the average TDS concentration for MW-26 was 4,183 mg/L. In the deep bedrock aquifer, the TDS concentrations are higher in comparison to the shallow aquifer; the calculated average TDS concentrations range from 1,160 to 13,500 mg/L. Monitoring well MW-707DD, with one measured TDS concentration of 13,500 mg/L, was the only TDS result from the deep aquifer exceeding the 10,000 mg/L limit. Monitoring wells MW-26 and MW-707DD are positioned directly adjacent to each other and located on the eastern border of the Excised Area (Figure 2-3).

The overall site average TDS concentrations from the shallow and deep aquifers at the Guterl Site are 975 mg/L and 2,880 mg/L, respectively. The TDS concentrations are on average less than the federal 10,000 mg/L criterion, indicating the groundwater at the site could be considered a potential future source of drinking water.

As additional points of reference, the TDS site values were compared to the U.S. EPA's TDS secondary drinking water standard of 500 mg/L and New York State's Class GSB saline groundwater classification TDS concentration of 2,000 mg/L. Of the 39 shallow bedrock wells with TDS measured concentrations, 29 have average values that exceed the 500 mg/L standard, and only three have average values that exceed the 2,000 mg/L. The individual TDS measurements from all twelve of the deep bedrock monitoring wells exceed the 500 mg/L secondary standard, but only six of the twelve deep bedrock wells exceed the 2,000 mg/L GSB saline groundwater classification concentration.

Based upon the federal guidelines and state regulations discussed above, this would indicate that groundwater at the Guterl Site can be classified as a potential source of drinking water.

2.1.8.3 CHLORIDE

As noted in Section 2.1.8, New York State classifies Class GSB saline groundwater, which is not usable for drinking water purposes, as having chloride concentrations in excess of 1,000 mg/L. As summarized in Table 2-1, the average chloride (as Cl) concentrations in the shallow and deep bedrock wells at the Guterl Site are 266 mg/L and 716 mg/L, respectively. Based upon the state regulations listed above, this would indicate that groundwater at the Guterl Site can be classified as a potential source of drinking water.

2.1.8.4 OTHER GROUNDWATER QUALITY CONSIDERATIONS

Volatile organic compounds (VOCs) have been detected in the groundwater in portions of the Guterl Site. The VOCs detected in the shallow and deep bedrock aquifer are shown in Table 2-1. The nature and extent of VOC contamination in groundwater is discussed in Section 2.4.4.

2.2 SITE HISTORY AND OPERATIONS

2.2.1 OWNERSHIP HISTORY

From 1910 to 1966, Simonds owned and operated the Guterl Site to manufacture steel and specialty steel alloys (high-alloy) used in the production of saws and other tools. During World War I and World War II, normal plant operations were suspended, and the plant produced armor plating for the U.S. government under various contracts.

From 1948 to 1956, Simonds performed rolling mill operations on uranium metal and, to a much smaller extent, thorium metal. The uranium and thorium metal operations were initially performed (1948 to 1952) under contracts with the New York Operations Office of the AEC. Simonds continued the work from 1952 to 1956 under a subcontract to National Lead of Ohio (NLO). During operations from 1948 through 1956, the AEC was responsible for providing radiological monitoring and safety guidance and assistance. The uranium, thorium, and radium byproduct from manufacturing operations, to the extent possible, was collected and returned to AEC or NLO.

In 1966, the Wallace-Murray Corporation acquired Simonds (Delaware Secretary of State, 1966). The Wallace-Murray Corporation continued to operate the plant as a specialty steel mill until 1978, when the Guterl Specialty Steel Corporation acquired the property (Niagara County Clerk's Department, 1978).

In 1982, the Guterl Specialty Steel Corporation filed for Chapter 11 bankruptcy protection in the U.S. Bankruptcy Court for the Western District of Pennsylvania (this was changed to a Chapter 7 bankruptcy in 1990). In 1984, using industrial development bonds received through the Niagara County Industrial Development Agency, the Allegheny Ludlum Corporation purchased the Guterl Specialty Steel Corporation assets at an auction (U.S. Bankruptcy Court, 1984).

According to U.S. Bankruptcy Court documents, "on information and belief, at the time, Allegheny was shown certain documents and learned from counsel for the United States Economic Development Association (USEDA) that the Guterl Site contained radioactive contamination."

As a result of the documents and information received, approximately nine acres of land were removed from the sale prior to closing. This portion of the property became known as the "Excised Area." Allegheny also excluded a portion of Guterl Specialty Steel Corporation's assets from the sale, including equipment utilized during AEC-related operations at the Guterl Site. As a result, the Excised Area and equipment therein remains under ownership of Guterl Specialty Steel Corporation (a Chapter 7 bankrupt corporation).

In 1996, the Allegheny Ludlum Corporation merged with Teledyne Incorporated to form Allegheny Technologies Incorporated (ATI). The Guterl Site, with the exception of the Excised Area, is currently owned and operated by ATI under the name ATI Specialty Materials.

2.2.2 HISTORICAL ATOMIC ENERGY COMMISSION USE OF THE PROPERTY

Previous investigations have established that more than 99% of all material processed by Simonds was natural uranium (i.e., uranium that has not been enriched or depleted and with uranium isotopic ratios consistent with naturally occurring abundances (NIOSH, 2005). Records indicate that Simonds processed between 25 million and 35 million pounds of natural uranium metal and approximately 30,000 to 40,000 pounds of thorium between 1948 and 1956 (ORISE, 1999). However, there is evidence to support that during the latter portions of the contract work small quantities of depleted and enriched uranium (up to 2.5%) were processed at the Guterl Site. Of the thorium metal that was processed, ^{228}Th and ^{232}Th are present in equal concentrations (secular equilibrium).

Atomic Energy Commission-related operations at the Guterl Site were mostly limited to buildings located within the Excised Area (Buildings 1, 2, 3, 4/9, 5, 6, 8, and 35). A summary of building use during AEC support operations is presented in Appendix E of this FS (Table 2-1 of the RI report). The majority of AEC support operations involved the processing of uranium metal through the 16-inch mills in Buildings 6 and 8; thorium was also processed to a lesser extent during the latter part of the contract period. On average, the AEC materials were processed one week per month over the period of 1948 through 1956.

Atomic Energy Commission support operations outside of the Excised Area included Building 17 and the southwest portion of Building 24. Building 17 is currently owned by ATI Specialty Materials and the first floor is used as office space. The southwest portion of Building 24 was constructed in 1941 and was used for AEC support operations. A 209 m^2 (2,250 ft^2) addition was built in 1951 onto the north end of the original 1941 structure. Another addition was completed in 1959; this addition widened and "squared off" the 1941–1951 footprint, extending Building 24 from Building 8 to the north end of the 1951 addition. A final northern addition was completed in 1966 that matched the full width of the then-existing building. Building 24 is an active warehouse facility for ATI Specialty Materials.

Aerial photographs of the Guterl Site from the period preceding, during, and shortly following the AEC contract performance period indicate significant areas of soil disturbance to the north and northwest of the Excised Area. It extends westward to the railroad spur and north along the spur (United States Army Geospatial Center (USAGC), 2010). Land disturbance (documented in the review of historical aerial photographs) during development could have buried or sporadically relocated wastes from those areas. Such disturbance may account for the detection of radioactive materials outside of the areas known to have been utilized for processing the AEC materials.

2.2.3 HISTORICAL DISPOSAL OPERATIONS AT THE PROPERTY

Aerial photographic analysis (USAGC, 2010) was used to provide a visual timeline of disposal operations at the Guterl Site. Before 1958, there was no visible activity in the 3.5 ha (8.6 ac) inactive hazardous waste disposal site in the northwest corner of the Guterl Site. The 1958 aerial photograph shows that the northeastern most area of the disposal site had been cleared. In 1963, aerial photography shows the first evidence of mounded material in the northeastern area of the site. See Figure 1-1 and the area marked as the inactive hazardous waste disposal site footprint. Photographs from 1963, 1966, 1972, and 1978 show continued growth in the areal extent of the disposal site. By 1995, the hazardous waste disposal site was no longer active.

Simonds performed the AEC contract work from 1948 to 1952 and NLO contract work from 1952 to 1956. Simonds was acquired by Wallace-Murray in 1966 and then Guterl Specialty Steel in 1978. Aerial photos from 1958 to 1963 show that the disposal site was expanding to accommodate wastes such as slag, bag house flue dust, foundry sand, and other plant rubbish. By 1966, the disposal site was enlarged to seemingly accept surface material in preparation for plant expansion and additional rail spurs as seen on the 1966 aerial photographs (i.e., surface material in the northern area of the site was partially relocated there during construction preparations). By 1972, the general extent of the inactive hazardous waste disposal site reflects the 2016 extent. The inactive hazardous waste disposal site consolidation occurred after the AEC support work was completed in 1956 (Niagara County Department of Health [NCDOH], 1983a).

In August 1980, NYSDEC required Guterl Specialty Steel to stop disposing of chromium-contaminated bag house dust, a listed Resource Conservation and Recovery Act (RCRA) hazardous waste, in this area. In 1982, Guterl salvaged approximately two million pounds of metal slag from the disposal site for recycling. The disposal site has not been used since. In

1983 (at which point the disposal site had been inactive for approximately two years), representatives of the NCDOH conducted a visual inspection of the inactive hazardous waste disposal site. Disposed refuse included brick, slag, wood, foundry sand, empty oil drums, ore products, grinding dust, and bag house dust. The NCDOH inspector noted that "the waste has not been properly covered or graded which has led to minor ponding and erosion problems" (NCDOH, 1983b). At that time, waste oil was being salvaged by a private contractor, and the hazardous blower dust was being manifested for off-site disposal. Today, this area is a NYSDEC Inactive Hazardous Waste Disposal Site (Site No. 932032).

2.3 SUMMARY OF PREVIOUS INVESTIGATIONS

At the Guterl Site, a number of previous investigations addressing non-FUSRAP constituents have been provided for the benefit of the reader, but it is noted that this FS only addresses contamination associated with FUSRAP constituents.

Previous investigations include:

- *Nuclear Science and Engineering Corporation/Carborundum Metals 1958—Radiological Survey, 1958. Prepared by Nuclear Science and Engineering/Carborundum Metals,* 1958.
- *Oak Ridge National Laboratory (ORNL) 1978—Radiological Survey of the Former Simonds Saw and Steel Company, Lockport, New York, Final Report*, September 1978. Prepared by ORNL for DOE.
- *Ford, Bacon and Davis Utah, Inc. (FBDU) 1981—Preliminary Engineering and Environmental Evaluation of the Remedial Action Alternatives for the Former Simonds Saw and Steel Company Site, Lockport, New York*, November 1981. Prepared by FBDU for Bechtel National, Inc., for DOE.
- *ORNL 1984—Radiological Survey of the Former Simonds Saw and Steel Company, Lockport, New York*, July 1984. Prepared by ORNL for DOE.
- *NYSDEC 1988—Engineering Investigations at Inactive Hazardous Waste Sites-Phase I Investigation, Guterl Specialty Steel, City of Lockport, Niagara County*, January 1988. Prepared by Engineering-Science and Dames & Moore for NYSDEC.
- *NYSDEC 1991—Engineering Investigations at Inactive Hazardous Waste Sites-Preliminary Site Assessment, Task 1 Records Search, Guterl Specialty Steel Corporation, City of Lockport, Niagara County, Volumes I and II*, April 1994. Prepared by E.C. Jordan for NYSDEC.
- *American Geosciences, Inc. (AGI) 1992—Site Reconnaissance Report*, September 1992.
- *U.S. Environmental Protection Agency (U.S. EPA) 1996–1997—Region II, Phase 1 Guterl Steel Site Removal Action,* 1996–1997.
- *U.S. EPA 1998—Final Report, Guterl Steel Site, Lockport, New York, U.S. EPA Work Assignment No. 2-194*, April 1998. Prepared by Roy F. Weston, Inc. for U.S. EPA Environmental Response Team Center (ERTC).
- *ORISE 1999—Radiological Survey of the Guterl Specialty Steel Corporation, Lockport, New York*, December 1999. Prepared under a contract with DOE by ORISE for United States Bankruptcy Court for the Western District of Pennsylvania.

- *NYSDEC 2000—Immediate Investigative Work Assignment Report for the Unlisted Guterl Excised Area, City of Lockport, Niagara County*, October 2000. Prepared by NYSDEC.
- *USACE 2001—Preliminary Assessment (PA)/ Site Inspection (SI) Report- Former Guterl Specialty Steel Corporation, Lockport, New York,* April 2001. Prepared by USACE Buffalo District.
- *US Army Geospatial Center (AGC)—Historical Photographic Analysis, Draft Report, Guterl Specialty Steel Corporation, Lockport, New York*, March 2010. Prepared by AGC for USACE Buffalo District.
- *USACE 2010—Remedial Investigation (RI) Report Former Guterl Specialty Steel Corporation FUSRAP Site, Lockport, New York*, July 2010. Prepared by Earth Tec for USACE Buffalo District.
- *USACE 2012a—Final Data Gap Analysis Report Former Guterl Specialty Steel Corporation, Lockport, New York,* March 2012. Prepared by Shaw Environmental & Infrastructure, Inc. for USACE Buffalo District.
- *USACE 2012b—Final Technical Memorandum, Data Gap Investigation to Support the Feasibility Study, Former Guterl Specialty Steel Corporation, Lockport, New York, October 2012*. Prepared by Shaw Environmental & Infrastructure, Inc. for USACE Buffalo District.
- *USACE 2013—Final Supplemental Sampling Technical Memorandum, Former Guterl Specialty Steel Corporation, Lockport, New York, July 2013.* Prepared by Shaw Environmental & Infrastructure, Inc. for USACE Buffalo District.

2.3.1 NUCLEAR SCIENCE AND ENGINEERING CORPORATION/CARBORUNDUM METALS 1958—RADIOLOGICAL SURVEY

This radiological survey identified elevated radiation levels in certain manufacturing areas. Area decontamination was performed; clean steel plates were placed over floor areas; and a second radiological survey was performed in December 1958 to verify decontamination and shielding were effective. A copy of this document and specific information regarding the location of the survey and decontamination are not available.

2.3.2 OAK RIDGE NATIONAL LABORATORY 1979—RADIOLOGICAL SURVEY OF THE FORMER SIMONDS SAW AND STEEL COMPANY, FINAL REPORT

This investigation report, performed under FUSRAP, included the results of a radiological survey of the Former Simonds Saw and Steel Company, Lockport, New York. The survey was conducted to characterize the existing radiological status of the property, primarily in the Excised Area. Investigations conducted in October 1976 included measurement of residual alpha and beta-gamma radiation levels in the rolling mill building and forging shop; external gamma radiation in the same area; uranium, radium, and thorium in soil samples taken from beneath removable floor plates in the rolling mill area and from other parts of the Guterl Site; radon and radon daughter concentrations in air samples in the rolling mill building; and contamination in drainage paths leading from the buildings and grounds. A few samples were also analyzed for individual uranium isotopes (^{234}U, ^{235}U, and ^{238}U) by mass spectrometry. The data were determined to be useful for supporting the assessment of nature and extent of radiological contamination. Selected tables and figures presented in the ORISE report are provided in Appendix A of the RI report (USACE 2010).

2.3.3 FORD, BACON AND DAVIS UTAH, INC. (FBDU) 1981—PRELIMINARY ENGINEERING AND ENVIRONMENTAL EVALUATION OF THE REMEDIAL ACTION ALTERNATIVES FOR THE FORMER SIMONDS SAW AND STEEL COMPANY SITE

The purpose of this report was to present the results of a preliminary engineering evaluation and the environmental assessment leading to the selection of appropriate remedial action options for the Guterl Site (formerly Simonds). The investigation conducted in October 1980, included analysis of cinder samples from the Guterl Excised Area, primarily within the 16-inch rolling mill area. FBDU also collected external gamma radiation measurements in “Building A” (equivalent to Building 8 in the RI report and the ORISE [1999] report) near the 16-inch rolling mill, and in “Building B” (equivalent to Building 3 in the RI report and the ORISE [1999] report). Test parameters included radium, thorium, and uranium. The report included analytical results with units, and sample location and depth. The data were determined to be useful for supporting the assessment of nature and extent of radiological contamination. Selected tables and figures presented in the FBDU report are provided in Appendix A of the RI report (USACE 2010).

2.3.4 OAK RIDGE NATIONAL LABORATORY 1984—RADIOLOGICAL SURVEY OF THE FORMER SIMONDS SAW AND STEEL COMPANY SITE

On July 1984, the DOE conducted a survey at the Guterl Site to determine if there had been any significant changes in the radiological status of the facility. Representatives of the Oak Ridge National Laboratory (ORNL) determined that the measurements made during the 1984 survey were consistent with those made during the 1976 and 1980 surveys, and noted that a layer of "yellowish" material a few inches below the floor plates appeared to be the source of the elevated radiation levels. Based on the survey results, the ORNL concluded that the rolling mill area of the site did not meet the criteria for release of facilities and equipment for safe use.

2.3.5 NYSDEC 1988—ENGINEERING INVESTIGATIONS AT INACTIVE HAZARDOUS WASTE SITES-PHASE I INVESTIGATION, GUTERL SPECIALTY STEEL

The purpose of this report was to assess the environmental hazards caused by the then-present condition of the disposal site. The Phase I investigation report included results of five rounds of prior groundwater analyses, collected between 1980 and 1982 by Secure Landfill Contractors, Inc., from the disposal site. Test parameters reported included oil and grease, phenols, total organic carbon, total halogenated organics, and metals. However, the reported analytical suite of this document did not include all of the analyses performed. The report included sample location figures, boring logs, and monitoring well construction logs.

2.3.6 NYSDEC 1991—ENGINEERING INVESTIGATIONS AT HAZARDOUS WASTE SITES—PRELIMINARY SITE ASSESSMENT, TASK 1 RECORDS SEARCH, GUTERL SPECIALTY STEEL CORPORATION

This report was prepared solely to determine the proper classification of the Guterl Site in accordance with NYSDEC regulations (i.e., to determine if hazardous waste is present at the Guterl Site [6 New York Codes, Rules and Regulations (NYCRR) Part 371] and if the waste at the Guterl Site poses a “significant threat”). This investigation included a summary of previous groundwater analyses of samples Secure Landfill Contractors collected from the disposal site from 1980 to 1982. No analyses were conducted as part of this Phase 1 preliminary site assessment (Task 1). Data from the December 1980 through April 1982 samples presented in this report are a restatement of the same set of samples presented in the NYSDEC, January 1988 Phase I report; however, a more complete summary is provided in an appendix of the preliminary site assessment report (NYSDEC, 1991) than was presented in the 1988 Phase I report.

2.3.7 AMERICAN GEOSCIENCES, INC. (AGI) 1992—SITE RECONNAISSANCE

On August 25, 1992, in response to reports that chemical contamination might be present at the site, representatives of AGI conducted a visual reconnaissance on the property and submitted the results to the court-appointed bankruptcy trustee overseeing the site. During the site reconnaissance, AGI encountered approximately 30 drums with labels identifying their contents as trichlorotrifluoroethene, phosphoric acid, transformer oil, hydrochloric acid, or caustic soda. AGI also encountered approximately 70 drums without labels that appeared to contain quench oil, unidentified ash, unidentified liquids, and unidentified sludges. AGI observed several spills from drums, transformers and capacitors. Several rusted, compressed gas cylinders were noted. AGI representatives also observed two aboveground storage tanks, one of which had rusted and released its unidentified contents. AGI concluded that numerous areas of the plant were not in compliance with the Toxic Substance Control Act, RCRA, or New York State environmental regulations, and that further investigations would need to be conducted on the soil and waste materials.

2.3.8 U.S. EPA 1996 AND 1997—REMOVAL ACTION

In mid-1996, the U.S. EPA, Region II, began the first phase of a planned two-phase removal action at the site in response to an order by the U.S. Bankruptcy Court for the Western District of Pennsylvania. Phase 1 of the removal action planned to include the stabilization, packing, and disposal of all CERCLA hazardous substances contained in drums and other containers at the site, sampling and analysis of visibly contaminated soil, removal and disposal of compressed gas cylinders, and removal and disposal of asbestos insulation that presented a direct threat to U.S. EPA response workers. Over the course of the Phase 1 removal, the U.S. EPA removed and tested over 360 drums of material, 15 transformers, and the contents of five acid tanks. Materials removed included sodium hydroxide, fuel oil, polychlorinated biphenyls (PCBs), organic solids, corrosive liquids, hydrochloric acid, hydrofluoric acid, and other nonregulated materials.

In addition to the removal action at the site, the U.S. EPA conducted sampling for radiological contamination, including building surfaces and contents, and sampled for any mixed waste before shipping hazardous materials off site to be disposed of. Before leaving the site, U.S. EPA personnel placed warning signs around the site to warn trespassers and personnel of the presence of radioactive material. In October 1996, U.S. EPA representatives conducted a pilot decontamination study in an effort to determine the cost of decontaminating radiologically contaminated materials at the site. The effort failed to decontaminate a selection of items at the site, and the U.S. EPA suggested that cleaning the site would require more aggressive techniques.

Based on the results of the radiological survey at the site, the U.S. EPA recommended that a more comprehensive soil test and a characterization survey of the site be conducted. The Phase II removal action that was planned for the site was not conducted.

2.3.9 U.S. EPA 1998—FINAL REPORT, GUTERL STEEL SITE, U.S. EPA WORK ASSIGNMENT NO. 2-194

The purpose of this investigation was to conduct *in situ* surficial, and *ex situ* subsurface soil analyses for target metals using X-ray fluorescence (XRF). The samples were collected within the Excised Area, inside and outside Buildings 1, 2, 3, and 4/9. The samples were analyzed to evaluate the horizontal and vertical distribution of cadmium and lead, arsenic, nickel, and zinc. Additionally, shallow subsurface soil samples analyzed *ex situ* by XRF were submitted for toxicity characteristic leaching procedure (TCLP) metals analysis. Samples were also collected for PCB analysis from oil-stained areas and in the vicinity of an electric transformer.

Surficial lead and cadmium concentrations were detected in excess of the "screening level" of 400 parts per million (ppm) for lead and 200 ppm for cadmium over variable areas in each of the buildings and in the building exterior vicinity. The TCLP analyses showed limited areas of lead exceedances per regulatory guidance (5 ppm). Some PCBs (Aroclor 1260) were detected in samples collected near the transformer area but were not detected in samples from oil-stained areas of Building 3. The USACE (2005) concluded that the data may be usable in the determination of nonradiological contamination; however, this FS evaluates only FUSRAP-related radiological constituents.

2.3.10 OAK RIDGE INSTITUTE FOR SCIENCE AND EDUCATION (ORISE) 1999- RADIOLOGICAL SURVEY

The purpose of the ORISE investigation was to (1) adequately characterize the radiological status of the land and building areas at the Guterl Site including the Allegheny property, and (2) to be comprehensive enough to provide both a volume and cost estimate for remedial design. This work was conducted in response to a request of the U.S. Bankruptcy Court for the Western District of Pennsylvania and with the approval of the DOE.

This investigation included analysis of surface and subsurface soil and sediment samples from the Excised Area, the inactive hazardous waste site, and the operating ATI Specialty Materials area. The investigation also included a radiological survey of the buildings in the Excised Area. Test parameters included radium, thorium, and uranium. The report included analytical results with units, uncertainty, data qualifiers, analytical methods, and sample location and depth. Sample locations are often generalized to an item rather than a specific coordinate. The data are useful for supporting the assessment of nature and extent of radiological contamination. Selected tables and figures presented in the ORISE (1999) report are reproduced in Appendix A of the RI report (USACE, 2010).

2.3.11 NYSDEC 2000—IMMEDIATE INVESTIGATIVE WORK ASSIGNMENT REPORT

The purpose of this report was to determine the presence and extent of hazardous wastes at the Guterl Site. Specifically, the purpose was to determine if consequential amounts of hazardous wastes were disposed of in the Excised Area that would require the Excised Area be listed in the New York State Registry of Inactive Hazardous Waste Sites. In addition, this report evaluated the effects of the Erie Canal and the Frontier Stone Products quarry on the groundwater flow pattern in the vicinity of the Guterl Site by studying the strata underlying the Guterl Site. This investigation included analysis of surface and subsurface soil, groundwater, surface water, and sediment samples collected from the Excised Area. Analytical parameters included VOCs, semivolatile organic compounds, pesticides, PCBs, metals, and TCLP. Selected tables and figures presented in the NYSDEC (2000b) report are reproduced in Appendix A of the RI report (USACE, 2010).

2.3.12 USACE 2001—PRELIMINARY ASSESSMENT/SITE INSPECTION REPORT

The USACE Buffalo District completed a preliminary assessment/site inspection (PA/SI) report in May 2001 (USACE, 2001). The Guterl Site was included in FUSRAP based on evidence of residual contamination. The PA/SI concluded that there was no current threat to human health or the environment at the site; however, because of the potential for the FUSRAP-related contaminants to pose a threat to human health and the environment in the future, it was recommended that the Guterl Site proceed to the RI phase to further characterize radioactive residuals associated with past activities.

2.3.13 U.S. ARMY GEOSPATIAL CENTER (AGC) 2010—HISTORICAL PHOTOGRAPHIC ANALYSIS

The Army Geospatial Center completed a geographic information system (GIS)-based historical photographic analysis of the Guterl Site. The results of this historical photographic analysis were used in conjunction with results from previous DOE and USACE investigations in the development of the CSM for the Guterl Site.

2.3.14 USACE 2010—REMEDIAL INVESTIGATION REPORT

To prepare for the RI, a data gap analysis was performed to summarize existing data and focus RI efforts (USACE, 2006). Field sampling data for the RI was obtained between June and December 2007. The RI field data collection consisted of sampling and analysis of on-site soil, sediment, on-site surface water (water in utility trenches, drains, pits, and catch basins), groundwater, and building materials. In addition, surface water and sediment samples were collected from the Erie Canal. The final RI report was issued in July 2010. The constituents of potential concern (COPCs) identified for the RI phase of work included radium (^{226}Ra and ^{228}Ra), thorium (^{228}Th, ^{230}Th, and ^{232}Th), and uranium (^{234}U, ^{235}U, and ^{238}U).

The FUSRAP-related COCs were identified for the Guterl Site in the human health risk assessment (HHRA) prepared as part of the RI. By media, the COCs for soil and buildings included thorium (^{232}Th) and uranium (^{234}U, ^{235}U, and ^{238}U), and the COC for groundwater was limited to total uranium. Thorium and radium are not COCs for groundwater because the RI concluded these analytes are at background levels in groundwater.

The results from the RI field investigation activities are summarized in the following bullets.

- There are currently no imminent threats to human health or the environment due to FUSRAP-related materials on the Guterl Site.
- Concentrations of COPCs in soils and groundwater were detected above RI screening levels (levels established by the Nuclear Regulatory Commission (NRC) and/or the U.S.

EPA to assist in defining the nature and extent of contamination) within the Guterl Site boundary.
- Some FUSRAP-related material was detected above background levels in the Excised Area including all the buildings, the soil, and the utility water and sediments. The most heavily contaminated buildings in the Excised Area are Buildings 6 and 8.
- The RI confirmed the results of previous studies that indicated the presence of thorium and uranium contamination at the Guterl Site. The RI also added much new information regarding the nature and extent of thorium and uranium contamination at the Guterl Site.
- Shallow bedrock groundwater on the Guterl Site is impacted by FUSRAP-related materials.
- Surface water and sediment samples collected from the Erie Canal did not indicate FUSRAP-related impacts.
- Exposure to building materials and contaminated soils beneath Building 8 and a localized area of elevated activity in the railroad right-of-way posed the greatest potential human health risks of any areas on the site. Although the risk assessment estimated that potential lifetime cancer risks and yearly radiological dose rates received by someone trespassing in Building 8 (for 4 hours a week for 6 months of the year for 10 years) could exceed acceptable targets, the actual radiological doses received by the USACE and contractor investigators taking samples in that building were below health and safety monitoring detection limits. Uranium in groundwater below some areas of the site could pose unacceptable risks if the site groundwater were to be used as a source of potable drinking water.

The RI also concluded that bedrock groundwater contamination at the Guterl Site is localized, and the shallow bedrock hydrogeology is heterogeneous due to the presence of fractured bedrock. The presence of the Erie Canal and the dolostone quarry affect groundwater flow patterns on the Guterl Site. The vertical extent of bedrock groundwater contamination, as well as the horizontal extent of shallow bedrock groundwater contamination in the southeast and southwest quadrants of the Guterl Site, were not determined during the RI.

2.3.15 USACE 2012A—DATA GAP ANALYSIS REPORT

Following completion of the RI, a data gap analysis (DGA) was performed to identify gaps in existing data and recommend the collection of additional data to be used in the preparation of the *FS*. The results were presented in the DGA report (USACE, 2012a), which included the following recommendations.

- Soil—For the purpose of completing the *FS*, there was no additional data collection recommended for soil at the site based on a preliminary remediation goal (PRG) protective of the construction worker.
- Groundwater—Additional aquifer characterization data, including the determination of the size and depth of the uranium plume, were recommended to construct the groundwater model in support of the *FS*. The collection of additional data on the distribution of VOCs in the groundwater and geochemical characteristics of the aquifer that could affect uranium mobility was also recommended.
- Surface water and sediment—No further data collection was recommended.

- Buildings—Since the data on the building characteristics are sufficient for the *FS*, no additional data collection was recommended.

2.3.16 USACE 2012B- DATA GAP INVESTIGATION TECHNICAL MEMORANDUM

Based on the results of the DGA, a data gap investigation (DGI) was performed at the site to:

- Provide the additional data needed to assess the extent of impact to groundwater at the Guterl Site by uranium.
- Further delineate the Guterl Site conditions that control the mobility and fate and transport of the contaminants in groundwater.

The DGI included installation of additional shallow and deep monitoring wells, aquifer testing, a groundwater and seep sampling and analysis event, and City of Lockport sewer sampling and analysis. The results were provided in the *Final Technical Memorandum, Data Gap Investigation to Support the Feasibility Study, Former Guterl Specialty Steel Corporation* (*DGI Technical Memorandum*) (USACE, 2012b), which is provided in Appendix A. The results were used to supplement the RI for characterization of the site and summarized in this FS including geology and hydrogeology (Sections 2.1.3 through 2.1.6), surface water (Section 2.1.7), nature and extent of contamination (Section 2.4), and contaminant fate and transport (Section 2.4.8).

The primary conclusions of the DGI were:

- Two zones of groundwater flow are present and were identified as the shallow weathered bedrock (shallow groundwater) and the first main fracture zone (deep groundwater).
- Groundwater flow directions in the first main fracture zone (deep groundwater) are generally consistent with groundwater flow in the shallow weathered bedrock (shallow groundwater). Groundwater flow in both zones is generally to the south; however, it flows to the southeast toward the Erie Canal on the eastern part of the site and to the southwest toward the quarry on the western part of the site.
- The horizontal extent of groundwater with total uranium concentrations exceeding background covers approximately one-half of the area in the deep groundwater compared to the shallow groundwater. The areas exceeding background are primarily near the buildings or in historical operational areas in both zones.
- Groundwater with uranium concentrations exceeding background was discharging to the Erie Canal at one seep location (which is located on the northern wall of the Erie Canal).
- Geochemical conditions in the aquifer indicate total uranium is likely to remain in a soluble form at all locations investigated. Reduction-oxidation (redox) conditions do not favor uranium precipitation.
- Groundwater at the Guterl Steel Site is impacted by chlorinated solvent VOCs and related degradation compounds, including trichloroethene (TCE), cis-1,2-dichloroethene (DCE), vinyl chloride, 1,1,1-trichloroethane (TCA) and 1,1-dichloroethane (DCA). The data indicate little or no impact to groundwater from chlorinated VOCs (i.e., concentrations are below NYSDEC criteria) in wells installed at and around the inactive hazardous waste area, but reveal elevated VOCs in many wells at the Excised Area. The redox conditions of groundwater are affected by the presence of the VOCs, and as a consequence, affect the mobility of uranium in groundwater.

2.3.17 USACE 2013- SUPPLEMENTAL SAMPLING

Following the DGI, a supplemental sampling program was performed. The purpose of this investigation was to:

- Evaluate the stability of the uranium plume and the effect of seasonal groundwater fluctuation on total uranium concentrations and mobility in groundwater.
- Provide a continuous data set that will record the changes in geochemical parameters that affect the mobility of uranium in groundwater as the water level rises or falls.

The results are provided in the *Final Supplemental Sampling Technical Memorandum, Former Guterl Specialty Steel Corporation* (USACE, 2013). This report is provided in Appendix B. For this study, high frequency monitoring was performed at ten key monitoring wells located along the plume axis where uranium exceeds the maximum contaminant level[2] (MCL) and included collection of groundwater samples for both geochemical and uranium analysis. Groundwater levels were also collected to confirm groundwater flow conditions.

Based on the results of the supplemental sampling, USACE drew the following conclusions:

- Supplemental sampling results are consistent with the data obtained as part of the DGI.
- Comparison of filtered and unfiltered total uranium results indicates most of the uranium present is in dissolved form.
- Total uranium is present at concentrations exceeding the MCL in the deep groundwater flowing through the first main fracture zone of the competent dolostone, located between 9 and 12 m (30 ft and 40 ft) deep.
- Groundwater with uranium concentrations exceeding MCL continues to discharge to the Erie Canal. Multiple seep locations were identified on the north wall of the canal.
- The high-frequency monitoring indicates that the geochemical parameters are fairly stable in the wells monitored, and there were no discernible seasonal variations.
- Reducing conditions are present in the vicinity of the Excised Area that apparently allow for the reductive dechlorination of trichloroethylene to vinyl chloride.

2.3.18 USACE 2007 THROUGH 2016- ENVIRONMENTAL MONITORING

The USACE conducted environmental monitoring activities at the Guterl Site from 2007 through 2016, which included groundwater, groundwater seeps, and surface water in the Erie Canal (Figure 2-4). Uranium detected in groundwater from these events was consistent with previous sampling efforts. Seeps, located at groundwater discharge points downstream of the Guterl Site, show low-level impacts of uranium. The extent of uranium impacts from these groundwater seeps to surface water quality in the Erie Canal has been determined, and surface water samples collected from the Erie Canal continue to show no impacts from uranium. Groundwater, groundwater seep, and surface water monitoring will continue at the Guterl Site in order to monitor conditions.

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[2] The U.S. EPA maximum contaminant level (MCL) for total uranium in drinking water is 30 micrograms per liter (µg/L).

2.4 NATURE AND EXTENT OF CONTAMINATION

This section presents a brief discussion of the nature and extent of FUSRAP-related contamination detected in surface and subsurface soils, building surfaces and contents, utilities, surface water, sediments, groundwater, and seeps at the Guterl Site. Additional information can be found in the RI report, the DGI technical memorandum, and the supplemental sampling technical memorandum.

2.4.1 SOIL

A review of the available soil data is provided in the DGA report. The primary data sources are the RI report and the ORISE report (ORISE, 1999). A total of 1,785 soil samples were analyzed by gamma spectroscopy from 646 locations at an on-site laboratory. A total of 138 of the 1,785 soil samples analyzed at the on-site field screening laboratory (7.7%) were sent to the fixed analytical laboratory for alpha spectroscopic analysis for RI COPCs (radium [^{226}Ra and ^{228}Ra], thorium [^{228}Th, ^{230}Th, and ^{232}Th], and uranium [^{234}U, ^{235}U, and ^{238}U]).

Soil background values were calculated for each RI COPC and each analytical method as presented in Table 3-32 of the RI report (Appendix E of this *FS*). Weighted average background concentrations for each respective analytical method were used for the assessment of nature and extent of COPCs in Guterl Site soils.

The RI concluded the following:

- COPC concentrations were at or near background levels in the active ATI Specialty Materials production areas and in historically undisturbed areas of the Guterl Site.
- COPC contamination was found to be greatest in and around the former AEC support operations handling areas and in the portions of the property where miscellaneous land disposal of AEC-related materials may have occurred (inactive hazardous waste disposal site).
- COPCs are found in soils beneath or adjacent to each of the Excised Area buildings ranging from 0-5 feet deep. Buildings 6 and 8 were the most significantly impacted; these are the buildings that were used for uranium metal rolling and shipping during AEC support operations.
- Outside of the Excised Area buildings, COPCs were found to occur in several localized outdoor areas of the undeveloped parcel (i.e., the area north of Buildings 14, 24, and 37, including the inactive hazardous waste disposal site). Horizontal and vertical distributions of COPCs within these areas were variable. This is consistent with miscellaneous land disposal practices documented in the 2010 Historical Photographic Analysis.

At the time of completion of the DGA report, available soil data was determined to be sufficient to establish the nature and extent of contamination and risk to current and potential future users of the Guterl Site. Since then, lower PRGs (i.e., to protect groundwater) have been developed to address more of the contamination source impacting groundwater. PRGs for construction worker and groundwater are discussed in Section 3.5.

2.4.2 BUILDINGS

This section includes the assessment for the nature and extent of contamination in buildings, including building surfaces and building contents performed during the RI. A summary of the quantities of potential asbestos containing materials (PACM) is also included in this section.

2.4.2.1 BUILDING SURFACES

2.4.2.1.1 Background Reference Sampling and Development of Screening Levels

Nine volumetric, background reference samples were collected for six types of materials, (i.e., brick, ceramic tile, cinder block, particle board, wallboard and wood) from locations with low background exposure rates within the Excised Area. Background sample analysis in building materials was performed for radium, thorium and uranium. The results are presented in Appendix E of this FS (Table 3-36 of the RI report).

Since project-specific derived concentration guideline levels are not usually created for the RI, the parameters for comparison, called PRGs (specifically in this case, "Acceptable Surface Contamination Levels") are derived from existing guidance. For surfaces in buildings typical guidance is NRC Regulatory Guide 1.86; the values in this guidance are not derived based on dose, but they are widely accepted and currently referenced in other NRC documents, e.g., NRC Regulatory Guide 8.23. The screening levels used in the RI for uranium and thorium isotopes on building surfaces are presented in Appendix E of this FS (Table 3-4 of the RI report). For the FS, DCGLs were derived based on dose to a receptor; project-specific DCGLs are presented in Section 3.5.3 and Table 3-2a. Values for comparison of DCGLs to gross alpha and beta measurements, which have been modified for the effect of geometry and backscatter from the material being measured, are presented in Table 3-2b.

2.4.2.2 BUILDING SURFACE SAMPLING RESULTS

Building material samples were collected for each building within the Excised Area and for Building 24. Material sample results show that uranium concentrations exceeding background values were encountered in Buildings 2, 3, 6, 8, and 24. Section 4.2 of the RI report presents a detailed discussion of the sampling results for radium, thorium, and uranium contamination in building materials as they compare to the background values presented in Table 3-36 of the RI report. Radium and thorium results were used to determine the source of the uranium (AEC vs. non-AEC). Table 2-2 is a summary table presenting the number of material samples exceeding uranium background values.

Three dust samples were collected from the roof trusses of Building 24 to confirm previously reported contamination in this building (NLO, 1953). Roof truss dust sample results for Building 24, show that concentrations for ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, ^{234}U, ^{235}U, and ^{238}U, exceed background levels in at least one of the samples. The results for ^{226}Ra show that concentrations were only marginally above background, and not associated with AEC operations. Sampling results for dust samples in Building 24 are consistent with previous reports (NLO, 1953).

The radiological survey in the RI included total (static) and removable measurements on building interior surfaces including floors, walls (above and below 2 m [6.56 ft]), ceilings, structural surfaces, subfloor surfaces, trench side-walls and surfaces, manufacturing components, and other overhead surfaces. The results for total (static) measurements show that thorium exceeds the screening levels in all of the buildings except the exterior of Building 8. Uranium-fixed measurements exceeded the screening levels in all of the buildings except the exterior of Building 6. The maximum concentration was measured in Building 2 at 140,000 dpm/100 cm^2. Table 2-3 presents a summary of building surfaces static measurement results.

The results for removable measurements in building surfaces do not show any exceedances to the uranium screening levels. Thorium removable measurements exceed the screening levels, at least once, in Buildings 3 and 24. The maximum concentration was detected in Building 3 at 280 ± 50 dpm/100 cm^2. Table 2-4 presents a summary of building surfaces removable measurement results.

2.4.2.3 BUILDING CONTENTS

A summary of the building contents survey is presented in Appendix E of this FS (Appendix E from RI report). The Building Feature Survey table includes a description and quantifying inventoried features of the buildings along with associated photographic documentation and sketches.

2.4.2.4 ASBESTOS CONTAINING MATERIALS

Asbestos containing material is not considered a FUSRAP-related material; however, its presence may pose a risk to workers performing remediation activities at the site and incidental removal may be necessary.

A survey for PACM was conducted in Buildings 1, 2, 3, 4/9, 6, 8, and 35 as part of the RI on June 21, and 22, 2007. The presence of PACM in the Excised Area buildings was identified and the report is in Appendix E of the RI. Special considerations of possible asbestos containing bricks and wallboard in the buildings were documented. The majority of the PACM was pipe insulation in poor condition that was able to be quantified during the survey. The pipe insulation quantities were relatively small, generally less than 150 linear meters (LM) (500 linear feet [LF]) per building. The quantity of PACM, remediation, disposal and the safety personal protective equipment (PPE) required are accounted for in the remedial alternatives cost estimates. The PACM on piping are summarized as follows:

Summary of Potential Asbestos-Containing Material on Piping

Building	Horizontal Insulation	Vertical Insulation	Approximate Total Insulation
1	~3 LM (10 LF)	None	~3 LM (10 LF)
2	~370 LM (1,200 LF)	~6 LM (20 LF)	~370 LM (1,220 LF)
Between 2 and 3	~35 LM (120 LF)	None	~35LM (120 LF)
3	~150 LM (500 LF)	None	~150 LM (500 LF)
4	~20 LM (65 LF)	None	~20 LM (65 LF)
6	~40 LM (140 LF)	~1 LM (6 LF)	~40 LM (146 LF)
8	~120 LM (400 LF)	None	~120 LM (400 LF)
9	~2 LM (6 LF)	None	~1 LM (6 LF)
35	None	None	None
Total	~740 LM (2,440 LF)	~7 LM (26 LF)	~750 LM (2,460 LF)

2.4.3 SEWERS/UTILITIES

Results of nonnative surface water and sediment samples collected from sewers and other utilities are discussed in the following sections. The term "nonnative" is to distinguish these materials from naturally occurring, environmentally-available surface water and sediment.

2.4.3.1 SEDIMENTS (SITE UTILITIES)

RI report Figure 4-30 (Appendix E of this FS) presents the locations and analytical data for nonnative sediment sample locations. A total of 56 samples were collected from 53 sample locations. Samples were collected from in-site utilities, drains, pits, manholes, catch basins, and utility trenches. The COPCs evaluated in sediment samples were the same as COPCs for soil, i.e., ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, ^{234}U, ^{235}U and ^{238}U. All RI COPCs were detected above background values and in general, the highest concentrations occurred in the same areas as elevated soil concentrations. That is, the occurrence of elevated sediment sample concentrations can be attributed to migration of local materials to the local utility feature.

2.4.3.2 SURFACE WATER (SITE UTILITIES)

RI report Figure 4-29 (Appendix E of this FS) presents the 34 nonnative surface water sample locations and respective analytical data. Samples were collected from on-site utilities, drains, pits, manholes, catch basins, and utility trenches. In general, the highest concentrations in water occur in the same areas as elevated soil activity. That is, the occurrence of elevated surface water sample data can be attributed to migration of local materials to the local utility feature. Figure 2-12 in Appendix E presents the locations of the sewer lines at the site.

2.4.3.3 OFF-SITE SEWERS

Solid (sludge/sediment) and liquid samples were collected from two sanitary sewer locations. The sample locations and results are presented in Figure 2-2 and Table 4-10, respectively, of the DGI technical memorandum provided in Appendix A. The sample from Sewer #1 was collected from the accessible manhole closest to the facility. The sample from Sewer #2 was collected from the next accessible manhole downstream (Figure 2-2 in Appendix A).

The solid samples were collected and analyzed for RI COPCs. The results for the two solid samples show that, of all the RI COPCs, the concentrations of ^{234}U, ^{235}U and ^{238}U exceed the RI sediment background values.

The liquid samples were collected and analyzed for ^{234}U, ^{235}U and ^{238}U. The results were compared to the effluent limits provided in 10 CFR 20, Appendix B, Table 2 (and as presented in Section 2.4.3.2). The results were below the effluent limits for protection of the public as defined in 10 CFR 20.1302.

2.4.4 GROUNDWATER AND SEEPS

Groundwater and Erie Canal seep samples were collected during the RI (groundwater only), DGI, the supplemental sampling program, and subsequent yearly environmental monitoring. The complete results of the DGI and supplemental sampling program are provided in Appendices B and C.

As will be discussed in Section 2.5.1.1.5, uranium is the only COC for groundwater. Thorium and radium are not COCs for groundwater because the RI concluded that these analytes are at background levels in groundwater.

The highest uranium concentration detected in groundwater was in the shallow bedrock well, MW-605D, located near the center of the Guterl Site; MW-605D exhibited 302 micrograms per liter [µg/L] (Figures 2-5 and 2-6). Concentrations greater than 100 µg/L were detected north of Buildings 14 and 37 and appear to trend in a northwest to southeast direction across the Guterl Site towards the canal. Water discharging as seeps into the Erie Canal is characterized to be a potential discharge point for shallow groundwater. The distribution of uranium in deep groundwater appears in a similar orientation as the shallow groundwater; however, the plume is much smaller (Figure 2-6). The highest concentration detected in 2016 sampling is 271 µg/L from shallow well MW-605D centrally located at the site. Based on sampling results, the shallow and deep groundwater plumes are interpolated below the unused open space to the southeast of the Guterl Site and discharge at the Erie Canal wall as seeps.

Volatile organic compounds have been historically detected in the groundwater underneath the site. Although VOCs are non-FUSRAP contaminants, they impact redox conditions and therefore impact the solubility of uranium, and thus were investigated during the RI, DGI and supplemental sampling program. It is relevant during the FS to factor in the co-mingling of the VOC and the uranium plumes. The presence of high VOC concentrations and the movement of the VOC plume through the groundwater, under natural gradients and especially under gradients forced by a pump-and-treat based remedy, can alter the groundwater redox conditions. Laboratory analysis from 35 locations shows detectable concentrations of the chlorinated solvents 1,1,1-trichloroethane; 1,1-dichloroethane; 1,1-dichloroethene; chloroethane; chloroform; tetrachloroethene; 1,2-dichloroethene; trichloroethene; and vinyl chloride. The highest detected VOC concentrations were found at MW-23, immediately west of Building 24, outside of the Excised Area. Volatile organic compound concentrations in other monitoring wells are also highest immediately west of, and in, the Excised Area. Figures 4-24 and 4-25 of Appendix A (DGI) show the spatial distributions of VOCs in the shallow and deep groundwater units, respectively. Table 4-7 of Appendix A presents the analytical results for VOCs in groundwater.

During the DGI, groundwater flow was observed to discharge at two locations along the northern rock face of the Erie Canal. Additional seeps were identified during subsequent sampling events. This discharge appears to be a fraction of the groundwater flow that exits in the shallow and the deep groundwater units beneath the site. However, hydrogeologic data shown in Figures 2-1 through 2-9 indicate the majority of flow from the site enters the Erie Canal. Since access to the bedrock seeps is limited during low-water periods (winter season), when the canal is dewatered, not all seepage has been observed or inventoried. The steep gradients observed southeast of the site are indicative of higher permeability in the bedrock nearest the canal (i.e., the degree of fracturing is higher due to rock blasting during canal construction and aerial exposure to freeze-thaw cycles). Consequently, the shallow and deeper bedrock flow zones become more homogenized and not all the seeps observed and sampled during high-water periods will account for total discharge to the canal. This is exemplified in the groundwater model, which estimates discharge from the shallow and deep zones at 830 liters per day per lineal meter (67 gallons per day per linear foot) of canal along the site.

Other ancillary flow routes exist on site, including discharge to the quarry, flow underneath the Erie Canal, and to a lesser extent flow to the regional groundwater system through fractures in the dolostone and shaly dolostone that underlie the first main fracture zone of the competent dolostone. These other potential routes are exemplified in Figure 2-8. Army Corps of Engineers Buffalo District personnel collected seep samples at the locations shown on Figure 2-7.

Throughout all the historical sampling events, threeseep samples exceeded the uranium MCL of 30 µg/L (44.3 µg/L [Aug 2011], 33.0 µg/L [Oct 2012], 36.8 µg/L [Oct 2012]). All three of these samples were collected approximately 90 m (300 ft) upstream of the emergency water intake, which is located in the Erie Canal immediately southeast of the Guterl Site (Figure 2-7). Samples collected in the same vicinity in December 2011, May 2012, September 2013, and May 2014 did not exceed the MCL (ranging from 20.8 µg/L to 26.3 µg/L). The seep samples collected more than 150 m (500 ft) upstream of the emergency water intake also showed uranium concentrations below the MCL (from 5.3 µg/L to 6.2 µg/L). Low VOC concentrations (below the MCL for all compounds) have also been detected in the seeps.

Based on the sampling results, the following conclusions can be drawn:

- Trend data presented in the Supplemental Sampling Technical Memorandum (Appendix B) suggests that total uranium concentrations in groundwater, of approximately 10 µg/L, represent the upper limit of background levels.
- Total uranium is present at concentrations exceeding background in the deep groundwater, which flows through the first main fracture zone of the competent dolostone, located between 9 and 12 m (30 and 40 ft) deep, and corresponds with the screened locations of the deep monitoring wells.
- The horizontal extent of groundwater with total uranium concentrations exceeding background covers approximately one-half of the area in the first main fracture zone (deep groundwater) compared to the shallow weathered bedrock (shallow groundwater). The areas exceeding background are primarily near the buildings in both zones.
- Groundwater with uranium concentrations exceeding background is discharging to the Erie Canal via seeps and was found to sporadically exceed MCLs during subsequent supplemental sampling events as shown on Figure 2-7.
- The uranium isotope ratios for elevated concentrations are consistent with naturally occurring uranium (^{234}U and ^{238}U are present at equal concentrations by activity), indicating the uranium processed at the site was neither enriched nor depleted.
- Comparison of filtered and unfiltered total uranium results indicates most of the uranium present is dissolved. Approximately 98% of the total uranium was in the dissolved form in the samples collected.
- The horizontal and vertical extent of uranium in groundwater, exceeding background, has not been completely defined. Vertically, the DGI results determined that uranium impacted groundwater occurs in the deep groundwater flowing through the first main fracture zone of the competent dolostone that underlies the shallow weathered bedrock (shallow groundwater), where uranium contaminated groundwater was documented to be present during the RI. There is another 12 to 14 m (40 to 45 ft) of denser dolostone and shaly dolostone between the bottom of first main fracture zone and the Rochester Shale,

where the presence or absence of uranium impacted groundwater has not been determined. However, due to its low permeability and a characteristic lessening of uranium concentration with depth exemplified between the shallow and deep zone, uranium transport in this low-density fracture zone is not expected to be significant (i.e., the conceptual site model assumes the shallow and first fracture zone, or deep, groundwater zones are the primary transport pathways for uranium to the Erie Canal).

2.4.5 SURFACE WATER

2.4.5.1 ERIE CANAL

During the RI, surface water and sediment samples were collected from the Erie Canal at 12 locations. Sample results upstream of the seeps and emergency water intake showed an average of 0.33 µg/L total uranium. Samples collected during the RI in the area near the seeps and across the emergency water intake, show an average concentration of 0.55 µg/L total uranium, which is below the MCL for uranium.

In addition, surface water samples were collected from the Erie Canal in January, May, and October 2012; and yearly thereafter (2013-2016). Samples collected in the area near the seeps and across the emergency water intake, show an average concentration of 0.55 µg/L total uranium, which is below the MCL for uranium. The sampling program is detailed in the final Supplemental Sampling Technical Memorandum (USACE, 2013) provided in Appendix B, and in the Environmental Monitoring Report provided in Appendix L. All surface water samples met the screening levels used in the RI (U.S. EPA MCLs) for drinking water.

2.4.6 CONTAMINANT MIGRATION

The processing of natural uranium metal at the Guterl Site resulted in dust, mill shavings and associated land disposal that contaminated on-site soils and facility buildings; these operations are the potential sources of the uranium-impacted groundwater. Soil contamination depth varies from surface contamination to depths of approximately 9 feet in the vicinity of the inactive hazardous waste area. Groundwater in both the shallow and deep wells was documented to be impacted with uranium. The highest uranium concentrations were detected in groundwater near the center of the Guterl Site. The uranium plume centerline appears to trend in a northwest to southeast direction across the Guterl Site, extending across the property boundary towards the canal. The CSM assumes the vast majority of uranium-impacted groundwater discharges to the Erie Canal, with minor amounts migrating to the basal bedrock zones.

Figure 2-9 shows the relationship between total uranium plumes in the shallow and deep groundwater and the presence of uranium in the overlying unsaturated soil. The uranium plumes are defined by the total groundwater uranium concentrations exceeding the 30 µg/L MCL. There are five general soil areas with uranium activities sufficiently high to act as potential sources of uranium to the underlying groundwater. The infiltrating precipitation continually leaches a fraction of the uranium in soil when it recharges the groundwater indicating there is a net flux of uranium mass from the soil to groundwater. Over time the migration of uranium from soil to groundwater has created a uranium plume in the shallow groundwater approximately 15.7 ha (39 ac) in area. Due to the vertical downward hydraulic gradients in portions of the Guterl Site, a fraction of the uranium mass is being gradually transferred from the shallow to the deep groundwater, most likely via regional fractures apparent near the Guterl Site. The deep groundwater plume is approximately 7.3 ha (18 ac) in size.

The mobility of uranium in groundwater is sensitive to redox conditions. Its mobility is very low under reducing conditions and is much higher under oxidizing conditions, especially in the presence of soluble carbonate. Although moderately reducing conditions exist at some locations (i.e., locations where VOCs have been detected), the uranium is predicted to be in the soluble hexavalent form at all of the sampled locations. Uranium mobility is therefore not limited by precipitation, but will be controlled by sorption along groundwater flow paths. Where VOC contamination is notable in and near the Excised Area (i.e., the VOC-source area), lower levels of uranium are common, indicating a non-natural lower redox condition can lessen uranium transport.

It is expected that the residual uranium in soil will continue to provide a source of uranium to the groundwater plume for a long time (hundreds of years). The mass introduced to the shallow groundwater is gradually dispersed to deeper groundwater and to the Erie Canal via seeps. If the uranium soil source is not addressed by removal or other remedial actions, it could lead to the persistence of the groundwater plume for a period of approximately 840 years in the shallow groundwater and over 1,000 years in the deep groundwater. The shallow plume is predicted to extend off site beyond the site boundary for 700 (±50) years, while the deep plume is predicted to extend off site beyond the site boundary for over 1,000 years. Detailed evaluations and predictions of long-term impacts are provided in Appendix F.

As part of the DGI technical memorandum, a mass balance calculation was performed to estimate the amount of uranium that could potentially create an exceedance of the MCL in the Erie Canal waters. This concentration (i.e., the maximum tolerable concentration) was determined to be 35,500 µg/L of total uranium. The maximum concentration of total uranium in groundwater ever detected at the Guterl Site is 292 µg/L, which is considerably lower than the maximum tolerable concentration. The maximum predicted uranium leachate concentration that does not include any remedial action (i.e., baseline conditions) is approximately 35,280µg/L at the peak, which is in soil within the Excised Area. This concentration is coincident with the maximum tolerable concentration (35,500 µg/L) for discharge to produce a risk to the canal. Based on these calculations and observed dispersion of the plume concentrations toward the canal, it is not likely that the uranium concentration in the Erie Canal will exceed the MCL at any time within the next 1,000 years. The mass balance calculation and discussion is presented in Appendix D and groundwater modeling results are in Appendix F.

2.5 RADIOLOGICAL BASELINE RISK ASSESSMENT

A baseline risk assessment (BRA) was performed during the RI to evaluate risks to human health and the environment from potential exposure to the radioactive constituents at the Guterl Site in the absence of remedial actions. The BRA includes two components: the human health risk assessment and the screening level ecological risk assessment (SLERA). This section provides summaries of HHRA and the SLERA. For purposes of the BRA, the Guterl Site was divided into several exposure units (EUs) to support the risk assessment processes. These EUs were developed based on environmental conditions, historical uses of specific areas, and reasonableness of size in terms of representing receptor behavior, geographical similarity, and contamination potential. These EUs and their corresponding investigative areas are identified on Table 6-1 of the RI report (Appendix E of this FS). Exposure unit locations are shown in Figures 6-1 and 6-2 of the RI report (Appendix E of this FS)

2.5.1 HUMAN HEALTH RISK ASSESSMENT

The HHRA modeled human health risks from exposure to radioactive contaminants in the buildings, soils, and groundwater at the present time and 1,000 years into the future. Simultaneously, the potential for noncarcinogenic health effects from exposure to uranium, which primarily targets the kidney, was assessed by estimating the hazard index from oral intakes. The assessment modeled cancer risks, radiological doses, and non-cancer hazard indices to different potential human receptors from exposure to FUSRAP-related contamination in:

- Building materials within the Excised Area.
- Surface and subsurface soil.
- Groundwater.
- Sediment and surface water within utilities, ditches, trenches, etc.
- Surface water and sediment within the Erie Canal.

The COPCs evaluated in the HHRA were ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, ^{234}U, ^{235}U, and ^{238}U. To evaluate the noncarcinogenic health effects to uranium, the uranium intakes (in milligrams) were calculated from the activity intakes of the three uranium isotopes. The RI HHRA CSM identified the potential pathways for human exposure to COPCs at the Guterl Site as shown on Figure 6-3 from the RI report provided in Appendix E of this FS. The potential routes of exposure included ingestion of all media, inhalation of particulates, and exposure to external gamma radiation. The potential human receptors included in the risk assessment are as follows:

- Current potential receptors
  - Juvenile trespasser
  - On-site worker
- Future potential receptors
  - Construction worker
  - Juvenile trespasser
  - On-site worker
  - Hypothetical on-site resident

Only long-term chronic risks were evaluated, as the contamination is not present at levels that would pose acute or immediate risks. The HHRA determined whether risks are acceptable or unacceptable based on U.S. EPA and NRC criteria. Specifically:

- The risk is deemed unacceptable if a person, exposed to current site conditions, experiences an incremental lifetime cancer risk greater than 1 in 10,000 (U.S. EPA, 1990).
- If the hazard index is greater than 1, non-cancer health effects may be possible, which is considered to be an unacceptable hazard (U.S. EPA 1990).

- The risk is deemed unacceptable if a person, exposed to current site conditions, receives an annual dose rate of radiation greater than 25 mrem/year above background dose rates (25 mrem/year is the acceptable dose rate for a site with safe use after NRC license termination) (10 CFR 20 Subpart E).

The HHRA indicates that some increased risks exist for persons within the project area when chronic exposure is assumed. These risks vary within the project site and the type of person modeled. Present and potential future exposures and subsequent risks for each investigative area are briefly summarized below:

- ***Soil***—Potential exposure routes to the current and future juvenile trespasser, future construction worker, current and future on-site worker, and a hypothetical future resident have been identified as incidental ingestion of soils, inhalation of fugitive dust, and external radiation.
- ***Sediment***—Potential exposure routes to the current and future juvenile trespasser, future construction worker and current and future on-site worker have been identified as incidental ingestion of sediment in site utilities.
- ***Surface Water***—Potential exposure routes to the current and future juvenile trespasser, future construction worker, and current and future on-site worker have been identified as incidental ingestion of surface water in site utilities.
- ***Buildings, Structures, and Site Utilities***—Potential exposure routes to the current and future juvenile trespasser, future construction worker, and current and future on-site worker have been identified as incidental ingestion of building materials, inhalation of dust, and external radiation.
- ***Groundwater***—The RI HHRA showed that the ingestion pathway is incomplete for the current human receptors, juvenile trespasser, and on-site workers because they are not likely to drink groundwater from the site. The ingestion pathway is also incomplete for the future on-site worker. The ingestion pathway is potentially complete for the future construction worker and hypothetical resident. The BRA presented in the RI report evaluated a potential/hypothetical on-site resident that consumes site groundwater, even though municipal water is supplied for the site and surrounding community. Uranium in groundwater below some areas of the site could pose unacceptable risks if the site groundwater were to be used as a source of potable water.

The greatest potential human health risks at the Guterl Site are posed by exposure to building materials and contaminated soils beneath Building 8 and a localized area of elevated activity in the railroad right-of-way. Uranium in groundwater below some areas of the site could pose unacceptable risks if the site groundwater were to be used as a source of potable drinking water.

The critical group is defined as the individual receiving a dose that is representative of the members of the population who are subject to the higher exposures. As the contamination at the Guterl Site is not present at levels that would pose immediate risk, it is long-term chronic exposure that was analyzed to determine the critical group. In summary, of the current and future potential receptors analyzed, the construction worker would receive long-term exposure on this industrial site. The juvenile trespasser is on site temporarily which is less time than a construction worker on site. As the anticipated future use of the site is industrial, an on-site resident is not likely. The on-site worker and construction worker on this industrial site have the potential for the long-term exposure. The risk assessment compared the construction worker and on-site worker parameters indicating the construction worker experienced a greater annual dose. This focused the critical group to be the construction worker for this site. Present and potential future risks and hazards are presented in Tables 2-5 and 2-6 for each investigative area/exposure unit.

2.5.1.1 CONSTITUENTS OF CONCERN

2.5.1.1.1 Soil

The significant COPC contributors to incremental cancer risk, hazard index, and the radiological dose estimated in the risk assessment were examined in order to identify COCs. The COCs identified were those radionuclides that contribute over 10% of the total risk for soils for each EU and receptors in which the total risk exceeds 1×10^{-4} incremental lifetime cancer risk. Since the reasonable future land use is industrial, and not residential land use, risk to a hypothetical future residential land user is not considered for the purposes of identifying COCs for the FS. The juvenile trespasser was also not considered for the purposes of identifying COCs due to the short-term exposure a trespasser would encounter. The construction worker working on the site would spend the majority of time on site and receive long-term exposure and therefore is considered the critical group for development for remediation goals.

According to Table 6-13 of the RI report (Appendix E of this FS), there are several EUs in which the on-site worker received a risk above 1×10^{-4} for exposure to soils. The radionuclides that consistently contributed most significantly to the overall risk in these EUs are ^{232}Th (and associated daughter products ^{228}Ra and ^{228}Th) and uranium isotopes (^{234}U, ^{235}U, and ^{238}U). The other COPCs investigated by USACE, ^{226}Ra and ^{230}Th, always contributed less than 10% of the overall risk in these EUs.

This pattern of significant COPC contributions to risk for the on-site worker was also examined for radiological doses for the construction worker in those EUs that resulted in greater than 25 millirem per year (mrem/yr) total dose for soil exposure. The construction worker receives a greater annual radiological dose, whereas the on-site worker receives a greater incremental lifetime cancer risk from exposure to radionuclides over a period of several years. The pattern of significant COPC contributions to radiological dose for the construction worker was consistent with significant COPC contributions to risk for the on-site worker (i.e., ^{226}Ra and ^{230}Th were not found to be significant contributors to dose). In two instances, ^{226}Ra and/or ^{230}Th contributed over 1% (but less than 10%) of the overall risk or dose, but the slightly elevated ^{226}Ra or ^{230}Th was always collocated with either uranium and/or ^{232}Th. This is consistent with the history and nature of contamination on the site, in which refined uranium and thorium metals were not extracted but used in rolling mill operations. The isotopes ^{226}Ra and ^{230}Th are not COCs and will not be addressed during the FS.

The COCs for which soil cleanup goals will be developed in the FS are ^{232}Th (and associated short-lived daughter products ^{228}Ra and ^{228}Th, which are assumed to be in equilibrium with ^{232}Th), total uranium (including ^{234}U, ^{235}U, and ^{238}U), and ^{238}U as a surrogate for the total uranium derived concentration levels.

2.5.1.1.2 Surface Water and Sediments (Native)

There were no detected COPCs above risk-based screening levels in sediment samples or in surface water collected from the Erie Canal. The Erie Canal is an emergency backup water supply for the City of Lockport; although the emergency supply piping still exists, the canal has not been used for this purpose in approximately 23 years and the city does not expect to use it again for this purpose. Since uranium-impacted groundwater discharges (via seeps) into the Erie Canal, there is a potential for exposure to uranium if the intake was to be used for water supply. However, based on mass balance calculations, groundwater seeping into the Erie Canal will not impact surface water quality above the safe drinking water MCL for total uranium.

2.5.1.1.3 Surface Water and Sediments (Nonnative)

There were no detected COPCs above risk-based levels in nonnative surface water and sediment samples from on-site utility features. The term "nonnative" is to distinguish these materials from naturally occurring, environmentally available surface water and sediment. Samples were collected from on-site utilities, drains, pits, manholes, and catch basins, and utility trenches.

Extensive sampling of the site utilities was conducted and none of the sediment samples exceeded the PRGs, and the water was generally under or only slightly above the screening levels used in the RI (U.S. EPA MCLs) for total uranium. The AEC-related constituents were detected in nonnative surface water and nonnative sediment in Excised Area utility trenches, drains, pits, catch basins, and in the basement of Building 1.

The nonnative surface water results were compared to the effluent limits provided in 10 CFR 20, Appendix B, Table 2. The results were below the effluent limits for protection of the public as defined in 10 CFR 20.1302 (i.e., 300 pCi/L for ^{234}U, ^{235}U and ^{238}U; 200 pCi/L for ^{228}Th, 100 pCi/L for ^{230}Th and 30 pCi/L for ^{232}Th, and 60 pCi/L for ^{226}Ra and ^{228}Ra).

2.5.1.2 BUILDINGS

The evaluation of buildings included both building surfaces and building materials. The same COPCs found in site soils, ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th ^{234}U, ^{235}U and ^{238}U, were evaluated for buildings.

Radiological measurements on building surfaces were performed using handheld alpha/beta monitoring equipment (gross measurements). As recommended in the Multi-Agency Radiation Survey and Site Investigation Manual (MARSSIM), the gross beta surface contamination levels were used instead of the gross alpha surface contamination levels. Exposure unit-specific COPC concentrations were generated using static beta scans of the building interiors. Exposure unit-specific concentrations for each COPC were determined assuming that beta-emitting COPC progeny were in equilibrium with their parents and that the relative abundance of COPCs is the same in surface contamination as in soil contamination. The relative contributions of the COPCs and the net concentration from beta emitting COPC progeny were determined.

An evaluation of building materials, similar to the above, also included EU-specific concentrations for each COPC. It was assumed that beta emitting COPC progeny were in equilibrium with their parents, and that the relative abundance of COPCs, is the same in surface contamination as in soil contamination. The relative contributions of the COPCs and the net concentration from beta emitting COPC progeny were determined.

Six of the eight COPCs evaluated in the RI HHRA individually exceeded the risk or dose levels at least once for a given receptor in a given EU and may be considered potential COCs. Evaluation of risk, dose, and hazard in the RI HHRA revealed that, individually, COPCs ^{226}Ra, ^{228}Ra, ^{232}Th, ^{234}U, ^{235}U, and ^{238}U exceeded the carcinogenic risk, 1×10^{-4}, or the radiation dose criterion, 25 mrem/yr, at least once for a given receptor in a given EU. These constituents were therefore identified as preliminary COCs for at least one location (EU) at the Guterl Site. Some of these constituents; i.e., ^{226}Ra, were only above background in limited areas of the site; usually as a result of colocation with elevated ^{238}U. Conversely, COPCs ^{228}Th and ^{230}Th individually exceeded the lower risk threshold of 1×10^{-6}, but not the upper screening level and they are not COCs at the Guterl Site. The final determination of building material COCs is made in this FS and presented in Section 3.2.

2.5.1.3 GROUNDWATER

The RI HHRA determined that uranium in groundwater below some areas of the site could pose unacceptable risks if the site groundwater were to be used as a source of potable water. Thorium and radium are not COCs for groundwater because the RI concluded these analytes are at background levels in groundwater.

2.5.2 DEVELOPMENT OF RISK-BASED PRELIMINARY REMEDIATION GOALS AND REFINEMENT OF THE HHRA

At the conclusion of the RI HHRA, preliminary remediation goals (PRGs) were developed to meet the presumed dose limit of 25 mrem/year (see discussion of Applicable or Relevant and Appropriate Regulations in Section 3.3.2). These RI-based PRGs are presented in Table G-1. The RI-based PRGs were developed assuming that the present soil contamination would be allowed to leach to groundwater in a “worst-case” exposure scenario; i.e., the buildings were no longer present to limit rain infiltration into soil contamination under current building footprints, and there were no protections to prevent groundwater exposure to workers who may encounter groundwater during construction activities.

The derivation of the RI-based PRG for the construction worker is more fully explained in Section 3.5.1.1 and presented in Table 3-1, since that PRG is identified as the proposed clean up goal for the reasonable future use of the site (e.g., industrial). However, as the RI-based PRG for hypothetical residential use of the site includes the unrealistic assumption that residents would consume uranium-contaminated groundwater (as their primary source of drinking water) at concentrations that exceed the Safe Drinking Water Act MCL for uranium concentrations, and the surrounding community is actually serviced by a municipal water supply obligated to limit the uranium concentrations to below this MCL, a refinement to the RI-based PRG for residential use of the site was performed. This refinement involved eliminating the soil-to-groundwater leaching pathway from the risk assessment model, and limiting drinking water consumption to 5 mrem/year, which is the dose that would be received if the drinking water supply contained the MCL concentration of uranium (30 μg/L). This dose rate is then subtracted from the total allowable dose limit under the presumed ARAR (25 mrem/year), so that the soil exposure pathways must meet a dose limit of only 20 mrem/year. This refinement of the RI-based PRG for residential exposure is documented in Appendix G, Table G-2. That table indicates that total uranium concentrations up to 277 pCi/g in the soil would meet the allowable dose limit in the presumed ARAR for residential use of the site. Note that this refined residential PRG (277 pCi/g total uranium) is greater than the RI-based PRG for the construction worker (47 pCi/g total uranium), due mainly to differing assumptions about exposure to uranium contaminated groundwater for the worst-case on-site worker, vs. reasonable and realistic exposure assumptions for residential use of municipal (off-site supplied) drinking water. This indicates that the residential community surrounding the site would be protected from uranium exposure via direct soil exposure pathways if the RI-based PRG for the construction worker (47 pCi/g total uranium or 23 pCi/g U-238) is met on the site.

2.5.3 SCREENING LEVEL ECOLOGICAL RISK ASSESSMENT

Some habitat exists on both the terrestrial and aquatic areas of the Guterl Site, allowing relevant ecological receptors to either reside or use the Guterl Site as a forage base. Therefore, a SLERA was performed in order to assess the potential risks to the ecological receptors (plants and animals) from contamination in the environment. Some potential risks to terrestrial ecological receptors at the site were identified based on the SLERA. However, the site is not currently managed for ecological purposes. Although some limited patches of habitat exist on abandoned portions of the site, much of the Guterl Site is actively disturbed or occupied by buildings and paved areas. There are not any sensitive habitats (such as wetlands) on-site which require protection. The creation of an ecological preserve on-site in the future is unlikely, given the current land use of portions of the site (industrial), as well as the current land use surrounding the site (private residences, small farms, and light industrial). Future re-development of the abandoned site is most likely to be industrial or commercial, which would further preclude the need for ecological management goals in addressing site contamination. Further assessment and considerations of ecological risks on site are not necessary. Since the radiological standards (dose rate limits) for protection of human health are generally more conservative than recommended dose rate standards for protection of ecological populations, it is generally assumed that the environment is protected when remedial actions are taken to protect people from exposure to radioactive waste.

However off site, the adjacent section of the Erie Canal is designated as a Class C water by NYSDEC—suitable for fish, shellfish, and wildlife propagation and survival—despite undergoing seasonal dewatering. The application of relevant ecological surface water criteria is therefore appropriate. Since the SLERA was completed (USACE 2010), a new Canadian water quality guideline (CWQG) was developed for total uranium (CCME 2011). This CWQG consists of both short- and long-term risk-based surface water screening levels that are protective of freshwater aquatic life. No U.S. state or federal surface water quality criteria for uranium are available and this Canadian guideline is an appropriate alternative given that the Erie Canal discharges to Lake Ontario in locations downstream of the Guterl Site. The CWQG is based on uranium toxicity as a metal, not as a radionuclide. The radiological screening levels for ecological receptors (USDOE 1993, 2002) used in the SLERA are current.

The CWQG long-term screening level (15 µg/L) is intended to protect against "indefinite exposure"—considered 7+ days for fish and invertebrates or 24+ hours for plants and algae (CCME 2011). The short-term screening level (33 µg/L) is intended to protect against severe effects from transient exposure. Both screening levels are based on organism-level effects (e.g., survival, growth, or reproduction) that are useful for predicting ecologically significant population-level effects. They do not take potential bioaccumulation into account. The screening levels were derived by calculating the 5th percentile of the cumulative probability distribution of species sensitivity as a function of effect concentrations and are therefore expected to be protective of 95% of aquatic biota in Canadian freshwater systems. The SLERA (USACE 2010) had used a uranium screening level of 2.6 µg/L, established as a chronic toxicity value for the protection of aquatic life (Suter and Tsao 1996). This screening level, however, was developed based on limited data from a single species (Cushman et al. 1997). The CWQG is therefore a more robust screening level developed using more recent, relevant, and numerous studies than the previously used screening level.

These CWQG screening levels were applied to the surface water in the adjacent Erie Canal by comparing them to uranium concentrations in canal water and in groundwater discharging into the canal via seeps from the site. The mean total uranium concentration in canal water near the seeps and across from the emergency public water intake was measured to be 0.55 µg/L. This mean concentration was the same for samples taken during the RI (maximum of 0.8 µg/L) and in subsequent monitoring samples collected from 2012 to 2016. Groundwater discharge into the canal was modeled by mass balance calculations (Appendix D) and was determined to not result in an exceedence of the USEPA MCL for uranium (30 µg/L), which is two times the CWQG for long-term exposure. The maximum concentration of total uranium predicted to transfer to the Erie Canal is 0.24 µg/L. This results in a total uranium surface water concentration of 0.64 µg/L when added to the background concentration in the canal of 0.4 µg/L (Appendix D). This total is below both the short- and long-term CWQG screening levels. The previous conclusion made in the SLERA (USACE 2010) that the Erie Canal is not a medium of concern for ecological receptors is therefore still valid after consideration of the new CWQG for uranium.

3.0 IDENTIFICATION AND SCREENING OF REMEDIAL ACTION TECHNOLOGIES

This section presents the remedial action objectives (RAOs) and general response actions (GRAs) for the Guterl CERCLA response, and identifies and screens media-specific technology types and process options considered for possible use in site remediation of COCs.

3.1 INTRODUCTION

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 at the Guterl Site. The U.S. EPA's *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* (U.S. EPA 1988) has established a structured process 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.

The selection of the site remedial action alternatives involves:

- Identifying COCs (Section 3.2).
- Identifying ARARs (Section 3.3).
- Identifying RAOs (Section 3.4).
- Developing PRGs (Section 3.5).
- Identifying volumes or areas of media to which GRAs may be applied (Section 3.6).
- Identifying GRAs that may be taken to satisfy the RAOs for the site (Section 3.7).
- Identifying and screening technologies and process options applicable to GRAs to eliminate those that cannot be implemented technically at the site (Section 3.8).
- Evaluating the remaining technology process options in terms of effectiveness, implementability, and cost to select a representative process for each technology type retained for consideration (Section 3.9). Assembling the selected technologies and process options into alternatives representing a range of treatment and containment options, as appropriate (Section 4.0).

3.2 CONSTITUENTS OF CONCERN

The FUSRAP-related COCs for which soil cleanup goals will be developed in this FS are ^{232}Th (and associated short-lived daughter products ^{228}Ra and ^{228}Th, which are assumed to be in equilibrium with ^{232}Th) and total uranium (including ^{234}U, ^{235}U, and ^{238}U).

By media, the COCs for soil and buildings include, ^{232}Th, ^{234}U, ^{235}U, and ^{238}U, and the COC for groundwater is limited to total uranium. Thorium and radium are not COCs for groundwater because the RI concluded these analytes are at background levels in groundwater.

3.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

3.3.1 DEFINITION OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

Section 121(d)(2) of CERCLA sets requirements with respect to any hazardous substance, pollutant, or contaminant that will remain on site. Remedial actions must, upon completion, achieve a level or standard of control that at least attains legally applicable or relevant and appropriate substantive standards, requirements, criteria, or limitations under federal environmental law. The actions must also meet any promulgated substantive standard, requirement, criteria, or limitation under a state environmental or facility siting law more stringent than any federal standard, requirement, criteria, or limitation and is identified by a state in a timely manner. For a remedial alternative to be selected, it must be protective of human health and the environment, and meet the associated ARARs, unless waiver conditions identified in Section 121(d)(4) of CERCLA are met.

Identifying ARARs involves determining whether a requirement is applicable, and if it is not applicable, then whether a requirement is relevant and appropriate. Individual ARARs for each site must be identified on a site-specific basis. Factors that assist in identifying ARARs include the physical circumstances of the site, contaminants present, and characteristics of the remedial action.

Applicable Requirements: Applicable requirements are defined as:

> 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 state standards that are identified in a timely manner and that are more stringent than federal requirements may be applicable (40 CFR 300.5).

A law or rule is applicable if the jurisdictional prerequisites of the law or rule are satisfied. These jurisdictional prerequisites include:

- Who, as specified by the statute or regulation, is subject to its authority.
- 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.

Possible applicable requirements may be only federal requirements or those state requirements that are (1) promulgated so that they are of general applicability and legally enforceable, (2) identified by a state in a timely manner, and (3) more stringent than federal standards.

Relevant and Appropriate Requirements: Relevant and appropriate requirements are defined as:

> 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, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site. Only those state standards that are identified in a timely manner and are more stringent than federal requirements may be relevant and appropriate *(40 CFR 300.5).*

Determining whether a requirement is relevant and appropriate is a two-step process that involves determining whether the rule is relevant, and, if so, whether it is 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 it is well-suited to the site.

In determining whether a requirement is both relevant and appropriate, the following factors may be used to evaluate a requirement:

- The purpose of the requirement and the purpose of the response action.
- The medium regulated or affected by the requirement and the medium contaminated or affected at the site.

- The substances regulated by the requirement and the substances found at the site.
- The actions or activities regulated by the requirement and the remedial action contemplated at the site.
- Any variances, waivers, or exemptions of the requirement and their availability for the circumstances at the site.
- The type of place regulated and the type of place affected by the release or response action.
- 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 response action.
- 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 site.

While some requirements within a regulation will be both relevant and appropriate, other requirements in that same regulation may not be. Section 121(e) of CERCLA (42 USC 9621[e]) provides that no permit is required for the portion of any removal or remedial action conducted entirely on site. Although no permit is required, on-site actions must comply with substantive ARARs, but not with related administrative and procedural requirements. For example, remedial actions conducted on site would not require a permit but must be conducted in a manner consistent with permitted conditions, based on promulgated requirements found to be ARARs, as if a permit were required. Off-site activities, such as treatment of liquid waste at an off-site facility, are directly subject to both substantive and administrative requirements of the pertinent environmental regulations, including the permit requirements of those facilities. The management of CERCLA waste off site must be in accordance with the off-site rule 58 Federal Register 49200, September 12, 1993, as codified at 40 CFR 300.440.

<u>*To Be Considered Criteria*</u>: To be considered criteria include nonpromulgated advisories or guidance issued by federal or state governments that are not legally binding and do not have the status of ARARs. However, TBCs may be used in the absence of ARARs if they are reliable and useful to the development of remedial alternatives for the site. No to be considered criteria have been identified for the Guterl Site.

3.3.2 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS FOR THE GUTERL SITE

Chemical-specific requirements are media-specific and health-based limits (criteria) developed for site-specific levels of contaminants. Chemical-specific ARARs are health- or risk-based numerical values that, when applied to site-specific conditions, can be used to formulate PRGs. These values reflect potentially acceptable amounts or concentrations of substances (contaminants) that may remain in affected media or are discharged to the ambient environment.

During the development of this FS, USACE conducted a detailed evaluation of all potential ARARs as shown in Appendix K. From that evaluation USACE has identified the following federal regulations as chemical-specific ARARs for the Guterl Site:

- 10 CFR 20, Subpart E: Standards for Protection Against Radiation; Radiological Criteria for License Termination

    - 10 CFR 20.1402: Radiological Criteria for <u>Unrestricted</u> Use

- 40 CFR 141, Subpart G: National Primary Drinking Water Regulations; Maximum Contaminant Levels (MCLs) and Maximum Residual Disinfectant Levels
    - 40 CFR 141.66(e): Maximum Contaminant Levels (MCLs) for Radionuclides; MCL for Uranium

10 CFR 20, Subpart E: Standards for Protection Against Radiation:
10 CFR 20, Subpart E is applicable to NRC-licensed facilities where NRC is the successor to the AEC for licensing of nuclear materials and facilities. Subpart E of 10 CFR 20 applies to any facility licensed by the NRC to manage special nuclear, source, or byproduct radionuclide material undergoing decontamination and remediation for release of the property for reuse. The regulation was promulgated by the NRC to ensure consistent standards for determining the extent to which lands must be remediated at facilities before remediation can be considered complete, and the NRC license terminated. The Guterl Site does not have a current NRC license; therefore, this requirement is not applicable at the site but may be relevant and appropriate.

The NRC regulates byproduct, special nuclear, and source material pursuant to the authorization of the Atomic Energy Act of 1954. As an integral part of its statutory role, NRC promulgated 10 CFR 20 specifically to provide "Standards for Protection against Radiation." Subpart E "Radiological Criteria for License Termination" provides cleanup requirements for NRC licensees and serves as the primary remediation standard for non-DOE organizations in the U.S.

The criteria in 10 CFR 20, Subpart E, apply to the decommissioning of facilities licensed under Parts 30, 40, 50, 52, 60, 61, 63, 70, and 72 of 10 CFR, and release of part of a facility or site for unrestricted use in accordance with 10 CFR Section 50.83, as well as other facilities subject to the Commission's jurisdiction under the Atomic Energy Act of 1954, as amended, and the Energy Reorganization Act of 1974, as amended. For high-level and low-level waste disposal facilities (10 CFR Parts 60, 61, and 63), the criteria apply only to ancillary surface facilities that support radioactive waste disposal activities. The criteria do not apply to uranium and thorium recovery facilities already subject to Appendix A of 10 CFR Part 40, or to uranium solution extraction facilities. This regulation is not applicable to the site because the site was not licensed by the NRC.

A subpart of this regulation was evaluated for relevance and appropriateness to remediation of the site 10 CFR 20 Section 20.1402: Radiological Criteria for License Termination: radiological criteria under unrestricted conditions

10 CFR 20 Section 20.1402: Radiological Criteria for License Termination: radiological criteria under unrestricted conditions: The following is taken directly from the regulatory citation:

> A site will be considered acceptable for unrestricted use if the residual radioactivity that is distinguishable from background radiation results in a total effective dose equivalent (TEDE) to an average member of the critical group that does not exceed 25 mrem (0.25 mSv) per year, including that from groundwater sources of drinking water, and that the residual radioactivity has been reduced to levels that are as low as reasonably achievable (ALARA). Determination of the levels which are ALARA must

take into account consideration of any detriments, such as deaths from transportation accidents, expected to potentially result from decontamination and waste disposal.

This regulation establishes levels for cleanup required for unrestricted use. Although the Guterl Site was not licensed by the NRC, operations were similar to those described under 10 CFR 20. Accordingly, remedial actions taken at the site should be consistent with these requirements, which provide cleanup standards, or standards of control, that specifically address the hazardous substances at the Guterl Site. Therefore, requirements for closure under this regulation are considered both relevant and appropriate for cleanup of soil, buildings, and groundwater at the site. The cleanup levels developed in Section 3.6 are consistent with these requirements and relevant and appropriate for remedial alternatives being proposed in this FS.

40 CFR 141.66: National Primary Drinking Water Regulations - Maximum Contaminant Levels for Radionuclides: This part 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. This part shall apply to each public water system, unless the public water system meets all of the following conditions:

- Consists only of distribution and storage facilities (and does not have any collection and treatment facilities).
- Obtains all of its water from, but is not owned or operated by, a public water system to which such regulations apply.
- Does not sell water to any person.
- Is not a carrier that conveys passengers in interstate commerce.

Uranium is the only COC identified in groundwater. The regulation 40 CFR 141.66(e) establishes a MCL for total uranium of 30 µg/L. This regulation establishes primary drinking MCLs for radionuclides 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.

The national primary drinking water regulations apply to "public water systems." A "public water system" is defined in 40 CFR 141.2 as:

> …a system for the provision to the public of water for human consumption through pipes or, after August 5, 1998, other constructed conveyances, if such system has at least fifteen service connections or regularly serves an average of at least twenty-five individuals daily at least 60 days out of the year.

Evaluation and Conclusion

Groundwater underlying the Guterl Site is of sufficient quality and quantity to be considered potable for drinking water purposes. Since no functioning groundwater wells (for domestic consumption) were identified within a half-mile radius of the Guterl Site (Appendix C) and groundwater at and near the site does not meet the criteria of a public water system (as defined above), the national primary drinking water regulation is not applicable to groundwater at the Guterl Site.

However, uranium is a FUSRAP-related COC in groundwater at the Guterl Site and the national primary drinking water regulation contains substantive criteria (i.e., MCL) pertaining to the hazardous substance, pollutant, or contaminant (i.e., uranium), so the MCL is relevant and appropriate to groundwater underlying the Guterl Site.

3.4 SITE-SPECIFIC REMEDIAL ACTION OBJECTIVES

The site-specific RAOs described in the following paragraphs consider the FUSRAP-related COCs (Section 3.2), ARARs (Section 3.3), proposed cleanup levels (Section 3.5), and current and assumed future land use and receptors.

As stated in Section 2.5.1, the HHRA indicated that ^{232}Th, ^{234}U, ^{235}U, and ^{238}U pose unacceptable radiological dose to a construction worker from exposure to contaminated soil and buildings, and groundwater Therefore, RAOs were developed for these media to:

- Prevent exposure to uranium and ^{232}Th in soil and buildings; and uranium in groundwater; such that a construction worker does not receive a total effective dose exceeding 25 mrem/yr above background from all pathways.
- Prevent human ingestion of groundwater that exceeds the uranium MCL of 30 µg/L.

3.5 DEVELOPMENT OF PROPOSED PRELIMINARY REMEDIATION GOALS

3.5.1 DEVELOPMENT OF PRELIMINARY REMEDIATION GOALS FOR SOIL

The BRA evaluated the risks to current and future potential receptors at the Guterl Site including the current and future juvenile trespasser, the current and future on-site worker, the future construction worker and the future on-site resident. As indicated in Section 2.1.1, USACE has identified the reasonable future land use for the Guterl Site as industrial. Based on the anticipated future land use being industrial and analysis completed in the BRA, USACE identified the construction worker as the critical group for demonstrating compliance with 10 CFR 20 Section 20.1402 (i.e., the group of individuals reasonably expected to receive the greatest exposure to residual radioactivity at the site).

Preliminary remediation goals for soil were developed based on two endpoints:

- Protection of direct soil exposures to the critical group (a construction worker) for the reasonable future land use (industrial).
- Protection of groundwater (i.e., removal of enough of the uranium soil source term to allow attenuation of uranium groundwater concentrations to the U.S. EPA MCL for protection of drinking water).

The two sets of soil PRGs, and soil background concentrations for each COC, are provided in Table 3-1, and discussed in detail in the following two sections.

3.5.1.1 CONSTRUCTION WORKER PRG

The construction worker PRG, designated as soil PRG-CW, was developed based on the information presented in the BRA for the construction worker scenario presented in the RI report (USACE, 2010). It was determined for the purposes of this FS that the exposure scenario utilized in the BRA (presented in Section 6.3.2 of the RI report) was still a reasonable exposure scenario for the construction worker as the critical group for soil PRG-CW development. The soil PRG-CW was developed to meet the 25 mrem/year dose limit (as per 10 CFR 20 Section 20.1402), considering all exposure pathways. The soil PRG-CW is defined as 23 pCi/g for ^{238}U and 6.6 pCi/g for ^{232}Th. The isotope ^{238}U will be used as a surrogate for the total uranium soil PRG-CW because it can be directly measured in the field during remediation efforts.

The construction worker was assumed to be exposed via external gamma, inhalation, and incidental ingestion to radioactivity in site soils, building materials, surface water, sediment, and groundwater for a full working year (8 hours per day, 5 days per week, for 50 weeks). The risk assessment in the RI assumed a groundwater ingestion rate for a construction worker greater than an ingestion rate of a resident. The residential PRG of 277 pCi/g of total uranium is greater than the PRG for the construction worker at 47 pCi/g total uranium. This is due to differing assumptions about exposure to uranium contaminated groundwater for the worst-case on-site worker vs. reasonable exposure assumptions for residential use of municipal (off-site supplied) drinking water that must meet the MCL. As explained in Sections 6.3.4 and 6.3.4.1 of the RI report, the BRA utilized the RESRAD computer code to estimate both incremental lifetime cancer risks and radiological doses from exposure to radionuclides of potential concern in site media. The exposure parameter input values and exposure pathways presented in Table 6-4 of the RI report (Appendix E of this FS) were used for development of cleanup goals for the FS. Section 8.2.2 of the RI report further explains how the soil PRGs were developed for each receptor based on the results of the BRA. Basically, unit soil concentrations for each COC were modeled in RESRAD from zero to 1,000 years for each receptor to determine times of peak dose. Dose-to-source ratios were recorded for times of single radionuclide maximum dose to generate soil dose PRGs for each receptor. The soil PRG-CW was determined by dividing the target dose (25 mrem/year) by the dose-to-source ratio.

The dose and risk data for the construction worker are provided in Table V.4-4 of the RI report (summary excerpted in Appendix G, Table G-1 of this FS) and explained in more detail herein. Specifically, for ^{232}Th, the time of peak dose (82 years) includes ingrowth from daughter radionuclides ^{228}Ra and ^{228}Th, so that the resulting soil PRG is protective of ^{232}Th and daughter products. (Summing the dose-to-source ratios for each of the individual radionuclides ^{228}Th, ^{232}Th, and ^{228}Ra from time zero would also produce the same soil PRG.) The dominant pathway for exposure to ^{232}Th in soil is external gamma. For uranium, the total uranium cleanup goal was developed including the contribution to dose from ^{234}U, ^{235}U, and ^{238}U, assuming natural abundance of uranium. Assuming a hypothetical future worst-case scenario, where buildings overlying contaminated soils are no longer on site and soils underneath are subject to rain infiltration and subsequent leaching, the time of peak dose (approximately 58 years) reflects the maximum uranium groundwater concentration resulting from this leaching of uranium from soil as modeled in RESRAD. (As discussed in the following paragraphs, the groundwater model presented in this FS is more refined and produces slightly different timing and amount of peak uranium groundwater concentration.)

The BRA assumed that the construction worker would encounter shallow groundwater during the course of construction activities, and an incidental ingestion rate for groundwater of 0.2 L/day (approximately 10% of overall water ingestion) was used in the exposure assessment. The dominant pathway contributing the majority of the 25 mrem/year dose limit for uranium at this time is from incidental ingestion of contaminated groundwater. The amount of uranium in groundwater resulting from the RESRAD model leaching the uranium soil source term to groundwater at this time (58 years) is much greater than the MCL (30 μg/L). For the direct soil exposure pathways, inhalation, incidental soil ingestion, and external gamma (^{235}U only) contribute to the overall dose. The summary report from the RESRAD run is provided in Appendix G.

If the groundwater exposure pathway were eliminated for the construction worker, the direct exposure threshold for uranium in the soil would have to be nearly 10 times higher to reach the 25 mrem/year dose limit. However, the RESRAD exposure breakdown indicates that the pore-water and groundwater impacts below the contamination zone could be significant enough to pose risk to the construction worker, so the pathway was retained for soil PRG development.

A soil-to-groundwater leaching model (SESOIL) was used in conjunction with the Modular Three-Dimensional Finite-Difference Groundwater Flow Model and a solute transport model (Model Transport in 3 Dimensions) to construct a comprehensive groundwater flow and contaminant-transport model for the site. This groundwater model is more refined and produces slightly different timing and concentration peaks for uranium in groundwater than the RESRAD results. A comparison of the peak soil leachate to groundwater from RESRAD to the SESOIL result indicates that the groundwater model produces a higher uranium leachate concentration, which equates to a lower soil PRG than RESRAD dictated for the long-term protection of the construction worker. The groundwater model output is presented in Appendix F.

Based on the results of the three-dimensional groundwater modeling effort, uranium will remain above the MCL (30 μg/L) for approximately 430 years in the shallow groundwater and 660 years in the deep groundwater if soils are removed to the soil PRG-CW and no other actions are taken.

3.5.1.2 GROUNDWATER PROTECTION PRG

As presented in Section 2.1.8 of this FS, groundwater in sections of the Guterl Site is considered a potentially viable source of drinking water; thus, a PRG for soil protective of groundwater was developed to include the removal of soil sources for groundwater contamination, in order to attain compliance with 40 CFR 141.66(e).

The calculation of this groundwater protection PRG for soil, designated as soil PRG-GW, was performed using the groundwater models described previously. The input parameter, soil to water partitioning (Kd) of uranium, in the transport model was based on geotechnical analysis of soil samples in the lab during the RI and the DGI to support this FS. These models were used to determine the effect that residual uranium distributions in soil would have on groundwater concentrations and then “back calculate” a soil PRG protective of groundwater (i.e., residual uranium leachate would be low enough to prevent future MCL exceedances in groundwater). The objective was to develop a soil PRG-GW that could be used as a lower threshold for soil removal that could be coupled with a separate remedial action for the current groundwater plume, both of which would attain a 30-120 year remedial timeframe. The threshold soil value for uranium would ensure future leaching will not result in regrowth of a uranium plume greater than the MCL after 30 years of optimal remedy implementation (e.g., active plume control and removal). Modeling performed to support the development of the soil PRG-GW is included in Appendix F.

Modeling results indicate a soil PRG-GW of 11 milligrams per kilogram (mg/kg) total uranium (equivalent to 3.66 pCi/g ^{238}U) is predicted to be protective of groundwater. Based on the results of the three-dimensional groundwater flow model, uranium will attenuate to meet the MCL throughout the majority of the site in 30 years for the shallow and 120 years in the deep water-bearing zones, respectively.

Unlike the soil PRG-CW, the soil PRG-GW is not a dose-based PRG and should be addressed as a “not-to-exceed” value throughout the site (i.e., would be remediated as a heavy metal). The PRG for thorium is not separately defined for the protection of groundwater because thorium is not a COC in groundwater. However, since ^{232}Th has been found to be collocated with ^{238}U, removal of soil that exceeds the ^{238}U soil PRG-GW will include the removal of the collocated soil with activity concentrations that exceed the ^{232}Th soil PRG-CW.

Leaving residual concentrations of uranium in soil up to the soil PRG-CW around the northern and eastern perimeters of the site (a semi-circle of concentrations at the site boundary that may be above background once the on-site soils exceeding the PRG-GW have been removed) will not impact the groundwater alternatives. Refer to Appendix F for more details on the groundwater modeling. These concentrations are also protective of residents, based on evaluations of potential residential risks. Since the land use to the north of the site includes some residential properties, potential PRGs for protection of residential exposures to uranium and thorium were evaluated for this FS, to confirm that no remediation of soils beyond the site boundary would be warranted. For this refined residential risk assessment, as explained in Section 2.5.2, the drinking water pathway was turned off in the RESRAD program since municipal potable water is supplied for the site and surrounding community. However, to ensure that the total dose limit of 25 mrem/year specified in the ARAR (10 CFR 20) would still be met, an allowance for dose from consumption of groundwater was made. Based on previous evaluations, the MCL for uranium, 30 μg/L, results in a dose of approximately 5 mrem/year, assuming a resident drinks 2 liters of water a day (conservative drinking water intake assumption). Therefore, the dose limit for direct exposure to soils was set at 20 mrem/year only (25 mrem/year – 5 mrem/year). Table G-2 in Appendix G indicates that the total uranium PRG of 277 pCi/g which is protective of a resident who is exposed via soil pathways (incidental ingestion, inhalation of dust, external gamma) and up to 30 μg/L uranium in drinking water (e.g., not more than the MCL of uranium).

The RESRAD summary output of the residential evaluation is also included in Appendix G. This concentration is greater than the construction worker PRG (who is assumed to have exposure to contaminated soils and also groundwater concentrations greater than the MCL of 30 μg/L uranium) and is not exceeded anywhere along the site boundary (Figure 3-1). The results of groundwater simulations presented in Appendix F show that the leachate from the “rind” of PRG-CW soils is adequately diluted by ambient groundwater and does not affect the plume fate associated with the soils GW-PRG. Consequently, the simulation of bordering soils at the PRG-CW does not pose a risk to the residential receptor nor elevate groundwater concentrations above the uranium MCL of 30 µg/L. Therefore, it is not necessary to remediate soils outside the site boundary.

3.5.2 PROPOSED GROUNDWATER AND SEEP PRG

Groundwater at the Guterl Site has been determined to be a potentially viable source of drinking water (e.g., U.S. EPA Class IIb). Although there are no known groundwater users immediately downgradient of the site, the groundwater in portions of the site could be of sufficient yield and quality to be used for drinking water purposes. In addition, directly southeast of the site, groundwater seeps have been identified that discharge into the Erie Canal. The seeps are located across from the City of Lockport emergency drinking water inlet. Since there is a potential that the groundwater at the Guterl Site could be used for drinking water, a groundwater protection PRG was developed based in the ARARs. The RAO applicable to water is to prevent the ingestion of water exceeding the federal MCL of 30 µg/L for total uranium. Groundwater in New York State has a default classification of "GA" (fresh groundwater), for which potable water supply is the best usage (6 NYCRR 701.15). Section 2.1.8 of this FS established that, based on quality and yield, the groundwater at the Guterl Site meets the classification of "GA." The use of groundwater as a drinking water supply on the site must either be controlled or restricted, or the total uranium concentrations in groundwater must be limited to the MCL (30 µg/L).

3.5.3 DEVELOPMENT OF BUILDING SURFACE DERIVED CONCENTRATION GUIDELINE LEVELS

The USACE Buffalo District developed project-specific DCGLs for the structures (Appendix H). These DCGLs are the measured surface contamination concentrations in disintegrations per minute per 100 square centimeters (cm^2) that will result in 25 mrem/yr to the critical group; i.e., the construction worker. These DCGLs were derived using RESRAD-BUILD Version 3.5 computer code developed by Argonne National Laboratory (Argonne) and a site-specific radionuclide mixture taking into consideration the radionuclide emissions and the effect of beta backscatter on the measured results. These project-specific DCGLs are presented in Tables 3-2a and 3-2b.

The RESRAD-BUILD is a widely utilized code to analyze radiological doses from human activities in buildings contaminated with radioactive material. Three receptor scenarios (on-site worker, construction worker, and juvenile trespasser) were considered for both fixed and removable contamination. For both types of contamination, the construction worker was the critical group. Unit dose factors were calculated for the building COCs (^{232}Th, ^{234}U, ^{235}U, and ^{238}U). Decay progeny (daughters) were included as appropriate. Ratios of the COCs were derived from significantly elevated "soils in buildings" data in the RI report.

The alpha and beta emissions from each COC, and a beta backscatter correction, were applied to the radionuclide mixture and unit dose factors determined previously to quantify the measured emission rate (alpha disintegrations per minute/100 cm^2 or beta disintegrations per minute/100 cm^2) that would result in a 25 mrem/yr dose to the critical group. These DCGL values were used to evaluate the facility surface measurements taken during the RI.

3.6 MATERIALS IMPACTED

This section provides an estimate of the quantities of impacted media. The estimates used the data generated during the RI and previous characterization efforts, and the results of the more recent DGI.

3.6.1 SOIL

The USACE Buffalo District developed estimates of FUSRAP-contaminated soil at the Guterl Site for use in the detailed analysis of alternatives. This estimation was used to develop conceptual excavation footprints and associated *in situ* contaminated soil volumes to support cost estimates developed during the detailed analysis of alternatives. *In situ* soil volume is the volume of soil calculated in place or within the ground surface. *Ex situ* soil volume is actual volume after removal or excavation and reflects that soil volumes increase with removal due to bulking.

The USACE Buffalo District used a method developed by Argonne to estimate contaminated soil volumes at the Guterl Site. This method, known as the Bayesian Approaches to Adaptive Spatial Sampling (BAASS), uses both “soft” and “hard” data to generate a probability that a given area of a site will exceed a targeted cleanup objective or threshold (Argonne, 2005). Soft data includes anomalies identified during a historical aerial photograph analysis, a nonintrusive geophysical survey, gamma walkover surveys, anecdotal information, and historical site/process knowledge. This information is used to create an initial conceptual site model. Hard data can be defined as the results of laboratory analysis of collected soil samples, and is applied in BAASS to update the initial conceptual site model. The results of the BAASS model were then exported to ArcGIS (a Geographic Information System [GIS] software suite produced by Esri). The ArcGIS software was used to convert the BAASS output into spatial extents that represent areas that were greater than or equal to a certain probability of soil contamination.

Soil volumes were estimated using the two different soil PRGs: soil PRG-CW and soil PRG-GW. For the construction worker scenario, the soil PRG-CW is defined as 23 pCi/g for ^{238}U and 6.6 pCi/g for ^{232}Th. A sum-of-ratios (SOR) approach was used to calculate the ratio of the concentration of each radionuclide versus the radionuclide-specific soil PRG-CW. The SOR method is based on the principle that a ratio greater than 1 represents unacceptable exposure and a ratio less than or equal to 1 represents acceptable exposure; if there are multiple radionuclides in the medium being evaluated, the sum of the ratios for all of the radionuclides must also be less than or equal to 1. For sample locations with an SOR score above 1, a hit value of 1 was assigned in BAASS; for sample locations that had an SOR score between 0.99 and 0.5, a hit value of 0.5 was assigned; and for sample locations that had an SOR score below 0.5 a hit value of 0 was assigned.

For the impact to groundwater scenario, each spatial extent represents a two-dimensional area with a probability that soil contained within the boundaries exceeded the soil PRG-GW of 11 mg/kg total uranium (equivalent to 3.66 pCi/g ^{238}U.) The ^{232}Th results above the soil PRG-CW were collocated with ^{238}U PRG-GW exceedances, so only the ^{238}U data was used for this volume estimate. Removal of soil that exceeds the ^{238}U soil PRG-GW will include the removal of the collocated soil with activity concentrations exceeding the ^{232}Th soil PRG-CW. A complete discussion of the methods and the results of the analysis are provided in Appendix I.

The contamination footprint was derived from the 50% confidence (0.5 probability) contour and shows several distinct areas of contamination, as shown in Figures 3-1 and 3-2. Figure 3-3 presents the overlap of the footprints for both PRGs. Upon applying the three-dimensional modeling, a surface depicting the contamination depth within the footprint is obtained. This surface is presented in Appendix I. Figure I-4 depicts the PRG-CW scenario and Figure I-5 depicts the PRG-GW.

When the volume of each area is summed, the result yields an *in situ* contaminated soil estimate of approximately 3,800 cubic meters (m^3) (5,000 cubic yards [yd^3]) for the construction worker scenario, and 44,000 m^3 (58,000 yd^3) for the groundwater protection scenario. Any non-FUSRAP-related wastes that are comingled with FUSRAP-related material will be excavated and disposed off site. Any non-FUSRAP-related materials that are not comingled will remain on site.

Table 3-11: Estimated Volume of Contaminated Soil for Preliminary Remediation Goals

Soil PRG	***In Situ* Contaminated Soil Volume m^3 (yd^3)**	***Ex Situ*[a] Contaminated Soil Volume m^3 (yd^3)**
Construction Worker (PRG-CW)	3,800 (5,000)	5,000 (6,500)
Groundwater Protection (PRG-GW)	44,000 (58,000)	57,200 (75,400)

[a] *Ex situ* contaminated soil volume estimates assumed a 1.3 times bulking factor from the *in situ* volume estimate to account for the increase in volume when naturally compacted soil is excavated.

3.6.2 GROUNDWATER

Shallow and deep groundwater underneath the Guterl Site have been impacted from the potential liquid disposals on site and the leaching of uranium from the soil by infiltrating precipitation. The volumes of groundwater currently impacted by uranium, defined by the groundwater total uranium concentrations exceeding the uranium MCL of 30 µg/L, were estimated on the basis of August 2011 sampling data. Figure 2-9 presents the outlines of the shallow and the deep groundwater plumes, which are respectively 16 ha and 7 ha (38.7 and 18.0 ac) in areal dimensions. The shallow groundwater vertical extent averages 5 m (17 ft), while the deep groundwater extent averages 12 m (38 ft). The volume of groundwater per cubic feet of bedrock mass is less in the deep groundwater as compared to the shallow groundwater since fracture density generally decreases with depth. At the Guterl Site, the effective porosity of the deeper dolostone rock is less than the weathered shallow bedrock.

The existing groundwater plume was specified in the groundwater model based on concentrations measured in August 2011 and reported in the Final DGI Technical Memo

(USACE, 2012b). A trend analysis of the uranium data from each well and a comparison of plume distributions derived from the annual sampling program (2012 to 2016) indicate the 2011 dataset still is appropriate to represent site conditions that are observed in subsequent monitoring efforts. The groundwater elevations may be subject to seasonal variation, however the overall flow directions, plume distributions and magnitudes (gradients) are similar in each sampling event. These consistent site conditions are applied in the groundwater model. Current sampling data is available in the annual Guterl environmental monitoring reports located on the USACE FUSRAP website (https://www.lrb.usace.army.mil/Missions/HTRW/FUSRAP/Guterl-Steel-Site/).

As shown in the following table, the estimated impacted groundwater volumes for the shallow and the deep groundwater are 204 and 42 million liters (54 and 11 million gallons), respectively.

Table 3-12: Estimated Volume of Uranium Impacted Groundwater

Groundwater Unit	Area		Average Thickness Meters (Feet)	Assumed Porosity (%)	Volume Impacted	
	Meters^2 (Feet^2)	Hectares (Acres)			Meters^3 (Feet^3)	Million Liters (Million Gallons)
Shallow Groundwater	156,500 (1,685,000)	15.7 (38.7)	5.2 (17)	25	204,000 (7,161,000)	204 (54)
Deep Groundwater	72,600 (782,000)	7.3 (18.0)	11.6 (38)	5	42,000 (1,486,000)	42 (11)

3.6.3 BUILDINGS

Section 6.0 of the DGA report presents an assessment of the data collected for the buildings during the RI and prior investigations. This section presents estimates of impacted building surfaces (e.g., floors, walls, and ceilings/roofs) and building contents. For the purposes of this FS, impacted materials are defined as those that, in their current state, exceed the project-specific DCGL.

3.6.3.1 BUILDING SURFACES

A summary of the static measurement data shows that 994 (approximately 20%) of the 4,855 total static measurements exceeded the project-specific DCGL. Table 3-2a presents the DCGLs for buildings. Of the approximately 4,500 swipes taken for removable contamination, only two were above project-specific removable DCGLs, indicating the vast majority of contamination on interior building surfaces is fixed. Exceedances to the DCGLs in building surfaces are presented in the following sections. A summary of building construction material, areas and volumes are presented in Table 3-3. An estimate of impacted building surfaces is presented in Table 3-4. Figures 3-4 to 3-13 present an estimate of surfaces exceeding the DCGLs in each of the buildings.

Table 3-2a: Project-Specific Derived Concentration Guideline Levels (DCGL)

	DCGL[a]	
	Total[b]	Removable
Alpha (α) dpm/100 cm^2	2,391	240
Beta (β) dpm/100 cm^2	2,515	252

[a] DCGLs are derived in Appendix H. dpm: disintegrations per minute

3.6.3.1.1 Building 1

No radiological surveys were conducted in the basement of Building 1, which was flooded throughout the RI; this observation was consistent with prior investigation reports (ORISE, 1999 and USACE, 2001b). A total of six surface water samples and seven sediment samples were collected from Building 1. Six surface water/sediment sample pairs were collected from the flooded basement. One sediment sample was collected in the alleyway between Building 1 and Building 2 from the ground surface below a drainpipe that originates in the workroom at the south end of Building 1. The sample data contained elevated soil COPCs.

Of the 225 locations measured, nine (4%) exceeded the project-specific DCGLs. Floor locations accounted for three values exceeding the project-specific DCGLs, and six of the locations were located on structural surfaces (upper walls, ceilings, and exterior wall surfaces). The following surfaces exceeded the project-specific DCGLs:

- Interior upper walls and ceilings: three of 70 measurements (4%)
- Exterior/outer walls: three of 35 measurements (9%)
- Work room floors: three of seven measurements (43%)

3.6.3.1.2 Building 2

Of the 1,380 locations measured, 68 exceeded the project-specific DCGLs. Approximately 70% of the locations in Building 2 that exceed the project-specific DCGLs are located on structural members such as:

- Exterior walls.
- Interior walls.
- Ceiling cross beams.
- Roof.

The remaining locations exceeding project-specific DCGLs are located on floors and equipment. Approximately, 1% of the upper building surfaces and less than 1% of the lower building surfaces exceed the project-specific DCGLs.

3.6.3.1.3 Building 3

Of the 1,571 locations measured, 510 exceeded the project-specific DCGLs. Survey locations that exceed the project-specific DCGLs are located on both the floors and the structural surfaces, including:

- Floors: entire building.
- Interior lower walls: entire building with the exception of the southwest wall and the south wall.
- Interior upper wall: the only exceedances were located on the far north wall.
- Ceilings: entire building.

Approximately, 47% of the upper building surfaces and 39% of the lower building surfaces exceed the project-specific DCGLs.

3.6.3.1.4 Buildings 4/9

Of the 813 locations measured, 211 exceeded the project-specific DCGLs. Survey locations that exceed the project-specific DCGLs are located at the following areas:

- Floors: entire building.
- Lower walls: entire building.
- Ceiling: east half of ceiling.

Approximately, 4% of the upper building surfaces and 12% of the lower building surfaces exceed the project-specific DCGLs.

3.6.3.1.5 Building 5

Of the 28 locations measured, no measurements exceeded the project-specific DCGLs.

3.6.3.1.6 Building 6

Contamination on building surfaces was detected on the outside surfaces of Building 6. No measurements were taken inside Building 6 because of elevated radiological exposure measurements.

Of the 39 exterior wall surface locations measured, two exceeded the project-specific DCGLs.

3.6.3.1.7 Building 8

Similar to Building 6, a detailed survey was not conducted in Building 8 due to elevated radiological exposure measurements.

Of the 75 locations measured, 11 exceeded the project-specific DCGLs. The survey locations that exceed the project-specific DCGLs are located at the following area:

- Floor surfaces: eight contamination points centrally located in the building, and three points in the north and northwest portions of the building.

3.6.3.1.8 Building 17

A radiological scanning survey was conducted in the laboratory; no other matrices were sampled. Of the 60 locations measured, none exceeded the project-specific DCGLs.

3.6.3.1.9 Building 24

Of the 541 locations measured, 172 exceeded the project-specific DCGLs. With the exception of a few expected floor locations, the majority of the measurements in excess of the project-specific DCGLs were on building structural surfaces (column pedestals, interior ceiling surfaces, and roofing joists).

Approximately, 39% of upper building surfaces and 2% of lower building surfaces exceed the project-specific DCGLs.

3.6.3.1.10 Building 35

Of the 123 locations measured, no measurements exceeded the project-specific DCGLs.

3.6.3.2 BUILDING CONTENTS

A summary of the building contents survey is presented in Appendix E of this FS (Appendix E-2 from the RI report). Table 6-4 of the DGA report describes and quantifies the inventoried features along with associated photographic documentation and sketches. Inventories were performed both inside and outside of Buildings 1, 2, 3, 4/9, 5, and 35 (detailed surveys were not conducted in Buildings 6 or 8 due to elevated radiological exposure measurements, and a survey of building contents was not conducted in Buildings 17 and 24 because they are active facilities for ATI Specialty Materials). Typical materials inventoried included miscellaneous metal, wood, electrical, and paper debris, machinery, overhead cranes, and miscellaneous materials (e.g., steel rolls, wood, fire brick, and asbestos). A summary of the volumes of building contents and their potential for being impacted is presented in Table 3-5.

3.6.3.3 BUILDING DISPOSITION

The results of the building evaluations (Section 3.6.3) were used in combination with the extent of soil contamination to determine the disposition of each building for development of the alternatives. The decision process needs to consider the potential removal of the soil underlying each building. Locations of buildings with respect to impacted soils are shown on Figure 3-1 for the soil PRG-CW and Figure 3-2 for soil PRG-GW, respectively.

3.6.3.3.1 Building Disposition- Soil PRG-CW

As shown on Figure 3-1, Buildings 2, 3, 4/9, 6, 8, and 24 are located on impacted soils above the soil PRG-CW. The following presents a summary of the actions for each of the buildings (based on the soil PRG-CW):

- Building 1—this building has limited portions of the building materials and surfaces above the DCGLs which will be decontaminated due to the risk of release to the environment due to the condition of the building structure. Underlying soils are not impacted above the PRG-CW; therefore, Building 1 is carried over for evaluation in the Building Alternatives in Section 4.0.

- Buildings 2, 3, 4/9, 5, 6, and 8—because both building materials and soils are impacted, these locations will be addressed under both the Building and Soils Alternatives in Section 4.0.
- Building 5—the soils beneath Building 5 were not sampled, but according to sample results are impacted on all four sides of the building above the soil PRG so it is assumed that impacted soils extend beneath this building.
- Building 17—both this building and the underlying soils are not impacted; thus, this building is not evaluated in alternatives considering soil cleanup to the soil PRG-CW.
- Building 24—both building materials and soils are impacted above the soil PRG-CW. Building 24 will be addressed under both the Building and Soils Alternatives in Section 4.0.
- Building 35—both this building and the underlying soils are not impacted; thus, this building is not evaluated in any alternatives considering soil cleanup to the soil PRG-CW.

3.6.3.3.2 Building Disposition- Soil PRG-GW

The building disposition for remedial alternatives where soil is removed above the soil PRG-GW is similar to that presented above for the soil PRG-CW with the following differences, Buildings 1 and 35 are located on impacted soils above the soil PRG-GW.

- Building 1—since building materials, surfaces, and soils are impacted above the soil PRG-GW, this building will be addressed under both the Building and Soils Alternatives in Section 4.0.
- Building 35—the building is not impacted, but soils underneath the building are impacted above the soil PRG-GW. The building will be addressed under the Building and Soils Alternatives in Section 4.0.

3.7 IDENTIFICATION OF GENERAL RESPONSE ACTIONS

General Response Actions describe the broad approaches of remedial measures that can potentially achieve RAOs for the media of interest including soil, buildings, and groundwater. These GRAs may encompass many remedial technologies and remedial technology process options. For example, groundwater treatment is a GRA; *in situ* groundwater treatment is a remedial technology, and chemical oxidation is a remedial technology process option. Some GRAs can meet the RAOs alone, while others may be combined with additional GRAs or performed in stages to meet the RAOs and cleanup levels. Remedial technologies that have been considered are included under the general response actions described in the following sections.

The term “remedial technology” is used to refer to general categories of technologies, such as chemical treatment or capping. The term “process option” refers to specific processes within each technology type. In accordance with U.S. EPA RI/FS guidance, remedial technologies and process options are evaluated during the screening phase on the basis of technical implementability (U.S. EPA, 1988). The physical conditions at the site, types and concentrations of COCs were used to determine which technologies could be effectively implemented. Additionally, technical feasibility was evaluated using several technology reference guides and screening tools.

3.7.1 GENERAL RESPONSE ACTIONS

This section provides a brief overview of the five GRAs selected for evaluation for the Guterl Site. The GRAs are summarized in Table 3-6 and include: Land Use Controls (LUCs), Containment, Removal, Treatment, and Disposal.

3.7.1.1 LAND USE CONTROLS

LUCs are legal, administrative, or engineering (physical) mechanisms that restrict the use of, or limit access to, contaminated property to reduce risk to human health and the environment and minimize any potential exposure. The NCP allows the use of LUCs to supplement controls for short- and long-term management of hazardous substances, pollutants, or contaminants [(40 CFR 300.430(a)(1)(iii)(D)]. Most commonly used where active response measures such as containment, removal, treatment, or beneficial use of source material are determined not to be practicable or LUCs are used as a supplement to those measures, LUCs do not reduce the toxicity, mobility, or volume of contamination, but are implemented to limit routes of exposure. The primary purpose of controls for the Guterl Site would be to control the human exposure to contaminated soil and building structures, during the remedial action.

3.7.1.2 CONTAINMENT

Containment (i.e., physical barriers) could be used to reduce exposure by providing a physical barrier or to control or reduce the migration of contaminants into the surrounding environment, but do not actually reduce contaminant volume or toxicity. This GRA could also be used to isolate contaminated groundwater and soils, and to reduce precipitation infiltration and groundwater flow through source materials. Containment actions considered for the Guterl Site include capping contaminated soils, vertical and horizontal barriers for groundwater, and sealant for buildings/structures. Containment actions may be combined with other response actions to meet RAOs.

3.7.1.3 REMOVAL

Removal activities could be implemented to reduce the toxicity levels of soils and building materials to acceptable levels, eliminate contaminant migration, and mitigate the long-term potential of human exposure to COCs above the threshold levels. Technologies under this action would be effective in reducing contaminant mobility since the contaminated media would be physically removed and isolated. However, they would not reduce the volume or toxicity of the removed material. As a result, this activity is often used in combination with other response actions, such as treatment or disposal (on or off site) of the removed material. Soil, groundwater, and building removal are considered viable response actions at the Guterl Site.

3.7.1.4 TREATMENT

This GRA is the preferred action under the Superfund Amendments and Reauthorization Act, which states that the U.S. EPA expects to use “treatment to address the principal threats posed by a site wherever practicable” [40 CFR 300.430(a)(1)(iii)]. Treatment can meet RAOs by reducing the toxicity, mobility, and volume of contaminated media. Treatment may be combined with other response actions.

Treatment is considered a viable GRA for the soils, buildings, and groundwater at the Guterl Site. Soil treatment actions include physical, chemical, biological, and thermal technologies that are used to reduce mobility or remove contamination from soils. Groundwater treatment includes physical, chemical, or biological treatment used to reduce the amount of contamination in an aquifer and would reduce the potential risks from exposure. Treatment in buildings refers to decontamination actions for buildings/structures including physical and chemical decontamination procedures.

Treatment may be conducted *ex situ* or *in situ*, although the methods between them may differ. *Ex situ* treatment could be performed on or off site; however, *in situ* treatment occurs on site in the ground below the site surface. Both *in situ* and *ex situ* treatment technologies have been identified for soil and groundwater at the Guterl Site.

3.7.1.5 DISPOSAL

Disposal activities may be implemented on or off site. Disposal actions would not reduce the volume or contamination level of the affected media, but they would reduce the mobility of contaminants through the permanent and final placement of the waste materials in a manner that protects human health and the environment.

Disposal actions for the soils, buildings, and groundwater would involve the permanent and final placement of the waste materials in a manner that protects human health and the environment. Contaminated soils, building materials, and bulk waste above cleanup criteria would be disposed of on site or off site in accordance with local, state, and federal regulations. Disposal can reduce the mobility of COCs through proper placement and when used in combination with removal and/or treatment, can meet the RAOs.

3.8 IDENTIFICATION AND SCREENING OF REMEDIAL TECHNOLOGIES

This section provides general descriptions of potentially applicable technologies for impacted media and presents the initial screening of these technologies based on technical implementability. The impacted media include soil, buildings, and groundwater. Comparisons of soil results to the PRGs and building results to the DCGLs developed for this FS have shown there is a risk in soil and building materials. Uranium in groundwater on site and off site could pose unacceptable risks if the groundwater were to be used as a drinking water source. No unacceptable human health risks were identified for potential exposures to other media such as surface water and sediment.

The identification and initial screening process was performed in accordance with the CERCLA FS guidance document (U.S. EPA, 1988), as specified by the NCP (40 CFR Part 300, Subpart E). Initial identification, as potentially applicable, was based on the following criteria:

- Compatibility with constituent characteristics.
- Compatibility with media characteristics.
- Ability to achieve RAOs, either alone or in conjunction with other technologies.

Based on these criteria, some remedial action technologies were eliminated from further consideration. Those technology types considered technically implementable at the Guterl Site were retained for further screening.

Available literature for remediation technologies and process options was also researched to determine the potential technologies that may be feasible for implementation at the site. The U.S. EPA RI/FS guidance states that remedial technologies may be eliminated during the screening phase on the basis of technical implementability (U.S. EPA, 1988).

In accordance with the NCP requirement (40 CFR §300.430[e][3][i]), remedial alternatives developed through the FS process shall reduce the toxicity, mobility, or volume of the contaminant, if possible. Although technologies for radiologically contaminated media can effectively reduce the volume or mobility of contaminated material, none of the treatment technologies will change the radioactivity of the COCs. Over time, the level of radioactivity emitted from the immobilized radionuclides reduces itself through a process of radioactive decay. The COCs at Guterl have half-lives that range from approximately 240,000 years (^{234}U) to 14 billion years (^{232}Th), so no appreciable reduction in radioactivity will occur for several millennia. Therefore, the main focus for identification and screening of technologies in this FS is to reduce the volume or mobility of the radiological contaminants or reduce exposures to radiological contaminants in the media of concern. The technologies, associated process options, and applicable media are listed in Table 3-7 and discussed in the following sections.

3.8.1 LAND USE CONTROLS

LUCs limit human exposure to the COCs by restricting human access to the property and restricting human exposure to contaminants migrating from the site. Control mechanisms can be administrative, legal, and/or engineering (physical) controls, and will require cooperation among property owners, regulatory authorities, and the authority of local governments for their implementation. Specific characteristics of the site will determine which controls will be appropriate. LUCs are typically part of a more comprehensive remedial action, incorporated to provide protection during implementation of other measures or in combination with other process options when concentrations of COCs have not reached a level that would allow for safe use of the media impacted. The protectiveness of a remedy utilizing LUCs can also be enhanced by employing a system of mutually reinforcing LUCs. LUCs remain in place until RAOs are achieved.

LUCs evaluated for the Guterl Site include administrative and legal control mechanisms, and engineering controls, as described in the following paragraphs. LUCs at the Guterl Site are being evaluated for all media (i.e., soil, groundwater and buildings).

3.8.1.1 ADMINISTRATIVE AND LEGAL CONTROLS

Administrative or legal controls are types of LUCs that are used to protect human health and the environment from residual contamination. The four administrative and legal process options screened here are: proprietary controls, government controls, enforcement and permit tools, and informational tools.

3.8.1.1.1 Proprietary Controls

A proprietary control is a private contractual mechanism between the landowner and a third party contained in the deed. Proprietary controls involve placement of restrictions on land through use of deed restrictions. Proprietary controls give their holders and subsequent holders the right to use or restrict the use of land. If the remedial action achieves the RAOs once complete, and results in no risk to human health or the environment, proprietary controls would not be necessary. **Proprietary controls, such as deed restrictions, will be retained for further consideration.**

3.8.1.1.2 Governmental Controls

Governmental controls are restrictions that are implemented and enforced by state and local governments. They may include zoning restrictions, ordinances, statutes, building permits, or other provisions that restrict land or resource use at a site. Zoning use restrictions are imposed through a local zoning authority and are intended to prohibit activities that could disturb certain aspects of a remedy or to control certain exposures not otherwise protected under a remedy. Zoning restrictions have inherent weaknesses. Zoning laws can be repealed, or exceptions can be granted by the government.

Specifically for the Guterl Site, groundwater use restrictions were considered. Groundwater use restrictions are directed at limiting or prohibiting certain uses of groundwater which may include limitations or prohibitions on well drilling. This is a governmental control, generally at the local or county level (e.g., City of Lockport or NCDOH). If the remedial action results in no risk to human health or the environment, governmental controls would not be necessary. **Governmental controls are retained for further consideration.**

3.8.1.1.3 Enforcement and Permit Tools

Administrative orders under CERCLA can be used to restrict land use. Enforcement authority can be used to prohibit a party from specific land use or on-site operations; or require a settling party to place some other form of control on the property. **USACE does not have enforcement authority; therefore, these tools are not implementable for the Guterl Site.**

3.8.1.1.4 Informational Tools

Informational tools provide information or notification that residual contamination exists on a property. Common examples include state registries of contaminated properties, deed notices, and advisories. Due to the nature of some informational devices and their potential to not be enforceable, it is important to carefully consider the objective of this category of LUCs. Informational devices are most likely to be used as a secondary “layer” to help ensure the overall reliability of other actions. **These informational tools are retained for further consideration.**

3.8.1.2 ENGINEERING CONTROLS

The engineering control options screened here include site access restrictions and permanent markers/signage.

3.8.1.2.1 Site Access Restrictions

Site access restrictions which include the use of physical barriers (fences) and security personnel can be used to deter unauthorized access to the site during remedial action. These measures are designed to minimize the potential for direct human contact with contaminated media. Access to the Excised Area is currently restricted through the use of fencing and warning signs. There are no other security measures to ensure that trespassers do not climb or cut the fence to obtain access to the Excised Area. Since the site is not owned by USACE, it would be necessary to negotiate an agreement with the property owners to allow site access restrictions during remedial action**. These engineering controls are retained for further consideration.**

3.8.1.2.2 Permanent Markers/Signage

Permanent markers (warning signs) can be used around a contaminated site to warn against unauthorized access. These measures are designed to minimize the potential for direct human contact with contaminated media. Since the site is not owned by USACE, it would be necessary to negotiate an agreement with the property owners to allow markers/signage during the remedial action. **These engineering controls are retained for further consideration.**

3.8.2 CONTAINMENT

Containment (i.e., physical or hydraulic barriers) is used to prevent the migration of COCs from an impacted area to a non-impacted area and to isolate the impacted media to minimize the risk of exposure to COCs. The contaminated media is neither chemically nor physically changed, nor are the volumes of contaminated media reduced. These technologies do not involve any treatment, so no reduction of toxicity or volume is provided. Containment technologies at the Guterl Site are being considered for soils, groundwater, and buildings. The following sections describe several containment technology types available for the Guterl Site.

3.8.2.1 SOIL CONTAINMENT OPTIONS

3.8.2.1.1 Capping

A low permeability cover layer of clay or synthetic material is used to isolate buried waste material or contaminated soil, reduce infiltrating precipitation to groundwater, and prevent erosion of contaminated soil via wind and surface water runoff. Caps are also used to prevent direct contact with impacted material. Capping would not reduce the toxicity of the soil contaminants, but it could reduce mobility or migration, as well as risk of exposure to the receptors. Process options for soil capping include native soil, clay, synthetic liner, multi-layered, asphalt, or concrete. Native soil can be used in areas of low radioactivity to provide an exposure barrier and, in conjunction with surface controls, reduce migration by wind and water erosion. However, material left in place would not allow for unrestricted use of the site. Clay capping of waste is a proven technology commonly used as a source control measure in the remediation of waste sites. Alternative materials include asphalt or concrete pavement to cover contaminated soil.

Due to the high water table at the Guterl Site, this option would need to be used in conjunction with other engineered controls such as a vertical barrier to prevent groundwater contact with impacted soils (i.e., the remedy would have to be a full landfill design). Capping also requires long-term maintenance and limits future land use. **The soil capping technology is not retained for further screening.**

3.8.2.1.2 Vertical Barriers

Vertical barrier options for soil include sheet pile, slurry walls, grout walls, or other impermeable materials. The physical barriers prevent infiltration and control groundwater flow through soil source materials, and are used to contain the migration of contaminants. They are generally keyed into an impermeable horizontal layer to contain contaminants from migrating below or around the barrier.

3.8.2.1.2.1 Slurry Walls

Slurry walls are subsurface barriers that consist of a vertically excavated trench filled with slurry (generally a mix of bentonite and water or, in some cases, cement, bentonite, and water). Slurry walls are typically installed at depths less than 15 m (50 ft). Slurry walls are the most common type of vertical barrier due to their low relative cost. The use of slurry walls can be limited by the topography, geology, and the type of contamination at the site. For example, a soil-bentonite slurry will flow unless the site and confining layer are nearly level (Evanko and Dzombak, 1997). Since bedrock is at a depth of approximately 1 to 2 m (approximately 3 to 6 ft), the implementation of vertical barriers is hindered by the difficulty for trenching in dolostone bedrock, and cannot completely contain contamination due to the fractured nature of the bedrock. **Use of a slurry wall is not feasible at the Guterl Site and therefore it will not be retained**.

3.8.2.1.2.2 Sheet Piling

Sheet piling is a form of driven piling using thin interlocking sheets of steel to obtain a continuous barrier in the ground. Because of the fractured nature (observed combination of horizontal and vertical fractures) of the bedrock, which does not provide an impermeable layer to key in the vertical barrier, **use of sheet piles is not feasible at the Guterl Site and it will not be retained.**

3.8.2.1.2.3 Grout Curtains

Grout curtains are narrow, vertical grout walls installed in the ground. The grout curtains are constructed 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 will solidify and reduce water flow through the contaminated region (U.S. EPA, 1996). Grout curtains may be used upgradient of the contaminated soil area, to prevent clean groundwater from migrating through waste, or downgradient, to limit migration of contaminants. Grout curtains are generally used at shallow depths (9 to 12 m [30 to 40 ft] maximum depth). This technique is more expensive than slurry walls and its use is therefore usually limited to sealing voids in bedrock (Evanko and Dzombak, 1997). **The grout curtain barrier option is not retained due to the highly fractured nature of the shallow bedrock.**

3.8.2.2 GROUNDWATER CONTAINMENT OPTIONS

3.8.2.2.1 Vertical Barriers

Several types of vertical barriers were evaluated in the previous section as a soil containment process option. These processes included sheet piles, slurry walls, and grout walls. Vertical barriers can also serve as a process option for the containment of groundwater by hydraulically preventing groundwater flow in a specific area. The high groundwater table, the shallow and highly fractured bedrock at the Guterl Site presents limitations for these vertical barriers i.e., sheet piles, slurry walls, and grout walls. **These process options will not be retained for further consideration**.

3.8.2.2.1.1 Jet Grouting

Jet grouting is another type of vertical barrier which can be used to fill or strengthen fissures in the bedrock. Borings are used to insert a jet grouting tool into the subsurface. The tool uses high-pressure water and air to flush silt and other weak deposits from the surrounding area and simultaneously fill those spaces with a cement mix. The jet grouting barrier option for groundwater is retained because it may be useful on a limited basis to seal fractures. **Jet grouting is retained for further consideration.**

3.8.2.2.2 Hydraulic Containment

Hydraulic containment technologies include groundwater extraction wells and trenches. Extraction wells can be installed vertically, inclined, or horizontally to the required depth. Vertical wells are typically installed in open areas, whereas inclined or horizontal wells can be installed underneath buildings. Containment is provided by continuous pumping, which influences the localized groundwater flow pattern, allowing for interception and removal of contaminated groundwater. The number of wells required to establish containment is dependent on the size of the area(s) to be contained, interconnectedness of fractures, pumping rate, and groundwater yield, among other factors. One of the factors to consider is the difficulty in controlling fracture flow in bedrock.

Groundwater interceptor trenches can be installed to any required length across the site to depths to 24 m (approximately 80 ft) or more. Trenches installed in fractured rock via *in situ* blasting to further rubblize the rock provide for enhanced recovery of contaminated groundwater in fractured bedrock by increasing hydraulic conductivity and well yields. This technology is beyond the demonstration phase and has been employed both locally and regionally. Supporting references include:

- Lane, J.W., Jr., Haeni, F.P., Soloyanis, Susan, Placzek, Gary, Williams, J.H., Johnson, C.D., Buursink, M.L., Joesten, P.K., and Knutson, K.D., 1996. Geophysical characterization of a fractured-bedrock aquifer and blast-fractured contaminant-recovery trench, in Bell, R.S. Application of Geophysics to Engineering and Environmental Problems.
- Miller, Ralinda R., 1996. Artificially-Induced or Blast-Enhanced Fracturing. Ground-Water Remediation Technologies Analysis Center, http://www.gwrtac.org.
- Smerekanicz, J.R., J.J. Elsea, F. Gheorghiu, and M.C. Pedersen, 2004. U.S. EPA/NGWA Fractured Rock Conference, September 13-15, 2004 Portland, Maine.

This technology will be retained for further consideration because it may be useful for containing a plume and preventing it from further migrating.

3.8.2.3 BUILDING SURFACE CONTAINMENT

Surface containment (i.e., surface sealing) employs paint, resins/plastics, or other sealants, or placement of impermeable barriers (plastic sheeting on wood structures) to prevent direct contact and to reduce mobility. The use of sealants can be effective for the COCs present at the Guterl Site. However, considering the long half-lives and relatively fixed nature of radiological contaminants, these containment options could only be considered as temporary. **This technology will be retained for further screening.**

3.8.3 REMOVAL

Removal activities could be implemented to reduce the COC levels in the remaining soil, waste debris, and buildings to acceptable levels; reduce or eliminate contaminant migration; and mitigate the long-term potential of human exposure to COCs above the threshold levels. Process options such as excavation for soils and dismantlement/removal for buildings would be effective in reducing COC mobility since the contaminated media would be physically removed and isolated. However, they would not reduce the volume or contaminant levels of the removed material. As a result, this activity is often used in combination with other response actions, such as treatment or disposal (on or off site). In addition, removal may be combined with other actions such as LUCs.

3.8.3.1 SOIL REMOVAL OPTIONS

3.8.3.1.1 Excavation

Removal technologies involve the active excavation, handling, and management of contaminated media before treatment and/or a disposal action to control further migration of contaminants.

3.8.3.1.1.1 Conventional Earth-Moving Equipment

Conventional soil excavation techniques, such as excavators, backhoes, draglines, front-end loaders, and shovels, are used to remove soil and debris from contaminated areas. Excavation is a commonly used technique currently being conducted at other similar FUSRAP sites.

Excavation and removal apply to almost all site conditions; however, such actions may become cost-prohibitive at great depths or in complex hydrogeologic conditions. At the Guterl Site, bedrock is encountered at shallow depths and thus excavation by conventional earth moving equipment is a viable technology. Excavation of soils adjacent to building foundations may require shoring or the removal of the structure. Removal of soil by excavation would require the use of dust control and surface runoff measures to ensure worker safety and to protect the general public and the environment. These measures have been successfully used at other FUSRAP sites. **Removal via conventional earth-moving equipment is retained for further consideration.**

3.8.3.2 GROUNDWATER REMOVAL OPTIONS

Groundwater removal actions would be used to reduce the amount of contamination in the subsurface and could also be used to control groundwater migration. Groundwater removal is generally not a stand-alone groundwater GRA. It is typically used in combination with other groundwater GRAs. Groundwater monitoring is generally used to document the performance of the groundwater removal system.

3.8.3.2.1 Groundwater Extraction

Pumping systems to remove contaminated groundwater can be effective in reducing contaminant mass from the subsurface, but are most effective if the source (contaminated soil) is removed as well. Process options for the extraction of groundwater include vertical and horizontal extraction wells, and interceptor trenches.

3.8.3.2.1.1 Vertical and Horizontal Wells

The use of standard vertical well installation techniques to recover groundwater can be used to address source areas of contamination or control migration. This option may be effective to remove the uranium plume. Directional drilling and horizontal wells can be used to replace a vertical well network and maximize the zone of influence for remediation technologies. Horizontal wells also can be located beneath surface obstacles and can reduce disruption at a site. This method can be difficult to execute and expensive in bedrock conditions present at the site. However, horizontal wells may be more effective than standard vertical wells in the fractured bedrock present at the site. **These methods are retained for further evaluation**.

3.8.3.2.1.2 Interceptor and Rubblized Trenches

Trenches can be used to address source areas or control migration, primarily for the shallow bedrock; however, trenches would be difficult and expensive to execute in the deep bedrock due to the nature of the dolostone (i.e., fractured bedrock) and the depth of contaminated groundwater, which extends approximately 12 m (about 40 ft) below grade. Treatment options are necessary following removal to reduce constituent levels from the water before discharge.

A rubblized trench is an extraction technology process option installed in an area to extract groundwater for treatment. The rubblized trench is created by directionally blasting bedrock into highly permeable material to enhance the extraction of groundwater. Sumps (wells) are placed in the trenches to collect groundwater inflow. The *in situ* fractured bedrock trenches can be used to create a cell as part of the treatment of groundwater. The rubblized trench technique provides a line sink in the groundwater system managed via pumping or a geosiphon (treatment flow cell). Rubblized trenches are combined with *ex situ* groundwater treatment and groundwater reinjection to create a complete groundwater treatment system. The success of the rubblized trenches will depend on the degree of bedrock fracturing that can be achieved. Rubblized trenches are retained for further consideration for shallow bedrock. The use of rubblized trenches would be difficult and expensive to execute in the deep bedrock due to the nature of the contamination in the dolostone, which decreases in concentration with depth and produces cost inefficiencies to actively capture. The incorporation of a *in situ* rubblized trench in the groundwater removal scheme promotes greater efficiency of the collection system since multiple singular wells would be needed to achieve the same goals with less initial costs (one versus multiple pumping wells) and associated operations and maintenance costs (lower energy requirements and pump replacement). **Trenching methods are retained for further evaluation.**

3.8.3.3 BUILDING REMOVAL OPTIONS

3.8.3.3.1 Dismantlement

Radiological contamination on building materials can be remediated by dismantlement using conventional methods, such as an excavator with a grappler attachment to remove entire buildings or by removing portions of a building. Removal actions for buildings/structures could include partial or complete dismantlement. Partial dismantlement involves the blasting, wrecking, drilling, or sawing of appropriate portions or sections of the buildings. This results in a reduced volume of waste materials requiring disposal compared to complete dismantlement, which is often used when an entire building is contaminated. Due to the age and conditions of the building structures, partial removal of any building will need to consider the structural stability and general safety of the remaining portions. Dismantlement protects human health and the environment by reducing exposures to the contaminated building material from potential receptors. Dismantlement may be necessary in some cases to access other contaminated media associated with a building, including contaminated soil beneath a foundation. Dust control measures are necessary to prevent exposures to contaminants in the material. Building removal may be combined with other GRAs in order to meet RAOs. **Dismantlement is a well proven technology and is retained for further consideration.**

3.8.3.3.1.1 Size Reduction/Sorting

Size reduction is a part of the removal method for buildings that includes concrete crushing, metal shredding, and compaction. These processes make the materials easier to handle, transport, and dispose, and in some cases, reduce the waste volume. The size reduction techniques have been successfully used at other FUSRAP sites. Sorting of building materials is a waste minimization method, which aims to reduce the volume of building materials requiring management as “licensable” (regulated) residuals of source material. **Both size reduction and sorting are retained, as waste minimization methods, for further evaluation.**

3.8.4 TREATMENT

Technology types evaluated for soil, groundwater, and buildings treatment included physical, chemical, biological, and thermal treatment options. Physical/chemical treatment uses the properties of the contaminants and/or the contaminated medium to destroy (i.e., chemically convert), separate, or immobilize the contamination. Biological treatment is the use of plants and microorganisms, such as bacteria and fungi, to remediate contaminated soil. Thermal treatment uses high temperatures to volatize, decompose, or melt the contaminants. The process options for each technology type and media are presented herein.

3.8.4.1 SOIL TREATMENT OPTIONS

Physical/chemical treatment process options evaluated for soils at the Guterl Site include stabilization/solidification, soil washing, redox, solvent extraction, stabilization, neutralization (soil flushing), and electrokinetic separation. One biological treatment process option, bioremediation, was evaluated. Thermal treatment process options for soil include vitrification and incineration.

3.8.4.1.1 Stabilization/Solidification

Stabilization/solidification employs cement-, silicate-, or plastic-based materials and other suitable additives to physically or chemically bind a waste material in a soil matrix to reduce the mobility of contaminants. It is a potentially effective technology for immobilizing radiological contaminants. This method can also be used as a part of a treatment chain. *Ex situ* and *in situ* stabilization/solidification methods are available. *In situ* stabilization/solidification will not be retained for the Guterl Site because it would be difficult to monitor the implementation and effectiveness due to the shallow water table. ***Ex situ* stabilization/solidification is retained for further consideration.**

3.8.4.1.2 Soil Washing

Soil washing involves the *ex situ* physical separation of impacted material in an aqueous base. The method dissolves or suspends contaminants in a wash solution or concentrates COCs into a smaller volume through particle size separation. Soil washing can be enhanced by the addition of additives, such as surfactants, to the wash water. Also, it usually requires other physical and chemical processes to more effectively treat soils. **Soil washing is retained for further screening.**

3.8.4.1.3 Oxidation Reduction

The redox method is implemented by adding oxidizing agents to the soil matrix to produce redox reactions to render the contaminant less toxic. **This method will not be retained because it is not applicable for the site COCs.**

3.8.4.1.4 Solvent Extraction

Solvent extraction involves applying an organic chemical as a washing agent to remove contaminants from waste or soil. **This method will not be retained because it is more effective for organic contaminants than inorganics.**

3.8.4.1.5 Neutralization

In situ neutralization (i.e., soil flushing) is a treatment process option for soil whereby chemicals are injected into saturated and/or unsaturated soil strata to adjust the hydrogen ion potential (pH) of the soil. However, at the Guterl Site, the shallow water table would make it difficult to control and recover the liquids used in flushing. **Therefore, this technology will not be retained for further consideration for the Guterl Site.**

3.8.4.1.6 Electrokinetic Separation

Electrokinetic separation is a process that separates and extracts heavy metals, radionuclides, and organic contaminants from saturated or unsaturated soil, using a low intensity direct current across electrode pairs that have been implanted in the ground on each side of the contaminated soil mass. Contaminants are desorbed from the soil surface and are transported in ionic form to respective electrodes, depending on their charge. The contaminants may then be extracted to a groundwater well recovery system or deposited at the electrode and removed. The residuals would likely require further treatment and/or disposal. Electrokinetic separation has been used with some success for uranium, but removal has been limited for thorium. The problems associated with the inability to successfully remediate all FUSRAP-related COCs using this technology indicates an uncertain effectiveness (see Section 3.2 for a list of COCs). Therefore, **electrokinetic separation is eliminated from further consideration.**

3.8.4.1.7 Soil Flushing

Soil flushing is the extraction of contaminants from the soil with water or other suitable aqueous solutions. Soil flushing is accomplished by passing the extraction fluid through in-place soils using an injection or infiltration process. Extraction fluids must be recovered from the underlying aquifer and, when possible, they are recycled. The target contaminant group for soil flushing is inorganic compounds, including radioactive contaminants. Environmentally compatible surfactants may be used to increase the effective solubility of some organic compounds. Due to the nature of the fractured bedrock on site this process would be difficult to implement. **Therefore, soil flushing is eliminated from further consideration.**

3.8.4.1.8 Bioremediation

Bioremediation technologies are destruction or transformation techniques directed towards stimulating microorganisms to grow and use the contaminants as a food and energy source by creating a favorable environment for the microorganisms. Phytoremediation and enhanced bioremediation were evaluated as process options for soil treatment at the Guterl Site.

3.8.4.1.8.1 Phytoremediation

Phytoremediation is a remedial process that uses plants to remove, transfer, stabilize, and/or destroy contaminants in soil or sediment. Phytoremediation may be used for the remediation of metals, pesticides, solvents, explosives, crude oil, polycyclic aromatic hydrocarbons or landfill leachate. The mechanisms of phytoremediation include enhanced rhizosphere biodegradation, phytoextraction (also called phytoaccumulation), phytodegradation, and phytostabilization. Phytoremediation is an emerging, rather than an established, technology for remediation but has shown effectiveness for the treatment of select radiological contaminants in shallow soil. Phytoremediation does not address the presence of insoluble COCs, such as thorium. In addition, site contamination is found at depths up to 9 feet below grade, which would have to be considered when selecting phytoremediative plants. The potential for applying phytoremediative solutions to the Guterl Site exists as a companion component of implementing the PRG-CW (i.e., use phytoremediative plants to address COC concentrations below the PRG-CW and above the PRG-GW), yet site-specific field studies would be necessary to ensure remedial viability. **Therefore, phytoremediation will not be retained for further evaluation.**

3.8.4.1.8.2 Enhanced Bioremediation

Enhanced bioremediation is a remedial process in which indigenous or inoculated 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 may be used to enhance bioremediation and contaminant desorption from subsurface materials. Enhanced bioremediation of soil typically involves the percolation or injection of groundwater or uncontaminated water mixed with nutrients and saturated with dissolved oxygen (DO). The primary targets for enhanced bioremediation are redox-sensitive metals, pesticides, solvents, explosives, crude oil, polycyclic aromatic hydrocarbons, or landfill leachate. While radioactive contaminants cannot be biodegraded, biological organisms can alter the oxidation state and solubility of those contaminants, thus increasing or reducing their mobility. However, due to the fractured nature of the bedrock on site and the high groundwater table, it would be difficult to control the movement (introduction) of the biological agents, ensure substrate absorption in the fracture spaces (i.e., colony viability), and prevent "flushing" of the biologic treatment material from the fracture system due the higher fracture-flow velocities associated with secondary porosity. **As such, enhanced bioremediation is eliminated from further consideration.**

3.8.4.1.9 Vitrification

Vitrification uses an electric current to melt soil at a high temperature, volatilizing or destroying organic constituents by pyrolysis. Nonvolatilized inorganic pollutants are incorporated within the vitrified crystalline mass. *Ex situ* vitrification is potentially applicable; however, it will require off-site disposal. *In situ* vitrification is a rather involved and somewhat extreme technology to implement. It requires a high power generator, or power source, and specialized equipment available from a very limited number of vendors. The effectiveness of *in situ* vitrification is difficult to verify. **On this basis, vitrification will not be retained for further evaluation**.

3.8.4.1.10 Incineration

Incineration requires high temperatures to volatilize and combust (in the presence of oxygen) halogenated and other refractory organics in hazardous wastes (FRTR 2009). Auxiliary fuels are often employed to initiate and sustain combustion. Off gases, emissions and combustion residuals are difficult to control and generally require treatment. Incineration only potentially reduces the volume and chemical toxicity of the waste; it does not however reduce the radioactivity of the waste. Incineration it is not applicable to the COCs at the Guterl Site since the contamination is in soil and less combustible building materials, therefore **incineration is eliminated from further consideration.**

3.8.4.2 GROUNDWATER TREATMENT OPTIONS

Physical, chemical, or biological treatment would be used to reduce the amount of contamination in an aquifer and would reduce the potential risks from exposure. Nine physical/chemical process options were considered for the treatment of groundwater at the Guterl Site (adsorption, reverse osmosis, filtration/ultrafiltration, ion exchange, clarification/coagulation, permeable reactive barrier (PRB), precipitation using phosphate compounds, redox alteration, and MNA). One biological process option, bioremediation, was evaluated.

3.8.4.2.1 Adsorption

In the adsorption process, media such as activated alumina, activated carbon, copper-zinc granules, granular ferric hydroxide, or surfactant-modified zeolite, is packed into a column. Contaminated water is then passed through the column and contaminants are adsorbed. This technology can treat radiological contaminants. However, the adsorption of organics that are not COCs, but have been documented to be present in site groundwater, would need to be treated before disposing of the treated water, reducing the efficiency. **This process option will be retained for further screening.**

3.8.4.2.2 Reverse Osmosis

Reverse osmosis is a high-pressure process that primarily removes smaller ions by membrane filtration. This technology is more expensive than other *ex situ* treatment technologies, but it would treat radiological and organic contaminants. **This technology is retained for consideration in the development of the remedial alternatives.**

3.8.4.2.3 Filtration/Ultrafiltration

The filtration and ultrafiltration techniques use pressure and a semipermeable membrane to separate nonionic materials from wastewater. This process option can be effective on large organic molecules and complex heavy metals. This technology is capable of removing the COCs from an aqueous waste stream. It would treat radiological and organic contaminants. **This technology is retained for consideration in the development of the remedial alternatives.**

3.8.4.2.4 Ion Exchange

Ion exchange is a physical/chemical process in which ions held electrostatically on the surface of a solid are exchanged for ions of a similar charge in a solution. Exchange of cations or anions between the contaminants in the wastewater and the exchange media occurs. This technology is capable of removing the COCs from an aqueous waste stream. However, it is not effective on organic contaminants. **This technology is retained for consideration in combination with other *ex situ* groundwater technologies in the development of the remedial alternatives.**

3.8.4.2.5 Clarification/Coagulation

Clarification/coagulation is a process whereby suspended particles are removed by the addition of alum or ferric chloride in the form of an acidic solution, followed by settling, filtration, or centrifugation, often with the addition of flocculants. This method can be effective in removing uranium. It may have high reagent demand and may produce a large volume of sludge. **This option will be retained for further consideration.**

3.8.4.2.6 Permeable Reactive Barrier

The PRB is an *in situ* technique that consists of a reactive medium installed in a trench constructed across the groundwater flow path. The PRB allows passage of groundwater while treating contaminants. Zero-valent iron is the most common reactive medium used in PRB. Construction of a PRB at the Guterl Site would be difficult since the plume is in bedrock. However, it could be performed using a series of closely spaced wells, which simulate a trench, or by removing the rubble from a rubblized trench. **This process option will be retained for further screening.**

3.8.4.2.7 Precipitation Using Phosphate Compounds

In situ phosphate treatment consists of adding various phosphates (e.g., orthophosphate and/or polyphosphates) with or without calcium compound additions to precipitate uranium as a sparingly soluble compound. Uranium exists at the site as sparingly soluble tetravalent [U(IV)] or groundwater mobile hexavalent [U(VI)] species. Based on the sites groundwater pH, carbonate content and oxidation reduction potential (ORP), the majority of the dissolved uranium

(U[VI]) will be complexed as a uranyl compound (UO_2^{2+}), most likely as a highly soluble carbonate ($[UO_2]CaCO_3$). Uranyl forms with low solubility include phosphate compounds, which would be added to the water-bearing zones in a method to promote uranyl phosphate that would immobilize the uranium in the fracture network or vadose-zone soils. **It can be effective for uranium immobilization and will be retained for further screening**.

3.8.4.2.8 Oxidation-Reduction (Redox) Alteration

Redox alteration is an *in situ* groundwater treatment technique that involves the chemical or biological (enhancing microbiological activity) manipulation of the redox state of the aquifer environment. This remediation method is used to cause the precipitation of sparingly soluble metals compounds and/or the adsorption of metals on mineral surfaces. **It can be effective for radionuclides such as uranium, and will be retained for further screening.**

3.8.4.2.9 Monitored Natural Attenuation

Monitored natural attenuation involves a variety of natural processes that work together to reduce the concentration of contaminants and their impact on the environment. Monitored natural attenuation monitors these natural processes through sampling of environmental media. To apply this method, an evaluation of natural attenuation rates and any changes in groundwater geochemical conditions over time that may affect the stability and mobility of uranium is necessary. Monitored natural attenuation is not effective at attaining the MCL for uranium within a short timeframe (e.g., years to decades), but may achieve MCLs within a longer time period (e.g., centuries). **Monitored natural attenuation will be retained for further evaluation**.

3.8.4.2.10 Bioremediation

As stated earlier as a soil remediation method, bioremediation technologies for groundwater also are designed as contaminant destruction, transformation, or immobilization techniques directed towards stimulating microorganisms to grow and use the contaminants as a food and energy source by creating a favorable environment for the microorganisms. Microorganisms do not effectively destroy or transform uranium in groundwater. However, microorganisms can effectively alter the redox conditions of the aquifer by creating an anaerobic environment. The application of this technique changes groundwater conditions to a reducing environment, therefore slowing uranium transport. Due to the highly fractured bedrock at the Guterl Site, bioremediation would be difficult to implement since the organisms would not have sufficient residence time to colonize the aquifer without routine reintroductions of a substrate (carbon source) due to the generally high groundwater velocities, associated pore-volume flushing, and low available organic carbon in the fractured rock aquifer (Williams et al., 2011; Mousser et al., 2014). In addition, since the uranium is not actually bioremediated but instead its transport is affected by changes in the redox conditions of the aquifer, **bioremediation is not retained as a stand-alone technology** and the use of microorganisms is further discussed under redox alteration.

3.8.4.3 BUILDINGS TREATMENT OPTIONS

Physical procedures include mechanical treatment, such as, scrubbing, scraping, sanding, grinding, scabbling, dry ice, or pelletized carbon dioxide (CO_2) blasting and sandblasting. These methods use physical force to mechanically separate contaminants from the surface of the material. Chemical procedures involve the use of chemicals (water, solvents, complexing agents, acids, and bases) to dissolve or suspend the contaminants in the decontamination fluid to facilitate their removal from the surface of the material. Both physical and chemical treatment process options are evaluated herein.

3.8.4.3.1 Mechanical Treatment/Physical Decontamination

The mechanical treatment methods for buildings include vacuuming, grinding, shaving, spalling, scabbling, blasting, and strippable coatings. For these methods, physical force is used to remove contaminants from the surfaces of the building. Building treatment process options include both in-place physical and chemical decontamination methods.

3.8.4.3.1.1 Vacuuming

The dry vacuuming method is a surface cleaning method that uses suction to draw air and loose surface materials into the vacuum storage unit. High efficiency particulate air (HEPA) filters are used to filter the vacuum exhaust air. Vacuuming is limited to the collection of loose materials and requires disposal of the captured particles. This method is generally easy to implement and is typically used in conjunction with other methods. However since a majority of the building contamination is fixed on the structures the **dry vacuuming method is not retained for further consideration.**

The steam vacuuming method uses pressurized, superheated water to dislodge contaminants, then collects the dislodged materials by vacuum removal. This method is also primarily a surface cleaning technique that generates a liquid waste stream. This method is fairly easy to apply, but does not have the ability to clean crevices, corners, or irregular surfaces. **Steam vacuuming will not be retained for further screening** based on the inability to clean irregular surfaces, and potential health and safety concerns.

3.8.4.3.1.2 Grinding, Shaving, and Spalling

The concrete grinder is a hand tool that uses a diamond grinding wheel to strip off concrete surfaces. This method is primarily applicable for general radiological decontamination of relatively flat surfaces and for known hot spots. The concrete shaver is a self-propelled tool that shaves flat concrete floor surfaces by means of a rotating drum containing embedded diamonds. **Both concrete grinding and shaving will be retained as options for further screening.**

The concrete spaller is a tool designed for a quicker, more roughly finished removal of concrete surfaces. It is powered by an 8,200-kilogram (kg) (9-ton) hydraulic cylinder that applies pressure to predrilled holes in the concrete to spall (i.e., chip or splinter) the concrete surface. **This method allows for removal of deeper contamination in concrete and will be retained for further consideration.**

3.8.4.3.1.3 Blasting

Blasting methods include centrifugal shot blasting, dry ice blasting, grit blasting, and soft media blasting. Each of these methods uses a specific material that is rapidly propelled at a surface to remove its coating. Centrifugal shot blasting employs hardened steel shot; dry ice blasting involves the use of CO_2 pellets; grit blasting uses various available abrasive particle types (i.e., silicon dioxide, aluminum oxide, titanium oxide, etc.), and soft media blasting (also called sponge blasting) uses a soft media often impregnated with abrasive materials. **These methods are all effective in removing surface debris, and thus will be retained for further screening.**

3.8.4.3.1.4 Scabbling

Scabbling techniques are designed to scarify (i.e., scratches, superficial incisions) concrete floors and walls, generating minimal airborne dust. This method uses machinery to mechanically fracture the concrete by a series of pistons attached to the scabbling head. The scabbled concrete is then removed by vacuuming to a storage drum on the unit as the head continuously operates. Various types of scabblers include piston head scabblers, electro-hydraulic scabblers, and robotic wall scabblers. **This option is an effective means of performing physical decontamination of surfaces and is retained for further screening.**

3.8.4.3.1.5 Strippable Coatings

Strippable coatings are paints, polymers, or related coating materials that can be applied to a surface contaminated with loose, removable particulates. The coatings penetrate small voids on the surface and adhere to the contaminants, allowed to set or cure, and then removed bringing the contamination with the coating. The coatings can be applied by various means including spray, brush, or roller. This technology can also be used as a means of fixing loose contamination on surfaces by skipping the stripping step (at least temporarily) to prevent the further spread of contamination. Strippable coatings target loose particulates or other loose debris that may harbor contaminants. However, as is the case for other physical decontamination technologies, there is no radionuclide specificity. Strippable coatings can be used on a wide variety of surfaces and shapes. As expected, the more complex the shape, the more involved the stripping process. Minor amounts of wastewater will be produced in cleaning up equipment. Operating concerns include spray gun clogging and associated delays for removing and cleaning. In addition, it is recommended that airline respirators be used to prevent inhalation during application of the product. **This technology is not retained for these reasons**, in addition to the fact that it is best suited for loose particulates, whereas the majority of the surface contamination at the Guterl Site is fixed.

3.8.4.3.2 Chemical Decontamination

Chemical decontamination involves the application of chemicals (i.e., chelation and organic acids, strong mineral acids, chemical foams and gels, redox agents, and proprietary materials such as TechXtract®) to the building surface or the material for removal by suspension or dissolution. These techniques may be applicable if structural contamination at a building is limited. Chemical decontamination methods are effective on steel surfaces (which are present to varying degrees in the Guterl Site buildings), but are limited on porous surfaces such as concrete. Chemical decontamination methods generate significant liquid waste streams that require containment and treatment. The necessary treatment of secondary waste streams could add significant cost. **Chemical decontamination technologies are not retained for further consideration.**

3.8.5 DISPOSAL

Disposal of soil, building materials, and groundwater are discussed in this section.

3.8.5.1 SOIL AND BUILDINGS DISPOSAL OPTIONS

Disposal relocates impacted materials from one place to another for long-term containment. It is not a treatment to destroy or detoxify contaminants; however, treatment can be used prior to disposal to reduce the toxicity, mobility, or volume of contaminated media. The options for disposal following excavation of soils at the site are an on-site constructed landfill and use of an off-site disposal facility. Disposal activities for soil and building materials may be implemented on or off site.

3.8.5.1.1 On-Site Disposal

3.8.5.1.1.1 On-Site Engineered Landfill

On-site disposal would require new construction of an engineered landfill in accordance with state regulations. An on-site disposal facility can be designed and constructed using state-of-the-art technology to contain all excavated materials and post-treatment residuals.

However, an on-site engineered structure would be difficult to implement due to siting requirements. The Guterl Site is located in a groundwater recharge zone and the groundwater table at the site can be within 1 to 2 m (approximately 3 to 6 ft) of the ground surface; therefore, the potential for groundwater contamination would be considered high. These factors alone would not meet the siting requirements of Chapter IV, Subpart B Part 361.7 of the NYSDEC regulations. In addition, there is a residential area less than 0.5-mile from the site, which is another siting consideration. **This on-site disposal option is not retained.**

3.8.5.1.2 Off-Site Disposal

3.8.5.1.2.1 Existing Licensed or Permitted Disposal Facility

Contaminated soil above cleanup criteria would be disposed of off site at an approved facility in accordance with local, state, and federal regulations. This involves the transport of treated and/or untreated soils, rubble, and building materials meeting waste acceptance criteria to an off-site disposal facility. Off-site disposal would use existing permitted and licensed disposal facilities. Off-site disposal is an uncomplicated method currently being used at other FUSRAP sites. Several options exist for the transportation of waste materials to off-site disposal facilities. These options include, but are not limited to, transportation by truck to a properly licensed or permitted disposal site or to a rail transload site. **This option for off-site disposal is retained for further consideration**.

3.8.5.1.2.2 Recycling/Beneficial Use

Recycling/beneficial use of noncontaminated soil and/or building materials is an option for consideration as well. Building materials that meet the required radiological release criteria can be processed by an accepted facility for recycling. This technology is easy to apply and may be used for portions of a structure removed that have not been impacted above facility acceptance levels. **This option is retained for further screening.**

3.8.5.2 GROUNDWATER DISPOSAL OPTIONS

When groundwater is treated *ex situ*, it would need to be either disposed of or discharged. Disposal options under consideration for groundwater include both on-site and off-site methods. Potential on-site disposal includes the use of infiltration ponds or injection wells for reintroduction of treated water back into the aquifer. Off-site disposal options are sending treated groundwater to the local publicly owned treatment works (POTW), or discharging treated groundwater to a surface water body. Any wastewater present in the site utilities (and removed and handled along with the soils) may be discharged in a manner similar to groundwater. Both FUSRAP and non-FUSRAP contaminants will need to be evaluated to determine if pretreatment is necessary to meet potential discharge limits.

3.8.5.2.1 Off-Site Disposal

For this remedial technology, treated groundwater is discharged to a surface water body such as the Erie Canal. Implementability of this technology is high, because the Canal is located within 90 m (300 ft) of the site. Surface water discharges would be required to meet NYSDEC requirements for water quality. **Discharge of treatment plant effluent to surface water is retained for consideration.**

A second option is to discharge treated groundwater to a POTW. Discharge of treated groundwater is an effective technology when used in conjunction with *ex situ* treatment technologies. **Discharge of treatment plant effluent to the POTW is retained for consideration.**

3.8.5.2.2 On-Site Disposal

3.8.5.2.2.1 Surface Ponds

One on-site disposal option is the discharge of groundwater on site through infiltration ponds (surface ponds) in contact with the top of bedrock. Surface ponds are an on-site water disposal process option that would be installed on top of fractured bedrock to reinject treated discharge water. Contaminated soil removal on site would leave areas of open excavations and exposed bedrock that could be converted to surface ponds rather than being backfilled. The surface pond would be coupled with groundwater extraction and treatment technologies to create an injection-recirculation cell. It is possible that the circulation cell may be difficult to create due to the location, spacing, and permeability of the bedrock fractures. The success of the surface ponds would depend on the rate of infiltration achievable compared to the volume of extracted groundwater. The surface ponds would have to be sized to accommodate the volume of extracted groundwater. Additionally, the circulation cell would have to be monitored to determine if contaminated groundwater is being captured and not spread over a larger volume of the aquifer. **The surface pond process option is retained.**

3.8.5.2.2.2 Injection Wells

Another on-site disposal option for groundwater would be the use of injection wells to dispose of treated groundwater on site by replacing it back into the aquifer system. However, **this option will not be retained for further consideration** because of the difficulty in controlling flow in fractured bedrock.

3.9 EVALUATION OF TECHNOLOGY PROCESS OPTIONS

This section contains an evaluation and description of process options for each remedial technology. Each process option is rated as low, moderate, or high according to the following criteria:

- Effectiveness—which includes evaluation of the following:
    - Potential effectiveness of the process in handling the estimated areas or volumes of media and in meeting the RAOs
    - Potential impacts to human health and the environment during the construction and implementation phase
    - Demonstrated reliability of the process with respect to contaminants and conditions at the site (U.S. EPA, 1988)

The criterion of effectiveness measures the ability to effectively protect human health and the environment by reducing the toxicity, mobility, or volume of contaminants through treatment. Short-term protection involves reducing existing risks to the community and workers during implementation of remedial actions. The ability of a technology to meet remediation goals was evaluated. The time required for the technology to achieve remediation goals was also considered. The criterion also includes long-term protectiveness and addresses the magnitude of residual risk and the long-term reliability. Process options providing significantly less effectiveness than other more promising options would be rated as low, and can be eliminated from further consideration.

- Implementability—which includes both the technical and institutional feasibility of implementing a process option:
    - Technologies passing the initial screen of applicability are then screened on the basis of technical feasibility. This criterion means feasibility under site-specific conditions. This evaluation may indicate that although a technology may be generally applicable for the COCs, the specific technology may be unworkable or limited due to site-specific conditions.
    - Institutional feasibility emphasizes the institutional aspects of implementability, such as the ability to obtain permits for off-site actions; the availability of treatment, storage, and disposal services (including capacity); and the availability of equipment and skilled workers to implement the technology (U.S. EPA, 1988).

  Process options that are technically or administratively infeasible or require equipment, specialists, or facilities that are not available within a reasonable period of time would be rated as low, and would not be retained for further consideration. Process options that are technically feasible, where specialists and facilities needed are available, and when the technology is believed to be acceptable to the public and regulators and is rated high is retained for further consideration.

- Cost—which plays a limited role in the screening of process options. Cost is considered a deciding factor only when two alternatives are found to be equally protective. Ranges or approximations of relative capital and operations and maintenance (O&M) costs, are used rather than detailed estimates. At this stage in the FS process, the cost analysis is made on the basis of prior experience with technologies, readily available information, and engineering judgment. Each process is evaluated relative to other process options of the same technology type, based on a cost range.

- The average reported or estimated costs of a process option for soil were rated as follows:
    - Low— less than \$105/m^3 (\$80/yd^3)
    - Moderate—between \$105/m^3 and \$160/m^3 (\$80/yd^3 and \$150/yd^3)
    - High—greater than \$160/m^3 (\$150/yd^3)
- The average reported or estimated costs of a process option for buildings were rated as follows:
    - Low—less than \$110/m^2 (\$10/ft^2)
    - Moderate—between \$110/m^2 and \$220/m^2 (\$10/ft^{2}and \$20/ft^2)
    - High—greater than \$220/m^2 (\$20/ft^2)
- The average reported or estimated costs of a process option for groundwater were rated as follows:
    - Low—less than \$1.32 per 1,000 L (\$5.00 per 1,000 gallons)
    - Moderate—between \$1.32 per 1,000 L (\$5.00 per 1,000 gallons) and \$26.00 per 1,000 L (\$100.00 per 1,000 gallons)
    - High—greater than \$26.00 per 1,000 L (\$100.00 per 1,000 gallons)

Costs that are grossly excessive compared to the overall effectiveness of alternatives may be used as a factor to exclude the technology from further consideration.

Following the selection of the most appropriate process options for each technology type, the process options will be combined in the FS to form remedial alternatives.

Tables 3-8, 3-9, and 3-10 provide a summary of the evaluation for each soil, building, and groundwater technology, respectively. The tables provide a summary of the effectiveness, implementability, and relative cost of each considered process option. Also listed is whether or not the technology is retained for further consideration for the development of remedial alternatives. The remainder of the text in this section provides the rationale used to evaluate each technology.

3.9.1 LAND USE CONTROLS

These measures are implemented as part of a remedy when the remedy does not achieve levels for UU/UE. If the remedial action achieves the RAOs once complete, and results in no risk to human health or the environment, land use controls would not be necessary.

3.9.1.1 ADMINISTRATIVE AND LEGAL CONTROLS

Administrative and legal controls are one type of control used to protect human health and the environment. Controls at the site could be established as part of the remedy or in combination with other remedial technologies to prevent human exposure to contaminated media during remedial action. This could include proprietary controls such as deed restrictions that would prevent a landowner from using the groundwater; government controls set in place by the governing municipality to control permissions on well drilling; or informational tools such as, registries, deed notices, and/or advisories that may be used to notify future landowners of residual contamination. Depending on specific site circumstances, LUCs may not by themselves be protective/effective, in which case they could not be the sole component of a site remedy. However, in this case, administrative and legal controls can be protective/effective when used in combination with other process options.

Effectiveness:
Administrative and legal controls increase protection of human health and the environment over baseline conditions by limiting use of the site via deed restrictions or prohibitions on well drilling. To implement a deed restriction the federal government may need to purchase environmental rights, negotiate deed restrictions with the property owner, or land use restrictions would have to be imposed by the appropriate state or local governmental authority. Deed restrictions could be included as part of the remedy if the remedy will not achieve RAOs upon completion of the remedial action.

The effectiveness of these controls is dependent on a long-term commitment of funding and enforcement from the administering and responsible agency (local, state, or federal government). Since public agencies tend to periodically change staff, organization, responsibility, and levels of funding, guaranteeing the continuity of such controls would be increasingly difficult due to the indefinite timeframe over which they must be implemented. Although administrative and legal controls would limit exposure to residual contamination, it would not reduce the toxicity, mobility, or volume of COCs.

The primary purpose of LUCs for the Guterl Site would be to control the human exposure to contaminated soil and building structures and to prohibit the use of groundwater, for drinking water purposes for the period of time during implementation of remedial actions. Therefore, the effectiveness of administrative and legal controlsis rated as low to moderate.

Implementability:
Administrative and legal LUCs require involvement of the local governments to implement, maintain, and enforce restrictions such as deed restrictions, zoning, and well installation/drilling bans. If deed or use restrictions are applied, the cooperation of the landowners will be necessary. Local government involvement occurs on a voluntary basis. Specific LUCs, such as a deed restriction, may make transfer of the property from one owner to another more difficult. In some cases, the state or federal government may have to acquire a real estate interest in order to restrict land use and control access. Potential negotiation timeframes and property costs impact the implmentability. The site and most adjoining properties are currently zoned for industrial use, are on the City of Lockport's water supply, and are anticipated to remain so in the future. If the remedial action results in no risk to human health or the environment, administrative and legal controls are not necessary. The implementability of administrative and legal controls is rated low.

Cost:
Costs vary widely depending on the nature of the site, type of controls that are implemented, and the level of enforcement necessary. Although unlikely, the costs associated with imposition of LUCs must include the costs of acquiring landowner property rights. Potential legal fees and compensation for deed restrictions could increase the costs of this alternative. Deed restrictions negotiated with property owners could generate significant legal fees, depending on the length and success of negotiations. The lower bounding cost would be only legal fees; however, the upper bounding cost would be full purchase of property at fair market value.

In 2006, DOE presented "predictive" costs obtained by contacting state and federal agencies at the Institutional Control Roundtable and Training (co-sponsored by U.S. EPA, DOE, and several other agencies) for right-of-access. The cost estimates presented ranged from $200 to $42,000, one-time cost. For a typical urban site, capital costs for setup (planning, zoning deed, restrictions) are estimated to be approximately $60,000. Administrative and legal controls would require low to moderate costs.

Evaluation Results:
The use of administrative and legal controls as the sole remedial option does not reduce the toxicity, mobility, or volume of COCs at the Guterl Site. It would provide mechanisms to decrease the potential exposure to contamination, although the enforcement of these controls is not fail-proof. In addition, implementability of the admistrative and legal controls is difficult when acquiring cooperation of landowners to implement, maintain, and enforce restrictions on a property and the time and costs associated with negotiations, legal fees and potential real estate interests.

The effectiveness is rated as low to moderate, implementability is rated as low, and the cost of LUCs is rated as low to moderate. Administrative and legal controls retained include land use notices, deed restrictions, groundwater well-use advisories, well drilling prohibition, and zoning restrictions. If the remedial action results in no risk to human health or the environment, administrative and legal controls would not be necessary.

3.9.1.2 ENGINEERING CONTROLS

Engineering controls at the site would be set in place to prevent exposure to contaminated media. These actions could include site access restrictions and/or markers/signage throughout the remedial action. Depending on specific site circumstances, engineering controls may not by themselves be protective/effective, in which case they could not be the sole component of a site remedy. However, in this case engineering controls can be effective when used in combination with other remedial options.

Effectiveness:
Engineering LUCs increase protection of human health and the environment over baseline conditions by limiting direct access to the site using passive or active site security measures. Engineering controls used to prevent or deter access, such as fencing or posting signs, are effective, but only to the degree they are maintained and enforced. Such restrictions will not prevent a determined trespasser from accessing the site. The federal government could implment passive or active site security measures in coordination with the property owner during remedial action activites on the site. The impacted soils and buildings at the Guterl Site are currently

fenced with signs and other security measures that provide access control. These engineering controls would have to be maintained throughout the remedial action timeframe. The effectiveness of engineering LUCs is rated as low.

Implementability:
Engineering controls using physical mechanisms such as fencing and signage are easy to implement. Maintaining ongoing funding for maintenance and enforcement, as well as a mechanism for performing the necessary maintenance of these controls would be the major requirement to assure continued implementability. The implementability of engineering controls is rated as high.

Cost:
The cost estimate for implementing engineering controls, such as fencing and signage, including capital and maintenance costs would be low to moderate.

Evaluation Results:
Although engineering controls exhibit low effectiveness, they are easy to implement and their cost is low. Engineering controls retained include site access restrictions (fencing) and permanent markers/signage.

3.9.2 LONG-TERM MANAGEMENT

At the Guterl Site, long-term management (LTM) could consist of continuing the existing groundwater monitoring program and/or the monitoring of seepage to the Erie Canal, along with routine inspections and reviews of the engineering LUCs currently in place. The environmental monitoring program currently being conducted at the Guterl Site would continue into the future, with modifications of the program, as necessary, should changes in site conditions be observed such as the size and shape of the uranium-contaminated groundwater plume or increased discharge of uranium at the seeps into the Erie Canal. The current monitoring program consists of routine (annual) sampling and analysis of groundwater and seeps. Monitoring and reporting would be conducted by the organization responsible for site management and protection. Sampling periods would be optimized based upon observed changes in groundwater conditions (e.g., if the aquifer reacts slowly to soil remedies, then the sampling would be infrequent).

Effectiveness:
Long-term monitoring is not a treatment process in itself, but is an action that can be used in conjunction with other GRAs to meet the RAOs. Long-term monitoring process options would not reduce the mobility, toxicity, or volume of the COCs in site buildings, soils, or groundwater. However, monitoring will provide data on any changes in site conditions and any off-site impacts. Long-term monitoring is necessary to measure the effectiveness of the remedy elements. As such, it is an effective means of providing the status of the remedy, is easily applied for the types and volumes of impacted media, and will support the meeting of RAOs.

Monitoring the environment downgradient of the site would also help to minimize the risk to human health and the environment by tracking the migration of the COCs, both on and off site, as well as documenting the reduction of COCs in groundwater due to natural attenuation processes. The natural attenuation and mobility of uranium is highly dependent on geochemical conditions within the aquifer. Groundwater monitoring, both along the plume's flow path and cross-gradient to the flow, allows for effective groundwater contaminant tracking. Additionally, groundwater monitoring is usually conducted to determine whether COC concentrations have decreased to acceptable levels. The effectiveness of LTM is rated as high.

Implementability:
LTM is typically easy to implement. A program of regular monitoring is established and regular reporting is performed to assess any changes in conditions. The implementability of LTM is rated as high.

Cost:
The costs for implementing LTM include low capital costs and potentially moderate long-term costs if monitoring is performed, when projected over the duration of the caretaker period. Long-term monitoring includes regular monitoring of the soil and groundwater contaminants to provide data to track the potential migration of contaminants from the site. Monitoring will be necessary until RAOs are achieved. Current groundwater monitoring costs are approximately $30,000 annually for one round of sampling. Long-term costs are expected to be similar; however, if the plume remains stable or reduces in size, monitoring frequency could be reduced. The cost of LTM is rated as low to moderate depending on the years of operation.

Evaluation Results:
Long-term monitoring is considered highly effective in combination with other GRAs. Long-term monitoring is easy to implement, its implementability is rated as high, and its initial costs are minimal; however, long-term monitoring requirements may result in a moderate long-term cost. Each of the process options included under LTM are retained to evaluate against costs for more active remedial measures which may require higher upfront costs, but potentially lower long-term maintenance. In addition, LTM can be used as a part of an overall strategy for remedial action.

3.9.3 CONTAINMENT

Containment process options considered for the Guterl Site for groundwater include jet grouting and hydraulic containment via wells or trenches. Containment for buildings includes sealants. Containment for soil was eliminated during the initial screening of technologies. LTM measures would need to be implemented, along with containment, for adequate protection and monitoring of conditions over time.

3.9.3.1 SOIL CONTAINMENT

No soil containment options were retained from the initial screening of technology types and process options for further evaluation and screening.

3.9.3.2 GROUNDWATER CONTAINMENT

Containment actions for groundwater include technologies that protect human health and the environment by use of physical or hydraulic barriers. The goal of the physical and hydraulic barriers is to reduce the migration of COCs and to reduce/eliminate exposure of clean groundwater to the contaminants.

The physical barrier technology retained here for further evaluation is the vertical barrier installed in the subsurface by means of jet grouting. Vertical barriers for groundwater prevent or alter the natural groundwater flow by constructing a low-permeability material barrier.

Hydraulic barriers include French drains and groundwater extraction wells. Each of these containment actions would require the use of engineering LUCs and LTM.

3.9.3.2.1 Vertical Barriers-Jet Grouting

Jet grouting involves injecting a grout mixture at high pressure under controlled velocities into the pore spaces of soil or rock. Typically, Portland cement grout or cement-bentonite grout is used. The jetted grout cuts, replaces, and mixes the soil with cementing material to form a column, or it fills the bedrock fractures. The jet grouting technique utilizes a drill rig to penetrate into the subsurface, and the grout is jetted directly through the drill string. One advantage is the ability of the method to drill at any angle, and therefore inject the grout into places that might otherwise limit installation (i.e., can be introduced beneath buildings without disrupting the structure).

Effectiveness:
This is an effective method in soil and has been applied to the sealing of bedrock fractures as well. This method may be useful as a supporting technology, but may not be as effective for widespread sealing of the bedrock fracture system because it would also be difficult to assess the degree of sealing success. Groundwater contamination has been documented to a depth of 11 to 12 m (approximately 35 ft) below ground surface. Jet grouting has been used at depths up to 45 to 60 m (150 to 200 ft) below the ground surface.

This method would reduce the mobility of contamination in groundwater via the bedrock fractures, but would not reduce volume or toxicity of contaminants. Jet grouting could be combined with other process options to meet RAOs by minimizing expansion of the uranium plume in groundwater, if the fracture system can be defined and the seal effectively placed. Minimal potential impacts to human health and the environment are expected as a result of the application of this method. The identification of fractures would be the determining factor in the degree of success and the effective longevity of this process option. This process option is rated as having low effectiveness as a stand-alone technology, but could be moderately to highly effective as a supporting technology.

Implementability:
This technology is difficult to implement since the fractures controlling groundwater flow must be identified to properly use the technology. If the target fractures are identified, the installation process is easy. The process is essentially the same as drilling. The implementability of jet grouting is rated as low, because of the difficulty in identifying the fracture orientations.

Cost:
The cost of this process option would be similar to the cost of drilling in bedrock with some added cost for injection tools, grout, and specialized personnel. Cost range for jet grouting has been documented as from \$320 to \$430/m^2 (\$30 to \$40/ft^2). The capital cost of jet grouting is

rated as moderate. Related costs, including the costs to carry out long-term inspection and monitoring programs over a long period, would be considered moderate.

Evaluation Results:
Jet grouting may be effective to seal fracture zones or features that facilitate flow; however, the locations of the fracture zones would need to be known through extensive investigation and testing. Jet grouting of bedrock fractures could be very useful as a supporting technology for the Guterl Site. It can be difficult to implement and to assess its effectiveness. The cost is considered moderate.

3.9.3.2.2 Hydraulic Containment

Hydraulic containment involves the use of wells or trenches to contain a groundwater plume within a selected area by controlling the gradient using pumping. Containment is provided by continuous pumping, which influences the localized groundwater flow pattern, allowing for interception and removal of contaminated groundwater.

Effectiveness:
Hydraulic containment of groundwater may be effective in the shallow, highly fractured zone. It may also be effective in the deeper bedrock, assuming recovery wells intercept fracture zones, which are the primary mechanism for groundwater flow. A groundwater interceptor trench can be used and may have higher initial (installation) costs to implement in dolostone. Hydraulic containment would not address the vertical migration of impacted groundwater along fractures beyond the zone addressed by the extraction system. Maintaining long-term hydraulic containment would be difficult if the fracture flow is not adequately characterized. Therefore, the effectiveness of hydraulic containment for the Guterl Site is rated as low to moderate in deep bedrock, and moderate in the shallow bedrock.

Implementability:
Either vertical or horizontal wells may be used for hydraulic containment. Drilling of wells is easy to implement. However, characterization of the fractures to be targeted for installation of the wells is moderate to difficult. The implementability of hydraulic control of the Guterl Site is rated as low to moderate using only pumping well arrays, thus a fractured trench would augment the plume-capture efficiency.

Cost:
Capital costs would consist of the construction of the groundwater flow barriers, or a pump and treat system to provide hydraulic containment. Pump and treat costs are generally high, estimated to be in the range of $74 to $82 per 1,000 L ($280 to $312 per 1,000 gallons). The cost would vary depending on the permeability of the aquifer. Lower permeability zones would require more wells to achieve hydraulic containment.

Capital costs for vertical wells are high due to the number of wells that will be necessary and may range from $390 to $1,150/m ($120 to $350/ft) based on estimates previously obtained for the site. Horizontal/inclined wells have high capital costs due to design and installation requirements. Costs for horizontal wells can vary from approximately $490 to $4,100/m ($150 to $1,250/ft) for an advanced guidance bi-directional fluid drilling system. Sonic drilling can be as much as \$330/m (\$100/ft). Costs at the Guterl Site are expected to be at the high end of the range due to drilling in the dolostone bedrock. Rubblized or a blast fractured trench could be used to construct an interceptor trench. This technology is discussed in Section 3.8.3.2.1.2. Rubblized trench costs range from \$490 to \$820/m (\$150 to \$250/ft) for trenches installed to a 15 m (50 ft) depth.

Related costs including the costs to carry out the long-term inspection, monitoring, and containment system maintenance program over a long period are considered moderate.

Evaluation Results:
The use of hydraulic containment is retained since this technology may be effective for the control of groundwater migration to the Erie Canal. For hydraulic containment to be an effective remedy for deep groundwater at the Guterl Site, the locations of the fracture zones would need to be known through extensive investigation and testing, which may affect the ease of implementation. The cost of hydraulic containment is considered high.

3.9.3.3 BUILDING CONTAINMENT

Containment actions related to buildings/structures involve the surface sealing or covering of contaminated surfaces with appropriate sealants to prevent direct contact or inhalation exposure, and to reduce potential contaminant mobility. The applicable options include painting, applying resins or liquid plastic, or using other impermeable materials (e.g., using plastic sheeting or wooden structures to provide a physical barrier). However, considering the long half-lives of the radiological contaminants, these containment options could only be considered as temporary.

Effectiveness:
Surface sealing on the contaminated building surfaces would be effective for the short term in limiting exposure to the contaminants. This method is suitable for the amount of surface coverage required in terms of square footage of building surfaces. Potential impacts during implementation would primarily be to workers, but can be minimized through proper PPE. Routine inspection and maintenance would be necessary to ensure the integrity of the sealant, and reapplications may be necessary. However, sealants are not effective in the long term, and the majority of the contamination on the structures is fixed. Therefore, the effectiveness of building containment is rated as low.

Implementability:
Sealant materials are readily available. Application of sealants may be difficult due to the height and stability of the structures. Operations and maintenance would be necessary for the long term to periodically inspect the treated surfaces and reapply the sealants, as needed. A structural survey may be necessary prior to implementation of this technology. The implementability of building containment is rated as moderate.

Cost:
The capital costs associated with the application of sealants to the impacted building surfaces are relatively low. The cost associated with long-term maintenance, inspections, and reapplication

of the sealants could be low to moderate depending on the lifetime of the building structures remaining on site. The cost of building containment is rated as low.

Evaluation Results:
The use of sealants as containment for impacted building surfaces is not retained due to the limited lifetime of the sealants and the majority of the contamination on the structures being fixed.

3.9.4 REMOVAL

In this section, technology process options are evaluated individually for soil, buildings, and groundwater removal.

3.9.4.1 SOIL REMOVAL

This category includes two associated process options: soil excavation and radiological soil sorting. Radiological soil sorting is actually a waste minimization technique and it is an added step during soil removal which is used to sort the soil according to radiological cleanup criteria.

3.9.4.1.1 Soil Excavation-Conventional Earth Moving Equipment

The bulk removal of contaminated soil would minimize direct human contact and reduce the long-term potential for human exposure. Excavation of the impacted soils would eliminate the source of contaminants available for leaching from the soil to the groundwater. Soil would be excavated using conventional earth-moving equipment; manual excavation techniques would be necessary in areas with limited access. Excavation of soil adjacent to building foundations may require shoring or removal of the structure. Removal of soil by excavation would require the use of dust control and surface runoff measures to ensure worker safety and to protect the general public and the environment. These measures have been successfully used at other FUSRAP sites around the country.

Effectiveness:
Removal by excavation protects human health and the environment by reducing the level of exposure by potential receptors to contaminated material. This technology is often a component of remedial alternatives, because soil removal typically requires additional measures such as treatment or disposal. Excavation can be used for large or small quantities of impacted soils and can be more effective when used with characterization activities to identify excavation boundaries, which can limit both under- and over-excavation of soil. Removal of the volume of contaminated soil at the Guterl Site would reduce the mobility and exposure of radiological contaminants to humans and the environment at the site. Therefore, the effectiveness of soil removal is rated as high.

Implementability:
Technically, this process option is easy to implement. Resources are readily available for removing soil, and standard excavation and construction equipment would be used. Special engineering techniques involving precautions on excavating near buildings and structures also would be observed during remediation. Transportation and disposal are technologies that are usually combined with excavation. In addition, some supporting and construction activities would be associated with soil removal activities, such as: construction of temporary roads for

access and hauling, a staging area for loading and unloading, soil erosion control, excavation dewatering, water treatment, dust control, and additional clearing and grubbing, as appropriate. Operationally, coordination between remediation activities and the current owner's operations would need to be well planned to minimize reduced productivity. Other FUSRAP sites have successfully implemented soil removal. The implementability of soil removal is rated as high.

Cost:
Relative cost for soil excavation is well documented and is estimated to range from \$25 to \$90/m^3 (\$20 to \$70/yd^3). The cost range estimates provided include equipment, staging, labor, and stockpiling soil. Additional costs associated with treatment and/or disposal are discussed in the following sections. The cost of soil removal is rated as low.

Evaluation Results:
Removal effectively limits mobility of COCs in soil and can facilitate treatment and disposal. The effectiveness of soil excavation was rated as high given that removal of contaminated soil would reduce the mobility of contaminants to the environment and would reduce exposures to humans at the site. The implementability of soil excavation was rated high as the technology uses readily available resources and conventional equipment. The cost of soil excavation was rated low. **Each of the process options (i.e., various mechanical equipment types and hand tools) for soil removal technologies are retained for further evaluation and screening.**

3.9.4.2 BUILDINGS REMOVAL

Removal actions for buildings/structures could include partial or complete dismantlement. Partial dismantlement involves the blasting, wrecking, drilling, or sawing of appropriate portions or sections of the buildings. Dismantlement allows for radiological surveying and physically separating and sorting clean or impacted building materials into different piles. Dismantlement and sorting of building materials is effective in reducing the volume of waste requiring additional treatment or specific disposal or recycling requirements. This is in comparison to complete dismantlement, which is often used when major portions of the building are contaminated.

Due to the age and conditions of the building structures, as well as the shared walls, the partial removal of any building will need to consider the structural stability of the remaining portions. Since many of the impacted buildings are located above impacted soils, the decision for removal should also take into account the actions considered for the underlying soils.

Resulting debris would be properly disposed of at an off-site landfill. Debris from the removed structures would be segregated into waste streams, size-reduced if necessary, and containerized and staged prior to disposal, or direct-loaded onto transport vehicles for off-site disposal. The waste generated by the removal would be characterized to determine the waste type for disposal in an appropriate facility.

Associated with removal of the buildings, size reduction and sorting would facilitate the transport and disposal of the building materials. Size reduction would involve the use of machines to crush concrete, shred metal, and compact debris. These processes make the materials easier to handle, transport, and dispose, and in some cases, reduce the waste volume.

Effectiveness:
Removal of the structures would reduce mobility, volume, and exposure to contaminated building materials, and would be protective of human health and the environment because potential risks would be reduced. Removal, in conjunction with disposal, will allow for meeting the RAO for buildings and is well suited to the scale and amount of existing buildings at the site. The primary impact to human health during construction would be the generation and release of airborne dust and direct exposure to the building contents, especially in Building 6 and Building 8 that were not sampled during the RI due to elevated radiological exposure measurements.

Mechanical equipment (e.g., heavy equipment) is a very effective means of dismantling, demolishing, and removing complete, or portions of buildings such as the ones at the Guterl Site. Hand tools are not effective over large areas or for large tasks, but may be necessary to complete small-scale supporting tasks. Measures (i.e., dust suppression techniques) would be necessary to minimize this potential risk.

Size reduction and sorting techniques are moderately effective ways to facilitate the handling, transport, and disposal of building debris. In some cases, a reduction in volume of waste is realized. The effectiveness of building removal is rated as high.

Implementability:
Removal of buildings is normally easy, although some of the structures share walls and foundations, which can make removal more difficult if one of the structures is impacted and the other is not. Resources are readily available. Minimizing mixing of materials during removal would facilitate recycling/beneficial reuse efforts. Some ancillary development of temporary roads, debris storage areas, staging areas for loading and unloading, soil erosion control, and additional clearing and grubbing may be necessary but appropriate areas for these temporary facilities are present at the site. This technique and the ancillary process options of size reduction and sorting have been successfully applied at other FUSRAP sites. The implementability of buildings removal is rated as high.

Cost:
These costs include those associated with both total and partial removal. Costs for O&M would be relatively low (i.e., site inspection and reporting). Costs related to building removal are estimated at \$2,200/m^2 (\$200/ft^2). Additional labor and machinery costs would be necessary for applying the ancillary process options of size reduction and sorting, but are often necessary for off-site transport and disposal. Building materials that are removed would also require transport and disposal costs. The cost for building removal is high for mechanical equipment, low for hand equipment and sorting.

Evaluation Results:
The removal option, by itself, is not an effective remedial option; it must be used with an additional option, such as treatment and/or disposal. Buildings can be removed using a variety of equipment (including backhoes, track hoes, bulldozers, and front-end loaders) in addition to manual techniques. Dismantlement using conventional construction equipment is typically used as a remedial alternative for radiologically contaminated buildings. Additionally, other isolated contaminated building materials can be easily and effectively remediated using removal with

replacement, as needed, to allow for reuse of the buildings. The effectiveness and implementability of removal by dismantlement is rated as high although the costs are comparatively high. Each of the process options (mechanical equipment, hand tools, size reduction, and sorting) for the building removal technology is retained for further screening.

3.9.4.3 GROUNDWATER REMOVAL

Groundwater removal actions would be used to reduce the amount of contamination in the subsurface by mass removal of impacted groundwater and may also be used to control groundwater migration pathways and therefore, reduce contaminant mobility. Typically, a groundwater extraction system is used to remove contaminated groundwater from the affected aquifer. Removal can be achieved by using vertical or horizontal extraction wells, conventional interceptor trenches, or rubblized trenches. Wells and rubblized trenches were retained for further evaluation in the initial screening. **Conventional interceptor trenches (fully excavated from the surface) were not retained based on the difficulty and expense to install in bedrock.**

3.9.4.3.1 Groundwater Extraction by Wells

Effectiveness:
Both vertical and horizontal extraction wells are effective means for removing uranium-impacted groundwater and for reducing contaminant mass. Removal of groundwater by pumping wells would allow for treatment of the groundwater and effectively meet respective RAOs. Compared to vertical wells, the use of horizontal wells can reduce the total number of wells needed to address the plume. Horizontal wells can also be used in areas where the site infrastructure, such as buildings, may interfere with the installation of multiple vertical wells. Horizontal and inclined wells are more complex to install due to design, equipment, and drilling requirements. The effectiveness of each method is dependent on the ability to locate wells within the contaminated water-bearing fracture zones.

Monitoring would be performed to confirm the effectiveness of the removal process options and to document continued protection of human health and the environment in the future. Engineering LUCs are also typically implemented to assist in the reduction of potential risks to human health and the environment by restricting access to the site and limiting the number of exposure pathways to media containing COCs during the removal actions. Maintenance of these engineering LUCs would be necessary until monitoring data demonstrate that the human health risks are at acceptable levels and RAOs are acheived. The effectiveness of groundwater extraction by wells is rated as high.

Implementability:
Installation of groundwater extraction wells in a shallow groundwater bearing zone would be easy; however, the installation in the fractured bedrock would present some challenges to target the water- and contaminant-bearing fracture zone and ensure plume capture. Installation of horizontal and inclined wells is more complex due to design, equipment, and construction requirements. The implementability of groundwater extraction by wells is rated as moderate.

Cost:
Capital costs for vertical wells are high due to the number of wells that will be necessary and may range from $390 to $1,150/m ($120 to $350/ft) based on estimates previously obtained for the site. Horizontal/inclined wells have high capital costs due to design and installation requirements. Costs for horizontal wells can vary from approximately $490 to $4,100/m ($150 to $1,250/ft) for an advanced guidance bi-directional fluid drilling system. Sonic drilling can be as much as $330/m ($100/ft). Costs at the Guterl Site are expected to be at the high end of the range due to drilling in the dolostone bedrock.

Costs for O&M are moderate and involve operation of pumps, maintenance, and periodic replacement/refurbishment of the system. The cost of groundwater extraction by wells is rated as high.

Evaluation Results:
The removal of groundwater, by itself, is not an effective remedial option; it must be used with an additional option, such as treatment and/or disposal. For groundwater, horizontal wells were retained for consideration due to the need to intercept vertical fractures, ensuring capture in the fractured bedrock present at the site. Vertical wells were also retained; however, a large number of wells installed at various depths would be necessary due to discontinuous flow paths and large extent of the uranium plume within the fractured bedrock. Although generally less expensive to install, the number of vertical wells that may be necessary could impact the cost, as compared to using horizontal wells, or vertical wells coordinated with a rubblized trench. **The use of wells to extract groundwater is retained for further consideration.**

3.9.4.3.2 Groundwater Extraction by Rubblized Trenches

Rubblized trenches, which are more commonly referred to as blast fractured trenches (or artificially-induced or blast-enhanced fracturing trenches), are used for groundwater remediation in bedrock. Blast fracturing is a technique used at remediation sites underlain by fractured bedrock formations to improve aquifer hydraulic conductivity, groundwater capture zone predictability, and the rate of recovery of contaminated groundwater using less infrastructure (i.e., extraction wells and pumps).

Rubblized trenches are created through controlled detonation of directional explosives in boreholes known as shotholes. The numbers, location, and spacing of shotholes are determined through the interpretation of site geologic and hydrogeologic data. The blasting program design is determined by a qualified explosives professional using information on rock strength and hydrogeologic data and considers expected results (e.g., desired capture zones and pumping rates). Other considerations include the locations of nearby buildings, utilities, and vibration sensitive processes. Determining the number of trenches, depth, location, orientation, and lengths would be part of the design program.

The advantages of rubblized trenches are decreased number of groundwater recovery wells due to increased hydraulic conductivity of the aquifer, decreased remediation times due to increased well yields and groundwater capture zone, and increased predictability of the groundwater capture through optimizing the location and length of the trench.

Effectiveness:
Rubblized trenches can be highly effective in enhancing the recovery of contaminated groundwater in fractured bedrock. These trenches could potentially have adverse impacts on human health and the environment, which will have to be mitigated through proper planning and design. Adverse impacts include those related to blasting (e.g., misfires, damage to buildings, flyrocks, and handling of explosive munitions). Rubblized trenches are reliable and have been sufficiently demonstrated to be effective in similar site settings. The effectiveness of rubblized trenches is rated as high.

Implementability:
Rubblized trenches are somewhat complex to implement. Site conditions have to be considered during design and a highly skilled blasting professional and contractor would have to be employed to complete the trench design and perform the trench installation. Implementation would need to consider both on- and off-site roads and utilities; potential disruptions to adjacent property owners, including ATI Specialty Materials operations; and potential geotechnical requirements because of the proximity to the Erie Canal. The implementability of rubblized trenches is rated as low.

Cost:
The cost of installing rubblized trenches is dependent upon several variables, including (1) the number of trenches, (2) trench lengths, (3) trench depths, and (4) trench locations and proximity to sensitive structures. Rubblized trench costs range from $490 to $820/m ($150 to $250/ft) for trenches installed to a 15 m (50 ft) depth. This is assuming an approximate trench length of 120 m (400 ft). Trenches installed deeper or shallower will cost more or less, respectively. The costs include project planning, drilling for shotholes, and blasting. The cost rating assigned to this technology is high.

Evaluation Results:
The effectiveness of rubblized trenches is rated as high and the implementability is rated as low. Cost for this process option is variable depending on lengths and depths of trenches. **This process option is retained for further evaluation.**

3.9.5 TREATMENT

Treatment technology process options are evaluated individually for soil, buildings, and groundwater in this section.

3.9.5.1 SOIL TREATMENT

Soil treatment actions include physical and chemical technologies that are used to remove or reduce the mobility of contaminants in soils. The soil treatment processes that passed the initial screen are *ex situ* stabilization/solidification and *ex situ* soil washing.

3.9.5.1.1 *Ex Situ* Stabilization/Solidification

Stabilization and solidification methods employ substances such as cement, lime-based reagents, pozzolanic materials, organic polymers, or asphalt to immobilize contaminants in a solidified matrix. These processes physically bind the contaminants within a stabilized mass to reduce their mobility. The processes may occur at both the chemical and physical levels. At the chemical level, the chemistry involved is fairly complex. The use of alkaline materials, such as lime or cement, can reduce the mobility of radionuclides by physical encapsulation or incorporation into low solubility minerals. The *ex situ* application of this technology is evaluated herein.

Effectiveness:
Ex situ stabilization is a well-documented remediation technology. It has been successfully used on radioactive waste (exchange resins, sludge) and impacted soils to reduce the mobility of contaminants. In the solidification process, contaminants are physically bound or enclosed in an impervious matrix. The advantage of *ex situ* processing is a greater ability to control mixing and blending to achieve the desired properties required for off-site disposal. The effectiveness of *ex situ* soil stabilization is rated as high.

Implementability:
For *ex situ* treatment, the soil would require excavation and transport to a centralized on-site staging area. The solidified materials would be significantly greater in volume than the original waste material due to the added reagents. The stabilized soil would be sent off site for disposal. The implementability of stabilization/solidification is rated as high, as widely available materials and equipment are used. All classes of radioactive contamination are treatable by this technology. Detailed characterization of the site soil and treated material matrix would be necessary to determine the suitability. The implementability of *ex situ* soil stabilization is rated as high.

Cost:
The cost for stabilization/solidification is estimated to range from \$123 to \$188/m^3 (\$94 to \$144/yd^3) depending on the type of soil. Higher moisture content in the sludge increases costs, and contaminant concentration and type determine the amount of reagents added to the waste to attain the necessary treatment standards. The transportation and disposal costs would be significantly increased with this treatment alternative due to the increased volume of the soil requiring disposal. The cost of *ex situ* soil stabilization is rated as moderate.

Evaluation Results:
The effectiveness and implementability of this process are both rated high. The cost is rated as moderate. **Therefore, this process option is retained as a possible treatment option prior to disposal.**

3.9.5.1.2 *Ex Situ* Soil Washing

Soil washing is a liquid/solid extraction process that consists of mixing contaminated soil (from which debris and rocks are removed) with an aqueous wash solution. The soil and wash solution is vigorously mixed in a contact unit, forming a soil slurry. Contaminants that are loosely sorbed onto coarse-grained particles are transferred to the liquid phase during the mixing cycle. The extraction is much less effective on contaminants tightly sorbed to fine-grained particles. Following mixing, the slurry is pumped to a separator and size classified using equipment such as a cyclone. The fine particles that tend to retain contamination after washing are separated from the clean, coarser particles. The coarse particles may receive additional washing before finally being dewatered. The fines from the process are settled and collected, at which point they can be disposed of as contaminated waste or receive further treatment. Wash water from the process must also be retained and treated appropriately. Soil washing can be adapted for radiological removal using chemically enhanced washing and leaching methods. For instance, a dilute solution of the oxidizer hydrogen peroxide and sodium carbonate has been effectively used to remove uranium from contaminated soil.

Effectiveness:
According to the RI report, significant areas of the Guterl Site land surface have been disturbed as the properties were developed and operated. Soils consist of man-made fill and native glacially derived silts and clays. Based on RI soil borings, overburden sequences consist of undisturbed native material (well to the north and south of the operating facility), man-made fill overlying native material (large areas immediately north of the operating facility), and man-made fill/reworked native material with very little to no undisturbed native material present (around the operating facility buildings). Outside the immediate area of the operating facility, the fill material consists predominantly of production and miscellaneous plant wastes containing coal fragments, apparent ash and coke fragments, and brick or crushed stone (gravel). In the area of the production buildings, the fill is predominantly crushed stone (gravel). Based on the heterogeneous nature of the subsurface materials at the Guterl Site, soil washing may not be effective. The technology may not meet cleanup levels for all soils treated and may not remove metals without aggressive enhancements; therefore, treatability studies would be necessary. The effectiveness of *ex situ* soil washing is rated as low.

Implementability:
The technology is available and would have to be optimized for site conditions. The biggest limitation on this technology is the treatment of the waste soil wash water produced. Often this water contains surfactants, which makes treatment using basic technologies ineffective. Treatability studies would be necessary. The implementability of *ex situ* soil washing is rated as moderate.

Cost:
Cost for this treatment ranges from \$69/m^3 (\$53/yd^3) for large sites (approximately 76,500 m^3 [100,000 yd^3] size) to \$186 m^3 (\$142/yd^3) for smaller sites (approximately 7,650 m^3 [10,000 yd^3] size). Costs associated with soil washing are moderate to high due to the treatment of both the soils and the wastewater. The cost of *ex situ* soil washing is rated as moderate because the amount of soil requiring treatment at the Guterl Site is estimated at 44,000 m^3 (58,000 yd^3), as there are cost savings for greater soil volumes to be treated.

Evaluation Results:
This process option is not retained due to the uncertainty of attaining cleanup levels and the generation of large volumes of wastewater for treatment and disposal.

3.9.5.2 BUILDING TREATMENT (PHYSICAL/MECHANICAL)

Decontamination actions for buildings/structures include chemical and physical/mechanical treatment decontamination procedures. Chemical treatment was eliminated in the initial screening of technologies. Physical/mechanical treatment decontamination procedures include vacuuming, grinding, shaving, spalling, scabbling, and blasting. These methods use physical force to mechanically separate contaminants from the surface of the material.

3.9.5.2.1 Vacuuming

Vacuuming methods include dry vacuuming and steam vacuuming. Steam vacuuming was not retained during the initial screen. These are mechanical surface cleaning methods that use suction to draw air and loose surface materials into the vacuum storage unit. Dry vacuuming is limited to the collection of loose materials and requires disposal of the captured particles. In addition, HEPA filters purify exhaust air prior to release from the vacuum tool.

Effectiveness:
The effectiveness of dry vacuuming is limited to the removal of loose, surficial particulate matter, primarily from coated or concrete (i.e., smooth) surfaces. For the Guterl Site, this method may be an effective supporting decontamination measure for removing radiological-impacted dust. For the Guterl Site, vacuuming is considered a supporting action that would not meet RAOs as a sole process option. Therefore, the effectiveness of vacuuming as a mechanical treatment method for buildings is rated as moderate.

Implementability:
In general, vacuuming is relatively easy to implement and is commercially available. The implementability of vacuuming is rated as high.

Cost:

The cost for dry vacuuming is rated as low (\$22/m^2 or \$2/ft^2). This actual cost will depend on site specific conditions.

Evaluation Results:
Dry vacuuming is a supporting remedial measure that is moderately effective, implementability is rated as high, and the cost is rated as low. **Therefore, vacuuming will be retained for further consideration.**

3.9.5.2.2 Grinding, Shaving, and Spalling

The concrete grinder is a hand tool that uses a diamond grinding wheel to strip off concrete surfaces. This method is primarily applicable for general radiological decontamination of relatively flat surfaces and for known hot spots. The concrete shaver is a self-propelled tool that shaves flat concrete floor surfaces by means of a rotating drum containing embedded diamonds. The concrete spaller is a tool designed for a quicker, more roughly finished removal of concrete surfaces. It is powered by an 8,200 kg (9 ton) hydraulic cylinder that applies pressure to predrilled holes in the concrete to spall (i.e., chip or splinter) the concrete surface. This method allows for removal of deeper contamination in concrete.

Effectiveness:
Concrete grinders, shavers, and spallers are all effective tools for removing contaminants from concrete surfaces. Shavers and spallers are designed to be used on concrete. Concrete may have been used in the construction of building foundations, which are not visible. Although the buildings are constructed primarily of metal and brick, concrete is used for several utility

trenches and pits and at the loading dock areas. Since the concrete has not been maintained (sealed) since the plant was in operation, shavers and spallers are not expected to be effective on all concrete surfaces, but may have limited applications. These technologies are not effective on brick or dirt floors. The effectiveness of concrete grinders, shavers, and spallers is rated as low.

Implementability:
Concrete grinders and shavers are relatively easy to implement. Slightly more complex, the concrete spalling technique requires drilling holes in a grid pattern prior to using the spaller machine. These types of tools and machines are readily available. Overall, the implementability of concrete grinders, shavers, and spallers is rated as high.

Cost:
The costs for concrete grinders (\$31/m^2 [\$2.92/ft^2]) and concrete shavers (\$14/m^2 [\$1.32/ft^2]) are rated as low, and the cost for concrete spallers (\$200/m^2 [\$18.52/ft^2]) is rated as moderate.

Evaluation Results:
The effectiveness is considered low for the types and condition of concrete surfaces present in the Guterl Site structures. Implementability of concrete grinders, shavers, and spallers is rated as high and costs are rated as low to moderate. **These options are retained because they may be useful on a limited basis.**

3.9.5.2.3 Scabbling

Scabbling techniques are designed to scarify (i.e., scratches, superficial incisions) concrete floors and walls, generating minimal airborne dust. This method uses machinery to mechanically fracture the concrete by a series of pistons attached to the scabbling head. The scabbled concrete is then removed by vacuuming to a storage drum on the unit as the head continuously operates. Various types of scabblers are available including piston head scabblers, electro-hydraulic scabblers, and robotic wall scabblers.

Effectiveness:
Scabblers are an effective means of removing contamination from concrete or coated surfaces. This technique would be protective of human health and the environment because the contaminated portion of the buildings would be removed. However, the buildings addressed under this FS have limited concrete surfaces and this method would be of limited use. The remote feature of scabblers allows for a higher level of worker protection as well. This technology would not be applicable to all portions of the buildings (i.e., roof surfaces) that may need to be decontaminated. The effectiveness of scabbling is rated low, because the structures included in this FS have limited concrete materials.

Implementability:
Scabbling decontamination methods are implementable and are a proven technology. Scabbling does require specialized equipment and trained personnel, which are readily available. The implementability of decontamination by scabbling is rated as high.

Cost:
The estimated cost for piston scabbling is \$65/m^2 (\$6/ft^2) and for electro-hydraulic scabbling is \$110/m^2 (\$10/ft^2). These costs are rated as low. The costs associated with using the En-vac Robotic Wall Scabbler, as stated in the literature, is \$52.74/hour. The use of the wall scabbler becomes cost effective when the surfaces to be treated are cumulatively greater than 139 m^2 (1,500 ft^2).

Evaluation Results:
The effectiveness is considered low for the volume, type, and condition of concrete surfaces present in the Guterl Site structures. Implementability of the scabbling techniques is rated as high. Overall, costs for these techniques are rated as low. For the wall scabbler, a minimum of 140 m^2 (1,500 ft^2) of wall area to be treated is the cross-over area for cost effective treatment. **Scabbling is retained for further evaluation because it may be useful on a limited basis.**

3.9.5.2.4 Blasting

Blasting methods include centrifugal shot blasting, dry ice blasting, grit blasting, soft media blasting, and high-pressure water blasting. Each of these methods uses a specific material rapidly propelled at a surface to remove its coating. Centrifugal shot blasting employs hardened steel shot, dry ice blasting involves the use of CO_2 pellets, grit blasting uses various available abrasive particle types (e.g., silicon dioxide, aluminum oxide, and titanium dioxide), soft media blasting (also called sponge blasting) uses a soft media often impregnated with abrasive materials, and high-pressure water uses pressurized water to remove contamination.

Effectiveness:
The blasting methods are all effective in removing surface coatings, paints, and other materials adhered to surfaces and would be applicable to any coated surfaces at the Guterl Site. These high-pressure methods will require additional care to ensure the protection of workers from potential physical hazards and release/inhalation of dusts generated from the blasting of surfaces. For instance, escaped steel shot from a centrifugal shot blaster could pose a physical hazard to workers. Dust collection/air filtration will be necessary in association with most blasting techniques. These methods can be used on various types of surfaces.

In addition, the effectiveness of blasting methods is dependent on the state of the radiological contamination (fixed versus not fixed), the building material (porous versus nonporous), and the degree of contamination. Since most of the contamination is fixed, this technology is of limited use on concrete and brick but may be effective on metal surfaces. Should this technology be chosen, prior to implementation, a test of the procedure should be performed to determine if the levels of COCs on the structural material could be reduced to the required levels for disposal. The effectiveness of blasting is rated as low to moderate.

Implementability:
Materials and services to perform this process option are readily available. Prior to implementation, a test of the procedure should be performed to determine if the levels of COCs on the structural material can be reduced to the required levels for disposal. The implementability of blasting is rated as high.

Cost:
Blasting costs are rated as low to high, depending on the particular method. The estimated cost of centrifugal shot blasting is \$370/m^2 (\$34.25/ft^2), soft media blasting is \$50/m^2 (\$4.60/ft^2), and high-pressure water is \$40/m^2 (\$3.63/ft^2). Cost information for grit blasting was only found on a project basis, and indicated a wide variation (\$32,780 to \$390,000) depending on the project size and the type of equipment used. Cost information for dry ice blasting was not readily available; however, the costs for this technology are high because of the specialized equipment required.

Evaluation Results:
The effectiveness is low for brick and concrete, and moderate for metal surfaces. Implementability is rated as high. Costs range from low to high depending on the method and the type of equipment used. **This process option will be retained.**

3.9.5.3 GROUNDWATER TREATMENT

This treatment option would be used to reduce the amount of contamination in groundwater and would reduce the potential risks from exposure. All of the treatment options retained from the preliminary screening of groundwater technology types involve physical/chemical process options. These process options can be further categorized into *in situ* treatment and *ex situ* treatment technologies.

Ex situ treatments that may be applicable to the Guterl Site groundwater would require construction of a treatment facility. Common techniques include filtration/ultrafiltration, ion exchange, coagulation, reverse osmosis, and adsorption. The treated water and concentrated waste streams must then be disposed of following treatment. While the treatment process will focus on the radionuclides, chlorinated volatile organics (non-FUSRAP constituents) present in groundwater at the site may require cotreatment to meet discharge limits or *in situ* recirculation requirements.

In situ treatment options for uranium in groundwater include (1) MNA, (2) redox alteration that chemically or biologically reduces mobile hexavalent to sparingly soluble tetravalent uranium, (3) applications of phosphates to precipitate sparingly soluble uranyl phosphate compounds, and (4) PRB technology. The effectiveness of *in situ* treatment technologies is dependent on the chemical and physical characteristics of the aquifer and subsurface soils.

3.9.5.3.1 *Ex Situ* Treatment

If groundwater is extracted at the Guterl Site, treatment would be necessary prior to disposal (discharge) to reduce contaminant concentrations. The main advantage of *ex situ* treatment is that there is more certainty regarding effectiveness because of the ability to monitor and control the process in real time. *Ex situ* treatment, however, requires pumping of groundwater to a treatment facility, treating the recovered water to remove contaminants, and the generation of a concentrated waste stream requiring further treatment and disposal. These processes lead to increased costs for engineering and equipment, possible off-site permitting requirements, treatment reagents, material handling, and off-site radioactive waste disposal. The treatment process options retained in the technology screen are described in the following paragraphs.

3.9.5.3.1.1 Coagulation

Coagulation is a process whereby suspended particles are removed by the addition of alum or ferric chloride in the form of an acidic solution, followed by settling, filtration, centrifugation, or the addition of flocculants. When the solution mixes with water, the added aluminum or iron hydrolyzes to aluminum or ferric hydroxide, which then precipitates as a fine flocculent that has a strong affinity to scavenge metals, including uranium, from solution. This flocculent is then removed by settling or filtration, often with the aid of a polymer. The resulting sludge would require disposal.

Effectiveness:
Coagulation methods can effectively remove uranium from recovered groundwater. However, the relatively high total dissolved solids (TDS) content of the groundwater (average 1,400 mg/L) will require more reagent addition and will generate higher sludge volume relative to treatment of lower TDS groundwater. The effectiveness of this process is rated as moderate to high.

Implementability:
Materials and services to perform this process option are readily available. This process option is easy to implement, and procedures are well documented. Implementability is rated as high.

Cost:
Costs per 3,785 L (1,000 gallons) for this treatment range from $17 (for a minimum of 128,700 L [34,000 gallons] to $41 for 37,850 L [10,000 gallons]). These treatment costs are moderate; however, sludge generated by the process will need to be disposed of off site, which will add to the O&M costs. The cost for this option is rated as moderate to high.

Long-term O&M costs associated with groundwater disposal include maintenance of the disposal system, such as pumps and piping to the discharge point, and off-site permitting fees. The cost for disposal of solid waste generated from *ex situ* groundwater treatment will depend on the classification of the waste (e.g., nonhazardous, hazardous, low-activity radioactive waste [LARW], "unimportant quantities of source material" if residuals are less than or equal to 0.05 weight percent uranium and/or thorium, or "licensable" [regulated] source material, if residuals are greater than 0.05 weight percent uranium and/or thorium). It is anticipated the wastes would be LARW but could also be "licensable" source material, if the uranium or thorium would be significantly concentrated by the treatment process.

Evaluation Results:
This process option is capable of removing the radiological contaminants from an aqueous waste stream although its effectiveness could be lowered due to the high TDS content of the groundwater**. The option is retained for consideration in combination with other technologies in the development of the remedial alternatives.**

3.9.5.3.1.2 Adsorption

In this process, an adsorption media such as activated alumina, activated carbon, copper-zinc granules, granular ferric hydroxide, or surfactant-modified zeolite is packed into a column. Contaminated water is then passed through the column and radionuclides are adsorbed on the media surface. When the adsorption sites become filled, the column must either be regenerated, or disposed of and replaced with new media.

Effectiveness:
Adsorption methods can remove uranium from recovered groundwater. However, the relatively high TDS content of the groundwater (average 1,400 mg/L) will limit the efficiency of the process due to rapid loading of the adsorption media with competing ions. Low concentrations of VOCs should not impact the effectiveness of this method, but may be considered in the selection of the adsorption media. The effectiveness of adsorption is rated as moderate.

Implementability:
Materials and services to perform this process option are readily available. This process option is easy to implement. Equipment is available and procedures are well documented. Implementability is rated as moderate to high.

Cost:
The cost for this option is high. Costs per 3,785 L (1,000 gallons) for this treatment range from $238 to $340.

Evaluation Results:
This process option is capable of removing the radiological contaminants from an aqueous waste stream, although its effectiveness is lowered by the high TDS content in site groundwater. Adsorption of uranium is less efficient than the ion exchange option discussed in the following paragraphs because available ion exchange media is more selective than adsorption media for uranium. **The option is retained for consideration in combination with other technologies in the development of the remedial alternatives.**

3.9.5.3.1.3 Ion Exchange

Ion exchange is a physical/chemical process in which ions held electrostatically on the surface of an engineered solid are exchanged for ions of a similar charge in a solution. Exchange of cations or anions occurs between the contaminants in the wastewater and the exchange media. For this treatment, contaminated groundwater is passed through a resin bed where ions are exchanged between the resin and the water. Cation resins are ineffective due to the anionic nature of dissolved hexavalent uranium species (such as uranyl carbonate, which is present at the site), but anion exchange resins are highly effective. Anion exchange is routinely used to remove uranium from recovered groundwater in uranium mining operations. It can be used in a regenerable process or a once-through mode where the resin would be directly disposed of off site. Dissolved uranium can be removed effectively with a porous anion resin operated in the chloride form. The resin can be regenerated with sodium chloride, which is inexpensive and avoids handling strong base solutions. Regeneration of the resin results in concentrated brine that would need additional treatment (solidification or evaporation) and off-site disposal.

Effectiveness:
Anion resins in the chloride form can easily reduce uranium levels by over 90%. Anion exchange is more efficient than adsorption because exchange resins are highly selective for

uranium (although pH adjustment may be necessary as a pretreatment). The effectiveness of this process is rated as high.

Implementability:
Materials and services to perform this process option are readily available. The uranium mining industry has perfected anion exchange methods for the removal of uranium from recovered groundwater. This process option is easy to implement and equipment is available and procedures are well documented. Implementability is rated as high.

Cost:
Cost range per 3,785 L (1,000 gallons) for this treatment range from \$0.30 to \$0.80 (rated as low cost). Pretreatment by increasing the pH may be necessary to optimize uranium removal, which would increase the cost. The cost for this option is rated as low.

Evaluation Results:
This process option is capable of removing the radiological contaminants from an aqueous waste stream. **The option is retained for consideration in combination with other technologies in the development of the remedial alternatives.**

3.9.5.3.1.4 Reverse Osmosis

Reverse osmosis is a high-pressure process that primarily removes smaller ions by membrane diffusion. The process is similar to other membrane technology applications such as filtration and ultrafiltration. However, there are key differences between these technologies. The predominant removal mechanism in membrane filtration is physical straining, or size exclusion, so the process can theoretically achieve perfect exclusion of particles regardless of operational parameters such as influent pressure and concentration. Reverse osmosis, however, involves a chemical diffusion mechanism so that separation efficiency is dependent on solute concentration, pressure, and water flux rate. This technology is effective for a wide variety of contaminants (including uranium and VOCs) and is compatible with groundwater compositions. Suspended solids, organics, and colloids can cause fouling of the diffusion membrane, so pretreatment of the water may be necessary. A concentrated brine stream is generated that must be further treated via solidification or evaporation and disposed of off site. The volume of this brine stream may be considerable, depending on the TDS of the influent and the pressure applied across the membrane.

Effectiveness:
Reverse osmosis is an effective method for removal of uranium from recovered groundwater. The method can also remove VOCs. The effectiveness of reverse osmosis is rated as high.

Implementability:
Materials and services to perform this process option are readily available. Equipment is available and procedures are well documented. This process option is easy to implement and is rated as high.

<u>Cost</u>:
Cost per 3,785 L (1,000 gallons) ranges from $1.38 to $4.56 (rated as low cost). Pretreatment of the water is an additional expense that could raise the costs to moderate; however, the pretreatment may be cost effective because it will minimize maintenance of the reverse osmosis unit and prolong the life of the membrane. The efficiency of the process can be increased up to a point by increasing the pressure across the membrane, which will minimize the rejected brine volume but requires more energy use. Minimizing the volume of rejected brine is important because the brine will need to be treated via solidification or evaporation, and disposed of off site as an O&M cost.

<u>Evaluation Results</u>:
This process option is capable of removing the radiological contaminants from an aqueous waste stream and has the advantage of also removing VOCs. **The option is retained for consideration in combination with other technologies in the development of the remedial alternatives**.

3.9.5.3.1.5 Filtration/Ultrafiltration

Filtration/ultrafiltration uses filters or polymer membranes to filter out dissolved substances, avoiding the use of coagulants. Ultrafiltration is a variation of membrane filtration in which hydrostatic pressure forces a liquid against a semipermeable membrane. Either positive pressure or suction can be applied across the membrane to drive flow. Suspended solids and solutes of high molecular weight are retained, while water and low molecular weight solutes pass through the membrane. Ultrafiltration has been found to be effective on uranium-impacted water. A brine reject stream is generated as a “bleed” in continuous systems, or episodically as a backwash in batch mode. The reject brine will need to be further concentrated and solidified or evaporated, and disposed of off site.

<u>Effectiveness</u>:
Ultrafiltration is an effective method for removal of uranium from recovered groundwater. The effectiveness of this process is rated as high.

<u>Implementability</u>:
Recent advances in this technology have been made for desalination of brackish water to provide high quality drinking water on a municipal scale. Materials and services to perform this process option are readily available. Equipment is available and procedures are well documented. This process option is easy to implement and is rated as high.

<u>Cost</u>:
Cost per 3,785 L (1,000 gallons) ranges from $1.38 to $4.56 (rated as low cost). However, pretreatment may be necessary to extend the life of the filtration membrane, and treatment and disposal of the reject stream will add to the O&M costs.

<u>Evaluation Results</u>:
This process option is capable of removing the radiological contaminants from an aqueous waste stream. **The option is retained for consideration in combination with other technologies in the development of the remedial alternatives.**

3.9.5.3.2 *In Situ* Treatment

The main advantages of *in situ* treatment are that it allows groundwater to be treated without being brought to the surface and no waste is generated. This usually results in significant cost savings relative to *ex situ* approaches. However, there is less certainty regarding the uniformity of treatment, primarily related to the capabilities of delivering treatment reagents to the contaminant zones in nonuniform and fractured media. Verifying achievement of treatment levels is typically more difficult because of the variability in aquifer characteristics and because samples are collected from discrete locations rather than from thoroughly mixed groundwater.

The geochemistry of an aquifer plays a major role in the effectiveness of the uranium treatment by *in situ* process options. The solubility and mobility behavior of uranium in the natural environment is controlled more by the dissolution/precipitation reactions rather than by adsorption/desorption reactions on the soil (PNNL, 2002; Kumar 2011). The specific assemblage of aqueous uranium species that exists at the site is a function of:

- Redox potential (Eh) - above a critical Eh the uranium is hexavalent [U(VI)] and mobile, and below the critical Eh uranium is tetravalent and insoluble in the form of uraninite [UO_2] (see Figure 4-23 in the *DGI Technical Memorandum* provided in Appendix A).
- Carbonate and phosphate concentrations.
- Reactions of calcium and magnesium with carbonate.
- Precipitation of U(VI) as a calcium or sodium salt.
- pH.

Groundwater at the site is under aerobic conditions. As a result, the majority of the dissolved uranium is in the more soluble hexavalent form, uranyl (UO_2^{2+}). Dissolved hexavalent uranium reacts with dissolved anions such as phosphate, carbonate, nitrate, hydroxide, fluoride, and chloride under specific conditions to form a wide variety of aqueous complexes (species). Hexavalent uranium can react with o-phosphate to form various low solubility precipitates. Carbonate is a very good complexing agent for U(VI), but only the carbonate ion (CO_3^{2-}), not bicarbonate or carbonic acid, forms the uranium complexes. Carbonate speciation is controlled by pH. At a higher pH, most of the total carbonate is present as CO_3^{2-}, so the solubility of U(VI) increases with increasing pH due to the formation of uranyl di- and tri-carbonate anions.

At pH values from 7 to 9, and in the presence of dissolved carbonate, most of the dissolved uranium is present as uranyl dicarbonate ($UO_2(CO_3)_2^{2-}$) and uranyl tri-carbonate ($UO_2[CO_3]_3^{4-}$) anions. Both these species are negatively charged and thus highly mobile in the environment, as they do not adsorb to geologic materials in that negative valence state. Increasing the total carbonate concentration also expands the hexavalent stability field, so uranium can remain soluble under moderately reducing conditions if the total carbonate concentration and pH are high. At higher pH, uranium carbonate species will convert to various sparingly soluble oxide/oxyhydroxide mineral or salt and precipitate.

Anions typically do not adsorb well to soil except for reactions with certain metal hydroxides (e.g., iron hydroxide). Under the correct pH regime, dissolved ferrous or ferric ions or iron reactive sites associated with soil, in particular clays, can be effective for uranium removal by providing a reactive negatively charged iron oxide surface that can aid in adsorbing uranyl anions. The extent of iron hydroxide immobilizing hexavalent uranium at near neutral pH appears to be limited.

Under reducing conditions and the correct pH, soluble U(VI) can be reduced to insoluble U(IV). More reducing conditions are needed as the pH is increased. U(VI) can be reduced chemically or microbially. Bacteria can utilize an organic or inorganic substrate to reduce soluble U(VI) to U(IV), which subsequently precipitates as one of several insoluble minerals, such as uraninite (UO_2) or coffinite ($U[SiO_4]_{1-x}[OH]_{4x}$). These organisms gain energy from this process while being directly involved in the reduction of U(VI). In some instances, the reduction of U(VI) can also occur as an indirect result of biological processes. Under reducing conditions, bacteria will reduce ferric iron (Fe[III]) to ferrous iron (Fe[II]) and sulfate to sulfide (S^{2-}). These reaction products act as reducing agents that can subsequently reduce U(VI) to U(IV) through a direct chemical process. In either case (i.e., the direct or indirect process), the biological reduction of U(VI) results in the formation of insoluble U(IV) minerals.

In summary, the speciation of uranium at the Guterl Site is controlled by several parameters, including Eh, pH, and carbonate concentrations. The saturated zone is a fractured bedrock containing carbonate-based rocks such as limestone and dolostone. At the groundwater pH values (average, 10th percentile, and 90th percentile values of 7.35, 6.9, and 7.9, respectively) there is enough carbonate present to largely convert uranyl to the negatively charged di- and tri-carbonate species. The site conditions and the uranium speciation affect uranium's mobility and *in situ* treatment effectiveness.

These uranyl carbonate species have limited sorption to rock and most soil types. There is some sorption on clays and potentially organic matter (e.g., biomass) present in the aquifer. For clays, the optimum pH for sorption is between 6 and 7, which are lower pH values than found over most of the site. The combinations of pH, redox, and carbonate concentrations at the Guterl Site result in the mobility of uranium because of the limited number of sorption sites to tie-up the uranium and make it immobile.

Several *in situ* remedial strategies are evaluated in this document including MNA, redox alteration, *in situ* treatment using phosphate, and PRBs. Site conditions may have a profound effect on the effectiveness of these treatments. Having site conditions that maintain uranium mobility and having a continuing source of uranium (that is, the soil above the aquifer) will significantly limit the effectiveness of *in situ* treatment unless actions are taken to remove the source and permanently change some of the site conditions. The presence of carbonate expands the hexavalent Eh-pH stability field. *In situ* treatment adjustments are necessary to increase reducing conditions and/or lower the pH in order to reduce hexavalent uranyl to tetravalent uranium in the presence of carbonate, as shown in Figure 4-23 in the *DGI Technical Memorandum* provided in Appendix A. Any treatment following redox alterations must maintain conditions in which the combination of pH and Eh will cause dissolution and release of uranium into the aquifer. The presence of carbonate and calcium in the groundwater may assist in the precipitation of uranyl with the addition of phosphate. The treatment will need to be optimized to the site conditions of pH, dissolved magnesium, calcium, and carbonate concentrations. In the presence of carbonate, PRBs using iron hydroxides for uranyl removal will need longer residence times to account for the slower kinetics and reduced capacity for removal of the carbonate species compared to noncarbonate species.

3.9.5.3.2.1 Monitored Natural Attenuation

Natural attenuation includes a variety of natural processes that work together to reduce the concentrations of contaminants and their impact on the environment. The definition of MNA provided in U.S. EPA documents includes the following processes: biodegradation, dispersion, dilution, sorption, volatilization, radioactive decay; and chemical or biological stabilization, transformation, and destruction of contaminants. In the case of uranium, the processes of dispersion, dilution, sorption, and chemical transformation (*in situ* chemical reduction and precipitation of uranium as insoluble minerals) are applicable if they can be shown to reduce exposure to acceptable levels.

Attenuation of contaminants occurs to some extent whether active remedial measures are implemented or not. However, natural attenuation should not be confused with no action. Monitored natural attenuation is a systematic approach of modeling, predicting, monitoring, and measuring the rate at which attenuation of contaminants occurs so as to determine if RAOs will be achieved. In general, for most nonpetroleum-based contaminants, MNA will often require long timeframes for restoration.

Intrinsic bioremediation is a natural biological activity whereby contaminants are degraded or immobilized. Intrinsic biological activities fall into two classes: aerobic and anaerobic. Anaerobic environments are chemically reductive, and have the capability of reducing uranium to the tetravalent state causing it to precipitate as an oxide mineral with low solubility if strongly reducing conditions can be established. Natural attenuation for uranium includes intrinsic bioremediation, along with sorption, dilution, and dispersion. When used as a remedial technique, a formal monitoring program is established and the action is termed MNA.

Effectiveness:
For MNA to be considered effective it must meet several criteria (U.S. EPA 1994, ITRC 2010):

- The plume is stable or shrinking.
- The aquifer has natural reductants (such as clays) to sorb uranium and/or a chemically reductive zone to convert U(VI) to U(IV).
- The amount of uranium and other reactive constituents does not exceed the capacity of the aquifer to reduce them.
- The time scale required to achieve the reduction of uranium to the target concentration is less than the time scale for the transport of the aqueous U(VI) from the source area to the point of compliance.
- The uranium will remain immobile or it does not mobilize to cause an exceedance at the point of compliance.

As initially presented in the final *Supplemental Sampling Technical Memorandum* (Appendix B), trends at 30 wells that have been sampled four or more times since 2007 were evaluated using the Kendall-Tau test to determine if the uranium concentrations are stable, increasing, or decreasing. A reanalysis of recent sampling data (2007-2016) from each site well employed the

Mann-Kendall method to determine well-specific trends. The update is included as Attachment A to Appendix F. The results indicate the following:

- 12 monitoring wells show increasing or probably increasing trends (23%)
- 32 monitoring wells show stable or no trends (62%)
- Eight monitoring wells show decreasing or probably decreasing trends (15%)

The figures in Appendix F, Attachment A show the spatial distribution of the uranium trends. The shallow groundwater shows a stable plume over the last nine years, with minor lateral dispersion (seen as increasing trends) along the eastern and western periphery of the plume. This normal mechanism was predicted in the groundwater model. The deep groundwater plume is stable and shows only one well of 12 with an increasing trend (MW-711DD near the Erie Canal).

The effectiveness of MNA at this site would be driven by dispersion of uranium in the groundwater. Uranium is highly mobile because:

- The aquifer is generally aerobic.
- The dissolved carbonate concentration and pH leads to the formation of the anionic uranium carbonate complexes.
- The dolostone aquifer environment provides minimal suitable adsorption surfaces.
- Influx of rainwater and melted snow water can transport uranium from the unsaturated zone to the groundwater in a well oxidized state that supports the establishment of an oxic aquifer. (If the uranium contaminated unsaturated zone soil is removed from the site, the influx of uranium to the groundwater will be minimized.)

Although there is a wide range of redox conditions at the site, none of the shallow or deep monitored locations indicate that redox potentials are low enough for reduction of hexavalent uranium to its immobile tetravalent form (with the exception of areas where VOC contamination has been observed). In areas of VOC contamination, the expected MNA mechanisms are mineral precipitation due to the reductive conditions of the aquifer and biological stabilization. If the source of VOC contamination is removed, uranium is expected to remobilize over time.

Site-specific adsorption of hexavalent uranium in the overlying soil is moderately strong, but adsorption in the fractured dolostone aquifer is much weaker, so uranium already in the dolostone is mobile thus establishing that the primary mechanism for MNA is dispersion. Monitored natural attenuation is not effective at attaining MCLs within a short timeframe (e.g., years to decades), but may achieve MCLs within a longer time period (e.g., centuries). The groundwater model constructed for the site (Appendix F) predicts that, without soil removal, the shallow and deep groundwater contaminant plume will persist at concentrations above the MCL for over 1,000 years. With soil removal to the PRG-CW, uranium will remain above the MCL for 430 years in the shallow groundwater and 660 years in the deep groundwater, with no hydraulic controls only natural attenuation. With soil removal to a cleanup level protective of groundwater (PRG-GW), this timeframe is predicted to be approximately 50 years in the shallow groundwater and 120 years in the deep groundwater; these periods reflect only natural attenuation timeframes with no active hydraulic controls or plume collection.

The groundwater model did not account for remobilization of tetravalent uranium potentially "sequestered" in the VOC plume and therefore, groundwater remediation timeframes associated with soil removal may be slightly underestimated. Groundwater model predictions could be refined during remedial design and/or reassessed after soil removal (i.e., after a period of groundwater monitoring). Other FUSRAP sites (e.g., Colonie, Hanford) have implemented interim remedial actions, like soil removal followed by a period of groundwater monitoring (approximately five to 10 years) to assess the viability of an MNA groundwater remedy. This period of monitoring is designed for observation of the uranium plume, and its behavior, compared to predictions of the groundwater model. The Colonie Site specifically had a VOC plume collocated with uranium contamination. Effectiveness is rated as high, when combined with other GRAs, such as soil removal.

Implementability:
The MNA option involving model verification, predicting, long-term monitoring, and contingency planning can be implemented at the site. Although the monitoring of groundwater is easy to implement, modeling the groundwater flow in fractured bedrock can be moderate to difficult to implement. Geophysical techniques can be employed to find preferential flow paths in fractured rock, which would be targeted for MNA sampling and potential extraction treatments discussed under other alternatives.

Cost:
Cost for the MNA option is low to moderate. A site-specific groundwater and uranium transport model and the necessary data that can be used for predicting attenuation rates already exist. Monitoring would need to be performed for an extended period of time. The cumulative costs for a groundwater-monitoring program may be considerably high if long-term monitoring is necessary.

Evaluation Results:
The MNA option is retained for consideration. Alone, MNA will probably not be effective in meeting the RAOs but will be retained for evaluation because it could be used in conjunction with soil removal and/or as an improving step for deeper groundwater, after the shallow groundwater has been remediated.

3.9.5.3.2.2 Redox Alteration- Chemical and Biological Treatments

The manipulation of the redox state of the aquifer environment is used as a remediation treatment method to cause the precipitation of metals, the adsorption of metals on mineral surfaces, or the enhancement of aerobic or anaerobic microbiological activity. These redox manipulation techniques are most effective for redox-active metals, which are metals that can exist in more than one valence state over the range of Eh, pH, temperature, and pressure conditions that exist in shallow groundwater environments. One of the best examples is uranium, which has a high solubility under oxidizing conditions when it is in the hexavalent form and has a solubility approximately six orders of magnitude lower under strongly reducing conditions when it is in the tetravalent form.

The creation of reducing conditions has been successfully used to immobilize uranium via precipitation as low-solubility oxide minerals. Both chemical and biological methods can be used to lower redox potentials. Chemical reduction methods for uranium include the injection of nanoscale zero-valent iron, calcium polysulfide, thiosulfate, or other reducing agents.

Biological methods (termed *bioremediation*) for uranium involve the use of indigenous microorganisms (i.e., fungi and bacteria) stimulated by the addition of a carbon source material to lower the redox potential of the aquifer, causing uranium to reduce from the hexavalent to the tetravalent state and precipitate in place. Microbial reduction techniques using acetate, lactate, emulsified soybean oil, or proprietary amendments can be effective for *in situ* treatment of uranium. Another site consideration is the collocation of VOC contaminants with uranium. The presence of VOCs can actually aid in the establishment of reducing conditions by acting as a source of organic carbon.

Caution should be exercised with redox manipulation techniques where there is more than one metal of concern, because treatment (immobilization) of one metal may mobilize one or more of the other metals. For instance, arsenic, iron, and manganese are susceptible to mobilization under low redox conditions that are conducive for uranium immobilization. It is important to note that uranium immobilized under local reducing conditions will remain immobilized as long as redox conditions remain reducing. If redox conditions revert to oxidizing at some point in the future, then the uranium will likely dissolve at some rate.

Effectiveness:
Active *in situ* redox alteration would consist of creating a chemically reducing environment to immobilize the uranium via precipitation as a low-solubility oxide mineral. Treatment of impacted groundwater would be effective in reducing the long-term risk to human health and the environment at the site for as long as the local redox conditions in the source area of the aquifer remains reducing. The reductive potential of the site groundwater is exemplified by the slow, but ongoing, *in situ* degradation of a VOC plume at the site, which indicates bioremediation is viable (at least for VOCs) in the Lockport dolostone aquifer. Treatability studies may be necessary as part of the design to help predict the effectiveness of redox control for uranium. Over time, redox conditions may reverse and reapplications will be necessary. The effectiveness of *in situ* redox groundwater treatment is rated as moderate.

Implementability:
In situ treatment may be performed with the existing well system augmented with additional injection points. Resources for sampling and analysis are readily available. Implementation of chemical or biological redox alteration is moderately complex. Bench-scale and pilot-scale treatability testing and modeling may be necessary for the design of the system. A large number of injection points may be necessary to address the contaminant plume. Location of the injection points will be complicated by the influence of fractures on groundwater flow.

An additional concern is that the long-term persistence of reducing conditions may not be viable in the upper Lockport Dolostone due to high flow velocities and rapid pore volume flushing that limits the residence time for adjustments to create chemically reducing conditions where dissolved organic carbon content is low (i.e., outside of the VOC plume). Due to the variable groundwater flow rates, existing dissolved oxygen and redox potential values, and the influx of rainfall and snowmelt, it will be difficult to achieve long-term, low-maintenance reductive conditions across the site. Chemical reductants would likely be more effective at creating the reductive condition than biological/nutrients amendments alone.

One consideration would be addition of a reductive media upgradient of the plume. Multiple treatments would likely be necessary. The naturally high oxygen carbonate-based geochemical condition in the site groundwater promotes highly mobile anionic uranium species that solubizes uranium that would then remobilize the contaminant in previously reduced treatment zones. The establishment of long-term reducing conditions would require routine maintenance (amendment additions) to sequester the uranium in this aquifer. Since uranium redox reactions occur quickly and are fully reversible, precipitated uranium would be prone to remobilize as oxic redox conditions eventually return. This geochemical condition precludes radox alteration for this groundwater system. Another option would be to place a treatment wall at the property boundary to provide reducing conditions to treat groundwater as it flows off site; this feature would also require maintenance (media eplacement) to ensure long-term geochemical stability.

The literature also indicates that the high permeability conditions common in the upper water-bearing zone may flush reducing agents, bioamendments, and bioremediative bacteria through the aquifer too quickly for establishing reducing conditions and precipitating the uranium. However, these higher flow velocities are conducive to *in situ* flushing and recirculation using treated water (e.g., through a pump and treat system, and reinject in a closed cell configuration system). The implementability of *in situ* redox groundwater treatment is rated as low.

Cost:
The cost of implementing treatment would be considered moderate. Cost for redox alteration ranges from \$41 to \$46 per 10,000 L (\$156 to \$175 per 10,000 gallons) of water treated. The short-term costs would be high considering the material handling required for initial setup of the system. *In situ* treatment techniques would require some level of effort in the monitoring of soil and groundwater to document the effectiveness of the treatment method. Reinjection or recirculation of the treatment media may be necessary during the O&M period.

Evaluation Results:
In situ redox alteration is proven for precipitation of uranium in the aquifer, thereby reducing the toxicity, mobility, and volume of COCs, and reducing the potential for exposure. However, due to the fractured bedrock system at the Guterl Site, redox alteration is not considered an implementable technology and **will not be retained for further consideration**.

3.9.5.3.2.3 *In Situ* Treatment Using Phosphates

In aerobic aquifers containing sufficient carbonate concentrations and pH greater than 6.5, dissolved uranium will typically be U(VI) carbonate anion. In the presence of limestone and soluble phosphate, apatite-like and autunite compounds (e.g., $Ca(UO_2)_2(PO_4)_2 \cdot nH_2O$) can precipitate. Carbonate, chloride, and fluoride may replace phosphate to some extent in these minerals. The extent of substitution can affect the solubility of the various minerals. These apatite-like compounds are very good exchangers with U(VI) and, if present, will significantly attenuate the U(VI) concentration in the groundwater. There is also significant literature showing that uranyl species can react with naturally occurring or man-made apatite-like minerals (e.g., in PRB) to remove dissolved uranium from groundwater.

The dolostone bedrock is composed primarily of magnesium, calcium, and carbonate. This chemistry should maintain a constant supply of calcium and carbonate to the groundwater. Injection of soluble phosphate can react with calcium and carbonate to form apatite-like minerals that then can scavenge uranyl species, or the phosphate can react directly with the uranyl species to immobilize uranium. Direct addition of orthophosphate to calcium-rich aquifers may result in near immediate formation of various calcium phosphate solids that may rapidly plug the injection well and/or decrease the permeability of the aquifer. However, moderated injection of polyphosphates (linear or cyclical) releases orthophosphate slowly and minimizes the calcium phosphate fouling issues (Giammar, 2001; PNNL, 2007; Wellman, et al., 2008; Wellman, 2009; Dayvault, 2009; PNNL, 2008; U.S. EPA, 2000; Kumar, 2011).

Application options include, but are not limited to, the following:

- Direct injection of phosphate mixtures containing polyphosphates and orthophosphate
- Injection of phosphates mixtures with soluble calcium salts
- Injection of slurries containing phosphate mixtures and finely ground apatite or other solid phosphate compounds

The last option would provide a reservoir of phosphate to react with soluble uranium entering the treatment area.

Effectiveness:
Active *in situ* phosphate treatment consists of creating a phosphate-rich environment to immobilize the uranium via precipitation as a low-solubility phosphate-based mineral. Treatment of impacted groundwater should be effective in reducing the long-term risk to human health and the environment at the site. Treatability studies will be necessary as part of the design to help predict the effectiveness for uranium immobilization.

The technology effectiveness is limited by the ability to achieve good subsurface mixing, which may be difficult, especially in the fractured bedrock and with the variable groundwater flow rates. Approaches at other facilities involved sequential injections of a mixture of sodium polyphosphate, o-phosphate, and calcium chloride in an effort to precipitate calcium-uranium phosphate minerals, but inadequate mixing of reagents in the subsurface proved problematic. Due to inadequate mixing, an insufficient quantity of apatite was formed; thus, there was an insufficient reservoir of phosphate to treat dissolved uranium entering the treatment area.

Using a different delivery technique and/or the use of slurry injections may minimize the impact of this issue. Under alkaline conditions, dissolved carbonate in the groundwater can destabilize the uranium-phosphate minerals, causing release of uranium over the long term (PNNL, 2008). In addition, under the correct circumstances, microbes can attack the uranium-phosphate precipitate to use the phosphate as a nutrient, which may lead to the release of uranium. However, this degradation process is expected to be relatively slow at the Guterl Site. For microbial populations to effectively grow in the saturated zone, they require a food source (organic substrate and nutrients [e.g., nitrogen in the form of nitrate and ammonia and phosphorous such as orthophosphate]) and, ideally, a surface on which the microbes can attach. Groundwater at the Guterl Site generally flows through larger openings in the fractured bedrock aquifer, creating a groundwater flow rate not conducive for growing significant microbial populations attached to the rock surfaces within the aquifer.

In the upper highly fractured zones and in areas where the permeability is high, the formation and precipitation of apatite-like minerals will have limited impact on the permeability. However, in areas with initially low permeability, the effectiveness of phosphate treatment may be limited due to the potential loss of permeability from the formation and precipitation of apatite-like minerals in the aquifer (promoting plume dispersion).

When polyphosphates are added to groundwater, insoluble uranyl phosphates (e.g., autunite $[Ca(UO_2)_2(PO_4)_2 \cdot nH_2O]$) are formed. Apatite minerals are also formed by either the addition of soluble calcium or from the dissolved calcium in the aquifer reacting with the added phosphate. Apatite serves two functions: (1) to provide soluble phosphate that reacts with uranyl in the groundwater, and (2) as a long-term solid sequestration reagent that removes uranyl released into the aquifer following phosphate treatment. Uranyl is removed from the groundwater by a sorption process where the negatively charged uranium complex becomes attached to the positively charged apatite surface. Over time, this sorbed uranium converts to a lower solubility mineral, free of carbonate.

The extent of uranium sorption on apatite is most extensive at a pH less than 7 and decreases in the pH range of 7 to 7.5. In this pH range, the apatite surface loses many of its positively charged sites and the surface becomes more negatively charged due to deprotonation of active sites. However, adsorption can occur up to a pH of 8.0. Based on data in the *DGI Technical Memorandum* (USACE 2012), about 85% of the groundwater at the Guterl Site has a pH less than 7.5. In an aquifer that has elevated dissolved carbonate/bicarbonate concentrations, the conversion of sorbed uranium to the noncarbonate species may be limited. An aquifer having pH values greater than 7 and elevated carbonate content may require the use of higher dose rates of apatite and/or multiple injections of phosphate amendments over the life of the treatment process.

Carbonate concentrations were not measured directly. Alkalinity, calcium, and magnesium were analyzed and all three of these parameters are high. In a dolomite aquifer, alkalinity will be primarily composed of carbonate. Therefore, it is assumed that the groundwater will contain carbonate and/or bicarbonate depending on the groundwater pH. If this treatment method is considered for the site, treatability studies would be needed and carbonate concentrations would be completed as a part of these studies.

The effectiveness is rated as moderate to high, depending on the groundwater pH and carbonate concentrations in groundwater.

Implementability:

In situ phosphate treatment may be performed using a combination of the existing well system augmented with additional injection points, direct push points, and potentially infiltration galleries. Resources for sampling and analysis are readily available. Implementation is moderately complex.

Bench-scale and pilot-scale treatability testing and modeling would be necessary for the design of the system. The bench-scale testing would define the correct mixture of soluble phosphates and solid phosphates to use. Pilot scale tests would define the correct implementation methods. A large number of injection points may be necessary to address the contaminant plume. Location of the injection points would be complicated by the influence of fractures on groundwater flow. Implementability is rated as low.

Cost:
The cost of implementing treatment would be considered moderate. The price of phosphates has increased significantly in the past few years and the price fluctuates depending on market events. The costs are expected to be similar to redox alteration, which ranges from $41 to $46 per 10,000 L ($156 to $175 per 10,000 gallons) water treated. The short-term costs would be high considering the price of phosphates and material handling required for initial setup of the system. *In situ* treatment techniques would require some level of effort in the monitoring of soil and groundwater to document the effectiveness of the treatment method. Reinjection or recirculation of the treatment media would likely be necessary during the O&M period. The cost is rated as moderate.

Evaluation Results:
Phosphate mediated *in situ* water treatment of uranium would reduce its solubility and mobility and reduce the potential for exposure. However, due to the fractured bedrock system at the Guterl Site, ***in situ* phosphate treatment is not considered an implementable technology and will not be retained for further consideration.**

3.9.5.3.2.4 Permeable Reactive Barrier

Permeable reactive barriers consist of a reactive medium installed in a trench, permeable wall, or in a series of wells across the groundwater flow path. They contain reactive material that acts as a passive *in situ* treatment zone to degrade or immobilize contaminants, such as radionuclides, as groundwater flows through the treatment medium. Hexavalent uranium is removed from the groundwater by chemically or microbiologically reducing soluble uranyl species to insoluble U(IV) species, adsorption on iron particles, and incorporation into other minerals such as apatite and calcite ($CaCO_3$). The treatments cause uranium to precipitate and/or sorb onto particles within the PRB. Chemically or microbiologically reducing soluble uranyl species to insoluble U(IV) species and incorporation into other minerals such as apatite and calcite ($CaCO_3$) has been described previously. Sorption on iron oxyhydroxides is controlled by the pH and carbonate content of the groundwater. Uranium sorbs best on iron hydroxides when the iron hydroxide surface charge is negative or neutral and the dissolved uranium complex has a neutral or negative charge. This limits U(VI) to pH values between about 5 and 8. Maximum uranium sorption on iron hydroxide is typically between pH 6 and 7. Higher groundwater TDS and/or carbonate contents decrease the sorption on iron hydroxide.

For the Guterl Site, as a result of the groundwater carbonate content, a larger size PRB with longer residence time may be needed to effectively remove uranium to below the discharge criteria. Since this is a sorption process, the sorbed uranium potentially may desorb from the iron hydroxide if the pH changes significantly. Most of the groundwater pH values are between 5.5 and 8; therefore, U(VI) will sorb onto a PRB containing iron hydroxides (U.S. EPA, 2000;

Naftz, 1999; U.S. EPA, 2002; Framework, 2000; DOE, 2004; DOE, 2005; FRTR, 2002). Permeable reactive barriers are best suited for sites that have well defined flow paths. It is preferable to have an impermeable layer to key the wall into, but hanging walls can be designed that capture plumes without a bottom layer.

Permeable reactive barriers can be installed using several methods including trenching or injection wells spaced to form a continuous treatment wall. Due to the dolostone bedrock, installation of a standard trench is not practical. A rubblized trench could be installed in the dolostone. This type of trench has been used to enhance permeability for groundwater extraction but it has had limited application for use as a PRB, where the treatment media would be injected into the rubblized bedrock zone.

Modifications to the basic passive treatment walls may include a funnel-and-gate system, which consists of low hydraulic conductivity (e.g., 1×10^{-6} cm/s) cutoff walls (the funnel) with a gate that contains *in situ* reaction zones. Groundwater primarily flows through high conductivity gaps (the gates). The types of cutoff walls most often used are slurry walls or sheet piles. Other methods such as deep soil mixing and jet grouting are also used as funnel walls.

Treatability studies are typically conducted to evaluate the performance of reactive materials to treat groundwater under site-specific conditions. Selection of material for the barrier is based on results of these treatability studies. Zero-valent iron is one of the more common reactive medium used in PRB, and has been effective for the treatment of uranium in groundwater at other sites. The reduction promoted by zero-valent iron in an aqueous solution removes metals and metalloids in the system primarily through reductive precipitation on surfaces, or as co-precipitates with the iron oxyhydroxides that form on the zero-valent iron surfaces. Phosphates have also been used in PRBs to treat uranium-impacted groundwater. Phosphate media is used to facilitate formation of insoluble uranyl phosphate compounds that precipitate out of solution. The effectiveness of removal of aqueous uranium by commercially available natural apatite materials (e.g., phosphate rock, bone meal, bone meal charcoal, and Apatite II®) has been evaluated either through laboratory studies or through field applications (U.S. EPA, 2000). Biological PRB that reduce uranyl to insoluble U(IV) are also effective. Typically, biological PRBs add organic substrate and nutrients to grow biomass that create a reductive zone to immobilize uranium. Reagents that have been used in biological treatment include, but are not limited to, lactic acid/sodium lactate, emulsified oil substrates, and EHC® (carbon source and zero-valent iron).

Effectiveness:
Application of a PRB would consist of the construction of a flow-through treatment cell creating an environment to immobilize the uranium. Treated groundwater would continue to flow downgradient of the PRB. This technology has been shown to be effective for the treatment of uranium at other sites. A comparison study for treatment of uranium in groundwater was performed by U.S. EPA using three different PRBs at Fry Canyon, Utah. During the first year of operation (September 1997 through September 1998), the PRBs removed most of the incoming uranium. The zero-valent iron PRB has consistently lowered the input uranium concentration by more than 99.9% after the contaminated groundwater travels 1.5 feet into the PRB. The percentage of uranium removed in the bone-char phosphate and amorphous ferric oxyhydroxide

PRBs exceeded 70% for most measurements made during the first year of operation. The uranium concentrations in monitoring wells downgradient of the PRBs are at or near background concentrations. This project has demonstrated that PRBs are an efficient and financially viable means of remediating uranium-contaminated groundwater (U.S. EPA 2000).

A possible application of this technology is to treat groundwater as it flows off the Guterl Site property and/or prior to reaching the Erie Canal. Treatment of impacted groundwater would be effective in reducing the long-term risk to human health and the environment downgradient of the PRB. If the PRB is not keyed into an impermeable unit, such as the shale at 80 ft bgs, or wider than the target plume, part of the groundwater may flow beneath or around the treatment cell. This is especially important where small permeability changes from treatment media installation can adversely affect PRB performance. Treatability studies will be necessary as part of the design to select and evaluate the effectiveness of the treatment media.

This treatment option typically requires less energy usage and maintenance than a pump and treat system (ITRC, 2005). However, over time, the reactivity and permeability of the PRB may decrease. Both siltation of particles in the treatment wall and chemical precipitation or corrosion (e.g., calcium carbonates, sulfates and phosphate minerals) may also reduce the permeability of the treatment media over time, resulting in mounding of groundwater behind the PRB and flow of groundwater around the wall if not properly designed (FRTR, 2002). Monitoring will be necessary to evaluate the performance of the wall over time, and periodic replacement of the treatment media will be necessary. The effectiveness of groundwater treatment using a PRB is rated as high.

Implementability:
Implementation of a PRB at the Guterl Site may be difficult since the groundwater is present in the fractured dolostone bedrock. Installation of a rubblized trench would be necessary in order to effectively intercept the fracture zones. A rubblized trench is not a standard technique used to construct a treatment wall due to complexity. The primary application of this type of trench has been to provide enhanced permeability of groundwater extraction, rather than a proven use as a treatment barrier for uranium, but has been used in a limited number of other applications (Dick, et. al, 2001; U.S. EPA, 2000; NAVFAC, 2002). Alternatively, a series of closely placed treatment wells may be used to simulate a treatment wall. This may be accomplished by placing the wells at a spacing for which the radius of influence will overlap. The treatment zone could be enhanced in each well using hydraulic fracturing (U.S. EPA, 2000; NAVFAC, 2002). An example site includes Pease Air Force Base Site 49 (http://des.nh.gov/organization/divisions/waste/hwrb/fss/superfund/summaries/pease.htm). The use of a series of vertical wells to mimic an *in situ* treatment trench has been shown effective for treatment of organic compounds but it has not been applied to radionuclides.

There are two common concerns with the use of a PRB to treat groundwater. First, biological activity or chemical precipitation may limit the permeability of the passive treatment wall over time. The second is the longevity of the reactive material. Passive treatment walls may lose their reactive capacity, requiring replacement of the reactive medium (FRTR, 2002; U.S. EPA, 2000). This may be difficult if a rubblized trench is used and the permeability of the trench is compromised. However, the U.S. EPA and DOE have studied several methods for rejuvenating

PRBs used for treatment of radionuclides in groundwater and have found several methods cost effective (U.S. EPA, 2004; U.S. EPA 2005). These studies are based on bench-scale tests performed in 2004 for a PRB hydraulically downgradient of the Monticello, Utah, mill site, which was completed June 30, 1999, by DOE.

Bench-scale and pilot-scale treatability testing and modeling may be necessary for the design of the system. Implementability is rated low.

Cost:
The cost of implementing treatment is considered moderate to high. Costs in the literature for installation of the treatment wall are \$1,500 to \$2,560/m^3 (\$1,142 to \$1,961 per yd^3). These costs do not consider installation of a rubblized trench or "continuous" wells installed into a dolostone bedrock. Treatment costs are typically \$0.10 to \$0.17/m^3 (\$0.08 to \$0.13 per yd^3) of groundwater. The short-term costs would be high considering the material handling required for initial setup of the system including installation of the trench or series of injection wells. Costs for O&M would include chemical and hydrogeologic monitoring, which would be required to document the performance of the PRB. Periodic replacement or reinjection of the treatment media may also be necessary.

Evaluation Results:
Standard PRBs have been shown to be effective for the treatment of uranium in groundwater. Zero-valent iron, phosphates, and biological technologies have been successful as treatment media. The fractured bedrock formation presents a challenge for implementation of a PRB, as a standard trench is not viable in dolostone. The wall would need to be constructed with a series of closely spaced injection wells with over-lapping zones of influence, or by injecting the treatment media into a rubblized trench. **Permeable reactive barriers will not be retained for further consideration.**

3.9.6 DISPOSAL

This section evaluates disposal options for soils, buildings, and groundwater.

3.9.6.1 SOIL AND BUILDING DISPOSAL

Disposal options that were retained after the initial screening and included disposal at an existing licensed or permitted off-site disposal facility and recycling/beneficial use of materials.

3.9.6.1.1 Off-Site Disposal

Impacted soil and building materials could be disposed of at an off-site landfill. Sampling and analysis of these materials in accordance with waste acceptance criteria requirements would be performed for waste debris before approval for disposal. Various types of building debris may be generated as a result of removal activities at the site: nonhazardous solid waste (RCRA Subtitle D landfill), LARW commingled with hazardous solid waste (RCRA Subtitle C landfill), and "licensable" source material disposed of at a properly-licensed off-site disposal facility. Some types of construction and dismantlement (C&D) wastes could also fall under the category of "clean fill" including materials such as rock, soil, gravel, concrete, broken glass, and/or clay products. Such materials may be used as fill in a variety of situations, with no solid waste permit or approval required, provided there is no violation of other regulations. Nonhazardous waste includes C&D wastes that are not classified as clean fill and not being reused or recycled, and would need to be disposed of at a Subtitle D landfill.

Subtitle C landfill facilities are commonly permitted to accept both RCRA and Toxic Substance Control Act hazardous waste, along with material that meets the acceptance criteria of 10 CFR 40.13(a). Subtitle C disposal requirements commonly limit total activity of naturally occurring constituents to a maximum of 2,000 pCi/g. In addition, source materials (i.e., uranium and thorium) are limited to a maximum of 0.05% by weight (i.e., to approximately 54.5 and 165 pCi/g for ^{232}Th and ^{238}U, respectively). The stated limits apply to both volumetrically contaminated media (i.e., soil) and to surficially contaminated materials, and are applied as a limit on the average concentration per unit mass as averaged over a conveyance or package. Subject to monitoring considerations, uranium is detectable with field radiation measurement instruments so that segregation should generally be implementable.

Solid radioactive waste that exceeds the Subtitle C requirements or is not exempt as defined in 10 CFR 40.13(a) requires disposal in a licensed facility. Waste generated as a result of a removal action would be transported to the off-site disposal facility in trucks, railcars, or in containers transported by truck or rail. The transport of wastes to an off-site disposal facility would comply with Department of Transportation regulations and directives as well as other applicable federal regulations. Specific requirements may include waste profiling, manifesting, packaging, marking, and labeling waste packages; placarding transport vehicles; choosing appropriate waste transporters and shipment destinations; and recordkeeping and reporting.

Effectiveness:
Disposal of soil and building debris in an off-site disposal facility is designed to be a long-term solution to waste disposal. However, without some treatment prior to disposal, it does not reduce the volume or concentration of the contaminants. To mitigate this, engineering design features of the disposal facility, such as liner integrity, monitoring, and mitigation procedures, are necessary to reduce the mobility and ensure effectiveness. Disposal facilities are designed to be reliable for 100 to 1,000 years with the appropriate maintenance activities, and are considered highly effective.

Environmental and human health risks are of principal concern when hazardous or radioactive materials are being removed and handled. Potential health impacts to site workers also include exposure to fugitive dust emissions. Appropriate mitigation measures would be implemented during waste handling activities to reduce worker exposures, airborne emissions, and surface water runoff. Potential short-term risks are associated with the transport of these materials to an off-site disposal facility. Worker and public exposure is minimized during transport by choosing rail transportation over truck, and strict enforcement of applicable federal and state safety provisions. Transportation risks increase with distance and volume, although the potential for any spillage and resultant public exposure would be low.

Disposal would reduce the mobility of COCs in site wastes, soils, and debris, but would not reduce their toxicity or volume. Disposal reduces the potential exposure to contamination, assuming an effective maintenance program is in place for the disposal area. Off-site disposal offers the advantage of releasing the obligation for long-term monitoring for the Guterl Site. The effectiveness of soil and building disposal is rated as high.

Implementability:
Off-site disposal would be easily implemented using established technologies and methods. Disposal of excavated wastes, soils, and debris at an off-site facility would involve loading and transporting the impacted materials off site. As part of these activities, manifesting would be required to address both intra- and interstate transport.

The following facilities arranged, according to type of waste/waste process, are potentially available to receive the waste. However, this list of disposal facilities is not meant to be all inclusive.

- Licensable (Regulated) Source Material:
    - EnergySolutions, Utah

- Subtitle C or LARW:
    - Chemical Waste Management, New York
    - The Environmental Quality Co. (EQ), Michigan
    - US Ecology Inc., Idaho
    - US Ecology Inc., Texas
    - Waste Control Specialists, LLC, Texas

- Construction and Dismantlement (C&D):
    - Niagara Falls Landfill (for miscellaneous debris and construction debris), New York
    - Swift River, New York

- Asbestos:
    - Niagara Falls Landfill, New York
    - Modern Disposal, New York

Off-site disposal would be technically feasible; however, it may involve detailed and lengthy permitting and administrative processes. In addition, given the relatively large volumes of wastes requiring disposal, local truck traffic would be significant during implementation. The implementability of soil and building disposal is rated as high.

Cost:
Cost estimates for off-site disposal range from approximately $40/m^3 ($30/yd^3) for nonradiological C&D debris, $140/m^3 ($110/yd^3) for Subtitle C waste and LARW, to $850/m^3 ($650/yd^3) for licensable source material. These estimates do not include transportation to an off-site facility. Transportation costs range from $5/ton for local facilities to approximately $250/ton for remote facilities. Additional costs may also include debris characterization and/or decontamination to meet disposal facility waste acceptance criteria. Costs associated with disposal of soil or building materials at an existing off-site disposal facility are generally low for nonradiological C&D debris and high for licensable source material. Cost may be reduced by

recycling any soils or building materials that meet the recycling facility criteria. The cost of soil and building disposal is rated as low.

Evaluation Results:
Off-site disposal would use existing permitted/licensed disposal facilities with the approval of the facility's regulator(s). USACE has performed similar work in New York and has identified qualified disposal facilities. **Off-site disposal at an existing facility is retained for further consideration.**

3.9.6.1.2 Recycling and Beneficial Use

Building materials such as steel, concrete, asphalt, bricks, and glass that have not been impacted by radiation or other contamination can be recycled at appropriate facilities. Non-impacted materials such as rock, soil, gravel, and broken concrete could be reused on site as fill material as a use beneficial to the chosen remedy. Beneficial reuse of some of the salvageable materials could include using site soil for backfilling of excavations, or broken concrete or rubble as basal material for temporary transport road construction. Scanning of the materials for radioactivity and sampling and analysis of the materials would be performed to verify that they are below limits agreed to with NYSDEC.

Use of materials at the Guterl Site for beneficial use would be based on a case-specific agreement with the NYSDEC. USACE would petition the department, in writing, for a determination that the solid waste under review in the petition may be beneficially used. Some of the materials at the Guterl Site have been identified as beneficial use items per Subpart 360.1-15 (Beneficial Use) of the NYSDEC Regulations provided that such materials are uncontaminated. These materials include: (1) *"uncontaminated soil which has been excavated as part of a construction project, and which is being used as a fill material, in place of soil native to the site of disposition"* and (2) *"recognizable, uncontaminated concrete and concrete products, asphalt pavement, brick, glass, soil and rock placed in commerce for service as a substitute for conventional aggregate."* Other site materials (not on the list of 16 beneficial use items identified by NYSDEC) that are potential candidates for beneficial use can still be approved as such by petitioning the NYSDEC and providing detailed information as required by Subpart 360.1-15.

Effectiveness:
Recycling and reuse of nonimpacted site materials are highly effective methods of disposal. Beneficial use is a well-documented process regulated by the NYSDEC. These methods are of *supplementary* benefit to the project in that they are effective in minimizing waste generated from the removal of materials from the site. Impacts to human health and the environment are the same as those of removal of soil or buildings in that the generation of dust would be held to a minimum, and a health and safety officer would work closely with site workers to minimize the potential for physical accidents and exposures to impacted media. The effectiveness of recycling/beneficial use is rated as high.

Implementability:
Recycling is easily implemented using established means and methods. The biggest factor in reducing the implementability of recycling/beneficial use would be the amount of

sorting/separating of materials required. This is a typical scenario when building dismantlement is conducted. Mixing of materials makes it less implementable and less cost effective since sorting of the materials becomes time and/or labor intensive. Additional parts of the process are loading and transporting the nonimpacted materials (e.g., steel, asphalt, concrete, glass) off site to appropriate recycling facilities, or staging on site for reuse.

In addition, accurate tracking of the materials slated for recycling is necessary for achieving maximum credit to the project. In the area of the Guterl Site, the following recycling facilities have been identified:

- Co-Steel Recycling (metals)
- Niagara Metals
- Swift River Associates (concrete and asphalt)
- Triad Recycling and Energy (asphalt, wood, metal, and glass)
- Metzger Removal (concrete and asphalt)

The implementability of recycling and beneficial use is rated as moderate to high (depending on the degree of mixing of materials).

Cost:
The cost for recycling and beneficial reuse of materials would be low, but also dependent on the degree of sorting of materials required along with sampling/analysis and transportation costs. The costs would be offset to some degree by recycling credit and/or on-site reuse of nonimpacted materials.

Evaluation Results:
Recycling and beneficial use of nonimpacted materials is highly effective and implementable. In addition, cost savings can be realized from both recycling and reuse of on-site materials. The USACE has performed similar work in New York and has identified qualified recycling facilities. **Recycling and beneficial use is retained for further consideration.**

3.9.6.2 GROUNDWATER DISPOSAL

When groundwater is treated *ex situ*, it would need to be either disposed of (discharged) off site or injected back into the aquifer. Typical disposal methods include reinjection, discharge to a POTW, or direct discharge to a surface water body. Injection was not retained in the initial screen due to the difficulty in controlling the hydraulics of the injected water in fractured bedrock. Another option for on-site disposal of groundwater is extraction and reinjection of the discharge water by the use of surface ponds located on top of bedrock to create a infiltration gallery and recirculation cell with a down-gradient extraction well or trench system.

3.9.6.2.1 Off-Site Disposal: Discharge to POTW or Surface Water Body

Any wastewater generated during other site remediation actions would be disposed of in a manner similar to groundwater. Both FUSRAP and non-FUSRAP contaminants will need to be evaluated to determine if pretreatment is necessary to meet discharge limits. *Ex situ* groundwater treatment systems such as reverse osmosis and ion exchange generate a concentrated liquid waste stream that would need to be treated via evaporation or solidification to yield a waste form suitable for disposal.

Effectiveness:
Discharge of treated groundwater to a POTW or surface water is effective when used in conjunction with *ex situ* treatment technologies. The effectiveness of treatment technologies is discussed in Section 3.8.5.2.1. The effectiveness of off-site groundwater disposal is rated as high.

Implementability:
Disposal would be easily implemented using established technologies and methods. These requirements would include discharge limits on contaminants and regular monitoring to meet the substantive permit requirements. The implementability of groundwater disposal via discharge to surface water or a POTW is rated as high.

Cost:
The capital costs for discharge of groundwater to surface water or a POTW are low to moderate depending on the complexity of the discharge stream approval processes. The associated costs for discharge to a POTW include the fee (estimated at \$500 to \$1,000), cost per 3,785 L (1,000 gallons) discharged (typically \$0.26 to \$0.53 per 1,000 L [\$1 to \$2 per 1,000 gallons]), and cost for routine sampling/analysis (i.e., sampling frequency of one per 378,500 L [100,000 gallons] discharged). These costs are independent of any necessary pretreatment.

The overall cost of discharge to a POTW or surface water body is rated as low to moderate.

Evaluation Results:
Disposal of treated groundwater to surface water or discharge to a POTW is retained for further consideration. This process is easy to implement and will require prior groundwater removal and treatment options.

3.9.6.2.2 On-Site Disposal: Injection-Recirculation via Surface Ponds

Surface ponds are an on-site water disposal process option that would be installed on top of fractured bedrock to reinject treated discharge water. Contaminated soil removal on site would leave areas of open excavations and exposed bedrock that could be converted to surface ponds rather than being backfilled. The surface pond would be coupled with groundwater extraction and treatment technologies to create an injection-recirculation cell.

Effectiveness:
The injection-recirculation cell using surface ponds may be difficult to create due to the location, spacing, and permeability of the bedrock fractures. The success of the surface ponds would depend on the rate of infiltration achievable compared to the volume of extracted groundwater and the control of injected water via fracture flow.

Surface ponds would have to be sized to accommodate the volume of extracted groundwater. The circulation cell would have to be monitored to determine if contaminated groundwater is being captured and not spread over a larger volume of the aquifer. The surface pond would have low to moderate impact (e.g., the construction and maintenance of an open water body) on human health and the environment. Surface ponds have been proven reliable under acceptable hydrogeologic conditions. An understanding of the fracture zone system would be necessary to document control and predicted flow of the injected water. The effectiveness of surface ponds is rated as low based on the complexity of building a surface pond in fractured bedrock.

Implementability:
Site conditions (e.g., surface location, infiltration rate) have to be considered during design along with the rate and volume of extracted groundwater to be handled by the pond. To implement this technology, a detailed understanding of the flow system is necessary, which is difficult in fractured bedrock present at the site. Implementability is rated as low.

Cost:
The cost of constructing a surface pond can be highly variable. On a per-acre basis, small ponds are generally more expensive than larger ponds. Small ponds can range from $25,000 to $50,000/ha ($10,000 to $20,000/ac) while larger ponds (4 ha [10 ac] or more) can range from $2,500 to $12,500/ha ($1,000 to $5,000/ac). The most critical single factor controlling the cost of constructing a pond is the amount of earthmoving necessary. If the surface ponds are constructed after or along with necessary soil remediation, then construction costs can possibly be reduced. The cost of surface ponds is rated as moderate to high, depending on the size of the basins necessary for the groundwater treatment system.

Evaluation Results:
The effectiveness of surface ponds is rated as low, the implementability of surface ponds is rated as low, and the cost of surface ponds is rated as moderate to high. **This process option will not be retained for further evaluation and screening.**

3.10 REPRESENTATIVE TECHNOLOGIES

Technology process options were screened based on three factors: (1) effectiveness, (2) implementability, and (3) cost. In the next step of this FS, the screened representative technologies and process options will be assembled into remedial alternatives for soil, buildings, and groundwater based on the previously-listed criteria. Alternatives will be developed from the following remedial technologies:

Soil Technologies
- LUCs
  - Administrative and Legal Controls (Zoning, Deed Restrictions)
  - Engineering Controls (Barriers, Signs, other Security Measures)
- Removal
  - Soil Excavation (Mechanical Earth Moving Equipment, Hand Tools, Radiological Soil Sorting)
- Treatment
  - *Ex Situ* Physical Treatment (Stabilization/Solidification)
- Disposal
  - Off-Site Disposal (Existing Licensed/Permitted Facility)
    - Recycling/Beneficial Use

Building Technologies

- LUCs
    - Administrative and Legal Controls (Zoning, Deed Restrictions)
    - Engineering Controls (Barriers, Signs, other Security Measures)
- Removal
    - Dismantlement (Mechanical Equipment, Hand Tools, Size Reduction, Sorting)
- Treatment
    - Physical or Mechanical (Vacuuming and Blasting)
- Disposal
    - Off-Site Disposal (Existing Licensed/Permitted Facility)
    - Recycling/Beneficial Use

Groundwater Technologies

- LUCs
    - Administrative and Legal Controls (Zoning, Deed Restrictions, Groundwater Use Restrictions)
    - Engineering Controls (Barriers, Signs, Other Security Measures)
- Containment
    - Vertical Barrier (Jet Grouting)
    - Hydraulic Containment
- Removal
    - Groundwater Removal via Extraction Wells (Vertical Wells, Horizontal Wells)
    - Groundwater Removal via Trenches (Rubblized Trenches)
- Treatment
    - *Ex situ* (Coagulation/Precipitation, Adsorption, Ion Exchange, Reverse Osmosis, Filtration/Ultra Filtration)
    - *In situ* (MNA)
- Disposal
    - Off-Site Disposal (POTW Discharge, Surface Water Discharge)

Remedial alternatives are formed by combining the treatment technologies/process options that passed both the initial screening (Section 3.8) and the second, more detailed screening (Section 3.9). Generally, one or more process options from each GRA are used to assemble the alternatives factoring in the effectiveness, implementability, and cost for each GRA.

Consistent with the U.S. EPA Region 2 Clean and Green policy and the Army's Green and Sustainable Remediation policy, USACE will evaluate the use of sustainable technologies and practices with respect to any remedial alternative selected for the site. Examples are:

- Use of renewable energy sources.
- Use of clean diesel fuel and technologies.
- Reduction of greenhouse gas emissions.
- Use of low carbon technologies.
- Conservation of natural resources.
- Recycling and reuse of clean materials, where possible.

- Incorporate sustainability into periodic reviews to identify opportunities to reduce energy and other impacts.

4.0 DEVELOPMENT OF REMEDIAL ALTERNATIVES

This section combines the remedial action technologies retained, from the evaluation of technology process options, in Section 3.9 to develop remedial action alternatives. Process options with the highest effectiveness and implementability ratings were retained. The media of concern at the site addressed by this FS are buildings, soil, and groundwater. Alternatives are first developed for each of these media independently. Media-specific alternatives for soil, buildings, and groundwater are identified by combining GRAs, technology types, and process options retained from the screening processes described in the previous section.

The following media-specific alternatives were identified for buildings at the site and are described in Section 4.1:

- Alternative B1—No Action.
- Alternative B2— Decontamination of Building 1; Dismantlement and Off-Site Disposal of Buildings 2, 3, 4/9, 5, 6, 8, and 24.
- Alternative B3—Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35.

The following media-specific alternatives were identified for soils at the site and are described in Section 4.2:

- Alternative S1—No Action
- Alternative S2—Complete Soil Removal to Soil PRG-CW and Off-Site Disposal.
- Alternative S3—Complete Soil Removal to Soil PRG-GW and Off-Site Disposal.

The following media-specific alternatives were identified for groundwater and seeps at the site and are described in Section 4.3:

- Alternative G1— No Action
- Alternative G2 and G3—Monitored Natural Attenuation with Environmental Monitoring after either the soil PRG-CW (G2) or soil PRG-GW (G3) are implemented
- Alternative G4—Groundwater Recovery using Vertical Extraction Wells and a Rubblized Trench with *Ex Situ* Treatment, with Environmental Monitoringafter the soil PRG-CW is implemented
- Alternative G5—Groundwater Recovery using Vertical Extraction Wells and a Rubblized Trench with *Ex Situ* Treatment, with Environmental Monitoring after the soil PRG-GW is implemented

These media specific alternatives are then combined to develop site-wide alternatives that address the three media and are provided in Section 4.4. Emphasis was placed on developing site-wide 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 contaminants. The development of remedial action alternatives for the site focused on those alternatives that achieve the remedial action objectives presented in Section 3.4.

4.1 BUILDING ALTERNATIVES

The following alternatives were identified for buildings at the site:

- Alternative B1—No Action
- Alternative B2—Decontamination of Building 1; Dismantlement and Off-Site Disposal of Buildings 2, 3, 4/9, 5, 6, 8, and 24
- Alternative B3—Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35

Each of these alternatives contains the retained process options as shown in Table 4-1.

4.1.1 ALTERNATIVE B1—NO ACTION

Alternative B1 leaves the buildings "as is" with no actions taken regarding access or LUCs beyond those already in place for other reasons. This alternative provides no additional protection to human health and the environment over current conditions. This alternative also assumes that existing controls and monitoring would not be maintained. The no-action alternative is required under the NCP as a baseline against which other alternatives can be compared.

Under this alternative, impacted buildings would remain. No building dismantlement, or decontamination would occur. Existing engineering controls (e.g., site security fence) would be left in place, but not maintained. Environmental monitoring would not be performed. In addition, no restrictions on land use would be pursued. However, the portions of the buildings outside of the Excised Area are assumed to operate in compliance with existing regulations that impose limitations on occupational exposures, and the existing landowners would be responsible for this compliance.

4.1.2 ALTERNATIVE B2—DECONTAMINATION OF BUILDING 1; DISMANTLEMENT AND OFF-SITE DISPOSAL OF BUILDINGS 2, 3, 4/9, 5, 6, 8, AND 24

Alternative B2 will be implemented in conjunction with soil PRG-CW. This alternative addresses contaminated soil above the PRG-CW levels that are underlying the buildings. Pairing the PRG-CW with buildings results in the following Alternative B2 parameters. Alternative B2 consists of:

- Decontamination of the portions of Building 1 above the DCGLs (approximately 4% of the samples exceeded DCGLs and the building has been determined to pose a potential risk). The underlying soils are not impacted above the soil PRG-CW.
- Dismantlement of impacted Buildings 2, 3, 4/9, 5, 6, and 8 (these buildings overlie soils impacted above the soil PRG-CW).

- The location and estimated depth of the PRG-CW impacted soil underlying Building 24, would compromise the structural integrity of the building, therefore Building 24 will need to be dismantled to access soils. The dismantlement of Building 24 and the remediation of underlying soils is intended to be conducted at the time of the site-wide remedial action with property owner consent to dismantle the building. If Building 24 is not available for dismantlement at the time of the site-wide remedial action, the inaccessible contamination and Building 24 will remain until it becomes available under a change of site conditions.
- Dismantlement of Building 5 (although this building was not impacted above the DCGLs and no soil samples were collected beneath Building 5, it is assumed that uranium concentrations in soil beneath this building exceed the soil PRG-CW based on the results of samples collected on each of the four sides of the building).
- Building 35 materials, surfaces and underlyings are not impacted above the PRG-CW and therefore is not addressed under this alternative.

The building locations are provided on Figure 4-1. The site-specific DCGLs developed for the buildings are presented on Table 3-2a.

Rationale for the selection of buildings addressed under this alternative was provided in Section 3.6.3. The contents in the impacted buildings would be screened, decontaminated (if feasible), and, if necessary, removed and disposed of. Table 3-3 presents a summary of the building construction materials, surface areas, and volumes. Table 3-4 presents a summary of the building surface locations exceeding building DCGLs.

This alternative would require close coordination of remediation and monitoring activities with ATI Specialty Materials to minimize health and safety risks to on-site personnel and to minimize the disruption to their activities consistent with a safe and effective remediation.

Components of this alternative include:

- Project plans.
- Limited building structure and content decontamination of Building 1.
- Building dismantlement.
- Sorting.
- Transportation.
- Off-site disposal/recycling.
- Confirmatory sampling.

These components are described in the following sections.

4.1.2.1 PROJECT PLANS

Project plans would be developed prior to the initiation of remedial actions. These plans would detail site preparation activities, remediation sequence, structure and contents decontamination procedures, building dismantlement extent and methods, waste sorting procedures, generated materials transportation and disposal, and confirmatory sampling procedures for buildings remaining at the site after remediation.

The safety of remediation workers, on-site employees, and the general public would be addressed in a site-specific health and safety plan. The health and safety plan would address potential exposures and monitoring requirements to ensure protection.

4.1.2.2 LIMITED BUILDING STRUCTURE AND CONTENTS DECONTAMINATION

Limited decontamination may include the following:

- Grinding and/or scabbling to remove fixed contamination on concrete, stone, or brick surfaces.
- Blasting to remove fixed contamination on metal surfaces.
- HEPA vacuuming to clean removable contamination in the interior of each building and on building contents before dismantlement or removal.

For the partial decontamination of Building 1, the floor of the building may need to be reinforced to support the remediation worker. Currently, the main floor is constructed of thin gauge steel over trusses; in some places plywood has been used to bridge weak areas of the floor. Building 1 contains a flooded, lower level/basement; the basement walls extend several feet above grade, thus creating an elevated main floor to the building. Additional testing will be necessary because it is not known if the basement construction materials are impacted. If water is found in the basement of Building 1, the liquid would be pumped out of the area and properly disposed of.

Grinding, scabbling, and blasting would be used where possible to reduce the volume of material requiring off-site disposal and/or increase the volume of material that may be recycled. HEPA vacuuming may be used in conjunction with the physical methods and as a separate method; when used as a separate method, any fixed contamination on surfaces would remain after vacuuming. The HEPA filters and debris would be radiologically surveyed, and all materials (filters, debris, and dust) would be sampled for radiological and RCRA constituents before disposal.

After decontamination, building contents would be radiologically surveyed and removed (if necessary) from the buildings. Removed equipment and materials that exceed project radiological release criteria after decontamination operations would be characterized for RCRA constituents prior to disposal as waste. All other removed materials would also be characterized for RCRA constituents to evaluate disposal options.

4.1.2.3 BUILDING DISMANTLEMENT

Alternative B2 includes the dismantlement of Buildings 2, 3, 4/9, 5, 6, 8, and 24. Dismantlement of buildings would remove the potential exposures to radiological contamination from building materials and would allow access for remediation of the contaminated soil beneath the buildings. Several of the buildings are in poor condition and removal would also ensure worker safety during other remedial activities. Since Building 8 and Building 24 share a common wall, shoring may be necessary to protect structural integrity of Building 24 (if it is not authorized for dismantlement at the time of remedial action) during the removal of Building 8.

Building 24 is an actively used building by the property owner (ATI Specialty Materials). Unlike buildings located in the excised area, continual maintenance is performed on Building 24. After evaluating the results of the RI for Building 24, USACE has concluded there is no evidence of a release from Building 24, as defined by CERCLA, nor evidence of a substantial threat of a release of hazardous substances into the environment from the building. CERCLA (40 CFR 300.5) defines the term "release" to mean *"any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment"*, and specifically excludes *"... any release which results in exposure to persons solely within a workplace, ..."*. Dismantlement of Building 24 is necessary to access contaminated soil above the soil PRG-CW that is underneath the building. The dismantlement of Building 24 and the remediation of underlying soils is intended to be conducted at the time of the site-wide remedial action with property owner permission to dismantle the building. If Building 24 is not available for dismantlement at the time of the site-wide remedial action, the inaccessible contamination and Building 24 will remain on site until it becomes available under a change of site conditions. Dismantlement of Building 24 will be deferred until a later date when the building is no longer actively used. Abandonment of the building will allow for dismantlement and therefore, access to underlying contaminated soil.

Prior to dismantlement of the buildings, the contents may be removed and staged. Staging areas would be properly contained, and warning signs posted to inform the workers at ATI Specialty Materials. The procedures in the Multi-Agency Radiation Survey and Assessment of Materials and Equipment (MARSAME) manual or a similar approach would be used to screen and sort the contents before disposal or recycling.

Mechanical equipment such as excavators or loaders would be used to dismantle the buildings, including the slab/foundation. This approach would require standard dismantlement practices with dust suppression to contain any potential airborne radioactivity. Water would need to be collected from dust suppression activities, managed, and either treated on site and discharged, or disposed of at an off-site disposal facility permitted to accept the waste stream. Control materials, such as silt fences and straw bales, would be installed to contain material. Impacted materials would be covered with tarps to minimize dust generation. Existing pavement areas would be utilized, as long as practical, during dismantlement activities to minimize transportation of material and dust generation. Access/haul roads may need to be constructed to provide access to buildings and areas. Dismantlement areas would be maintained as potentially contaminated until radiological release surveys could be performed. In general, the main dismantlement activities would include:

- Establishing site controls and work zones.
- General cleaning and/or decontamination of remaining equipment and building surfaces to prepare for recycling or disposal.
- Characterizing building structure and surfaces for waste disposal (e.g., evaluate if PCBs are present in building paint).
- Disassembling (as necessary) and removing equipment and systems.
- Removing lamp and ballast (potential PCB or mercury-containing items).
- Final inspection of buildings to confirm removal of hazardous items and materials.
- Removing utilities.

- Removing PACM from piping.
- Performing building dismantlement and materials processing.
- Segregating debris by waste type (e.g., licensable source material, licensable source material with PCBs, asbestos, hazardous, nonhazardous, unimportant quantities of source material [UIQSM], unconditional released).
- Keeping the floor slabs in place until any soil remediation program is implemented.

Potential asbestos containing material was identified at Buildings 1, 2, 3, 4/9, 6, and 8. The PACM would be removed and disposed of as part of the dismantlement activities. Section 2.4.2 presents the approximate quantity of PACM.

4.1.2.4 SORTING

Building materials, contents, or debris would be segregated to reduce the amount of waste requiring disposal at an off-site disposal facility. Segregating the materials will provide increased disposal options and cost savings. It is assumed that 35% of the building surfaces are impacted above DCGLs; therefore, at least 65% of the building materials may be diverted to facilities other than permitted radiological waste disposal facilities, and uncontaminated materials would be cleared for free release for salvage or nonradiological disposal (with NYSDEC concurrence).

Bulk building debris may be segregated using survey procedures such as those in the MARSAME manual. The inclusion of this component would further support waste minimization associated with the potential reuse or off-site disposal of radiologically impacted materials.

4.1.2.5 TRANSPORTATION

Building materials, contents, or debris requiring off-site disposal would be hauled to a licensed or permitted disposal facility by railcar (via trucking to a rail-loading facility) or direct trucking to the disposal facility. The appropriate shipping paper(s) would accompany the waste shipment. Regulated and licensed transportation would travel along predesignated routes, and an emergency response plan would be developed.

Building materials, contents, or debris that may be recycled would be hauled to a permitted facility by direct trucking. Shipping paper(s) would accompany the shipment.

4.1.2.6 OFF-SITE DISPOSAL/RECYCLING

Impacted building materials, contents, or debris would be disposed of 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. Building materials and debris may require size reduction, if specified in the disposal facility waste acceptance criteria (WAC). This can be achieved using the dismantlement equipment (e.g., crushing with an excavator bucket). Some materials, such as pipes, would be cut to conform to this requirement. Debris that does not meet this size criterion would be categorized as oversized debris. Materials with levels below DCGLs may be recycled (with NYSDEC concurrence). Equipment within or outside the buildings not contaminated with FUSRAP-related materials will not be disposed of under this FUSRAP action. As such, the USACE would coordinate transfer of these materials to the property owner for secure storage.

Based on the information in the RI, the following waste streams are anticipated to be encountered:

- Radiological Waste—This includes areas where radioactive concentrations exceed the DCGLs and decontamination would not be effective. These wastes may be disposed of either at a licensed source material facility or at a RCRA Subtitle C facility (and would be considered LARW [UIQSM]). Solid wastes with radiological concentrations that are not exempt as defined in 10 CFR 40.14(a) require disposal in a licensed source material facility.
- PCB Waste/New York Hazardous Waste—This includes materials that contain PCBs, such as transformers, light ballasts, and painted materials. In New York State, wastes containing greater than 50 ppm by weight or greater of PCBs are considered to be New York hazardous wastes. PCB wastes may be either nonradiologically impacted or radiological wastes. (For the purpose of this FS, it is assumed that approximately 25% of the building surfaces are PCB wastes.)
- PACM—This includes the materials presented in Section 2.4.2; depending on the building, they may be either nonradiologically impacted or radiological wastes. (For the purpose of this FS, it is assumed that approximately 100% of the PACM wastes are radiologically impacted wastes.)
- RCRA Waste—This includes universal wastes such as mercury-containing switches and mercury-containing vacuum tubes. A distinction will be made between UIQSM that are eligible to be shipped to a Subtitle-C facility and wastes that may need to be managed under RCRA for their hazardous constituents.
- Nonregulated materials—This includes materials that are not impacted and not considered hazardous under federal or New York State regulation. This type of waste includes materials such as paper, cardboard, metal/steel, poured concrete, and clean C&D debris. These materials may remain on site (e.g., large equipment in nonimpacted buildings), be recycled (e.g., concrete and metal/steel), or be disposed of in a C&D debris landfill. (For the purpose of this FS, it is assumed that approximately 50% of the nonradiologically impacted materials may be recycled and 25% of the nonradiologically impacted materials may be disposed of in a C&D debris landfill; the remaining 25% of nonradiologically impacted materials are assumed to be PCB wastes.)

Table 4-2 presents estimated quantities of these waste streams for each of the buildings.

4.1.2.7 CONFIRMATORY SAMPLING

Radiological surveys, using a statistical approach such as that presented in MARSSIM, would be performed in the remediated buildings remaining at the site (Building 1). Release surveys may be conducted for building materials that are identified for reuse, recycling, or disposal in Subtitle D landfills; these surveys would be evaluated using methods such as those in the MARSAME manual.

4.1.2.8 ASSEMBLED ALTERNATIVE

The components of Alternative B2 that are carried through for evaluation and costing in this FS include the following:

- Preparation of project plans.
- Decontamination of the portions of Building 1 that exceed the DCGL.
- Preparation of a staging area and access roads.
- Dismantlement of Buildings 2, 3, 4/9, 5, 6, 8, and 24.
- Screening and sorting of building contents and materials.
- Transport of materials to an appropriate disposal facility.
- Disposal of building materials, contents, and debris at an appropriate facility.
- Performance of confirmatory sampling using MARSSIM or similar guidance to demonstrate cleanup levels are met for remediated buildings remaining on site (i.e., Building 1).

These components will be considered while assembling the site-wide alternatives, for the evaluation against the CERCLA criteria in Section 5.0, and comparison of alternatives in Section 6.0.

4.1.3 ALTERNATIVE B3—DISMANTLEMENT AND OFF-SITE DISPOSAL OF BUILDINGS 1, 2, 3, 4/9, 5, 6, 8, 24, AND 35

Alternative B3 will be implemented in conjunction with soil PRG-GW. This alternative addresses contaminated soil above the PRG-GW levels that are underlying the buildings. Pairing the PRG-GW with buildings results in the following Alternative B3 parameters. Alternative B3 consists of:

- Dismantlement of impacted Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35 (these buildings overlie soils impacted above the soil PRG-GW).
- Contaminated soils above the PRG-GW underneath Building 1 affects the timeframe in which the remedial action achieves the MCL in groundwater. The dismantlement of Building 1 is necessary to remove the contaminated soils beneath the building above the PRG-GW.
- The dismantlement of Building 24 and the remediation of underlying soils is intended to be conducted at the time of the site-wide remedial action with property owner permission to dismantle the building. If Building 24 is not available or authorized for dismantlement at the time of the site-wide remedial action, the inaccessible contamination and Building 24 will remain until it becomes available under a change of site conditions.
- Dismantlement of Building 5 (although this building was not impacted above the DCGLs and no soil samples were collected beneath Building 5, it is assumed that uranium concentrations in soil beneath this building exceed soil PRG-GW based on the results of samples collected on each of the four sides of the building).

The building locations are provided on Figure 4-2. The site-specific DCGLs developed for the buildings are presented on Table 3-2a.

Additional rationale for the selection of buildings addressed under this alternative is provided in Section 3.6.3. The contents in the impacted buildings would be screened, decontaminated (if feasible), removed, recycled or disposed. Table 3-3 presents a summary of the building construction materials, surface areas, and volumes. Table 3-4 presents a summary of the building locations exceeding building DCGLs.

This alternative would require close coordination of remediation and monitoring activities with ATI Specialty Materials to minimize health and safety risks to on-site personnel and to minimize the disruption to its activities consistent with a safe and effective remediation.

Components of this alternative include:

- Project plans.
- Building dismantlement.
- Sorting.
- Transportation.
- Off-site disposal/recycling.
- Confirmatory sampling.

These components are described in the following sections.

4.1.3.1 PROJECT PLANS

Project plans for Alternative B3 are consistent with Alternative B2; see Section 4.1.2.1 for details.

4.1.3.2 LIMITED BUILDING STRUCTURE AND CONTENTS DECONTAMINATION

Limited decontamination including grinding, scabbling, blasting and HEPA vacuuming may be used where possible to reduce the volume of material requiring off-site disposal and/or increase the volume of material that may be recycled. The HEPA filters and debris would be radiologically surveyed, and all materials (filters, debris, and dust) would be sampled for radiological and RCRA constituents before disposal.

After limited decontamination, building contents would be radiologically surveyed and removed (if necessary) from the buildings. Removed equipment and materials that exceed project radiological release criteria after decontamination operations would be characterized for RCRA constituents prior to disposal as waste. All other removed materials would also be characterized for RCRA constituents to evaluate disposal options.

4.1.3.3 BUILDING DISMANTLEMENT

Alternative B3 includes dismantling Buildings 1, 2, 3, 4/9, 5, 6, 8, and 35. Dismantling would remove the potential exposures to radiological contamination from building materials and would allow access for remediation of the contaminated soil beneath the buildings. Several of the buildings are in poor condition and removal would also ensure worker safety during other remedial activities. Since Building 8 and Building 24 share a common wall, shoring may be necessary to protect structural integrity of Building 24 (if it is not authorized for dismantlement at the time of remedial action) during the removal of Building 8.

Building 24 is an actively used building by the property owner (ATI Specialty Materials). Unlike buildings located in the excised area, continual maintenance is performed on Building 24. After evaluating the results of the RI for Building 24, USACE has concluded there is no evidence of a release from Building 24, as defined by CERCLA, nor evidence of a substantial threat of a release of hazardous substances into the environment from the building. CERCLA (40 CFR 300.5) defines the term "release" to mean *"any spilling, leaking, pumping, pouring, emitting, emptying, discharging, injecting, escaping, leaching, dumping, or disposing into the environment"*, and specifically excludes *"... any release which results in exposure to persons solely within a workplace, ..."*. Dismantlement of Building 24 is necessary to access underlying contaminated soil above the soil PRG-GW. The dismantlement of Building 24 and the remediation of underlying soils is intended to be conducted at the time of the site-wide remedial action with property owner permission to dismantle the building. If Building 24 is not available for dismantlement at the time of the site-wide remedial action, the inaccessible contamination and Building 24 will remain until it becomes available under a change of site conditions. Dismantlement of Building 24 will be deferred until a later date when the building is no longer actively used. Abandonment of the building will allow for dismantlement and therefore, access to underlying contaminated soil.

Before dismantling the buildings, the contents may be removed and staged. Staging areas would be properly contained, and warning signs posted to inform the workers at ATI Specialty Materials. The procedures in the MARSAME manual or a similar approach would be used to screen and sort the contents before disposal or recycling. If water is found in the basement of Building 1, the liquids would be pumped out of the area and properly disposed of.

Mechanical equipment such as excavators or loaders would be used to dismantle the buildings, including the slab/foundation. This approach would require standard dismantlement practices with dust suppression to contain any potential airborne radioactivity. Water would need to be collected from dust suppression activities, managed, and either treated on site and discharged, or disposed of at an off-site disposal facility permitted to accept the waste stream. Control materials, such as silt fences and straw bales, would be installed to contain material. Impacted materials would be covered with tarps to minimize dust generation. Existing pavement areas would be utilized, as long as practical, during dismantlement activities to minimize transportation of material and dust generation. Access/haul roads may need to be constructed to provide access to buildings and areas. Dismantlement areas would be maintained as potentially contaminated until radiological release surveys could be performed. In general, the main dismantlement activities would include:

- Establishing site controls and work zones.
- General cleaning and/or decontamination of remaining equipment and building surfaces to prepare for recycling or disposal.
- Characterizing building structure and surfaces for waste disposal (e.g., evaluate if PCBs are present in building paint).
- Disassembling (as necessary) and removing equipment and systems.

- Removing lamp and ballast (potential PCB or mercury-containing items).
- Final inspection of buildings to confirm removal of hazardous items and materials.
- Removing utilities.
- Removing PACM from piping.
- Performing building dismantlement and materials processing.
- Segregating debris by waste type (e.g., licensable source material licensable source material with PCBs, asbestos, hazardous, nonhazardous, UIQSM, unconditional released).
- Keeping the floor slabs in place until any soil remediation program is implemented.

Potential asbestos containing material was identified at Buildings 1, 2, 3, 4/9, 6, and 8. The PACM would be removed and disposed of as part of the dismantlement activities. Section 2.4.2 also presents the approximate quantity of PACM.

4.1.3.4 SORTING

Sorting in Alternative B3 is consistent with Alternative B2; see Section 4.1.2.4.

4.1.3.5 TRANSPORTATION

Transportation in Alternative B3 is consistent with Alternative B2; see Section 4.1.2.5.

4.1.3.6 OFF-SITE DISPOSAL/RECYCLING

Off-site disposal/recycling for Alternative B3 is consistent with Alternative B2; see Section 4.1.2.6.

4.1.3.7 CONFIRMATORY SAMPLING

Confirmatory sampling methods for Alternative B3 are consistent with Alternative B2; see Section 4.1.2.7.

4.1.3.8 ASSEMBLED ALTERNATIVE

The components of Alternative B3 that are carried through for evaluation and costing in this FS include the following:

- Preparation of project plans.
- Preparation of a staging area and access roads.
- Dismantlement of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35
- Screening and sorting of building contents and materials.
- Transport of materials to an appropriate disposal facility.
- Disposal of building materials, contents, and debris at an appropriate facility.
- Performance of confirmatory sampling using MARSSIM or similar guidance to demonstrate cleanup levels are met for buildings remaining on site.

These components will be considered while assembling the site-wide alternatives, and for the evaluation against the CERCLA criteria in Section 5.0 and comparison of alternatives in Section 6.0.

4.2 SOIL ALTERNATIVES

Each of these alternatives contains the retained process options as shown in Table 4-3. The following alternatives were identified for soils at the site:

- Alternative S1—No Action
- Alternative S2—Complete Removal to the Soil PRG-CW and Off-Site Disposal
- Alternative S3—Complete Removal to the Soil PRG-GW and Off-Site Disposal

4.2.1 ALTERNATIVE S1 — NO ACTION

Soil Alternative S1 leaves the site "as is" with no actions taken regarding access or LUCs beyond those already in place for other reasons. This alternative provides no additional protection to human health and the environment over current conditions. This alternative also assumes that existing controls and monitoring would not be maintained. The no-action alternative is required under the NCP as a baseline against which other alternatives can be compared.

Under this alternative, impacted soil would remain at the current locations. Existing engineering controls (e.g., site security fence) would be left in place but not maintained. Environmental monitoring would not be performed. In addition, no restrictions on land use would be pursued.

4.2.2 ALTERNATIVE S2 — COMPLETE SOIL REMOVAL TO SOIL PRG-CW AND OFF-SITE DISPOSAL

Soil Alternative S2 consists of excavation of impacted soils exceeding the Soil PRG-CW and subsequent off-site disposal. The area for soil removal is shown on Figure 4-3. The health and safety of workers and conditions of occupied buildings and active property are the responsibility of the employer and property owner. The safety of remediation workers, on-site employees, and the general public would be addressed in a site-specific health and safety plan, in coordination with the on-site property owner, which addresses potential exposures and monitoring requirements to ensure protection during remedial action.

Dismantlement of Building 24 is necessary to access contaminated soil above the Soil PRG-CW. Building 24 is currently utilized by the property owner. The dismantlement of Building 24 and the remediation of underlying soils is intended to occur at the time of the site-wide remedial action with property owner permission to dismantle the building. If Building 24 is not available or authorized for dismantlement at the time of the site-wide remedial action, the inaccessible contamination beneath the building and Building 24 will remain while the other buildings and contaminated soil removal occurs. Since the contamination is located underneath a building actively used by the property owner, soil with FUSRAP-related contamination underneath Building 24 has been determined to be inaccessible, according to USACE Engineering Regulation, ER 200-1-4.

Inaccessible contamination is defined as "FUSRAP eligible contaminants, as defined by paragraph 6.b.(2)(b) of this regulation, that have been determined by USACE in coordination with the support agency and land owner, to be inaccessible because the contamination is located under an active road, bridge, building, rail line, utility line, permanent structure or other physical obstruction that prevents taking a response action at the present time." If Building 24 is not authorized by the property owner for dismantlement at the time of remedial action, dismantlement of Building 24 will be deferred until a later date when the building is no longer actively used.

Table 4-4 presents the estimated volume of impacted soil; the *in situ* volume of soil is based on the area shown on Figure 4-3 (the procedures used to develop the volume of impacted soil are summarized in Section 3.6.1 and detailed in Appendix I). The *ex situ* volume, shown in Table 4-4, will be used for cost estimating purposes, and is calculated by applying a 30% swelling factor to the *in situ* soil volume removed. Components of this alternative include the following:

- Project plans
- Soil removal
- Transportation
- Off-site disposal
- Confirmatory sampling
- Site restoration

These components are described in the following sections.

4.2.2.1 PROJECT PLANS

Project plans would be developed prior to the initiation of remedial actions. These plans would detail site preparation activities, remediation sequence, floor removal activities, soil excavation activities, transportation and off-site disposal of contaminated soil, confirmatory sampling, and site restoration. In addition, excavations greater than 1.5 m (5 ft) bgs would require benching, or sloping, to ensure worker safety in accordance with USACE safety guidance. These deeper excavations would be limited, because bedrock is generally present 0.9 to 1.5 m (3 to 5 ft) bgs in most impacted areas.

The safety of remediation workers, on-site employees, and the general public would be addressed in a site-specific health and safety plan. The health and safety plan would address potential exposures and monitoring requirements to ensure protection.

4.2.2.2 SOIL REMOVAL

Impacted soils above the soil PRG-CW (Figure 4-3) would be excavated and disposed of at a permitted off-site disposal facility. The total disposal volume (i.e., *ex situ*) is estimated at 5,000 m^3 (6,500 yd^3). Standard construction equipment such as excavators, bulldozers, and front-end loaders would be used to remove contaminated material. Site preparation may include removal of the existing fence, if the fence is located within areas to be excavated. The fence materials would be handled in a similar manner as the building materials. Any removed fencing would be replaced as part of site restoration.

Soil may require staging in order to sample the material for the disposal facility WAC prior to shipment. Staging areas would be properly contained, and warning signs posted to inform the workers at ATI Specialty Materials.

Erosion control materials, such as silt fences and straw bales, would be installed to minimize erosion. Impacted soils would be kept moist or covered with tarps to minimize dust generation. Existing pavement areas would be utilized, as long as practical, during excavation activities to minimize erosion and dust generation. Access/haul roads may need to be constructed to provide access to removal areas.

Excavation activities would be guided by various methods to detect radionuclides including handheld radiation meters, *in situ* gamma spectroscopy, and field and off-site laboratory analytical samples that will meet statistical significance criteria for release under CERCLA. Site preparation would be required prior to the excavation activities, including identification of existing utilities. If underground utilities are encountered, a determination would be made as to whether the utility is active and needed, before proceeding with excavation. If a utility line is needed, an evaluation would be made to determine the potential methods for supporting the line and removing contaminated soil from around the utility (e.g., hand digging), and then the utility would be surveyed and decontaminated to meet release criteria. If a utility is not active or needed, the utility would be removed and managed as waste debris. Oversized debris would be crushed or otherwise processed to meet disposal facility requirements. To avoid recontamination by groundwater or surface water, excavation would be conducted from north-to-south following groundwater flow direction across the site so that any precipitation infiltration and groundwater flow would travel from excavated areas towards unexcavated areas.

Excavation activities may induce infiltration of groundwater into the excavations. This water would need to be collected and analyzed for potential sanitary discharge (if permitted by the POTW) and, if contaminated, treated on site or sent off site for disposal at a licensed facility permitted to accept the waste stream. Provisions would be made to cover and protect the excavation areas until confirmatory sampling has been conducted and the areas have been released.

4.2.2.3 TRANSPORTATION

Impacted soils would be hauled to a licensed or permitted disposal facility by railcar (after trucking to a rail-loading facility) or direct trucking to the disposal facility. The appropriate shipping paper(s) would accompany the waste shipment. Regulated and licensed transportation would travel along predesignated routes, and an emergency response plan would be developed.

4.2.2.4 OFF-SITE DISPOSAL/RECYCLING

Impacted soils would be disposed of 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. Section 4.1.2.6 presents an overview of RCRA Subtitle C, UIQSM (LARW), and licensable source material considerations. Based on the data in the RI report, the Guterl Site soils appear to meet the UIQSM and Subtitle C requirements.

4.2.2.5 CONFIRMATORY SAMPLING

Confirmatory sampling would be conducted after the excavation of each area. This sampling would confirm the cleanup criteria have been achieved. Final status surveys, using the MARSSIM statistical sampling guidance, will be used to document that the soil PRG-CW has been met. Soil samples would be collected from the surface of the excavation and surface of unexcavated soils that would remain at the site after remediation. The isotope ^{238}U will be used as a surrogate for the total uranium soil PRG-CW because it can be more easily and directly measured in the field during remediation efforts; the ^{238}U soil PRG-CW is about half of the total uranium soil PRG-CW (by activity) for natural uranium.

4.2.2.6 SITE RESTORATION

After confirmatory sampling has demonstrated that the soil PRG-CW values have been met, the excavation would be backfilled with clean dolostone gravel and the surface restored (seeded) in accordance with the approved project plans. Prior to placement, the backfill would be tested to ensure the design criteria are met. Confirmatory sampling and site restoration would progress area by area to prevent the occurrence of a large volume of disturbed soils and to minimize erosion, dust generation, and excavation water infiltration. Any fencing that was removed during the removal process would be replaced, if needed.

4.2.2.7 FIVE-YEAR REVIEWS

This alternative, which uses the PRG-CW, may result in uranium and thorium remaining in soil above levels that allow for UU/UE. CERCLA requires that the site be reviewed at least once every five years to ensure the protectiveness of the remedy. The five-year review would review the land use to ensure that assumptions regarding the potential future land use of industrial and critical group as a construction worker are still valid to ensure the protectiveness of the remedy.

4.2.2.8 ASSEMBLED ALTERNATIVE

The components of Soil Alternative S2 that are carried through for evaluation and costing in this FS include:

- Preparation of project plans.
- Preparation of a staging area and access roads.
- Removal of soil impacted above the soil PRG-CW developed for protection of the construction worker, approximately 3,800 m^3 (5,000 yd^3) *in situ* volume or approximately 5,000 m^3 (6,500 yd^3) *ex situ* volume assuming a 30% bulking factor.
- Transport of soil to an appropriate disposal facility.
- Sampling and analysis of soils for WAC and disposal of soil at an appropriate facility; assume for costing purposes of this FS that the soil will be disposed of at the US Ecology Inc. Idaho facility as LARW.
- Performance of confirmatory sampling, using the MARSSIM statistical sampling guidance will be used to document that addressing the soil PRG-CW has been met. Soil samples would be collected from the surface of the excavation and surface soils in unexcavated soils that would remain at the site after remediation.
- Performance of site restoration including placement and grading of clean fill, and replacement of any fences removed and needed to secure the site in the future.

These components will be considered while assembling the site-wide alternatives, and for the evaluation of this alternative against the CERCLA criteria in Section 5.0 and comparison of alternatives in Section 6.0.

4.2.3 ALTERNATIVE S3 — COMPLETE SOIL REMOVAL TO SOIL PRG-GW AND OFF-SITE DISPOSAL

Soil Alternative S3 consists of excavation of impacted soils exceeding the soil PRG-GW and subsequent off-site disposal. The area for soil removal is shown on Figure 4-4. The health and safety of workers and conditions of occupied buildings and active property are the responsibility of the employer and property owner. The safety of remediation workers, on-site employees, and the general public would be addressed in a site-specific health and safety plan, in coordination with the on-site property owner, which addresses potential exposures and monitoring requirements to ensure protection during remedial action.

Dismantlement of Building 24 is necessary to access contaminated soil above the Soil PRG-GW. Building 24 is currently utilized by the property owner. The dismantlement of Building 24 and the remediation of underlying soils is intended to occur at the time of the site-wide remedial action with property owner permission to dismantle the building. If Building 24 is not available or authorized for dismantlement at the time of the site-wide remedial action, the inaccessible contamination beneath the building and Building 24 will remain as the remaining buildings are dismantled and the contaminated soil is removed. Since the contamination is located underneath a building actively used by the property owner, soil with FUSRAP-related contamination underneath Building 24 has been determined to be inaccessible, according to USACE Engineering Regulation, ER 200-1-4.

Inaccessible contamination is defined as "FUSRAP eligible contaminants, as defined by paragraph 6.b.(2)(b) of this regulation, that have been determined by USACE in coordination with the support agency and land owner, to be inaccessible because the contamination is located under an active road, bridge, building, rail line, utility line, permanent structure or other physical obstruction that prevents taking a response action at the present time." If Building 24 is not authorized by the property owner for dismantlement at the time of remedial action, dismantlement of Building 24 and the removal of contaminated soils beneath will be deferred until a later date when the building is no longer actively used.

The soils under Building 24 are approximately 451 bank cubic meters (590 bank cubic yards), which is about 1% of the total 44,000 m^3 (58,000 yd^3) (*in situ*) to be removed for the PRG-GW. This small-scale source for uranium in groundwater will sit dormant unless aerially exposed due to building removal where the roof, walls and floor slab are removed to recharge groundwater (i.e., the building exterior is an inhibitor and prevents further infiltration into the soils).

A groundwater simulation was examined to reflect unimpeded leaching from uranium impacts only below Building 24, which assumes the balance of the site is remediated to PRG-GW. Once this residual soil was exposed to recharge (infiltration into groundwater) and generated a small-scale uranium plume, the groundwater modeling indicated the contamination is attenuated (diluted) to below the 30 μg/L MCL in the aquifer immediately downgradient of the soil-based inputs. More specifically, the plume is attenuated to below 10 µg/L within the excised area boundary due to the small footprint of soil impacts under Building 24, the associated concentrations relative to the balance of site (low), and the dilution capability of the aquifer (four-fold dilution and dispersion of leachate).

This below-MCL plume is predicted to persist approximately 150 years after the balance of site is remediated to PRG-GW. Since the groundwater concentration does not exceed the MCL (the RAO for groundwater) and contributes minor inputs to the groundwater system, the residual plume will not affect the timeframe or performance of the preferred remedy (i.e., concentration would not exceed the MCL during remedial timeframes and in the long term after remedy completion). If Building 24 and soil were removed at the same time, the plume impact would not adjust the groundwater remediation timeframe indicated in the alternatives and modeling. The eventual removal of inaccessible soils below Building 24 will ensure remedial consistency (site cleaned up to a uniform standard) and minimize the risk to the beneficial use of groundwater should the prediction underestimate the residual plume.

Table 4-4 presents the estimated volume of contaminated material; the *in situ* volume of soil above the soil PRG-GW is based on the area shown on Figure 4-4 (the procedures used to develop the volume of impacted soil are summarized in Section 3.6.1 and detailed in Appendix I). The *ex situ* volume which is shown in Table 4-4 and which will be used for cost estimating purposes, is calculated by applying a 30% swelling factor to the *in situ* soil volume removed. Components of this alternative include the following:

- Project plans
- Soil removal
- Transportation
- Off-site disposal
- Confirmatory sampling
- Site restoration

These components are described in the following sections.

4.2.3.1 PROJECT PLANS

Project plans would be developed prior to the initiation of remedial actions. These plans would detail site preparation activities, remediation sequence, floor removal activities, soil excavation activities, transportation and off-site disposal of contaminated soil, confirmatory sampling, and site restoration. In addition, excavations greater than 1.5 m (5 ft) bgs would require benching, or sloping, to ensure worker safety in accordance with USACE safety guidance. These deeper excavations would be limited, because bedrock is generally present 0.9 to 1.5 m (3 to 5 ft) bgs in most impacted areas.

The safety of remediation workers, on-site employees, and the general public would be addressed in a site-specific health and safety plan. The health and safety plan would address potential exposures and monitoring requirements to ensure protection.

4.2.3.2 SOIL REMOVAL

Impacted soils above the soil PRG-GW (Figure 4-4) would be excavated and disposed of at a permitted off-site disposal facility. The total disposal volume (i.e., *ex situ*) is estimated at 57,200 m^3 (75,400 yd^3). Standard construction equipment such as excavators, bulldozers, and front-end loaders would be used to remove contaminated material. Site preparation may include removal of the existing fence, if the fence is located within areas to be excavated. The fence materials would be handled in a similar manner as the building materials in Section 4.1.2.6. Any removed fencing would be replaced as part of site restoration.

Soil may require staging in order to sample the material for the disposal facility WAC prior to shipment. Staging areas would be properly contained, and warning signs posted to inform the workers at ATI Specialty Materials.

Erosion control materials and excavation activities are the same as Alternative S2, see Section 4.2.2.2 for details.

4.2.3.3 TRANSPORTATION

Transportation of impacted soils for Alternative S3 is consistent with Alternative S2, see Section 4.2.2.3.

4.2.3.4 OFF-SITE DISPOSAL/RECYCLING

Off-site disposal/recycling for Alternative S3 is consistent with Alternative S2, see Section 4.2.2.4.

4.2.3.5 CONFIRMATORY SAMPLING

Confirmatory sampling would be conducted after the excavation of each area. This sampling would confirm the cleanup criteria have been achieved. Soil samples would be collected from the surface of the excavation and surface of unexcavated soils that would remain at the site after remediation. Removal of soils to the soil PRG-GW would require the use of an analytical lab since the ^{238}U activity established for the soil PRG-GW would be too low to reasonably be measured in the field using gamma radiation survey equipment during remediation efforts. Using this lower PRG-GW will impact both remediation schedule (i.e., turnaround time on field sample results to guide the remediation) and cost. Using the PRG-GW should achieve UU/UE for soil within the performance period. Five-year reviews may be required until contaminants on site are below levels that allow for UU/UE, unless the site achieves UU/UE after remedial action is completed. Achievement of UU/UE will be documented using the results of the confirmatory sampling in the post-remedial action dose assessment.

4.2.3.6 SITE RESTORATION

After confirmatory sampling has demonstrated that the soil PRG-GW values have been met, the site restoration plan is similar to Alternative S2; see Section 4.2.2.6.

4.2.3.7 ASSEMBLED ALTERNATIVE

The components of Soil Alternative S3 that are carried through for evaluation and costing in this FS include:

- Preparation of project plans.
- Preparation of a staging area and access roads.
- Removal of soil impacted above the soil PRG-GW developed for the protection of groundwater, approximately 44,000 m^3 (58,000 yd^3) *in situ* volume or *ex situ* volume of 57,200 m^3 (75,400 yd^3) assuming a 30% bulking factor.
- Transport of soil to an appropriate disposal facility.
- Sampling and analysis of soils for WAC and disposal of soil at an appropriate facility; assume for costing purposes of this FS that the soil will be disposed of at the US Ecology Inc. Idaho facility as LARW.
- Performance of confirmatory sampling to demonstrate cleanup levels are met and performance of final status surveys for surface soils that would remain at the site after remediation using the MARSSIM statistical sampling approach to address radiological constituents.
- Performance of site restoration including placement and grading of clean fill, and replacement of any fences removed and needed to secure the site in the future.

These components will be considered while assembling the site-wide alternatives, and for the evaluation of this alternative against the CERCLA criteria in Section 5.0 and comparison of alternatives in Section 6.0.

4.3 GROUNDWATER ALTERNATIVES

The following alternatives were identified for groundwater at the site:

- Alternative G1—No Action
- Alternative G2—Monitored Natural Attenuation and Environmental Monitoring with soil PRG-CW implementation.
- Alternative G3—Monitored Natural Attenuation and Environmental Monitoring with soil PRG-GW implementation.
- Alternative G4—Groundwater Recovery using Vertical Extraction Wells and a Rubblized Trench with *Ex Situ* Treatment, and Environmental Monitoring with soil PRG-CW implementation.
- Alternative G5—Groundwater Recovery using Vertical Extraction Wells and a Rubblized Trench with *Ex Situ* Treatment, and Environmental Monitoring, with soil PRG-GW implementation.

As a part of this FS, a groundwater fate and transport model was constructed. The model has been used as a tool to evaluate the effectiveness of each of the alternatives. There are uncertainties in modeling results that should be considered best estimates. The groundwater model may vary significantly from field results due to the significant changes that will occur on site due to remediation (e.g., soil source removal and building dismantlement). Therefore, groundwater data will be assessed following the completion of the soil removal to determine the reaction of the plume. The model assumptions and results are provided in detail in Appendix F. Each of these groundwater alternatives contains the retained process options as shown in

Table 4-5. The modeling performed to determine the viability of the alternative components is found in Appendix F.

Uranium was evaluated by transport modeling. Initial concentrations (Year Zero) for solute transport modeling and/or analytical analysis are based on data presented in the *DGI Technical Memorandum*. It was assumed that soil sources were removed prior to implementation of the FS scenarios except for the no-action scenario.

Groundwater from the site flows predominantly to the southeast (in addition to a westerly flow towards the quarry) and partially seeps from select segments of the Erie Canal walls. To address the seeps as a potential pathway for groundwater exposure, the seeps are included as a part of the groundwater alternatives. The environmental monitoring program includes sampling of seeps.

Historical surface water samples from the Erie Canal indicate that uranium concentrations downstream of the site are indistinguishable from uranium concentrations measured in the canal upstream of the site and have not exceeded the MCLs in any of the sampling events. The Erie Canal could be used as an emergency water supply for the City of Lockport; although the emergency supply piping still exists, the canal has not been used for this purpose in approximately 23 years and the city does not expect to use it again for this purpose.

Portions of the groundwater at the Guterl Site flow west, towards the quarry. The groundwater and seep alternatives were developed based on current conditions. Any future quarry expansion plans should be considered during the final design of groundwater and seeps remedial alternatives. The volume of impacted groundwater was discussed in Section 3.6.2 and is provided in Table 4-6. Table 7-1 presents the timeframe predictions for the modeled groundwater alternatives. The following sections describe the groundwater alternatives.

4.3.1 ALTERNATIVE G1—NO ACTION

Alternative G1, the no-action alternative, is required by the NCP and would be used as the baseline to measure performance of other alternatives. In this alternative, no groundwater remedial systems would be installed and no LUCs would be implemented. This alternative provides no additional protection to human health and the environment over current conditions. This alternative also assumes that existing controls and monitoring would not be maintained (that is, environmental monitoring would not be performed and existing monitoring wells would remain in place but not be monitored). Figure 4-5 and 4-6 presents the shallow and deep groundwater plume prediction for Alternative G1.

Any improvement of the groundwater quality would be through natural attenuation including biodegradation, adsorption to aquifer material, mineral precipitation, dispersion, and dilution. Since groundwater monitoring would not be conducted, any improvement or further degradation of water quality would not be documented. The alternative provides a baseline for comparison of risk reduction achieved by each treatment alternative.

In summary, Alternative G1 (i.e., no action) is not capable of achieving the groundwater protection PRG (i.e., MCL) within the 1,000-year performance period. However, Alternative G1 is retained as a component of a site-wide alternative, as required by the NCP, to be used as a baseline for comparative purposes.

4.3.2 ALTERNATIVES G2 AND G3—MONITORED NATURAL ATTENUATION AND ENVIRONMENTAL MONITORING FOR PRG–CW AND PRG–GW

Alternatives G2 and G3 have been developed to demonstrate the reduction of contamination by natural processes and to limit public exposure to the impacted groundwater and seeps. The toxicity, mobility, or volume of groundwater contaminants would not be reduced by any engineering process. To document that natural attenuation is occurring, a MNA program would be implemented at the site to address impacted groundwater once impacted soils are remediated to either the soil PRG-CW or the soil PRG-GW. Therefore, Alternative G2 would be implemented in conjunction with Soil Alternative S2. Alternative G3 would be implemented in conjunction with Soil Alternative S3.

Monitored natural attenuation is the passive remediation technique that utilizes a protocol for determining whether natural processes can be relied on to attenuate the dissolved uranium concentrations found in groundwater. Natural process include biodegradation, adsorption to aquifer material, mineral precipitation, dispersion, and dilution. The uranium concentration is expected to decrease naturally over time, once the source of the contamination is removed. Under the MNA alternatives, sufficient geochemical data are collected to provide the information necessary to assess the attenuative processes that occur in the aquifer. The geochemical evaluation that was performed as part of the DGI (Appendix A of this FS, Section 4.4 of DGI) concluded that uranium in groundwater requires extremely reducing conditions for it to reduce to the tetravalent form and precipitate uranium as insoluble oxides. Moderately reducing conditions exist at some locations, which may include locations with VOCs. In these areas, the main attenuation mechanism is expected to be precipitation of insoluble oxides driven by reducing conditions, and sorption, driven by bacterial activity. The primary attenuation mechanism is expected to be dispersion along groundwater flow paths. Precipitation and adsorption are currently observed at the Guterl Site in the vicinity of the VOC plume; however, in the case that VOC source term is removed due to comingling with FUSRAP-eligible material, it is expected that insoluble uranium will remobilize.

Environmental monitoring would include collection of groundwater and seep samples. These alternatives would require close coordination of remediation and monitoring activities with ATI Specialty Materials, with the aim to minimize health and safety risks to on-site personnel and to minimize the disruption to their activities consistent with a safe and effective remediation. Components of these alternatives include the following:

- Project plans
- MNA sampling program
- Engineering LUCs

These components are described in the following sections.

4.3.2.1 PROJECT PLANS

Project plans detailing the monitoring program would be developed prior to the initiation of remedial actions. These plans would evaluate and detail the number and location of monitoring wells, groundwater seeps, the constituents to be monitored, the sampling frequency, and the criteria to determine if MNA is occurring. These plans would also provide procedures for replacement of wells, as necessary, over the duration of the sampling program. Well decommissioning and installation procedures would be included to address wells that are no longer needed or may be added as the shape of the plume changes over time.

These plans would detail engineering LUCs that would be necessary. Short-term engineering LUCs (e.g., signage and fencing) would be necessary during the active construction period to ensure a safe remediation. The safety of remediation workers, on-site employees, and the general public would be addressed in a site-specific health and safety plan which would also address potential exposures and monitoring requirements to ensure protection during remedial action.

4.3.2.2 MONITORED NATURAL ATTENUATION SAMPLING PROGRAM

For these alternatives, groundwater samples would be collected to demonstrate that natural attenuation is occurring at the site. It is assumed that monitoring would be accomplished by sampling 16 shallow and 10 deep existing monitoring wells, although the number and location of wells to be sampled may be modified during remedial design and as the extent of the plume decreases over time.

While the actual duration of the groundwater monitoring program included in these two alternatives would be based on the data results that demonstrate that the impacted groundwater has been naturally attenuated to meet the RAOs, the groundwater model has been used to estimate the timeframe to achieve the MCL for uranium (Appendix F). If no soils are removed from the site, as in the no-action alternative, the timeframe to achieve the MCL for uranium is estimated to be 780 years for shallow groundwater and greater than 1,000 years for deep groundwater. If the soils that exceed the soil PRG-CW are removed (Alternative S2), in conjunction with Alternative G2, the timeframe to achieve the MCL for uranium is estimated to be 430 years in shallow groundwater and 660 years in deep groundwater. If the soils that exceed the soil PRG-GW are removed (Alternative S3), in conjunction with Alternative G3, the timeframe to achieve the MCL for uranium is estimated to be 50 years in shallow groundwater and 120 years in deep groundwater. However, there is inherent conservatism in both the development of preliminary remediation goals for soil and groundwater model predictions that may render these performance timeframes to be upper bounding estimates. Figure 4-7 and 4-8 represents the shallow and deep groundwater plume when the soils that exceed the soil PRG-CW are removed in Alternative G2. Figure 4-9 and 4-10 represents the shallow and deep groundwater plume when the soils that exceed the soil PRG-GW are removed in Alternative G3.

For development of these alternatives and for costing purposes, it is assumed that both the 16 existing shallow wells and the 10 deep groundwater wells will be sampled. Wells would be sampled semiannually for the first three years, then annually for Years 4–30, and subsequently at five-year intervals for the remainder of the program. These wells would provide data along the central axis of the plume as well as at the downgradient property boundary, and would define the extent of the plume to the MCL.

Alternative G2 implemented with Alternative S2 results in the monitoring program continuing for 660 years. This is based upon predicted MCL exceedances in the shallow groundwater until Year 430 and in the deep groundwater until approximately Year 660. Alternative G3 implemented with Alternative S3 indicates the monitoring program will continue for 120 years. This is based upon predicted MCL exceedances in shallow groundwater until Year 50 and Year 120 in the deep groundwater. The timeframes provided are estimates, based on the results of the groundwater flow and transport model (provided in Appendix F) constructed for the site and used to evaluate each of the alternatives.

The analytical program would include:

- Total uranium—filtered and unfiltered.
- Anions (chloride, fluoride, sulfate, nitrate, nitrite, and ortho-phosphate)—unfiltered.
- General chemistry (alkalinity, total dissolved solids)—unfiltered.
- VOCs—unfiltered.
- Field parameter measurements at each well, including temperature, pH, DO, ORP, turbidity, and specific conductivity.

Volatile organic compounds are included in the program because the presence of VOCs impacts the redox state of groundwater, which affects the solubility of uranium, along with ensuring worker safety from chemical hazards.

For the preparation of each annual report, the data would be reviewed to determine whether or not the well locations, sampling frequency, or analytical parameters should be reduced or eliminated for specific wells. For example, as the size and shape of the plume changes over time, wells may be removed or added to the sampling program. On occasion, a complete round of samples may be collected from all wells to support data analysis.

Any well proposed for long-term monitoring that becomes damaged or is necessary to be removed due to remedial action or other activities would be replaced or repaired, as needed. The need for continuing the long-term monitoring at the location would be evaluated based on existing and expected future groundwater conditions. The water quality results and the results of the review would be provided in an annual monitoring report. In the reports, FUSRAP groundwater monitoring wells may be proposed for decommissioning in accordance with NYSDEC guidance, after it is determined the well is no longer necessary for the monitoring program.

4.3.2.3 ENGINEERING LAND USE CONTROLS

Engineering LUCs would be benefical under these alternatives, to ensure health and safety measures are established during remedial action. The engineering controls include maintenance of site fences and information signs and inspections to confirm that these engineering contols remain in place throughout the remedial action. Once the remedial action achieves the RAOs, and results in no risk to human health or the environment, no further land use controls would be necessary.

Specific action items and maintenance frequencies associated with the engineering LUCs would be detailed in the Land Use Control Implementation Plan (LUCIP) prepared after the record of decision (ROD). The objectives of the LUCIP are to:

- Identify the engineering LUCs on the site, their planned duration, and any factors that could require modification of the engineering LUC requirements (e.g., changes in ownership, use changes, property modifications impacting the contamination at the site, and achievement of remedial action goals and objectives).
- Establish roles and responsibilities for implementation, monitoring, reporting, and enforcement of the engineering LUCs.
- Identify the lifecycle costs developed in this FS (Appendix J) and funding allocations to support the engineering LUCs and the LUCIP.
- Establish communication strategies and protocols between parties.

4.3.2.4 ENVIRONMENTAL MONITORING

Environmental monitoring would be conducted to assess potential off-site contaminant migration via the groundwater pathway. Monitored environmental media would include groundwater and seeps discharging into the Erie Canal. For the purpose of this FS, it is assumed that groundwater samples and seep samples would be collected annually. The monitoring program would be periodically reassessed and modified, as appropriate. Long-term monitoring would continue for approximately 660 years if the soil is removed to the soil PRG-CW or for approximately 120 years if the soil is removed to the soil PRG-GW.

Groundwater monitoring would be conducted in accordance with the monitoring program after soil source removal. This data collection period will provide a dataset with sufficient statistical power to assess the efficacy of the MNA process to achieve RAOs. Reviews allow evaluation of the effectiveness of remediation as well as data obtained from ongoing monitoring to assess the presence and behavior of remaining contaminants. If monitoring demonstrates changes to environmental conditions or the attenuation process is not proceeding as expected, then decisions regarding what actions are necessary will be made at that time based on the data and information gathered during the monitoring program.

4.3.2.5 FIVE-YEAR REVIEWS

Alternative G2 would result in uranium remaining in groundwater above the MCL and potentially seeping to the Erie Canal throughout the performance period; therefore CERCLA five-year reviews may be required until contaminants on site are below levels that allow for UU/UE, unless the site achieves UU/UE after remedial action is completed.

Alternative G3 is estimated to achieve uranium MCL in groundwater in approximately 120 years. Five-year reviews may be required until contaminants on site are below levels that allow for UU/UE, unless the site achieves UU/UE after remedial action is completed.

4.3.2.6 ASSEMBLED ALTERNATIVE

The components of Alternative G2 and Alternative G3 are carried through for evaluation and costing in this FS. Actual design details of the selected remedial action to be implemented would be determined during the design phase, which would be implemented after the ROD is approved.

These assembled alternative components for Alternative G2 and G3 assume that removal of soils has been implemented, respectively. The components include the following:

- Develop project plans to include natural attenuation and groundwater monitoring plans.
- Conduct the groundwater analytical program, as documented in the monitoring plan, at 16 shallow wells and 10 deep wells (downgradient along the boundary of the plume and along the axis of the plume). It is assumed that both alternatives require sampling at 16 existing shallow wells and the 10 deep groundwater wells. Wells would be sampled semiannually for the first three years, then annually for Years 4–30, and subsequently at five-year intervals for the remainder of the program. On occasion, all available site wells would be sampled to optimize the monitoring program. Samples would be analyzed for total uranium (filtered and unfiltered), unfiltered anions (chloride, fluoride, sulfate, nitrate, nitrite, and ortho-phosphate), general chemistry (alkalinity, total dissolved solids), VOCs, and field parameter measurements (e.g., temperature, pH, DO, ORP, turbidity, and specific conductivity). The data would be validated upon receipt from the laboratory. The depth to groundwater and groundwater elevations would be measured and determined for each monitoring well at the site.
- Monitor total uranium, uranium isotopes, and VOCs in groundwater samples and seep locations annually for the monitoring period.
- Prepare annual monitoring reports.
- Repair/replace monitoring wells, as needed, at an assumed rate of two wells every five years and then decommission all wells upon program conclusion.

The current and future monitoring wells included in the groundwater sampling program were chosen to monitor groundwater quality downgradient and at the property boundary. Wells also were chosen to monitor the extent and concentration trends of the uranium along dominant groundwater flow paths. All monitoring well data would be evaluated and adjustments to the sampling program, if necessary, would be recommended at that time. Any well proposed for long-term monitoring that becomes damaged, or is necessary to be removed due to remedial action or other activities, would be replaced or repaired, as needed. The long-term monitoring would continue until concentrations of uranium in underlying groundwater are below the uranium MCL of 30 µg/L. All water quality results, and the results of the review, would be provided in an annual monitoring report.

In summary, Alternative G2 (i.e., MNA using soil PRG-CW) and Alternative G3 (MNA using soil PRG-GW) are capable of achieving the MCL, therefore both alternatives are retained as a component of a site-wide alternative.

4.3.3 ALTERNATIVE G4—GROUNDWATER RECOVERY USING A RUBBLIZED TRENCH AND VERTICAL EXTRACTION WELLS WITH *EX SITU* TREATMENT, ENVIRONMENTAL MONITORINGWITH SOIL PRG-CW IMPLEMENTATION

Alternative G4 has been developed to limit public exposure to the impacted groundwater and seeps through removal and treatment of impacted groundwater. This alternative would reduce the toxicity, mobility, and volume of impacted groundwater using treatment. Groundwater removal would be achieved by using a combination of vertical extraction wells installed in shallow and deep groundwater and a rubblized trench near the southern excised property boundary. Alternative G4 would be implemented in conjunction with Soil Alternative S2 (soil PRG-CW). Figure 4-11 and 4-12 represents the modeled shallow and deep groundwater plume for Alternative G4.

Environmental monitoring would include collection of groundwater and seep samples. This alternative would require close coordination of remediation and monitoring activities with ATI Specialty Materials with the aim to minimize health and safety risks to on-site personnel and to minimize the disruption to their activities consistent with a safe and effective remediation. Components of this alternative include the following:

- Project plans
- Groundwater extraction using a rubblized trench and vertical extraction wells with monitoring
- *Ex situ* groundwater treatment
- Groundwater disposal
- Engineering LUCs
- Environmental monitoring

These components are described in the following sections.

4.3.3.1 PROJECT PLANS

Project plans would be developed before initiating remedial actions. These plans would include pumping tests to support the groundwater extraction system design, treatability tests to support the treatment system design, construction details, and design of the piping system to relay extracted water to the treatment plant. These plans would also detail health and safety procedures and the performance monitoring and environmental monitoring procedures.

Preliminary groundwater contaminant transport models for Alternative G4 estimated an extended remedial timeframe of up to 580 years following the completion of the removal of impacted soil exceeding the PRG-CW. The actual groundwater response may vary significantly from preliminary model results due to the significant changes that will occur on site after soil remediation and building dismantlement. Therefore, groundwater data will be assessed following the completion of the soil removal to determine the reaction of the plume. Groundwater recovery will be implemented using a series of vertical extraction wells and a rubblized trench to extract contaminated groundwater. The groundwater model was used to provide a preliminary rubblized trench and extraction well layout to support this FS (Appendix F). As shown in Figure 4-11, a 418-m (1,370-ft) long rubblized trench and a total of three vertical extraction wells (two shallow wells and one deep well) are estimated based on the site-wide groundwater model results. As part of the design process, pumping tests would be performed in the shallow and deep aquifer near the proposed extraction well locations in the northwest portion of the site and in the vicinity of the proposed extraction wells near the southern property boundary to better characterize the aquifer and capture zones in the areas of the proposed rubblized trench and extraction wells. Additional monitoring wells may be necessary during the testing program to determine accurate aquifer parameters and capture zones. The pump test data would be used to fine-tune the number, location, and pumping rates of the extraction wells during the final design. In addition, a test trench would be blasted as part of the pumping test program to provide data on the change in permeability in the blast zone during the pumping test. Additional geotechnical and geochemical data such as distribution coefficients may be collected. The groundwater model may also be updated to assist in this analysis. The project plans would also identify treatability tests that may be completed to support the design of the treatment system.

The plans would also provide the monitoring program, which would evaluate and detail the number and location of monitoring wells, groundwater seep locations, any additional wells required, and the constituents to be monitored. The plans would also provide O&M procedures and procedures for replacement of wells, as necessary, over the duration of the sampling program. Well decommissioning and installation procedures would be included to address wells that are no longer needed or may be added as the shape and size of the plume changes over time.

The plans would detail engineering LUCs that would be necessary. Engineering LUCs would be necessary during the active construction period to ensure a safe remediation. The safety of remediation workers, on-site employees, and the general public would be addressed in a site-specific health and safety plan, which would also address potential exposures and monitoring requirements to ensure protection.

4.3.3.2 GROUNDWATER EXTRACTION AND MONITORING

The site-wide groundwater model was used to develop a conceptual design for a groundwater extraction system using a rubblized trench and vertical wells to address the uranium plume. Details of the use of the model to develop this alternative are provided in Appendix F. The assumption was made that soils above the soil PRG-CW have been removed (Soil Alternative S2). The depth and location of the wells and trench were optimized to reduce migration from the shallow to the deep groundwater zone with the least number of extraction wells and minimizing the length and depth of the trench. A total of three vertical extraction wells (two shallow wells and one deep well) and a singular 418-m- (1,370-ft-) long, 7.3-m- (24-ft-) deep, and 3-m- (10-ft-) wide rubblized trench installed near the southern property boundary would achieve these goals.

Shallow pumping rates are estimated at 26.5 liters per minute (L/min) (7 gallons per minute [gpm]). Deep pumping rates are estimated at 2 L/min (0.5 gpm). The estimated pumping rate for the trench is approximately 192 L/min (51 gpm). The actual number, locations, and pumping rates for the extraction wells would be refined during the design based on additional aquifer testing and groundwater modeling. While the actual duration for groundwater extraction system operation included in this alternative would be based on the data results that demonstrate that the impacted groundwater has been treated to meet the RAOs, the groundwater model used to support this FS indicates an operational timeframe of approximately 580 years.

For the development of this alternative and for costing purposes, it is assumed that 16 existing shallow wells and 10 existing deep wells, consistent with the current sampling program, would be sampled annually. These wells would provide data along the central axis of the plume and at the downgradient property boundary and would define the extent of the plume to the MCL. The wells would also be used to monitor the performance of the extraction system. It is also assumed that additional monitoring wells would be installed downgradient of the northernmost extraction wells and near any extraction well along the centerline of the plume that does not have a monitoring well nearby. For costing purposes, it is assumed that an additional six shallow and four deep monitoring wells would be installed and sampled. In addition, treatment system influent and effluent samples would be collected, for a total of 36 samples. The analytical program would include:

- Total uranium—filtered and unfiltered.
- Anions (chloride, fluoride, sulfate, nitrate, nitrite, and ortho-phosphate)—unfiltered.
- General chemistry (alkalinity, total dissolved solids)—unfiltered.
- VOCs—unfiltered.
- Field parameter measurements at each well, including temperature, pH, DO, ORP, turbidity, and specific conductivity.

Volatile organic compounds are included in the analytical program because the presence of VOCs can affect the solubility of uranium and pose a worker safety hazard. An extraction well and rubblized trench system have the potential to enhance the transport of non-FUSRAP VOCs in the groundwater which have been observed below the excised property. A rubblized trench with extraction wells placed down-gradient of Building 17, which is actively used by ATI Specialty Materials, could draw the VOC plume beneath the building. This direction of groundwater flow may enhance potential vapor intrusion issues within occupied buildings and increase the risk to human health for building occupants. Figure 4-11 and 4-12 represents the location of the trench and the modeled shallow and deep groundwater plume for Alternative G4.

For the preparation of each annual report, the data would be reviewed to determine whether the well locations, sampling frequency, or analytical parameters should be reduced or eliminated for specific wells. For example, as the size and shape of the plume changes over time, wells may be removed or added to the sampling program. On occasion, a complete round of samples may be collected from all available site wells to support program optimization.

Long-term O&M includes operation of the treatment and extraction system, as well as routine maintenance including periodic pump replacement, well repair and replacement, treatment media replacement, and residual disposal. Any well proposed for long-term monitoring or extraction that becomes damaged or is necessary to be removed due to remedial action or other activities would be replaced or repaired, as needed. The need for continuing the long-term monitoring at the location would be evaluated based on existing and expected future groundwater conditions. All water quality results and the results of the review would be provided in an annual monitoring report.

4.3.3.3 GROUNDWATER TREATMENT

Methods for *ex situ* groundwater treatment are dependent upon the flow rates and geochemistry of the groundwater recovered. The groundwater pH values are typically above 7.0 due to the carbonate bedrock and associated minerals present at the site. The site-wide redox conditions indicate a generally aerobic system that has localized anaerobic to anoxic conditions derived from VOC impacts. The overall aerobic conditions favor uranium being in the mobile anionic U(VI) carbonate species such as $UO_2(CO_3)_2^{2-}$ and $UO_2(CO_3)_3^{4-}$. This is consistent with the observation that uranium in the site groundwater exists predominately as dissolved ions and is not strongly associated with particulates. From the groundwater extraction modeling results, the estimated total flow rate is approximately 240 L/min (63.5 gpm), and the typical composite total uranium concentration would be 100 µg/L or less. The selected treatment system would treat this flow rate for approximately 580 years and would decrease the total uranium to near MCL levels and thus achieve an uncontrolled discharge criterion (based upon the final design and process water disposition). The extracted groundwater will contain VOCs as well as uranium. The selected treatment system will also need to treat the VOCs to meet discharge criteria of the POTW before being discharged.

Two proven commercially available technologies can treat dissolved uranium carbonate species to meet the performance goals under these conditions: ion exchange, geochemical adsorption, and sorption on zeolites. It is expected that ion exchange or a geochemical adsorption process (e.g., zero-valent iron) using a regeneration process will be selected. A detailed cost analysis at the remedial design phase would be required to select the system with the lowest total lifetime cost. For cost estimate calculations in this FS, ion exchange technology was used to determine cost of treatment. All the treatment media are expected to remove approximately 95% of the dissolved uranium. At this removal percentage and a starting concentration of 100 µg/L total uranium, the effluent concentration would be less than the MCL. A lead-lag design can be used to maximize uranium loadings on the media. As an example, the lead bed would be operated until its uranium effluent concentration is 50% of the influent concentration. The lag bed then would become the lead bed, while the other bed would either be replaced or regenerated. A pretreatment filter system is recommended to protect the media from plugging and to ensure maximum efficiency and media lifetime.

These processes may be used either as a single-use media or the media may be regenerated. It is expected that regeneration would be more effective with the ion exchange process than with zeolites or iron-based (uranium reduction) treatments. Single use ion exchange is often employed in the nuclear power industry, but in the case of water with lower uranium concentrations the media is often regenerated. The spent regenerant solutions are typically high TDS salt and/or acidic solutions that contain uranium at much higher concentrations than those in the groundwater due to accumulation of uranium on the media.

The waste streams from these two processes consist of radioactively contaminated spent media and used regenerate solution. The lifetime cost would be driven by total uranium loading capacity on the media, the number of bed volumes before breakthrough, and the disposal and labor costs associated with disposal. Due to the duration of the treatment period, and because these waste streams are radioactive, the disposal costs are more important than with many nonradiological treatment systems. As part of the design phase, treatability studies would be conducted to select the process with the lowest overall lifetime cost. It is critical that actual site water be used in these studies to evaluate the impact of competing ions on the process effectiveness and disposal of spent media.

For costing purposes in this FS, it is assumed that ion exchange would be used.

4.3.3.4 DISPOSAL

Solid waste, such as soil cuttings generated during well installation, would be disposed of similar to soils generated during Soil Alternative S2 (Section 4.2.2). Following treatment, groundwater would be discharged to the industrial sewer line, which connects to the City of Lockport POTW, in accordance with approved acceptance criteria.

The waste streams generated from the treatment process would be disposed of based on disposal facility acceptance criteria. It is anticipated for costing purposes, that these materials will require disposal at the US Ecology Inc. Idaho facility, or a similar permitted facility.

4.3.3.5 ENGINEERING LAND USE CONTROLS

Engineering LUCs would be necessary under this alternative, to to ensure health and safety measures are established during remedial action. The engineering controls include maintenance of site fences and information signs and inspections to confirm that these engineering contols remain in place throughout the remedial action. Once the remedial action achieves the RAOs, and results in no risk to human health or the environment, no further land use controls would be necessary.

Specific action items and frequencies associated with the engineering LUCs would be detailed in the LUCIP prepared after the ROD. The LUCIP would be prepared to document the procedures to be performed to implement and maintain engineering LUCs at the site. The objectives of the LUCIP are to:

- Identify the engineering LUCs on the site, their planned duration, and factors that could require modification of the engineering LUC requirements (e.g., changes in ownership, use changes, property modifications impacting the contamination at the site, and achievement of remedial action goals and objectives).
- Establish roles and responsibilities for implementation, monitoring, reporting, and enforcement of the engineering LUCs.
- Identify the lifecycle costs developed in this FS (Appendix J) and funding allocations to support the engineering LUCs and the LUCIP.
- Establish communication strategies and protocols between parties to the LUCIP.

4.3.3.6 ENVIRONMENTAL MONITORING

Environmental monitoring would be conducted to assess potential off-site contaminant migration via the groundwater pathway. For the purpose of this FS, it is assumed that seep samples would be collected also, as long as the Erie Canal is used as a potential emergency public water supply. The monitoring program would be periodically reassessed and modified, as appropriate. For the purpose of this FS, the long-term monitoring would continue until uranium concentrations in groundwater do not exceed the MCL.

4.3.3.7 FIVE-YEAR REVIEWS

This alternative would result in uranium remaining in groundwater and potentially seeping to the Erie Canal. For this alternative, five-year reviews are expected to be required to ensure the protectiveness of the remedy during the period of performance and are included in the cost estimates for the alternative. Five-year reviews may be required until contaminants on site are below levels that allow for UU/UE, unless the site achieves UU/UE after remedial action is completed.

4.3.3.8 ASSEMBLED ALTERNATIVE

Actual design details of the remedial action to be implemented would be determined during the design phase, which would be implemented after the ROD is approved. This alternative assumes that removal of soils to the soil PRG-CW has been implemented. The components include the following:

- Develop project plans that cover (1) pumping test procedures, (2) treatability testing design and procedures, (3) groundwater extraction and treatment system design, (4) procedures for installation and long-term O&M, and (5) a health and safety plan.
- Design the groundwater extraction and *ex situ* treatment systems. Based on the evaluations conducted for this FS, installation and operation of a 7.3-m- (24-ft-) deep, 418-m- (1,370-ft-) long, and 3-m- (10-ft-) wide rubblized trench combined with a total of three vertical extraction wells (two shallow wells and one deep well) achieved the MCLs. Shallow groundwater pumping rates are estimated at 26.5 L/min (7 gpm). Deep groundwater pumping rates were estimated at 2 L/min (0.5 gpm). The estimated pumping rate for the trench is approximately 192 L/min (51 gpm). The actual number, locations, and pumping rates for the extraction system would be refined during the design based on additional aquifer testing and groundwater modeling. A 580-year operational period is estimated. All treatment systems would be designed to comply with RCRA hazardous waste treatment, storage, and disposal requirements.
- Obtain off-site permits for treatment plant discharge to POTW, construction, utility survey clearance, site preparation, surveying, and system startup.
- Install the groundwater extraction system: the 418-m- (1,370-ft-) long, 7.3-m- (24-ft-) deep, and 3-m- (10-ft-) wide blasted rock rubblized trench and three extraction wells (two shallow wells and one deep). For costing purposes, it is assumed the shallow wells are 3-m (10-ft-) deep and the deep wells are 18-m- (60-ft-) deep, with a diameter of 10.16 centimeters (4 inches).
- Install the groundwater treatment system and operate for approximately 580 years. For estimating purposes, it is assumed that ion exchange will be implemented; however, the process will be selected based on the treatability studies performed during the design. Disposition of wastes generated during groundwater treatment system operations would comply with RCRA hazardous waste identification and disposal requirements.
- Maintain the groundwater extraction system for 580 years, which includes periodic performance or efficiency reviews, modifications of the extraction well array,

maintenance and repair (e.g., all pumps replaced every five years), and performing well replacement (the FS assumes two wells are replaced every five years).

- Prepare as-built drawings, a construction report, and a completion report.
- Conduct the groundwater analytical program, as documented in the monitoring plan, at 16 existing shallow wells and 10 existing deep wells plus an additional 10 shallow and four deep monitoring wells. The 40 wells and trench would be sampled under a telescopic periodicity from semiannual to annual for up to five years, and then every five years for the duration of the monitoring program (580 years). Samples would be analyzed for total uranium (filtered and unfiltered), unfiltered anions (chloride, fluoride, sulfate, nitrate, nitrite, and ortho-phosphate), general chemistry (alkalinity, total dissolved solids), VOCs, and field parameter measurements (e.g., temperature, pH, DO, ORP, turbidity, and specific conductivity), with the data validated upon receipt from the laboratory. The depth to groundwater and groundwater elevations would be measured and determined for each site well.
- Monitor total uranium and uranium isotopes at seep locations for a period of 580 years, at which time the concentrations are not expected to exceed the MCL, within or, beyond the site boundary.
- Prepare annual monitoring reports.

The current and future monitoring wells included in the groundwater sampling program were chosen to monitor groundwater quality downgradient and at the property boundary. Wells also were chosen to monitor the extent and concentration trends of the uranium along dominant groundwater flow paths. All monitoring well data would be evaluated annually, and adjustments to the sampling program, if necessary, would be recommended at that time. Any well proposed for long-term monitoring that becomes damaged, or is necessary to be removed due to remedial action or other activities, would be replaced or repaired, as needed. The long-term monitoring would continue until concentrations are below the uranium MCL of 30 µg/L. All water quality results, and the results of the review, would be provided in an annual monitoring report.

In summary, although Alternative G4 includes a more active groundwater treatment component (i.e., rubblized trench and vertical extraction wells), when combined with the Soil PRG-CW it is still not capable of achieving the groundwater protection PRG (i.e., MCL) in a timeframe that is competitive when compared to the other groundwater alternatives. Active treatment of groundwater, such as the use of vertical extraction wells, would not be effective when combined with Soil Alternative S2 (i.e., soil PRG-CW) because the residual uranium in the soil is predicted to contribute uranium to the current groundwater plume and likely expand parts of the plume throughout the 1,000-year performance period due to soil leachate in the future. The trench that was modeled to effectively capture groundwater under this Alternative G4 could potentially draw contaminated groundwater underneath the actively used Building 17 due to its location south of Building 17. This could generate a potential vapor intrusion issue in Building 17 increasing the risk to human health for building occupants. The trench location in Alternative G4 is less effective for mitigating risk. The energy use and emissions of operating the groundwater extraction and treatment system for the approximately 580-year remedial timeframe is not resourceful or cost effective. Alternative G4 is also not advantageous when compared to the other groundwater alternatives. Therefore, Alternative G4 is not retained as a component of a site-wide alternative.

4.3.4 ALTERNATIVE G5—GROUNDWATER RECOVERY USING A RUBBLIZED TRENCH AND VERTICAL EXTRACTION WELLS WITH *EX SITU* TREATMENT, ENVIRONMENTAL MONITORING WITH SOIL PRG-GW IMPLEMENTATION

Alternative G5 is similar to Alternative G4 with the following differences: 1) Alternative G5 would be implemented in conjunction with Soil Alternative S3 (soil PRG-GW) and 2) the orientation and extent of the rubblized trench, along with the extraction-well array, would be focused on capturing an attenuating uranium plume. Groundwater removal would be achieved using a combination of a rubblized trench near the excised area southern property boundary and vertical extraction wells installed in shallow and deep groundwater. This alternative requires a greater number of wells due to the smaller trench extents to achieve the required plume control and capture. Details of the construction and operations of a rubblized trench are provided in Section 3.8.3.2.1.2. Accordingly, the following discussion is assumed to incorporate the discussion presented above for Alternative G4, with the differences between the two alternatives highlighted in the following paragraphs.

This alternative would reduce the toxicity, mobility, and volume of impacted groundwater using treatment. Figures 4-13 and 4-14 represent the modeled shallow and deep groundwater plume for Alternative G5.

Environmental monitoring would include collection of groundwater and seep samples. This alternative would require close coordination of remediation and monitoring activities with ATI Specialty Materials, with the aim to minimize health and safety risks to on-site personnel, and to minimize the disruption to their activities consistent with a safe and effective remediation. Components of this alternative include:

- Project plans.
- Groundwater extraction using a rubblized trench and vertical wells with monitoring.
- *Ex situ* groundwater treatment.
- Groundwater disposal.
- Engineering LUCs.
- Environmental monitoring.

These components are described in the following sections.

4.3.4.1 PROJECT PLANS

Project plans similar to that outlined for Alternative G4 would be developed for Alternative G5 prior to the initiation of remedial actions. The plans would include pumping tests to support the groundwater extraction system design, treatability tests to support the treatment system design, construction details, and design of the piping system to relay extracted water to the treatment plant. The plans would also detail health and safety procedures and the performance monitoring and environmental monitoring procedures.

Preliminary groundwater contaminant transport models estimated an extended remedial timeframe of up to 115 years following the completion of the removal of impacted soil exceeding the PRG-GW. The groundwater model may vary significantly from field results due to the significant changes that will occur on site due to remediation (e.g., soil disturbances and building dismantlement). Therefore, the groundwater monitoring program and data will be assessed following the completion of the soil removal to determine the reaction of the plume. Groundwater recovery will be implemented using a series of vertical extraction wells and a rubblized trench along the southern Excised Area boundary to extract contaminated groundwater.

The groundwater model was used to provide a preliminary rubblized trench and extraction well layout for this FS (Appendix F). As shown on Figure 4-13, this layout would be highly effective by reducing the source of uranium to groundwater. Any soils impacted above the Soil PRG-GW (11 mg/kg total uranium [equivalent to 3.66 pCi/g ^{238}U] and 6.6 pCi/g for ^{232}Th) would be removed and disposed off site. Estimated volume of soil removal for this alternative is 44,000 m^3 (58,000 yd^3). As part of the design process, pumping tests (outlined in Alternative G4) would be performed to better characterize the aquifer and capture zones in the areas of the proposed rubblized trench and extraction wells. In addition, a test trench would be blasted as part of the pumping test program to provide data on the change in permeability in the blast zone during the pumping test. Additional geotechnical and geochemical data such as distribution coefficients may be collected.

The plans would also provide the monitoring program, which would evaluate and detail the number and location of monitoring wells, any additional wells required, groundwater seeps and the constituents to be monitored. The plans would also provide O&M procedures and procedures for replacement of wells, as necessary, over the duration of the sampling program. Well decommissioning and installation procedures would be included to address wells that are no longer needed or may be added as the shape and size of the plume changes over time.

The plans would detail engineering LUCs that would be necessary. Engineering LUCs would be necessary during the active construction period to ensure a safe remediation. The safety of remediation workers, on-site employees, and the general public would be addressed in a site-specific health and safety plan, which would also address potential exposures and monitoring requirements to ensure protection.

4.3.4.2 GROUNDWATER EXTRACTION AND MONITORING

The site-wide groundwater model was used to develop a conceptual design for a groundwater extraction system using a rubblized trench and vertical extraction wells to capture the uranium plume. Details of the use of the model to develop this alternative are provided in Appendix F. The assumption was made that soils above the soil PRG-GW have been removed (Soil Alternative S3), which initially would promote the reduction of uranium to less than the MCL of 30 μg/L in a reduced timeframe. The depth and location of the wells and trench were optimized to reduce migration from the shallow to the deep groundwater zone with the least number of extraction wells and minimizing the length and depth of the trench. A total of 10 vertical extraction wells (seven shallow and three deep wells) and a singular 183-m- (600-ft-) long, 7.3-m- (24-ft-) deep, and 3-m- (10-ft-) wide rubblized trench installed near the southern excised area property boundary would achieve these goals. The trench location in Alternative G5 is different from the trench in Alternative G4. For costing purposes, it is assumed that an additional 10 shallow and four deep monitoring wells would be installed to monitor the performance of the groundwater extraction system. Figure 4-13 and 4-14 indicate the northern location of the trench and extraction wells for Alternative G5.

The simulated shallow groundwater pumping rates range from 8 L/min to 26 L/min (2 gpm to 7 gpm) and total 134 L/min [35.5 gpm]. Deep groundwater pumping rates for the three wells was estimated at a range from 3.8 L/min (1.0 gpm) to 9.5 L/min (2.5 gpm) with a cumulative flow rate of 17.4 L/min [4.6 gpm]. The estimated pumping rate for the trench is approximately 162.8 L/min (43 gpm). The actual number, locations, and pumping rates for the extraction wells would be refined during the design based on additional aquifer testing and groundwater modeling. The duration for operating the groundwater extraction system would be based on data results that demonstrate the impacted groundwater has met the RAOs. Once the groundwater has met the RAOs then the extraction system would end.

For the development of this alternative and for costing purposes, it is assumed that 16 existing shallow wells and 10 existing deep wells, consistent with the current sampling program, would be sampled annually. These wells would provide data along the central axis of the plume and at the downgradient property boundary and would define the extent of the plume to the MCL. The wells would also be used to monitor the performance of the extraction system. It is also assumed that additional monitoring wells would be installed downgradient of the northernmost extraction wells, and near any extraction well along the centerline of the plume that does not have an existing monitoring well nearby. Monitoring wells will also be installed up and downgradient of the rubblized trench to monitor the performance of extraction from the trench along the property boundary. For costing purposes, it is assumed that an additional 10 shallow and four deep monitoring wells would be installed and sampled, resulting in a total of 40 wells to be monitored. In addition, treatment system influent and effluent samples would be collected for a total of 42 samples. Wells in the immediate vicinity of the rubblized trench may need to be replaced. The analytical program would include:

- Total uranium—filtered and unfiltered.
- Anions (chloride, fluoride, sulfate, nitrate, nitrite, and ortho-phosphate)—unfiltered.
- General chemistry (alkalinity, total dissolved solids)—unfiltered.
- VOCs—unfiltered.
- Field parameter measurements at each well, including temperature, pH, DO, ORP, turbidity, and specific conductivity.

Volatile organic compounds are included in the analytical program because the presence of VOCs can affect the solubility of uranium and pose a worker safety hazard. An extraction well and rubblized trench system have the potential to enhance the transport of non-FUSRAP VOCs in groundwater when installed down-gradient of Building 17, which is actively used. This is where Alternative G5 is different from Alternative G4, in that the rubblized trench is in a different location to capture the groundwater plume. The trench would be located north of Building 17, along the southern boundary of the excised property. This location will assist in capturing the groundwater before encountering the actively used Building 17 and assist in mitigating any potential vapor intrusion. Figure 4-13 and 4-14 indicate the northern location of the trench and extraction wells and the modeled shallow and deep groundwater plume for Alternative G5.

For the preparation of each annual report, the data would be reviewed to determine whether the well locations, sampling frequency, or analytical parameters should be reduced or eliminated for specific wells. For example, as the size and shape of the plume changes over time, wells may be removed or added to the sampling program. On occasion, a complete round of samples may be collected from all available site wells to support program optimization.

Long-term O&M includes operation of the treatment and extraction system, as well as routine maintenance including periodic pump replacement, well repair and replacement, treatment media replacement, and residual disposal. Any well proposed for long-term monitoring or extraction that becomes damaged or is necessary to be removed due to remedial action or other activities would be replaced or repaired, as needed. The need for continuing the long-term monitoring at the location would be evaluated based on existing and expected future groundwater conditions. All water quality results and the results of the review would be provided in an annual monitoring report.

The timeframes provided are estimates, based on the results of the groundwater flow and transport model constructed for the site and used to evaluate each of the alternatives. The model results are provided in Appendix F. The model predicts that around Year 30, uranium should be below the MCL in both shallow and deep groundwater. Therefore, 30 years of groundwater extraction, O&M, and monitoring are assumed for this alternative. The extraction system may be modified over time, as the location and size of the plume changes over time. Some extraction wells may be eliminated from the system; however, all wells will be considered operational for the full 30 years for the purpose of this FS.

4.3.4.3 GROUNDWATER TREATMENT

The groundwater treatment system for Alternative G5 is consistent with Alternative G4; see Section 4.3.3.3.

4.3.4.4 DISPOSAL

Disposal for Alternative G5 is consistent with Alternative G4; see Section 4.3.3.4.

4.3.4.5 ENGINEERING LAND USE CONTROLS

Engineering LUCs for Alternative G5 are consistent with Alternative G4; see Section 4.3.3.5.

4.3.4.6 ENVIRONMENTAL MONITORING

Environmental monitoring for Alternative G5 is consistent with Alternative G4; see Section 4.3.3.6.

4.3.4.7 FIVE-YEAR REVIEWS

Five-year reviews for Alternative G5 are consistent with Alternative G4; see Section 4.3.3.7.

4.3.4.8 ASSEMBLED ALTERNATIVE

The components of Alternative G5 are carried through for evaluation and costing in this FS. Actual design details of the remedial action to be implemented would be determined for the selected alternative during the design phase, which would be implemented after the ROD is approved. This alternative assumes that removal of soils to the soil PRG-GW has been implemented. The components include the following:

- Develop project plans that cover (1) pumping test procedures, (2) treatability testing design and procedures, (3) groundwater extraction and treatment system design, (4) procedures for installation and long-term O&M, and 5) a health and safety plan.
- Prepare a design for the groundwater extraction and *ex situ* treatment systems. Based on the evaluations conducted for this FS, installation and operation of a 7.3-m- (24-ft-) deep, 183-m- (600-ft-) long, and 3-m- (10-ft-) wide rubblized trench combined with a total of 10 vertical extraction wells (seven shallow and three deep wells) will achieve the MCL. Shallow groundwater well pumping rates average 134 L/min (35.5 gpm) total. Deep groundwater pumping rates for the three wells were estimated at 17.4 L/min (4.6 gpm) total. The estimated pumping rate for the trench is approximately 162.8 L/min (43 gpm). The actual number, locations, pumping rates and trench dimensions for the extraction system would be refined during the design phase based on additional aquifer testing and groundwater modeling. A 30-year operational period is estimated. All treatment systems would be designed to comply with RCRA hazardous waste treatment, storage, and disposal requirements.
- Obtain off-site permits. Permits may be required for treatment plant discharge to POTW, construction, utility survey clearance, site preparation, surveying, and system startup.
- Install the groundwater extraction system: the 183-m- (600-ft-) long, 7.3-m- (24-ft-) deep, and 3-m- (10-ft-) wide blasted rock rubblized trench and 10 extraction wells (seven shallow and three deep). For costing purposes, it is assumed an additional 14 wells (10 shallow and four deep) would be installed to account for future refinement of the extraction system and possibly used as additional monitoring wells. The shallow wells are 3-m- (10-ft-) deep and the deep wells are 18-m- (60-ft-) deep, with a diameter of 10.16 centimeters (4 inches).
- Operate the groundwater treatment system for 30 years. For estimating purposes, it is assumed that ion exchange will be implemented; however, the process will be selected based on the treatability studies performed during the design. Disposition of wastes generated during groundwater treatment system operations would comply with RCRA hazardous waste identification and disposal requirements.
- Maintain the groundwater extraction system for 30 years, which includes periodic performance or efficiency reviews, modifications of the extraction well array, maintenance and repair (e.g., all pumps replaced every five years), and extraction well replacement. Repair/replace monitoring wells, as needed, at an assumed rate of two wells every five years and then decommission all wells upon program conclusion.
- Prepare as-built drawings, a construction report, and a completion report.
- Conduct the groundwater analytical program, as documented in the monitoring plan. Sample an approximate 16 existing shallow wells and 10 existing deep wells, plus an additional 10 shallow and four deep monitoring wells. The 40 wells and trench would be sampled under a telescopic periodicity from semiannual to annual for up to five years, and then every five years for the duration of the monitoring program (30 years). Samples would be analyzed for total uranium (filtered and unfiltered), unfiltered anions (chloride, fluoride, sulfate, nitrate, nitrite, and ortho-phosphate), general chemistry (alkalinity, total

dissolved solids), VOCs, and field parameter measurements (e.g., temperature, pH, DO, ORP, turbidity, and specific conductivity), with the data validated upon receipt from the laboratory. The depth to groundwater and groundwater elevations would be measured and determined for each site well.
- Monitor total uranium and uranium isotopes in groundwater and seep locations for a period of 30 years, at which time the concentrations are not expected to exceed the MCL, within or, beyond the site boundary.
- Prepare annual monitoring reports.

The current and future monitoring wells included in the groundwater sampling program were chosen to monitor groundwater quality downgradient and at the property boundary. Wells also were chosen to monitor the extent and concentration trends of the uranium along dominant groundwater flow paths. All monitoring well data would be evaluated annually, and adjustments to the sampling program, if necessary, would be recommended at that time. Any well proposed for long-term monitoring that becomes damaged, or is necessary to be removed due to remedial action or other activities, would be replaced or repaired, as needed. The long-term monitoring would continue until concentrations are below the uranium MCL of 30 µg/L. All water quality results, and the results of the review, would be provided in an annual monitoring report.

In summary, Alternative G5 (i.e., rubblized trench and vertical wells in conjunction with soil PRG-GW) is capable of achieving the groundwater protection PRG (i.e., MCL), optimizes the rubblized trench location to capture the groundwater plume and mitigate any potential non-FUSRAP VOC issues with actively used buildings and is therefore retained as a component of a site-wide alternative.

4.4 SITE-WIDE ALTERNATIVES

The media-specific alternatives for buildings, soil, and groundwater are assembled to develop site-wide alternatives for this FS. The site-wide alternatives will be carried through for the evaluation against the CERCLA criteria in Section 5.0, and comparison of alternatives in Section 6.0.

4.4.1 SITE-WIDE ALTERNATIVE 1 — NO ACTION

Site-Wide Alternative 1 consists of the following media-specific alternatives:

- Building Alternative B1—No Action (described in Section 4.1.1)
- Soil Alternative S1—No Action (described in Section 4.2.1)
- Groundwater/Seep Alternative G1—No Action (described in Section 4.3.1)

Under this alternative, no action would be taken for building materials or contents, soil, or groundwater/seeps impacted at the site. Since no actions are taken under this alternative to address risk, it is not considered protective of human health and the environment. However, the no-action alternative is carried over as a baseline for comparison to the other alternatives as required by the NCP.

4.4.2 SITE-WIDE ALTERNATIVE 2 — DISMANTLEMENT AND OFF-SITE DISPOSAL OF BUILDINGS 1, 2, 3, 4/9, 5, 6, 8, 24, AND 35; COMPLETE SOIL REMOVAL TO THE SOIL PRG-GW AND OFF-SITE DISPOSAL; MONITORED NATURAL ATTENUATION WITH ENVIRONMENTAL MONITORING

Site-Wide Alternative 2 consists of the following media-specific alternatives:

- Alternative B3—Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35 (described in Section 4.1.3)
- Alternative S3—Complete Soil Removal to the soil PRG-GW and Off-Site Disposal (described in Section 4.2.3)
- Alternative G3—Monitored Natural Attenuation with Environmental Monitoring (described in Section 4.3.2)

For Site-Wide Alternative 2, Buildings 1, 2, 3, 4/9, 5, 6, 8, and 35 would be removed and disposed of off site, along with impacted materials and contents and underlying soils above the soil PRG-GW. The dismantlement of Building 24 and the remediation of underlying soils will be conducted at the time of the site-wide remedial action with property owner permission to dismantle the building. If Building 24 is not available or authorized for dismantlement at the time of the site-wide remedial action, the inaccessible underlying soil and Building 24 will remain until it becomes available under a change of site conditions. Impacted groundwater is addressed by MNA. Environmental monitoring would be used to document the performance of this alternative. The length of time required to meet the MCL may be reevaluated after the remediation of soil contamination (i.e., residual profiles may differ from FS-level modeling). The major components of this alternative are:

- Project plans (buildings, soil, and groundwater).
- Building dismantlement (buildings).
- Sorting (buildings and building contents).
- Soil removal above the soil PRG-GW (soil).
- Transportation (buildings, building contents, and soil).
- Off-site disposal/recycling (buildings, building contents, and soil).
- Confirmatory sampling (buildings and soil).
- Site restoration (soil).
- MNA sampling program (groundwater).
- Engineering LUCs (buildings, soil, and groundwater).
- Environmental monitoring (groundwater and groundwater seeps).

The details for each of these major components are provided in the corresponding media-specific alternative sections (Sections 4.1.2, 4.2.3, and 4.3.2). These components will be considered for the evaluation against the CERCLA criteria in Section 5.0 and comparison of alternatives in Section 6.0.

4.4.3 SITE-WIDE ALTERNATIVE 3 — DISMANTLEMENT AND OFF-SITE DISPOSAL OF BUILDINGS 1, 2, 3, 4/9, 5, 6, 8, 24, AND 35; COMPLETE SOIL REMOVAL TO THE SOIL PRG-GW AND OFF-SITE DISPOSAL; GROUNDWATER RECOVERY USING EXTRACTION WELLS AND A RUBBLIZED TRENCH WITH *EX SITU* TREATMENT, WITH ENVIRONMENTAL MONITORING

Site-Wide Alternative 3 consists of the following media-specific alternatives:

- Alternative B3—Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35 (described in Section 4.1.3)
- Alternative S3—Complete Soil Removal to soil PRG-GW and Off-Site Disposal (described in Section 4.2.3)
- Alternative G5—Groundwater Recovery using Extraction Wells and a Rubblized Trench with *Ex Situ* Treatment, Environmental Monitoring (described in Section 4.3.4)

For Site-Wide Alternative 3, Buildings 1, 2, 3, 4/9, 5, 6, 8, and 35 would be removed and disposed of off site, along with impacted materials and contents, and underlying soil above the soil PRG-GW. The dismantlement of Building 24 and the remediation of underlying soils is intended to be conducted at the time of the site-wide remedial action with property owner permission to dismantle the building. If Building 24 is not available or authorized for dismantlement at the time of the site-wide remedial action, the inaccessible underlying soil and Building 24 will remain until it becomes available under a change of site conditions. Impacted groundwater is addressed by extraction using a rubblized trench and vertical extraction wells with *ex situ* treatment. Environmental monitoring (groundwater and groundwater seeps) would document the performance of this alternative. The major components of this alternative are as follows:

- Project plans (buildings, soil, and groundwater).
- Building dismantlement (buildings).
- Sorting (buildings and building contents).
- Soil removal above the soil PRG-GW (soil).
- Transportation (buildings, building contents, and soil).
- Off-site disposal/recycling (buildings, building contents, and soil).
- Confirmatory sampling (buildings and soil).
- Site restoration (soil).
- Groundwater extraction using a rubblized trench and vertical extraction wells with monitoring (groundwater).
- *Ex situ* groundwater treatment (groundwater).
- Groundwater disposal at POTW (groundwater).
- Engineering LUCs (buildings, soil, and groundwater).
- Environmental monitoring (groundwater and groundwater seeps).

The details for each of these major components are provided in the corresponding media-specific alternative sections (Sections 4.1.3, 4.2.3, and 4.3.4). These components will be considered for the evaluation against the CERCLA criteria in Section 5.0 and comparison of alternatives in Section 6.0.

4.4.4 SITE-WIDE ALTERNATIVE 4 — DECONTAMINATION OF BUILDING 1; DISMANTLEMENT AND OFF-SITE DISPOSAL OF BUILDINGS 2, 3, 4/9, 5, 6, 8, AND 24; COMPLETE SOIL REMOVAL TO THE SOIL PRG-CW AND OFF-SITE DISPOSAL; MONITORED NATURAL ATTENUATION WITH ENVIRONMENTAL MONITORING

Site-Wide Alternative 4 consists of the following media-specific alternatives:

- Alternative B2—Decontamination of Building 1; Dismantlement and Off-Site Disposal of Buildings 2, 3, 4/9, 5, 6, 8, and 24 (described in Section 4.1.2)
- Alternative S2—Complete Soil Removal to soil PRG-CW and Off-Site Disposal (described in Section 4.2.2)
- Alternative G2—Monitored Natural Attenuation with Environmental Monitoring (described in Section 4.3.2)

For Site-Wide Alternative 4, Buildings 2, 3, 4/9, 5, 6, 8, and 24 would be removed and disposed of off site, along with impacted materials and contents and underlying soils above the soil PRG-CW. Decontamination of the portions of Building 1 above the DCGLs would occur. Since the soils underlying Building 1 are not impacted above the soil PRG-CW, no dismantlement or soil removal will occur beneath Building 1. Building 35 materials, surfaces and underlying soils are not impacted above the PRG-CW and therefore are not addressed under this alternative. The dismantlement of Building 24 and the remediation of underlying soils is intended to be conducted at the time of the site-wide remedial action with property owner permission to dismantle the building. If Building 24 is not available for dismantlement at the time of the site-wide remedial action, the inaccessible underlying soil and Building 24 will remain until it becomes available under a change of site conditions. Impacted groundwater is addressed by MNA. Environmental monitoring (groundwater and groundwater seeps) would be used to document the performance of this alternative. The length of time required to meet MCL may be reevaluated after the remediation of soil contamination (i.e., residual profiles may differ from FS-level modeling). The major components of this alternative are:

- Project plans (buildings, soil, and groundwater).
- Building dismantlement (buildings).
- Building decontamination (buildings).
- Sorting (buildings and building contents).
- Soil removal above the soil PRG-CW (soil).
- Transportation (buildings, building contents, and soil).
- Off-site disposal/recycling (buildings, building contents, and soil).
- Confirmatory sampling (buildings and soil).
- Site restoration (soil).
- MNA sampling program (groundwater).
- Engineering LUCs (buildings, soil, and groundwater).
- Environmental monitoring (groundwater and groundwater seeps).

The details for each of these major components are provided in the corresponding media-specific alternative sections (Sections 4.1.2, 4.2.2, and 4.3.2). These components will be considered for the evaluation against the CERCLA criteria in Section 5.0 and comparison of alternatives in Section 6.0.

5.0 DETAILED ANALYSIS OF ALTERNATIVES

5.1 INTRODUCTION

This section presents a detailed analysis of the retained remedial alternatives. Each remedial alternative presented in the FS is assessed against the CERCLA evaluation criteria. These criteria have been designed to enable the analysis of each alternative to address the statutory requirements and considerations, and the technical and policy considerations important for selecting among remedial alternatives. These evaluation criteria provide the framework for conducting the detailed analysis and for subsequently selecting an appropriate remedial action. The evaluation criteria have been divided into three groups based on the function of the criteria in the remedy selection. Each remedial alternative presented in the FS is evaluated against threshold and balancing criteria. Modifying criteria are considered after the proposed plan (PP) (i.e., document that proposes the preferred remedial alternative) has been released. The nine criteria are as follows:

- Threshold Criteria
    - Overall protection of human health and the environment
    - Compliance with ARARs)

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

- Modifying Criteria
    - State acceptance
    - Community acceptance

This FS does not select the proposed alternative, rather it provides information for the subsequent stages of the CERCLA process, which is the PP that proposes the preferred remedial alternative, and the ROD that documents the selected alternative.

5.1.1 THRESHOLD CRITERIA

The two threshold criteria that the NCP [40 CFR §300.430(f)(i)(A)] lists are, overall protection of human health and the environment and compliance with ARARs. Assessments against these two criteria relate directly to statutory findings that must ultimately be made in the ROD. Threshold criteria must be met by any remedy in order for the remedy to be selected. The ARARs for the Guterl Site include drinking water standards, because groundwater at the Guterl

Site is determined to be potable based upon potential yield and water quality criteria and is a potential source of drinking water (40 CFR 300.430(e)(2)(i) B and C).

5.1.1.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The assessment against this criterion describes how the alternative, as a whole, achieves and maintains protection of human health and the environment. Overall protectiveness is based largely on the degree of confidence that a remedy can achieve and maintain media-specific PRGs, or reduce the potential for human and ecological exposure. The media-specific PRGs (development of these levels is discussed in Section 3.5) that would eliminate unacceptable risk to human health and the environment for the COCs are as follows:

- Soil PRG-CW: 23 pCi/g for ^{238}U and 6.6 pCi/g for ^{232}Th.
- Soil PRG-GW: 11 mg/kg (3.66 pCi/g for ^{238}U) total uranium for the protection of groundwater.[3]
- Groundwater PRG: the MCL for uranium, 30 μg/L.
- Buildings: 2,391 total and 240 removable Alpha (α) dpm/100 cm^2 and 2,515 total and 252 removable Beta (β) dpm/100 cm^2. DCGLs will result in 25 mrem/yr to the limiting receptor (construction worker).

5.1.1.2 COMPLIANCE WITH ARARS

The assessment against this criterion describes how the alternative complies with ARARs, or if a waiver is required, provides grounds for invoking a waiver under 40 CFR 300.430(f)(1)(ii)(C). Each alternative is evaluated with respect to compliance with the ARARs established for the Guterl Site. The ARAR identified includes relevant and appropriate requirements in 10 CFR 20, Subpart E: Section 20.1402 for safe use by a construction worker. Although the Guterl Site is not a NRC-licensed facility, 10 CFR 20.1402 is relevant and appropriate to actions at the site, since the criteria provided specifically address cleanup standards and control of COCs at the Guterl Site. Criteria in 10 CFR 20.1402 provide for safe use for an average member of the critical group (i.e., dose less than or equal to 25 mrem/yr for the construction worker). Consistent with the site-specific conceptual site model, groundwater would be included in the 25 mrem/yr TEDE standard; the amount of radiation from all exposure media, cumulatively, is included in the calculation of PRGs discussed in Section 3.5.

Drinking water standards (federal MCLs, nonzero maximum contaminants level goals, or more stringent state drinking water standards) are relevant and appropriate to the Guterl Site as groundwater cleanup goals, because groundwater at the Guterl Site is determined to be potable based upon potential yield and water quality criteria and is a potential source of drinking water (40 CFR 300.430(e)(2)(i) B and C). The MCLs for radionuclides are specified in 40 CFR 141.66; analytical methodologies to demonstrate compliance with the MCL are identified in 40 CFR 141.25. The MCL for uranium is 30 μg/L, as provided in 40 CFR 141.66(e).

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[3] A soil PRG-GW is not separately defined for ^{232}Th because thorium is not a COC for groundwater. Removal of soil that exceeds the ^{238}U PRG-GW will include the removal of the collocated soil with activity concentrations that exceed the ^{232}Th soil PRG-CW.

5.1.2 BALANCING CRITERIA

If the remedial alternative meets threshold criteria, it is further screened against the five balancing criteria.

5.1.2.1 LONG-TERM EFFECTIVENESS AND PERMANENCE

This criterion addresses the results of a remedial action in terms of the risks remaining at the site after conclusion of the remediation (U.S. EPA, 1992). The extent, effectiveness, adequacy, and reliability of the controls, as well as the magnitude of the residual risk, are some of the components of this criterion against which the alternatives are evaluated. The purpose is to determine if the alternative offers adequate management of the risk posed by the treatment of residual and/or untreated waste.

The adequacy and reliability of controls is determined by assessing whether technologies meet the process efficiencies or performance specifications; what type and degree of long-term management and monitoring are necessary; and what uncertainties are associated with land disposal of residuals and untreated wastes. Alternatives that provide the highest degree of long-term effectiveness and permanence leave little or no untreated waste at the site, make long-term maintenance and monitoring unnecessary.

5.1.2.2 REDUCTION IN TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

This criterion addresses the preference for selecting remedial alternatives that employ treatment technologies that permanently and significantly reduce the toxicity, mobility, or volume of the impacted media on site (U.S. EPA, 1988). The major factors to be considered during evaluation of a particular remedial alternative are:

- Principal threats addressed by employing the treatment process.
- Special requirements for the treatment process.
- Percent of contaminated material affected by the treatment process (volume or mass).
- Extent of contaminant reduction.
- Extent of reduction in contaminant mobility.
- Extent of volume reduction.
- Extent of irreversible treatment effects.
- Quantities, characteristics, and types of residuals.
- Risks associated with treatment residuals.
- Degree to which the alternative satisfies the statutory preference for treatment on site as a principal element.

5.1.2.3 SHORT-TERM EFFECTIVENESS

The short-term effectiveness criterion is used to evaluate the short-term effects of the remedial action on the environment, remediation workers, and the community during the construction and implementation phase of the project, and is pertinent until the project levels are met (U.S. EPA, 1988). This criterion also includes an assessment of the relative timeframe necessary for the remedial action to achieve protection. The following analysis factors are addressed as appropriate for each alternative: (1) protection of the community during remedial actions, (2) protection of workers during remedial actions, (3) environmental impacts, and (4) timeframe until RAOs are achieved. The evaluation of short-term effectiveness includes consideration of the effectiveness and reliability of available worker protection, and mitigation measures to prevent or reduce potential impacts to the community, workers, and the environment.

5.1.2.4 IMPLEMENTABILITY

This criterion addresses three factors that affect the proper implementation of the alternatives. These factors are the technical and administrative feasibility of implementing the alternatives and the availability of various services and materials, equipment, and prospective technologies for carrying out the remedial alternatives.

Technical feasibility includes the following aspects:

- Technical difficulties or unknowns associated with construction and remedial action.
- Reliability of the technology and the likelihood of the implementation schedule being delayed due to technical problems.
- The ability to monitor the effectiveness of the remedial action and the risks of exposure in case the periodic monitoring of groundwater is insufficient to detect a system failure.

Administrative feasibility addresses the need for coordination of activities with other offices and agencies and property owners that may include obtaining permits or rights-of-way for construction.

Availability of services and materials addresses the following items:

- Availability of adequate off-site treatment, storage capacity, and disposal facilities.
- Availability of necessary equipment and specialists, and provisions to ensure any necessary additional resources.
- Availability of services and materials in addition to the potential for obtaining competitive bids, which may be particularly important for innovative technologies.
- Availability of prospective technologies.

5.1.2.5 COST

The cost criterion addresses capital costs (direct and indirect), annual O&M costs, accuracy of cost estimates, present worth, and cost sensitivity analyses as they relate to the implementation of the remedial alternative (U.S. EPA, 1992).

- Direct Capital Costs—Initial construction costs, equipment costs, cost of land acquisition, etc.
- Indirect Capital Costs—Engineering costs, start-up costs, contingencies, etc.
- Annual O&M Costs—Post-construction costs necessary to maintain the site in accordance with the post-closure regulations. Examples include: labor, material, and utility costs to operate and maintain any treatment facility and the cost for disposition of treatment residues. Annual O&M costs also include costs of construction for ongoing projects that may take several years to fully implement (e.g., multiyear major excavation with processing operations).
- Accuracy of Cost Estimates—The remediation costs presented in this FS are for planning and comparative purposes only, and are accurate to the required level of CERCLA accuracy (i.e., plus 50% to minus 30%).
- Present Worth Analysis—Present worth analysis is used to evaluate expenditures occurring over periods of time in the future, and discount them to a common base year so all alternatives are compared on the same basis. Present worth was calculated based on a 3.5% annual discount rate.
- Cost Sensitivity Analysis—The cost sensitivity analysis is usually performed after the present worth analysis is concluded. The purpose of this analysis is to evaluate the uncertainties concerning specific assumptions made during the detailed analysis of the alternative.

5.1.3 MODIFYING CRITERIA

The two modifying criteria are state and community acceptance. Following a comparative analysis among the alternatives in the FS, a preferred alternative is selected by USACE and identified in the PP, which is published for state and community review and comment. The modifying criteria, state and community acceptance, are considered as part of the final selection of the remedial alternative defined in the ROD.

5.1.3.1 STATE ACCEPTANCE

This criterion evaluates the technical and administrative issues and concerns the state regulators may have regarding each of the alternatives. This criterion will be addressed in the ROD after comments on this FS and the PP have been received and evaluated (U.S. EPA, 1988). The responses to comments are provided in the responsiveness summary of the subsequent ROD.

5.1.3.2 COMMUNITY ACCEPTANCE

This evaluation criterion addresses issues and concerns the public may have concerning the recommended alternatives. Community input will be encouraged during the comment period for the PP. This assessment will be addressed in the ROD, once the public comments on the FS and PP are received and evaluated (U.S. EPA, 1988). The responses to comments are provided in the responsiveness summary of the subsequent ROD.

5.2 EVALUATION OF INDIVIDUAL ALTERNATIVES

The following sections present detailed analysis and cost summaries of the four proposed site-wide remedial alternatives. The evaluation is summarized in Table 5-1, and detailed costs are included in Appendix J.

5.3 SITE-WIDE ALTERNATIVE 1—NO ACTION

5.3.1 DESCRIPTION

The no-action alternative is required by the NCP [40 CFR §300.430(e)(6)] and CERCLA guidance (U.S. EPA, 1988) to provide a baseline to which all other remedial alternatives are compared. Site-Wide Alternative 1 assumes no remedial actions would be implemented to address the radiological contamination in soil and building materials and contents. Impacted soil and buildings would remain at current locations. In this alternative, no groundwater remedial systems would be installed or operated, and no LUCs would be used. In addition, any access controls currently in place, such as the site security fence, would not be maintained, and annual groundwater monitoring would no longer be performed.

5.3.2 ASSESSMENT

Overall Protection of Human Health and the Environment

This alternative would not be effective in protecting human health. Results of the risk assessment indicate several FUSRAP-related radiological constituents present in soil and building materials and contents pose unacceptable radiological doses to human receptors. Under Site-Wide 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 land use controls would be implemented. The potential for human exposure to COCs in soil and buildings, and the potential for off-site migration, could increase over time as a result of disturbances by humans and natural processes.

Uranium-impacted soils, which are a source of groundwater contamination, would remain on site. Exposure to COCs at unacceptable levels identified in the risk assessment would not be eliminated in the foreseeable future through natural attenuation, since the contaminated soils would not be remediated. As a result, this alternative would be ineffective in abating migration of contamination in groundwater. It would provide no administrative system to control the use of impacted groundwater, or monitor impacts to determine where they have occurred. Any long-term improvement of the groundwater quality would be through natural attenuation of the contaminants by biodegradation, adsorption to aquifer material, mineral precipitation, dispersion, and dilution. Groundwater monitoring would not be conducted to document these processes.

The no-action alternative is also not protective of the environment. Some potential risks to ecological receptors at the Guterl Site were identified based on the SLERA. However, given the localized nature of the exceedances of the screening levels used in the assessment, as well as the current and future use of the site (as industrial use), further assessment and considerations of ecological risks was determined not necessary in the RI. The no-action alternative does not provide a mechanism to maintain or confirm the industrial land use in the future. Some limited patches of habitat exist on abandoned portions of the site. The no-action alternative does not control any future changes in land use that would permit these habitats to expand into disturbed areas, or areas occupied by buildings and paved areas.

Compliance with ARARs

Site-Wide Alternative 1 does not comply with the ARARs, because no remedial action would be implemented, current conditions would not change. The risk-based ARAR for soils and buildings at the site is 10 CFR Part 20 Subpart E, Section 1402 for safe use by a construction worker. The no-action alternative would not comply with the safe release provisions of Sections 20.1402, which require that the annual dose to the critical group (defined as a construction worker for this site) does not exceed 25 mrem/yr. The current concentrations of radionuclides in the soil and buildings exceed ARAR-based PRGs developed based on these requirements (see Sections 3.5 for PRGs).

The HHRA evaluated potential risks, doses, and systemic effects to both current and future human receptors from exposure to contaminated building materials within the Excised Area, surface and subsurface soil, groundwater, and sediment and surface water within ditches, trenches, etc., and within the Erie Canal. The HHRA conducted for the RI modeled current contaminant conditions and found that the baseline and future doses are expected to exceed 25 mrem/yr. The HHRA, summarized in Section 6.7 of the RI report (USACE, 2010), presents that 10 EUs had annual dose estimates greater than 25 mrem/yr[4] at Year Zero, and 14 EUs had annual dose estimates greater than 25 mrem/yr in future years. Present and potential future risks, for each investigative area at the Guterl Site, are presented in Table 2-5.

Site-Wide Alternative 1 would not be protective of groundwater. The MCL for uranium [30 µg/L, as provided in 40 CFR 141.66(e)] is the chemical-specific ARAR for groundwater. This requirement is considered relevant and appropriate for groundwater. This alternative would not meet this ARAR because groundwater above the MCL would remain on and off site, and may continue to discharge via seeps along the Erie Canal. Although concentrations may be attenuated by natural processes, this alternative does not provide a mechanism to measure any natural reduction. This alternative also leaves soil in place, which may continue to impact groundwater.

Long-Term Effectiveness and Permanence

This alternative would not achieve long-term effectiveness or permanence. Radiologically contaminated soils, building materials, contents, and groundwater would remain in place. Although the existing site security fence could limit exposure to site contaminants, this alternative assumes that controls would not be maintained and provides no additional controls to prevent or reduce exposure to contaminants. Potential future exposures would remain at unacceptable levels because potential exposures currently exceed target levels, and none of the contaminated soil or buildings would be remediated. In addition, impacts to groundwater continue, and may increase. The remedy would not meet the RAOs provided in this FS. There would be no protection of potential receptors through contaminant containment, removal, or treatment. Impacted groundwater would continue to migrate off site, and would not be contained or monitored.

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[4] Excluding contributions from background.

Over a period of time, natural processes (such as radioactive decay and wind or surface water erosion) would result in some contaminant mass reduction on site; however, this process would be slow and would not be monitored. Under the current and expected future land use scenarios, there are potential exposures to human health if contamination remains in place. Therefore, Site-Wide Alternative 1 would not be effective in the long term and would not achieve any level of permanence.

The site-wide groundwater fate and transport model (detailed in Appendix F) was used to evaluate the no-action alternative. For the no-action scenario, it was assumed that soils will be left in place and no groundwater remedial actions will be performed. Uranium in soil is expected to continuously leach to groundwater for hundreds of years. The leachate concentrations over time were predicted and applied to the groundwater as transient recharge with concentrations varying over time. The leachate was allowed to mix with the existing groundwater plume, and the resultant plume was subjected to fate and transport processes such as advection and dispersion. The existing groundwater plume was based on concentrations measured in August 2011 and reported in the final *DGI Technical Memorandum* (Appendix A).

Due to contributions from soil leachate, the existing shallow groundwater plume persists at concentrations above MCL for approximately 780 years (Figures 4-5 and 4-6). Portions of the shallow groundwater plume remain off site in the vicinity of the southern property boundary towards the Erie Canal for approximately 670±50 years, and off site in the vicinity of the western boundary towards the quarry for approximately 710±50 years. In deep groundwater the existing plume persists at concentrations above MCL for over 1,000 years due to contributions from the soil leachate and the slower groundwater flow in this zone. Portions of the deep groundwater plume remain off site in the vicinity of the southern property boundary towards the Erie Canal for the entire 1,000+ year duration modeled, and off site in the vicinity of the western boundary towards the quarry between years 15±5 and 1,000+.

Groundwater discharges (via seeps) to the Erie Canal, which is an emergency backup water supply for the City of Lockport. Although the emergency supply piping still exists, the canal has not been used for this purpose in approximately 23 years and the city does not expect to use it again for this purpose. As shown in the mass balance calculations in Appendix D, this seep water is diluted by a factor of approximately 1,200 once it reaches the Erie Canal and any groundwater seeping to the canal will not impact surface water quality above the MCL for total uranium.

Reduction in Toxicity, Mobility, or Volume Through Treatment

This evaluation criterion refers to a reduction in toxicity, mobility, or volume through recovery or treatment. There is no treatment, so the statutory preference for treatment is not a component of the remedy. There would be no reduction in toxicity or volume. Mobility of contaminants would be unaffected. The volume of impacted media would be unaffected under this alternative.

Short-Term Effectiveness

Since there is no remediation or treatment being implemented, there would be no associated short-term increase in potential risk to site workers, community, or the environment. However, a reduction of contamination and achievement of site protection would not occur under this alternative.

Implementability
There would be no technology or engineering controls to implement under this alternative. There would be no services required, no permits to obtain, no administrative approvals, and no resources involved.

Cost
There would be no costs associated with this alternative.

5.4 SITE-WIDE ALTERNATIVE 2—DISMANTLEMENT AND OFF-SITE DISPOSAL OF BUILDINGS 1, 2, 3, 4/9, 5, 6, 8, 24, AND 35; COMPLETE SOIL REMOVAL TO THE SOIL PRG-GW AND OFF-SITE DISPOSAL; MONITORED NATURAL ATTENUATION WITH ENVIRONMENTAL MONITORING

5.4.1 DESCRIPTION

Site-Wide Alternative 2 consists of the following media-specific alternatives:

- Alternative B3—Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35 and building contents (described in Section 4.1.3)
- Alternative S3—Complete Soil Removal to the Soil PRG-GW and Off-Site Disposal (described in Section 4.2.3)
- Alternative G3—Monitored Natural Attenuation with Environmental Monitoring (described in Section 4.3.2)

For Site-Wide Alternative 2, impacted building materials, contents and soil above the PRG-GW would be removed and disposed of off site (see Figure 4-4). Impacted groundwater is addressed by MNA and environmental monitoring during the remedial timeframe. For this alternative, five-year reviews are expected to be required and are included in the cost estimates for the alternative. Five-year reviews may be required until contaminants on site are below levels that allow for UU/UE, unless the site achieves UU/UE after remedial action is completed. Environmental monitoring (including groundwater and seeps) would document the performance of this alternative until the uranium MCL is achieved.

5.4.2 ASSESSMENT

Overall Protection of Human Health and the Environment
Site-Wide Alternative 2 is protective of human health and the environment. Removal of radiologically contaminated soil above the soil PRG-GW would limit risks from exposure to contaminated soil to within acceptable levels for the construction worker critical group. Contaminated buildings and the contents above building DCGLs would be dismantled, decontaminated, and/or removed. Radiological contamination surveys would be conducted to sort materials to determine if building surfaces meet DCGLs, or if additional decontamination or removal is necessary. Whenever possible, materials would be recycled. Some of the larger equipment that can be decontaminated to meet DCGLs may be staged on site for decontamination for possible recycling or a disposition determined by USACE.

Dismantlement of Building 24 is necessary to access contaminated soil above the PRG-GW. All buildings except Building 24 are available for dismantlement and removal upon commencement of the remedial action. Building 24 is utilized and the dismantlement of Building 24 and the remediation of underlying soils is intended to occur at the time of the site-wide remedial action with property owner's consent. If Building 24 is not available or the property owner does not consent to its dismantlement at the time of the site-wide remedial action the inaccessible underlying soil and Building 24 will remain in place while the other buildings and contaminated soil are removed. If the building remains in place the FUSRAP-related contaminated soil underneath Building 24 will be determined to be inaccessible since the contaminants are located underneath an actively used building by the property owners. Dismantlement of Building 24 and removal of underlying soil would be deferred until a later date when the building is no longer actively used. If Building 24 becomes available prior to the completion of the site-wide remedial action then it would be dismantled and underlying soil removed at that time.

Once Building 24 and underlying soils were deemed accessible, the USACE would dismantle the building and excavate the soils to mitigate predicted groundwater impacts and preclude remedy modifications (i.e., long-term monitoring of Building 24 groundwater to ensure predictions are accurate for the below-MCL plume and associated effects on remedy durations).

If Building 24 remains in place the contamination under Building 24 would sit dormant unless aerially exposed due to building removal, where the roof, walls and floor slab are removed to facilitate infiltration into groundwater. Once this residual soil was exposed to infiltrate groundwater and generated a small-scale uranium plume, the groundwater modeling indicated the contamination is diluted to below the 30 μg/L MCL in the aquifer within the excised area boundary due to the small footprint of soil impacts under Building 24. This below-MCL plume is predicted to persist approximately 150 years after the balance of site is remediated. Since the groundwater concentration does not exceed the MCL (the RAO for groundwater) and contributes minor inputs to the groundwater system, the residual plume will not affect the timeframe or performance of the preferred remedy. If Building 24 and soil were removed at the same time, the plume impact would not adjust the groundwater remediation timeframe indicated in the alternatives and modeling. Additional information is in the following *Long-Term Effectiveness and Permanence* section.

Groundwater exceeding the MCL for uranium occurs beneath and downgradient of the site including at seeps along the Erie Canal. Although it is a potentially viable source, groundwater is currently not utilized at the site for drinking water or industrial purposes as the area is currently on the public water supply. The soil PRG-GW was developed to be protective of groundwater so that the uranium source will be removed. Concentrations of uranium in groundwater will decrease over time due to natural processes. Monitoring of groundwater would be performed to document the extent and levels of contamination and to document the reduction in uranium concentration. Natural attenuation parameters would be collected to document the conditions for natural degradation. Based on the groundwater fate and transport model (Appendix F), concentrations are predicted to decrease to below the MCL in approximately 120 years.

Compliance with ARARs

Chemical-specific ARAR-based PRGs selected for the Guterl Site were detailed in Section 3.5. Site-Wide Alternative 2 would comply with ARARs. The ARAR for radionuclides in soil would be satisfied by removal and off-site disposal. Radionuclide concentrations in soils would be reduced to below the soil PRG-GW, which is protective of groundwater to the MCL and protective of the construction worker. It would achieve the release conditions of 10 CFR 20.1402, which require residual radioactivity distinguishable from background radiation to result in a PRG that does not exceed 25 mrem/yr for potential receptors. Site-Wide Alternative 2 would ensure that the maximum dose to the average member of the critical group (the construction worker) would not exceed the 25 mrem/yr dose limit through the removal and off-site disposal of contaminated media including soil, buildings, and building contents exceeding the PRGs. Removal of building materials, contents, and soil to the PRGs would meet these requirements.

The MCL for uranium [30 µg/L, as provided in 40 CFR 141.66(e)] is the chemical-specific ARAR. As discussed previously, this requirement is considered relevant and appropriate for groundwater throughout the aquifer. This alternative would meet this ARAR through the natural reduction in concentration over time, using MNA to measure performance. The groundwater model predicts that if the soils that exceed the soil PRG-GW are removed, concentrations in groundwater will exceed MCLs for approximately 50 years in shallow groundwater and 120 years in deep groundwater. The MNA timeframe for Site-Wide Alternative 2 to achieve the uranium MCL in groundwater (i.e., 120 years) is considered reasonable when compared to the cleanup timeframes of PRG-CW modeled alternative (i.e., 660 years, respectively). Additionally, since the current and reasonable future land use of the site is industrial and due to the availability of a public water supply, the use of site groundwater for drinking water purposes is not planned for the foreseeable future.

Long-Term Effectiveness and Permanence

Under Site-Wide Alternative 2, soil and building COCs will not remain on site above the media-specific cleanup goals for a current and future expected industrial land use scenario; therefore, it is protective in the long term. The remedial goals are also protective of groundwater, which results in a low soil PRG-GW. Remediation to this level should allow for UU/UE, which will be demonstrated during the confirmation sampling.

Removal of impacted buildings, contents, and soils will be effective at reducing the risks on site for the long term. Decontamination of building contents, where feasible, also provides risk reduction. Removal of soil to the soil PRG-GW is also protective of groundwater for the long term throughout the majority of the site by reducing the source of uranium to groundwater to a level that does not impact this media above the MCL. Since the building material, contents, and soil are disposed of off site, these actions are considered a permanent reduction in risk. The soils and building actions can be implemented in approximately 19.4 months.

The removal of soils above the soil PRG-GW based on impact to groundwater would be permanent and highly effective in the long term for reducing groundwater contamination. Additionally, the alternative would provide a passive remediation system that would monitor groundwater quality and natural attenuation parameters to document the natural attenuation of contaminants through degradation, retardation, dispersion, adsorption, and mineral precipitation. The effectiveness of the natural attenuation of groundwater was evaluated (estimated) using the groundwater flow and transport model provided in Appendix F.

The MNA simulation results depict uranium fate and transport after the soil removal action has occurred such that soils that exceed the soil PRG-GW are removed. The uranium concentrations in the shallow groundwater are shown on Figure 4-9 (Alternative G3). Due to contributions from residual soil leachate, the existing plume persists at concentrations above the MCL for approximately 50 years in shallow groundwater. The shallow uranium plume is predicted to extend off site for approximately 20 years. The uranium concentrations in the deep groundwater are shown on Figure 4-10 (Alternative G3). The existing plume persists in deep groundwater at concentrations above MCL for approximately 120 years due to residual leachate through the soils. The deep uranium plume migrates off the site across the western boundary for approximately 100 years.

The soils under Building 24 include approximately 451 bank cubic meters (590 bank cubic yards), which is about 1% of the total 44,000 m^3 (58,000 yd^3) (*in situ*) to be removed for the PRG-GW. This small-scale source for uranium in groundwater will sit dormant unless aerially exposed due to building removal where the roof, walls and floor slab are removed to recharge groundwater (i.e., the building exterior is an inhibitor and prevents further infiltration into the soils).

A groundwater simulation was examined to reflect unimpeded leaching from uranium impacts only below Building 24, which assumes the balance of the site is remediated to PRG-GW. Once this residual soil was exposed to recharge (infiltration into groundwater) and generated a small-scale uranium plume, the groundwater modeling indicated the contamination is attenuated (diluted) to below the 30 µg/L MCL in the aquifer immediately downgradient of the soil-based inputs. More specifically, the plume is attenuated to below 10 µg/L within the excised area boundary due to the small footprint of soil impacts under Building 24, the associated concentrations relative to the balance of site (low), and the dilution capability of the aquifer (four-fold dilution and dispersion of leachate).

This below-MCL plume is predicted to persist approximately 150 years after the balance of site is remediated to PRG-GW. Since the groundwater concentration does not exceed the MCL (the RAO for groundwater) and contributes minor inputs to the groundwater system, the residual plume will not affect the timeframe or performance of the preferred remedy (i.e., concentration would not exceed the MCL during remedial timeframes and in the long term after remedy completion). If Building 24 and soil were removed at the same time, the plume impact would not adjust the groundwater remediation timeframe indicated in the alternatives and modeling. The eventual removal of inaccessible soils below Building 24 will ensure remedial consistency (site cleaned up to a uniform standard) and minimize the risk to the beneficial use of groundwater should the prediction underestimate the residual plume.

Groundwater discharges (via seeps) to the Erie Canal, which is an emergency backup water supply for the City of Lockport; although the emergency supply piping still exists, the canal has not been used for this purpose in approximately 23 years and the city does not expect to use it again for this purpose. As shown in the mass balance calculations in Appendix D, this seep water is diluted by a factor of approximately 1,200 once it reaches the Erie Canal and any groundwater seeping to the canal will not impact surface water quality above the MCL for total uranium. The time to achieve RAOs for groundwater is approximately 120 years.

Preliminary groundwater contaminant transport models estimated an extended remedial timeframe of up to 115 years following the completion of the removal of impacted soil exceeding the PRG-GW. The groundwater model may vary significantly from field results due to the significant changes that will occur on site due to remediation (e.g., soil disturbances and building dismantlement). Groundwater monitoring would be conducted in accordance with the monitoring program after soil source removal. Therefore, groundwater data will be assessed following the completion of the soil removal to determine the reaction of the plume. This data collection will provide a dataset with sufficient statistical power to assess the efficacy of the MNA process to achieve RAOs. Reviews allow evaluation of the effectiveness of remediation as well as data obtained from ongoing monitoring to assess the presence and behavior of remaining contaminants. If monitoring demonstrates changes to environmental conditions or the attenuation process is not proceeding as expected, then decisions regarding what actions are necessary will be made at that time based on the data and information gathered during the monitoring program. The frequency of groundwater well sampling would occur semi-annually for years 1–3; annually for years 4–30; and every five years for years 35–120. The existing 16 shallow and 10 deep monitoring wells on site would be sampled. Five groundwater seep locations along the Erie Canal (if five seeps are active and available to collect groundwater from) would be sampled, annually for 120 years. Sampling frequency could change depending on groundwater response to soil source removal.

Reduction in Toxicity, Mobility, or Volume through Treatment

Future groundwater contamination volume and mobility would also be reduced by the soil removal. MNA is considered a passive treatment technology. There is no active recovery or active treatment for groundwater, so the statutory preference for treatment is not a major component of the remedy. Mobility of contaminants in groundwater is unaffected by treatment. The volume of impacted groundwater is unaffected by treatment under this alternative, except for that which occurs naturally through dispersion and sorption.

Short-Term Effectiveness

Since the implementation of this alternative would involve soil remediation, building remediation, and the drilling and installation of monitoring wells, there would be a potential risk to on-site workers and the community commensurate with these types of activities, but risks would be controlled by mitigative measures included in a site-specific health and safety plan.

The excavation, transport, and disposal activities could pose short-term risks to site workers and the surrounding community. There could also be short-term risks due to potential exposures to remediation workers during the decontamination and building dismantlement activities. Air quality could be affected by release of particulates during soil excavation. To minimize dust generation during excavation activities, impacted soil would be kept moist or covered with tarps. If dry building decontamination methods are used, a dust collection shroud would be used to control dust and debris. The short-term risks to workers resulting from remediation activities would be mitigated through the use of good safety practices and PPE.

There is a slight potential for an increase in short-term risks to the surrounding community from excavation and dismantlement activities due to fugitive dust generation, but risks would be controlled by mitigative measures. In addition, air monitoring would be conducted at the work site and the site perimeter to ensure the health of workers and the surrounding community. Some minimal short-term risks to the surrounding community would result from the transport of wastes off site through nearby residential areas. The transportation of contaminated building materials and contents to an off-site disposal location is required as part of this alternative, which presents transportation-related risks. Risks would be mitigated by packaging shipped materials in accordance with Department of Transportation regulations to ensure the contents remain safely enclosed in the event of an accident. A site-specific health and safety plan would address potential exposures and monitoring requirements to ensure protection of the workers and community.

There would be a low risk to the workers during well drilling, installation, and groundwater sampling activities. There would be low risk to the community because the monitoring wells would remain capped and locked except during sampling, all sampling and purge water would be contained and transported off site for proper disposal, and traffic controls would be maintained during sampling for any wells installed in or near roadways.

Short-term environmental impacts (such as loss of vegetation, disturbance of soil, and increased erosion) could result from soil and building removal. If needed, erosion control materials such as silt fences would be installed to minimize erosion and reduce surface water runoff during excavation activities. Water that has collected within the excavations will be sampled and analyzed, and either sent to an off-site lab or an on-site laboratory and treatment plant. If analysis results indicate treatment is necessary, the water will be treated before discharge.

Time to achieve the RAOs for Site-Wide Alternative 2 is 120 years. The time estimate to implement the soil removal action, building remedial action, implementation plans and final documentation of the remedy is approximately 136 weeks (32 months). Time to complete the full remedial action and groundwater remediation is approximately 122 years and 8 months.

Implementability

The construction activities for Site-Wide Alternative 2 would involve building contents decontamination and building dismantlement, soil remediation, the installation and maintenance of additional monitoring wells, and well decommissioning.

Differentiating clean soils from impacted soils using only field instrumentation will be difficult because of the low soil PRG-GW. The extent of impacted soils will be determined using the current RI data as well as a laboratory. In addition, confirmatory samples will be submitted to an off-site laboratory.

Decontamination is a conventional method of remediating radiologically contaminated structures and would be easily implemented. Decontamination equipment and trained personnel are readily available. Soil excavation, well decommissioning, installation, and sampling are well known technologies. Services and materials would be readily available. Long-term maintenance and care for the monitoring wells would need to be provided. For this alternative, installation of the groundwater recovery wells is rated as easy to implement. No major administrative problems are anticipated that would limit the implementability of Site-Wide Alternative 2.

Cost

Detailed costs are provided in Appendix J. The total capital costs are estimated to be $180.9 million and include preparation of project plans, building/contents decontamination, building dismantlement, excavation, confirmatory sampling, transport, off-site disposal, site restoration, preparation of a remedial action completion report, preparation of a groundwater MNA plan, and preparation of a long-term environmental monitoring plan. The present worth costs for lifetime O&M, assuming a 120-year period, is estimated at $5.2 million. O&M includes MNA groundwater sampling, environmental sampling, maintenance of fencing and signage, and performance of five-year reviews until UU/UE is achieved. The total present worth (discounted) cost for this alternative is estimated at $186.1 million of which $180.9 million are capital costs and $5.2 million are total O&M costs over 120 years.

5.5 SITE-WIDE ALTERNATIVE 3—DISMANTLEMENT AND OFF-SITE DISPOSAL OF BUILDINGS 1, 2, 3, 4/9, 5, 6, 8, 24, AND 35; COMPLETE SOIL REMOVAL TO THE SOIL PRG-GW AND OFF-SITE DISPOSAL; GROUNDWATER RECOVERY USING EXTRACTION WELLS AND A RUBBLIZED TRENCH WITH *EX SITU* TREATMENT, WITH ENVIRONMENTAL MONITORING

5.5.1 DESCRIPTION

Site-Wide Alternative 3 consists of the following media-specific alternatives:

- Alternative B3—Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35 and building contents (described in Section 4.1.3)
- Alternative S3—Complete Soil Removal to the Soil PRG-GW and Off-Site Disposal (described in Section 4.2.3)
- Alternative G5—Groundwater Recovery using Vertical Extraction Wells and a Rubblized Trench with *Ex Situ* Treatment, and Environmental Monitoring (described in Section 4.3.4)

For Site-Wide Alternative 3, impacted building materials, contents, and soil above the PRG-GW would be removed and disposed of off site. Impacted groundwater is addressed by extraction using a rubblized trench and vertical extraction wells with *ex situ* treatment. For this alternative, five-year reviews are expected to be required and are included in the cost estimates for the alternative. Five-year reviews may be required until contaminants on site are below levels that allow for UU/UE, unless the site achieves UU/UE after remedial action is completed. Environmental monitoring would document the performance of this alternative.

5.5.2 ASSESSMENT

Overall Protection of Human Health and the Environment

Site-Wide Alternative 3 is protective of human health and the environment. Under this alternative, potential human health exposure for the construction worker critical group would be controlled by the removal of radiologically contaminated soil and buildings. The use of groundwater recovery on site would remove contaminant mass and stabilize the uranium plume from migrating off site. Actions taken under this alternative for soil and buildings are identical to those taken under Site-Wide Alternative 2.

Actions for groundwater include groundwater extraction and *ex situ* treatment and a rubblized trench will be installed near the southern excised property boundary with vertical extraction wells to remove uranium impacted groundwater above the MCL. *Ex situ* treatment for this alternative indicates the groundwater will be pumped out of the ground into a treatment facility, which treats the recovered water to remove contaminants. The rubblized trench will act as a sink or drain in the shallow groundwater system to intercept the uranium plume before additional impacted groundwater migrates off site. The use of a trench in place of standard vertical wells to recover groundwater increases the likelihood of intercepting fractures that control groundwater flow. The extracted groundwater may be treated with ion exchange technology or a similar technology in the treatment facility built on site to reduce the amount of contamination in groundwater.

Monitoring of groundwater would be performed while the treatment system is in operation. Included in the monitoring program will be additional piezometers in the vicinity of the trench to document hydraulic performance and determine if modifications or maintenance are necessary. This alternative would be implemented in conjunction with soil removal to the soil PRG-GW, which is protective of groundwater. Based on the groundwater fate and transport model (Appendix F) concentrations are predicted to decrease to below the MCL in approximately 30 years. This alternative provides for the continual evaluation of removing soil to the soil PRG-GW at both the implementation and monitoring stages; through sampling and modeled timeframe to achieve MCLs, the groundwater-monitoring program will further demonstrate that the soil PRG-GW concentration is protective of groundwater.

Dismantlement of Building 24 is necessary to access contaminated soil above the PRG-GW. All buildings except Building 24 are available for dismantlement and removal upon commencement of the remedial action. Building 24 is utilized and the dismantlement of Building 24 and the remediation of underlying soils is intended to be conducted at the time of the site-wide remedial action with the property owner’s consent. If Building 24 is not available or the property owner does not consent to its dismantlement at the time of the site-wide remedial action the inaccessible underlying soil and Building 24 will remain while the other buildings and contaminated soil are removed and the groundwater treatment and recovery system is installed. The FUSRAP-related contaminated soil underneath Building 24 will be determined to be inaccessible, since the contaminants are located underneath an actively used building by the property owners. Dismantlement of Building 24 will be deferred until a later date when the building is no longer actively used. If Building 24 becomes available prior to the completion of the site-wide remedial action then it would be dismantled and underlying soil removed at that time.

Once Building 24 and underlying soils were deemed accessible, the USACE would dismantle the building and excavate the soils to mitigate predicted groundwater impacts and preclude remedy modifications (i.e., long-term monitoring of Building 24 groundwater to ensure predictions are accurate for the below-MCL plume and associated effects on remedy durations).

If Building 24 remains in place the contamination under Building 24 would sit dormant unless aerially exposed due to building removal, where the roof, walls and floor slab are removed to facilitate infiltration into groundwater. Once this residual soil was exposed to infiltrate groundwater and generated a small-scale uranium plume, the groundwater modeling indicated the contamination is diluted to below the 30 µg/L MCL in the aquifer within the excised area boundary due to the small footprint of soil impacts under Building 24. This below-MCL plume is predicted to persist approximately 150 years after the balance of site is remediated. Since the groundwater concentration does not exceed the MCL (the RAO for groundwater) and contributes minor inputs to the groundwater system, the residual plume will not affect the timeframe or performance of the preferred remedy. If Building 24 and soil were removed at the same time, the plume impact would not adjust the groundwater remediation timeframe indicated in the alternatives and modeling. Additional information is in the following *Long-Term Effectiveness and Permanence* section.

Compliance with ARARs

Site-Wide Alternative 3 would comply with ARARs. The chemical-specific ARAR for radionuclides in soil and buildings would be satisfied by removal and off-site disposal. The MCL for uranium [30 µg/L, as provided in 40 CFR 141.66(e)] is the chemical-specific groundwater ARAR. As discussed previously, this requirement is considered relevant and appropriate throughout the aquifer. This alternative would meet this ARAR through removal from the soil subsurface combined with *ex situ* treatment.

Long-Term Effectiveness and Permanence

Under Site-Wide Alternative 3, soil and building COCs will not remain on site above the media-specific PRGs, which are protective of both the construction worker and groundwater; therefore, it is protective in the long term for industrial land use. The remedial goals are also protective of groundwater which results in a low soil PRG-GW. The soils and building actions can be implemented in approximately 19.4 months. To complete the full action, including installing the groundwater recovery system and final documentation will require approximately 31 months.

The excavation and removal of impacted soils under the soil remedial action would result in a permanent reduction in the primary source of groundwater contamination. Additionally, the uranium in groundwater would be remediated using groundwater extraction and *ex situ* treatment.

Preliminary groundwater contaminant transport models estimated an extended remedial timeframe of up to 115 years following the completion of the removal of impacted soil exceeding the PRG-GW. The groundwater model may vary significantly from field results due to the significant changes that will occur on site due to remediation (e.g., soil disturbances and building dismantlement). Therefore, groundwater data will be assessed following the completion of the soil removal to determine the reaction of the plume. This data collection will provide a dataset with sufficient statistical power to assess the efficacy of the remedial process to achieve RAOs. Data assesment allows evaluation of the effectiveness of remediation as well as monitoring the presence and behavior of remaining contaminants. Groundwater recovery will be implemented using a series of vertical extraction wells and a rubblized trench along the southern Excised Area boundary to extract contaminated groundwater.

The uranium concentrations in the shallow groundwater are shown on Figure 4-13 (Alternative G5). Based on modeling, within 10 years after the operation of vertical extraction wells and the trench, the trench would prevent further off-site plume migration and separate the off-site plume from the on-site plume (i.e., create an orphaned plume downgradient of the trench). Both the off-site and on-site uranium plumes shrink to within the property boundary within approximately 30 years, based on groundwater modeling.

The uranium concentrations in the deep groundwater are shown on Figure 4-14 (Alternative G5). The deep uranium plume also shrinks to near MCL levels by 30 years (and is contained within the site boundaries). The modeling results indicate that groundwater extraction with vertical extraction wells and a rubblized trench is a viable alternative for achieving MCLs in groundwater. The extraction and treatment of impacted groundwater is considered a permanent solution once MCLs are achieved. For the purposes of this FS, it is assumed that an environmental monitoring program, including groundwater and seeps, would remain part of the alternative until the extraction and treatment resulted in groundwater meeting the RAOs. The removal of contamination source soils would be permanent and highly effective in the long term for reducing groundwater contamination. The frequency of groundwater well sampling would occur semiannually for years 1–3; annually for years 4–5; and every five years for years 10–30. After installation of additional groundwater monitoring wells, approximately 26 shallow and 14 deep monitoring wells on site and estimated installation of five trench extraction sumps/wells would be sampled at that frequency. Five groundwater seep locations along the Erie Canal (if five seeps are active and available to collect groundwater from) would be sampled, annually for 30 years. Sampling frequency could change depending on groundwater response to soil source removal.

The soils under Building 24 include approximately 451 bank cubic meters (590 bank cubic yards), which is about 1% of the total 44,000 m^3 (58,000 yd^3) (*in situ*) to be removed for the PRG-GW. This small-scale source for uranium in groundwater will sit dormant unless aerially exposed due to building removal where the roof, walls and floor slab are removed to recharge groundwater (i.e., the building exterior is an inhibitor and prevents further infiltration into the soils).

A groundwater simulation was examined to reflect unimpeded leaching from uranium impacts only below Building 24, which assumes the balance of the site is remediated to PRG-GW. Once this residual soil was exposed to recharge (infiltration into groundwater) and generated a small-scale uranium plume, the groundwater modeling indicated the contamination is attenuated (diluted) to below the 30 µg/L MCL in the aquifer immediately downgradient of the soil-based inputs. More specifically, the plume is attenuated to below 10 µg/L within the excised area boundary due to the small footprint of soil impacts under Building 24, the associated concentrations relative to the balance of site (low), and the dilution capability of the aquifer (four-fold dilution and dispersion of leachate).

This below-MCL plume is predicted to persist approximately 150 years after the balance of site is remediated to PRG-GW. Since the groundwater concentration does not exceed the MCL (the RAO for groundwater) and contributes minor inputs to the groundwater system, the residual plume will not affect the timeframe or performance of the preferred remedy (i.e., concentration would not exceed the MCL during remedial timeframes and in the long term after remedy completion). If Building 24 and soil were removed at the same time, the plume impact would not adjust the groundwater remediation timeframe indicated in the alternatives and modeling.

The eventual removal of inaccessible soils below Building 24 will ensure remedial consistency (site cleaned up to a uniform standard) and minimize the risk to the beneficial use of groundwater should the prediction underestimate the residual plume.

Groundwater discharges (via seeps) to the Erie Canal, which is an emergency backup water supply for the City of Lockport; although the emergency supply piping still exists, the canal has not been used for this purpose in approximately 23 years and the city does not expect to use it again for this purpose. As shown in the mass balance calculations in Appendix D, this seep water is diluted by a factor of approximately 1,200 once it reaches the Erie Canal and any groundwater seeping to the canal will not impact surface water quality above the MCL for total uranium.

Reduction in Toxicity, Mobility, or Volume Through Treatment

Future groundwater contamination volume and mobility would also be reduced by the soil removal. Under this alternative, groundwater would be extracted from the aquifer and treated to remove contaminants, thus reducing their volume and mobility. Off-site migration would be reduced or eliminated through the hydraulic control (groundwater capture zones) produced by the operation of the extraction wells and the rubblized trench, which would intercept the plume at the property boundary. Groundwater extraction and treatment would meet the preference in CERCLA for treatment on site because this remedy would result in a reduction in toxicity, mobility, and volume of uranium in groundwater, and reduce the potential for migration of the COC from the site. Other contaminants within the capture zone may also be removed and treated. Portions of the uranium plume downgradient of the rubblized trench and extraction wells will continue to migrate towards the Erie Canal and naturally attenuate via dispersion and discharge to the canal. This “orphaned plume” will be monitored and pose an exposure risk during a portion of the 30-year treatment period, when site-area groundwater controls are in place to minimize such risks.

Short-Term Effectiveness

Since the implementation of this alternative would involve soil remediation, building/contents remediation, drilling and installation of monitoring and extraction wells, and rubblized trench blasting; there would be a potential risk to on-site workers and the community equal with these types of activities. These risks would be controlled by mitigative measures included in a site-specific health and safety plan (SSHP). The SSHP will include a site-specific blasting plan that includes all notifications, surveys, and testing needed to protect above and underground structures and personnel. The soil and building alternatives are the same as Site-Wide Alternative 2, where these short-term risks are discussed in detail (Section 5.3).

The excavation, transport, and disposal activities could pose short-term risks to site workers and the surrounding community. There could also be short-term risks due to potential exposures to remediation workers during the decontamination and building dismantlement activities. Air quality could be affected by release of particulates during soil excavation. To minimize dust generation during excavation activities, impacted soil would be kept moist or covered with tarps. If dry building decontamination methods are used, a dust collection shroud would be used to control dust and debris. The short-term risks to workers resulting from remediation activities would be mitigated through the use of good safety practices and PPE.

Site-Wide Alternative 3 has the potential to enhance the transport of non-FUSRAP VOCs in groundwater which have been observed below the excised property. This should be considered as a short-term effectiveness risk. A rubblized trench with extraction wells placed down-gradient of Building 17, which is actively used by ATI Specialty Materials, could draw the VOC plume beneath the building. This may exacerbate a vapor intrusion issue within the building and increase the risk to human health for building occupants. Challenges during the remedial design phase include effectively capturing the uranium plume in a reasonable time frame, while minimizing transport of volatiles, especially under any current or future building where it has the potential to create a vapor intrusion pathway. Consequently, the rubblized trench would be located along the southern boundary of the excised property, which is north of Building 17. This will assist in capturing the groundwater before encountering the actively used buildings.

There is a slight potential for an increase in short-term risks to the surrounding community from excavation and dismantlement activities due to fugitive dust generation, but risks would be controlled by mitigative measures. In addition, air monitoring would be conducted at the work site and the site perimeter to ensure the health of workers and the surrounding community. Some minimal short-term risks to the surrounding community would result from the transport of wastes off site through nearby residential areas. The transportation of contaminated building materials and contents to an off-site disposal location is required as part of this alternative, which presents transportation-related risks. Risks would be mitigated by packaging shipped materials in accordance with Department of Transportation regulations to ensure the contents remain safely enclosed in the event of an accident. A site-specific health and safety plan would address potential exposures and monitoring requirements to ensure protection of the workers and community.

There would be low risk to the workers during well drilling, installation, and groundwater sampling activities and moderate risk during blasting of the rubblized trench. There would be low risk to the community for all on-site activities. There is low risk to the community for off-site monitoring, because the monitoring wells would remain capped and locked except during sampling, all sampling and purge water would be contained and transported off site for proper disposal, and traffic controls would be maintained during sampling for any wells installed in or near roadways. There is some additional risk for operation of the treatment plant, which will generate a spent treatment media high in uranium concentration, which will require handling and disposal.

Short-term environmental impacts (such as loss of vegetation, disturbance of soil, and increased erosion) could result from soil and building/contents removal. If needed, erosion control materials such as silt fences would be installed to minimize erosion and reduce surface water runoff during excavation activities. Water that has collected within the excavations will be sampled and analyzed, and either sent to an off-site lab or an on-site laboratory and treatment plant. If analysis results indicate treatment is necessary, the water will be treated before discharge.

The remedial actions including soil removal, building remediation, installing the groundwater recovery system, and final documentation would require approximately 135 weeks (31 months).

The entire remedial action including the groundwater remediation would take approximately 32 years and 7 months.

Implementability

Construction activities for this alternative include radiologically contaminated soil and building/contents remediation, installation of recovery and monitoring wells, installation of a rubblized trench, construction of a treatment plant and associated piping from the wells to the plant, and groundwater sampling.

Actions taken under this alternative for soil and building materials and contents are identical to those taken under Site-Wide Alternative 2, as discussed in Section 5.3.2. Differentiating clean soils from impacted soils using only field instrumentation will be difficult because of the low soil PRG-GW. The extent of impacted soils will be determined using the current RI data as well as an off-site laboratory. In addition, confirmatory samples will be submitted to an off-site laboratory.

For Site-Wide Alternative 3, installation of the groundwater recovery wells, collection piping, and treatment system are rated as low (difficult) to implement. Under Site-Wide Alternative 3, use of a rubblized trench on the property boundary will facilitate interception of natural bedrock fractures by creating a continuous high-permeability sump for the collection of groundwater. Since the trench is created by subsurface blasting, the locations of on-site and off-site buildings, roadways, utilities, and the canal will need to be considered. Design-level data collection would include the definition of bedrock properties required for blasting plans that would limit infrastructure risks, delineation of preferential migration pathways in the bedrock (regional fractures) via geophysics to ensure plume capture, and potential infrastructure protection during trench installation (e.g., temporarily fortifying at-risk structures, trench blasting in small increments, or using directional charges designed to offset seismic artifacts). The design requirements will ensure the bedrock rubblization will not extend beyond the intended target zones (both vertically and horizontally).

Site-Wide Alternative 3 has the potential to enhance the transport of non-FUSRAP VOCs in groundwater which have been observed below the excised property. This should be considered an implementability risk as well as a short-term effectiveness risk. A rubblized trench with extraction wells placed down-gradient of Building 17, which is actively used by ATI Specialty Materials, could draw the VOC plume beneath the building. This may exacerbate a vapor intrusion issue within the building and increase the risk to human health for building occupants. Challenges during the remedial design phase include effectively capturing the uranium plume in a reasonable time frame, while minimizing transport of volatiles, especially under any current or future building where it has the potential to create a vapor intrusion pathway. Consequently, the rubblized trench would be located along the southern boundary of the excised property, which is north of Building 17. This will assist in capturing the groundwater before encountering the actively used buildings.

Future site development of the excised area would be limited due to the existence of the trench, extraction wells, and the groundwater treatment plant for the duration of the estimated 30-year O&M period.

Decontamination is a conventional method of remediating radiologically contaminated structures and would be easily implemented. Decontamination equipment and trained personnel are readily available. Soil excavation, well decommissioning, installation, and sampling are well known technologies. Services and materials would be readily available. Long-term maintenance and care for the monitoring wells would need to be provided.

No major administrative problems are anticipated that would limit the implementability of Site-Wide Alternative 3. Well and rubblized trench locations have been selected so that they are within the excised property boundary. The location of on- and off-site roadways and utilities will need to be considered. This alternative would require close coordination of remediation activities with ATI Specialty Materials.

Cost
Detailed costs are provided in Appendix J. Total capital costs for this alternative are estimated to be $189.3 million and include preparation of project plans, building/contents decontamination, building dismantlement, excavation, confirmatory sampling, transport, off-site disposal, site restoration, preparation of a remedial action completion report, design of a groundwater recovery and treatment system, installation of the groundwater recovery and treatment system, and preparation of a long-term groundwater and environmental monitoring plan. The present worth costs for lifetime O&M, assuming a 30-year period, is estimated at $16.3 million. O&M includes long-term operation of the groundwater recovery and treatment system, groundwater sampling, environmental sampling, maintenance of fencing and signage, and performance of five-year reviews until UU/UE is achieved. The total present worth (discounted) cost for this alternative is estimated at $205.6 million of which $189.3 million are capital costs and $16.3 million are total O&M over 30 years.

5.6 SITE-WIDE ALTERNATIVE 4—DECONTAMINATION OF BUILDING 1; DISMANTLEMENT AND OFF-SITE DISPOSAL OF BUILDINGS 2, 3, 4/9, 5, 6, 8, AND 24; COMPLETE SOIL REMOVAL TO THE SOIL PRG-CW AND OFF-SITE DISPOSAL; MONITORED NATURAL ATTENUATION WITH ENVIRONMENTAL MONITORING

5.6.1 DESCRIPTION

Site-Wide Alternative 4 consists of the following media-specific alternatives:

- Alternative B2—Decontamination of Building 1; Dismantlement and Off-Site Disposal of Buildings 2, 3, 4/9, 5, 6, 8, and 24 (described in Section 4.1.2)
- Alternative S2—Complete Soil Removal to the Soil PRG-CW and Off-Site Disposal (described in Section 4.2.2)
- Alternative G2—Monitored Natural Attenuation with Environmental Monitoring (described in Section 4.3.2)

For Site-Wide Alternative 4, impacted building materials, contents, and soil would be removed and disposed of off-site. Decontamination of portions of Building 1 above the DCGLs would be performed. The soils underlying Building 1 are not impacted above the Soil PRG-CW, therefore building dismantlement is not required. Impacted groundwater is addressed by MNA. The length of time required to meet MCL may be re-evaluated after the remediation of soil contamination. For this alternative, five-year reviews are expected to be required and are included in the cost estimates for the alternative. Five-year reviews may be required until contaminants on site are below levels that allow for UU/UE, unless the site achieves UU/UE after remedial action is completed. Environmental monitoring (including groundwater and groundwater seeps) would document the performance of this alternative until the uranium MCL is achieved.

5.6.2 ASSESSMENT

Overall Protection of Human Health and the Environment

Site-Wide Alternative 4 is protective of human health and the environment. Removal of radiologically contaminated soil above the Soil PRG-CW would limit risks from exposure to contaminated soil to within acceptable levels for the critical group (construction worker). For buildings located on impacted soil, the contaminated buildings and the contents above DCGLs would be dismantled, decontaminated, and/or removed. Limited decontamination would be performed on building contents to remove radiological contamination. Decontamination of portions of Building 1 above the DCGLs would be performed. The primary methods for decontamination of building materials would be vacuuming and scabbling. Radiological contamination surveys would be conducted to sort materials after treatment to determine if building surfaces meet DCGLs, or if additional decontamination or removal is necessary. Whenever possible, materials would be recycled. Some of the larger equipment that can be decontaminated to meet DCGLs may be staged on site. Soils underlying Building 1 do not exceed the Soil PRG-CW, thus dismantlement of the building is not necessary.

Dismantlement of Building 24 is necessary to access contaminated soil above the PRG-GW. All buildings except Building 24 are available for dismantlement and removal upon commencement of the remedial action. Building 24 is utilized and the dismantlement of Building 24 and the remediation of underlying soils is intended to be conducted at the time of the site-wide remedial action with property owner's consent. If Building 24 is not available or the property owner does not consent to its dismantlement at the time of the site-wide remedial action the inaccessible underlying soil and Building 24 will remain while the other buildings and contaminated soil are removed. Dismantlement of Building 24 will be deferred until a later date when the building is no longer actively used. The FUSRAP-related contaminated soil underneath Building 24 will be determined to be inaccessible, since the contaminants are located underneath an actively used building by the property owners.

Once Building 24 and underlying soils were deemed accessible, the USACE would dismantle the building and excavate the soils to mitigate predicted groundwater impacts and preclude remedy modifications (i.e., long-term monitoring of Building 24 groundwater to ensure predictions are accurate for the below-MCL plume and associated effects on remedy durations).

If Building 24 remains in place the contamination under Building 24 would sit dormant unless aerially exposed due to building removal, where the roof, walls and floor slab are removed to facilitate infiltration into groundwater. Once this residual soil was exposed to infiltrate groundwater and generated a small-scale uranium plume, the groundwater modeling indicated the contamination is diluted to below the 30 μg/L MCL in the aquifer within the excised area boundary due to the small footprint of soil impacts under Building 24. This below-MCL plume is predicted to persist approximately 150 years after the balance of the site is remediated. Since the groundwater concentration does not exceed the MCL (the RAO for groundwater) and contributes minor inputs to the groundwater system, the residual plume will not affect the timeframe or performance of the preferred remedy. If Building 24 and soil were removed at the same time, the plume impact would not adjust the groundwater remediation timeframe indicated in the alternatives and modeling. Additional information is in the following *Long-Term Effectiveness and Permanence* section.

Groundwater exceeding the MCL for uranium occurs beneath and downgradient of the site including at seeps along the Erie Canal. Although it is a potentially viable source, groundwater is currently not utilized at the site for drinking water or industrial purposes. The area is currently on the public water supply and currently the City of Lockport generally does not approve well permits. Although the Soil PRG-CW was developed to be protective of the construction worker, removal of soil above this value would also address a portion of the uranium present in soils, which acts as a continuing or residual source for groundwater contamination. Concentrations of uranium in groundwater will decrease over time due to natural processes, which would be monitored to document the extent and levels of contamination, along with the reduction in uranium concentration. Natural attenuation parameters would be collected to document the conditions for natural degradation. Based on the groundwater fate and transport model (Appendix F), concentrations are predicted to decrease to below the MCL in approximately 660 years.

Compliance with ARARs

Site-Wide Alternative 4 would comply with ARARs. The chemical-specific ARAR for radionuclides in soil would be satisfied. Radionuclide concentrations in soils would be reduced to below the Soil PRG-CW, which is protective of the critical group, the construction worker. It would achieve the unrestricted release conditions of 10 CFR 20.1402, which require residual radioactivity that is distinguishable from background radiation to result in a PRG that does not exceed 25 mrem/yr for potential receptors. Site-Wide Alternative 4 would ensure that the maximum dose to the average member of the critical group (the construction worker) would not exceed the 25 mrem/yr dose limit through the decontamination of selected buildings, removal and off-site disposal of contaminated media including soil, buildings, and building contents exceeding the PRG-CW. Removal of building materials, contents, and soil to the PRG-CW would meet these requirements.

The MCL for uranium [30 µg/L, as provided in 40 CFR 141.66(e)] is the groundwater ARAR. As discussed previously, this requirement is considered relevant and appropriate for groundwater throughout the aquifer. This alternative would meet this ARAR through the natural reduction in concentration over time, using MNA to measure performance. The groundwater model predicts that if the soils that exceed the Soil PRG-CW are removed, concentrations in groundwater will exceed MCLs for approximately 430 years in shallow groundwater and 660 years in deep groundwater. Additionally, since the current and reasonable future land use of the site is industrial and due to the availability of a public water supply, the use of site groundwater for drinking water purposes is not planned for the foreseeable future.

Long-Term Effectiveness and Permanence

Under Site-Wide Alternative 4, soil and building COCs will not remain on site above the media-specific cleanup goals for an expected industrial land-use scenario; therefore, it is protective in the long term for the critical user. Remediation to the building DCGLs and the Soil PRG-CW may allow for minimal risk for the critical group for soils, which will be demonstrated during the confirmation sampling. Removal of impacted buildings, contents, and soils will be effective at reducing the risks on site for the long term. Decontamination of building contents, where feasible, also provides risk reduction. Since the building material, contents, and soil are disposed of off site, these actions are considered a permanent reduction in risk. The soils and building actions can be implemented in approximately 19.4 months.

The soil remedial goal was not developed to eliminate impacts to groundwater but some reduction of the uranium source in soil occurs with the removal of soil above the soil PRG-CW. This reduction is considered permanent because the soils are disposed of off site. The alternative would include plume monitoring and document the natural attenuation of contaminants through degradation, retardation, dispersion, adsorption, and mineral precipitation. The effectiveness of the natural attenuation of groundwater was evaluated (estimated) using the groundwater flow and transport model provided in Appendix F.

The soils under Building 24 include approximately 451 bank cubic meters (590 bank cubic yards) (*in situ*), calculated using the PRG-GW levels that would provide a small uranium source load to the groundwater.

This is a small-scale source for uranium in groundwater, which will sit dormant unless aerially exposed due to building removal where the roof, walls and floor slab are removed to recharge groundwater (i.e., the building exterior is an inhibitor and prevents further infiltration into the soils).

A groundwater simulation was examined to reflect unimpeded leaching from uranium impacts only below Building 24, which assumes the balance of the site is remediated to PRG-GW. Once this residual soil was exposed to recharge (infiltration into groundwater) and generated a small-scale uranium plume, the groundwater modeling indicated the contamination is attenuated (diluted) to below the 30 μg/L MCL in the aquifer immediately downgradient of the soil-based inputs. More specifically, the plume is attenuated to below 10 μg/L within the excised area boundary due to the small footprint of soil impacts under Building 24, the associated concentrations relative to the balance of site (low), and the dilution capability of the aquifer (four-fold dilution and dispersion of leachate).

This below-MCL plume is predicted to persist approximately 150 years after the balance of the site is remediated to PRG-GW. Since the groundwater concentration does not exceed the MCL (the RAO for groundwater) and contributes minor inputs to the groundwater system, the residual plume will not affect the timeframe or performance of the preferred remedy (i.e., concentration would not exceed the MCL during remedial timeframes and in the long term after remedy completion). If Building 24 and soil were removed at the same time, the plume impact would not adjust the groundwater remediation timeframe indicated in the alternatives and modeling.

The eventual removal of inaccessible soils below Building 24 will ensure remedial consistency (site cleaned up to a uniform standard) and minimize the risk to the beneficial use of groundwater should the prediction underestimate the residual plume.

Groundwater discharges (via seeps) to the Erie Canal, which is an emergency backup water supply for the City of Lockport; although the emergency supply piping still exists, the canal has not been used for this purpose in approximately 23 years and the city does not expect to use it again for this purpose. As shown in the mass balance calculations in Appendix D, this seep water is diluted by a factor of approximately 1,200 once it reaches the Erie Canal and any groundwater seeping to the canal will not impact surface water quality above the MCL for total uranium. The time to achieve RAOs for groundwater is approximately 660 years.

The MNA simulation results depict uranium fate and transport after the soil removal action has occurred such that soils that exceed the soil PRG-CW are removed. The uranium concentrations in the shallow groundwater are shown on Figure 4-7 (Alternative G2). Due to contributions from residual soil leachate, the existing plume persists at concentrations above the MCL for approximately 430 years in shallow groundwater. The shallow uranium plume is predicted to extend off site for approximately 320 years. The uranium concentrations in the deep groundwater are shown on Figure 4-8 (Alternative G2). The existing plume persists in deep groundwater at concentrations above MCL for approximately 660 years due to residual leachate through the soils. The deep uranium plume migrates off the site across the western boundary for approximately 510 years. The frequency of groundwater well sampling would occur semi-annually for years 1–3; annually for years 4–30; and every five years for years 30–660. Five groundwater seep locations along the Erie Canal (if five seeps are active and available to collect groundwater from) would be sampled, annually for 660 years. Sampling frequency could change depending on groundwater response to soil source removal.

Groundwater monitoring would be conducted in accordance with the monitoring program after soil source removal. This data collection will provide a dataset with sufficient statistical power to assess the efficacy of the MNA process to achieve RAOs. Reviews allow evaluation of the effectiveness of remediation as well as data obtained from ongoing monitoring to assess the presence and behavior of remaining contaminants. If monitoring demonstrates changes to environmental conditions or the attenuation process is not proceeding as expected, then decisions regarding what actions are necessary will be made at that time based on the data and information gathered during the monitoring program.

Reduction in Toxicity, Mobility, or Volume Through Treatment

The volume of contaminated media at the site would be reduced by the treatment of buildings/contents. Decontamination of materials, where feasible, is considered physical treatment. The combination of decontamination and radiological sorting of materials would reduce the volume disposed as radiological waste. Future groundwater contamination volume and mobility would also be reduced by the soil removal. MNA is considered a passive treatment technology. There is no active recovery or active treatment for groundwater, so the statutory preference for treatment is not a major component of the remedy. Mobility of contaminants in groundwater is unaffected by treatment. The volume of impacted groundwater is unaffected by treatment under this alternative, except for that which occurs naturally through dispersion and sorption.

Short-Term Effectiveness

Since the implementation of this alternative would involve soil remediation, building remediation, and the drilling and installation of monitoring wells, there would be a potential risk to on-site workers and the community commensurate with these types of activities, but risks would be controlled by mitigative measures included in a site-specific health and safety plan.

The excavation, transport, and disposal activities could pose short-term risks to site workers and the surrounding community. There could also be short-term risks due to potential exposures to remediation workers during the decontamination and building dismantlement activities. Air quality could be affected by release of particulates during soil excavation. To minimize dust generation during excavation activities, impacted soil would be kept moist or covered with tarps. If dry building decontamination methods are used, a dust collection shroud would be used to control dust and debris. The short-term risks to workers resulting from remediation activities would be mitigated through the use of good safety practices and PPE. Additional supports may be necessary to augment the floor in Building 1 during decontamination activities to protect the safety of the workers.

There is a slight potential for an increase in short-term risks to the surrounding community from excavation and dismantlement activities due to fugitive dust generation, but risks would be controlled by mitigative measures. In addition, air monitoring would be conducted at the work site and the site perimeter to ensure the health of workers and the surrounding community. Some minimal short-term risks to the surrounding community would result from the transport of wastes off site through nearby residential areas. The transportation of contaminated building materials and contents to an off-site disposal location is required as part of this alternative, which presents transportation-related risks. Risks would be mitigated by packaging shipped materials in accordance with Department of Transportation regulations to ensure the contents remain safely enclosed in the event of an accident. A site-specific health and safety plan would address potential exposures and monitoring requirements to ensure protection of the workers and community.

There would be a low risk to the workers during well drilling, installation, and groundwater sampling activities. There would be low risk to the community because the monitoring wells would remain capped and locked except during sampling, all sampling and purge water would be contained and transported off site for proper disposal, and traffic controls would be maintained during sampling for any wells installed in or near roadways.

Short-term environmental impacts (such as loss of vegetation, disturbance of soil, and increased erosion) could result from soil and building removal. If needed, erosion control materials such as silt fences would be installed to minimize erosion and reduce surface water runoff during excavation activities. Water that has collected within the excavations will be sampled and analyzed, and either sent to an off-site lab or an on-site laboratory and treatment plant. If analysis results indicate treatment is necessary, the water will be treated before discharge.

Soil removal, building remediation and completing the final site documentation would require approximately 88 weeks (21 months). The entire remedial action, including the groundwater remediation time frame, is approximately 661 years and 9 months.

Implementability

The construction activities for Site-Wide Alternative 4 would involve building contents decontamination and building dismantlement, soil remediation, the installation and maintenance of additional monitoring wells, and well decommissioning. Differentiating clean soils from impacted soils using field instrumentation would be feasible using the Soil PRG-CW. Confirmatory samples will be submitted to an off-site laboratory.

Decontamination is a conventional method of remediating radiologically contaminated structures and would be easily implemented. Decontamination equipment and trained personnel are readily available. Soil excavation, well decommissioning, installation, and sampling are well known technologies. Services and materials would be readily available. Long-term maintenance and care for the monitoring wells would need to be provided.

Cost

Detailed costs are provided in Appendix J. Total capital costs are estimated to be $104.4 million and include preparation of project plans, building/contents decontamination, building dismantlement, excavation, confirmatory sampling, transport, off-site disposal, site restoration, preparation of a remedial action completion report, preparation of a groundwater MNA plan, and preparation of a long-term environmental monitoring plan. The present worth costs for lifetime O&M, assuming a 660-year performance period, is estimated at $5.2 million. O&M includes MNA groundwater sampling, environmental sampling, maintenance of fencing and signage, and performance of reviews. The total present worth (discounted) cost for this alternative is estimated at $109.7 million, of which $104.4 million are capital costs and $25.2 million are total O&M cost over 660 years.

6.0 COMPARISON OF ALTERNATIVES

6.1 ASSESSMENT

The site-wide remedial action alternatives presented in Section 4.4 and evaluated in Section 5 are compared in this section using a qualitative evaluation. The purpose of the comparative analysis is to weigh the relative performance of each alternative against a particular criterion and to determine which alternative performs consistently well or consistently better in relation to the criterion of interest. The alternatives are evaluated according to the criteria discussed in Section 5.0 and include:

- Threshold Criteria
    - Overall protection of human health and the environment
    - Compliance with ARARs
- Balancing Criteria

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

A table illustrating the comparative analysis is provided in Table 6-1. Each alternative is rated based on the individual criteria in the table, where a "High" rating is considered favorable for a specific criteria and "Low" represents the least favorable rating. Community and state acceptance will be fully addressed after the public comment period associated with the PP.

The four remedial alternatives retained for detailed analysis are:

- **Site-Wide Alternative 1** - No Action.
- **Site-Wide Alternative 2** - Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35; Complete Soil Removal to the soil PRG-GW and Off-Site Disposal; Monitored Natural Attenuation with Environmental Monitoring.
- **Site-Wide Alternative 3** - Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35; Complete Soil Removal to the Soil PRG-GW and Off-Site Disposal; Groundwater Recovery Using Extraction Wells and a Rubblized Trench with *Ex Situ* Treatment, with Environmental Monitoring.
- **Site-Wide Alternative 4 -** Decontamination of Building 1; Dismantlement and Off-Site Disposal of Buildings 2, 3, 4/9, 5, 6, 8, and 24; Complete Soil Removal to the Soil PRG-CW and Off-Site Disposal; Monitored Natural Attenuation with Environmental Monitoring.

The no-action alternative was retained, as required under CERCLA and the NCP. This alternative serves as a baseline for comparison with other alternatives and involves taking no action towards a remedy, implying no active management or expectation that the RAOs would be achieved over time.

6.1.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Each of the alternatives, except no action, is protective of human health and the environment. Although the existing site security fence could limit exposure to site contaminants under the no-action alternative, this alternative assumes that controls would not be maintained and provides no additional controls to prevent or reduce exposure to contaminants. No action provides no protection from the current site conditions and would not be protective of human health and the environment over the long term for foreseeable future land uses.

Site-Wide Alternatives 2 and 3 provide protection by removing soils to the soil PRG-GW which limit risks from exposure to contaminated soil to within acceptable levels. These alternatives also reduce the timeframe to achieve MCLs in groundwater. The protection for soils and buildings for Site-Wide Alternative 2 and Site-Wide Alternative 3 are the same, because under each of these alternatives the impacted media are removed and disposed of off site at a facility licensed for proper management.

Site-Wide Alternative 4 provides protection for the critical group, the construction worker, via decontamination of buildings, and the removal of soil and buildings based on PRGs developed for the construction worker and the anticipated future industrial use of the site.

For all alternatives (other than the no-action alternative), radiologically contaminated soil source areas to groundwater would be remediated to different degrees (i.e., Soil PRG-CW or Soil PRG-GW). The potential for future exposure to uranium above ARARs would be controlled with fencing and signage preventing site access during implementation of the remedy and during the O&M time period.

For the soil excavation, a mitigation action plan would be developed during remedial design to specify measures that would be taken during implementation of the remedial action to minimize risk to human health and the environment (e.g., environmental controls and contingency response actions).

In summary, Site-Wide Alternative 1 is not protective of human health and the environment. Site-Wide Alternatives 2, 3, and 4 are protective of human health and the environment.

6.1.2 COMPLIANCE WITH ARARS

A summary of the ARARs is presented in Section 3.3. The no-action alternative does not meet ARARs. Site-Wide Alternatives 2, 3, and 4 will satisfy ARARs for soil, buildings, and groundwater including 10 CFR 20.1402 and 40 CFR 141.66(e). Site-Wide Alternative 2 could take up to 120 years to meet ARARs for groundwater, Site-Wide Alternative 3 could take approximately 30 years to achieve ARARs for groundwater and Site-Wide Alternative 4 could take approximately 660 years to achieve ARARs for groundwater.

All alternatives, with the exception of Alternative 1, are compliant with ARARs.

6.1.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

Under Site-Wide Alternative 1, the no-action alternative, buildings, soil, and groundwater would not be addressed; therefore, Site-Wide Alternative 1 would not be effective in the long term. Radiologically contaminated soils, buildings, and groundwater would remain in place with no controls to prevent exposure. Based on the groundwater fate and transport model, due to contributions from soil leachate, the existing shallow groundwater plume persists at concentrations above MCL for approximately 780 years. In deep groundwater, the existing plume persists at concentrations above the uranium MCL for over 1,000 years, the total duration of modeling simulations. Portions of the deep groundwater plume remain off site in the vicinity of the southern property boundary towards the Erie Canal for the entire 1,000+ year duration modeled. The groundwater model may vary significantly from field results due to the significant changes that will occur on site due to remediation (e.g., soil disturbances and building dismantlement). Groundwater monitoring would be conducted in accordance with the monitoring program after soil source removal. Therefore, groundwater data will be assessed following the completion of the soil removal to determine the reaction of the plume. This data collection will provide a dataset with sufficient statistical power to assess the efficacy of the MNA process to achieve RAOs. Reviews allow evaluation of the effectiveness of remediation as well as data obtained from ongoing monitoring to assess the presence and behavior of remaining contaminants. If monitoring demonstrates changes to environmental conditions or the attenuation process is not proceeding as expected, then decisions regarding what actions are necessary will be made at that time based on the data and information gathered during the monitoring program.

Remedial actions for building materials and contents are similar for Site-Wide Alternatives 2 and 3. Site-Wide Alternative 4, includes decontamination of Building 1 and does not remediate Building 35. All other building materials and contents will be dismantled and disposed off site. For soil, Site-Wide Alternative 4 provides long-term effectiveness for the construction worker and the anticipated future industrial use of the site. Site-Wide Alternatives 2 and 3 remove soil to the soil PRG-GW, which provides additional long-term effectiveness for the protection of groundwater by reducing the source of uranium to groundwater to a level that does not impact this media above the MCL. COC-impacted soil and building materials will not remain on site above the media-specific cleanup goals; therefore, the building and soil remedial actions are permanent. Off-site disposal is considered permanent. Decontamination of building contents, where feasible, also provides risk reduction. Remediation under Site-Wide Alternatives 2, 3, and 4 should allow for UU/UE at the end of the performance period (120 years, 30 years, and 660 years for groundwater) and be protective. In accordance with CERCLA, five-year reviews will be conducted throughout the performance period of the alternative while impacted groundwater remains above the MCLs; if after confirmatory sampling at the completion of the remedial action it is determined that UU/UE status has not been achieved.

Site-Wide Alternative 2 is considered effective for the long term because engineering LUCs, coupled with MNA, mitigate exposure to contaminated media during remedial action. For Site-Wide Alternative 2, the groundwater fate and transport model predict contributions from residual soil leachate to the existing plume persist at concentrations above MCL for approximately 50 years in shallow groundwater, with off-site impacts lasting about 20 years. The existing deep groundwater plume persists on site at concentrations above MCL for approximately 120 years due to residual leachate, with off-site impacts lasting about 100 years.

Groundwater monitoring for Site-Wide Alternative 2 would be conducted in accordance with the monitoring program after soil source removal. This data collection period will provide a dataset with sufficient statistical power to assess the efficacy of the MNA process to achieve RAOs. Reviews allow evaluation of the effectiveness of remediation as well as data obtained from ongoing monitoring to assess the presence and behavior of remaining contaminants. If monitoring demonstrates changes to environmental conditions or the attenuation process is not proceeding as expected, then decisions regarding what actions are necessary will be made at that time based on the data and information gathered during the monitoring program.

Site-Wide Alternative 3 provides long-term effectiveness through the use of extraction and treatment of groundwater and hydraulic control using a combination of vertical extraction wells and a rubblized trench. By extracting and treating contaminated groundwater, groundwater uranium concentrations would be reduced to below the RAO in a shorter timeframe than natural attenuation. Based on modeling, the uranium plumes cease to exist above the MCL in approximately 30 years, both on site and off site.

The effectiveness of groundwater recovery using vertical extraction wells under Site-Wide Alternative 3 will be partially dependent on the ability to intersect viable fracture zones to recover groundwater over a zone of influence similar to that used in the groundwater model. Groundwater flow at the site is generally fracture flow, which was simulated in the model by porous media. The shallow groundwater zone is heavily fractured, and a porous media model is believed to provide adequate predictions for flow and transport behavior. Deep groundwater flow is within more competent bedrock, and the location and interception of fractures is more critical to the performance of extraction in this zone. Under Site-Wide Alternative 3, the use of a trench at the southern excised property boundary provides a continuous draw across the plume to intercept impacted groundwater rather than solely relying on overlapping zones of influence for individual extraction wells.

The extraction and treatment of impacted groundwater is considered a permanent solution once MCLs are achieved. In accordance with CERCLA, five-year reviews will be conducted throughout the performance period of the alternative while impacted groundwater remains above the MCLs; if after confirmatory sampling at the completion of the remedial action it is determined that UU/UE status has not been achieved. Given that the remedial alternatives achieve the RAOs once complete, and results in no risk to human health or the environment, administrative and legal LUCs would not be necessary.

Site-Wide Alternative 4 is considered effective for the long term because engineering LUCs coupled with MNA, mitigate exposure to contaminated media during remedial action. Based on modeling for Site-Wide Alternative 4, the groundwater fate and transport model predicts contributions from residual soil leachate to the existing plume persist at concentrations above MCL for approximately 430 years in shallow groundwater, with off-site impacts lasting about 320 years. The existing deep groundwater plume persists on site at concentrations above MCL for approximately 660 years due to residual leachate, with off-site impacts lasting about 510 years.

The decision of Building 24 applies to all site-wide alternatives (except the no action alternative). Once Building 24 and underlying soils were deemed accessible, the USACE would dismantle the building and excavate the soils to mitigate predicted groundwater impacts and preclude remedy modifications (i.e., long-term monitoring of Building 24 groundwater to ensure predictions are accurate for the below-MCL plume and associated effects on remedy durations). If Building 24 remains in place, the contamination under Building 24 would sit dormant unless aerially exposed due to building removal, where the roof, walls and floor slab are removed to facilitate infiltration into groundwater. Once this residual soil was exposed to infiltrate groundwater and generated a small-scale uranium plume, the groundwater modeling indicated the contamination is diluted to below the 30 µg/L MCL in the aquifer within the excised area boundary due to the small footprint of soil impacts under Building 24. This below-MCL plume is predicted to persist approximately 150 years after the balance of site is remediated. Since the groundwater concentration does not exceed the MCL (the RAO for groundwater) and contributes minor inputs to the groundwater system, the residual plume will not affect the timeframe or performance of the preferred remedy. If Building 24 and soil were removed at the same time, the plume impact would not adjust the groundwater remediation timeframe indicated in the alternatives and modeling. The eventual removal of inaccessible soils below Building 24 will ensure remedial consistency (site cleaned up to a uniform standard) and minimize the risk to the beneficial use of groundwater should the prediction underestimate the residual plume.

Site-Wide Alternative 1 is rated low for long-term effectiveness and permanence, Site-Wide Alternative 2 is rated as high, Site-Wide Alternative 3 is rated high and Site-Wide Alternative 4 is rated as moderate for long-term effectiveness.

6.1.4 REDUCTION OF TOXICITY, MOBILITY AND VOLUME THROUGH TREATMENT

Site-Wide Alternative 1, the no-action alternative, would not reduce contaminant toxicity, mobility, or volume using treatment because no treatment would occur. Under Site-Wide Alternatives 2, 3, and 4 some reduction in material volume would occur through limited decontamination of building materials/contents. Site-Wide Alternatives 2 and 4 would address the contaminant groundwater plume through passive treatment (MNA) of groundwater. MNA is a systematic approach of modeling, predicting, monitoring, and measuring the rate at which attenuation of contaminants occurs so as to determine if RAOs will be achieved. Toxicity, mobility, and volume of groundwater contamination would be addressed through naturally occurring dispersion, adsorption, and mineral precipitation. The primary attenuation mechanism for uranium would be dispersion. Site-Wide Alternative 3 would include active treatment of groundwater as part of the alternative, reducing the toxicity, mobility, and volume of the uranium in groundwater through extraction and *ex situ* treatment.

Reduction of toxicity, mobility and volume through treatment is rated as low for Site-Wide Alternative 2, moderate for Site-Wide Alternative 3 and low for Site-Wide Alternative 4. Site-Wide Alternative 1 is rated low.

6.1.5 SHORT-TERM EFFECTIVENESS

Short-term effectiveness includes four analysis factors for evaluation: protection of community during remedial action, protection of workers during remedial action, environmental impacts, and time until RAOs are achieved. Under the no-action alternative, because there is no remediation or treatment being implemented, there would be no associated short-term increase in potential risk to site workers, the community, or the environment.

Remedial actions to address soil and buildings under Site-Wide Alternatives 2, 3, and 4 would include excavation, transport, decontamination and disposal activities that could pose short-term risks to site workers, ATI workers, and the surrounding community. Site-Wide Alternative 4 involves excavation and disposal of a lesser contaminated soil volume with the PRG-CW when compared to the soil PRG-GW as part of Site-Wide Alternatives 2 and 3. Less soil to excavate reduces short-term risks because of a reduced construction timeframe and reduced potential contaminated soil exposure to remediation workers and community during the remediation. Air quality could be affected by the release of particulates during soil excavation. These short-term risks may be mitigated by following proper health and safety procedures including the use of PPE. Building dismantlement activities for Site-Wide Alternatives 2 and 3 are the same, with complete dismantlement and off-site disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35. Site-Wide Alternative 4 involves decontamination of Building 1, which remains on site and dismantlement of Buildings 2, 3, 4/9, 5, 6, 8, and 24.

For actions related to groundwater, under Site-Wide Alternative 3 there would be a low risk to the workers during well drilling, installation, and groundwater sampling activities. There would be low risk to the community because the monitoring wells would remain capped and locked except during sampling and all sampling and purge water would be contained and transported off site for proper disposal. Site-Wide Alternative 3 also results in an additional short-term risk during installation/blasting of the rubblized trench. There is some additional risk for construction and operation of the treatment plant under Site-Wide Alternative 3 which will generate a spent treatment media high in uranium concentration, which will require handling and disposal. Site-Wide Alternative 3 has the potential to enhance the transport of non-FUSRAP VOCs in groundwater which have been observed below the excised property. This may exacerbate a vapor intrusion issue within Building 17 and increase the risk to human health for building occupants. Consequently, the rubblized trench would be built along the southern boundary of the excised property, which is north of Building 17, and extraction wells located south of the building. This will assist in capturing the groundwater before encountering the actively used building.

Remedial timeframes to achieve the RAOs are considered in the short-term effectiveness criterion. Site-Wide Alternative 4 has the longest remedial timeframe of approximately 660 years to achieve the RAO to comply with the groundwater MCL. Site-Wide Alternative 2 is modeled to achieve the RAOs in approximately 120 years and Site-Wide Alternative 3 will take approximately 30 years. There is a difference in time to achieve RAOs between these remedial alternatives, which impacts the rating of the alternatives for this individual analysis factor.

Comparing the overall analysis factors within each alternative results in Site-Wide Alternative 4 being rated moderate for short-term effectiveness and Site-Wide Alternatives 2 and 3 are also rated moderate. Site-Wide Alternative 1 is rated high.

6.1.6 IMPLEMENTABILITY

Under Site-Wide Alternative 1—No Action, there would be no technology or engineering controls to implement under this alternative. There would be no services required, no permits to obtain, no administrative approvals, and no resources involved.

Actions related to soil and building materials and contents under Site-Wide Alternatives 2, 3, and 4 would generally be easy to implement. The construction activities would involve building/contents decontamination and dismantlement, soil remediation, the installation and maintenance of additional monitoring wells, and well decommissioning. Decontamination is a conventional method of remediating radiologically contaminated structures and would be easily implemented. Decontamination equipment and trained personnel are readily available. Soil excavation, well decommissioning, installation, and sampling are well-known technologies. Services and materials would be readily available.

Differentiating clean soils from impacted soils using field instrumentation to help guide the excavation, will only be feasible for Site-Wide Alternative 4. The extent of impacted soils for Site-Wide Alternatives 2 and 3, will be determined by taking samples, then submitting them to an off-site laboratory for analysis. This activity is easier to implement for Site-Wide Alternative 4, and is more difficult for Site-Wide Alternatives 2 and 3.

Under Site-Wide Alternative 3, installation of a groundwater recovery and treatment system is more difficult to implement. Well drilling and pumping techniques are commonly used. The only potential limitation is using vertical extraction wells to intercept fractures, especially in the deep zone where the fracture density is fairly low. Multiple borings may be necessary to optimize the pumping location. The effectiveness will be governed by the ability to pump sufficient groundwater in the deep groundwater to reduce concentrations. Services and materials would be readily available to decommission and install monitoring wells and perform regular monitoring. Maintenance and care for the monitoring wells would need to be provided

Use of a rubblized trench on the excised property boundary in Site-Wide Alternative 3 will facilitate interception of fractures in bedrock by creating a continuous draw for the collection of groundwater. Since the trench is created by subsurface blasting, the location of on-site and off-site buildings, roadways, and utilities will need to be considered.

Site-Wide Alternative 3 has the potential to enhance the transport of non-FUSRAP VOCs in groundwater which have been observed below the excised property. A rubblized trench with extraction wells placed down-gradient of Building 17, which is actively used by ATI Specialty Materials personnel, could draw the VOC plume beneath the building. This may exacerbate a vapor intrusion issue within the building and increase the risk to human health for building occupants. Challenges during the remedial design phase include effectively capturing the uranium plume in a reasonable time frame, while minimizing transport of volatiles, especially under any current or future building where it has the potential to create a vapor intrusion pathway. Consequently, the rubblized trench would be built along the southern boundary of the excised property, which would capture the plume moving southwest across the site before encountering Building 17. Future site development of the excised area would be limited due to the existence of the trench, extraction wells, and the groundwater treatment plant for the duration of the estimated 30-year O&M period. Therefore, the trench-based extraction system is considered complex to implement.

Implementability is rated as high for Site-Wide Alternative 1, moderate for Site-Wide Alternative 2, low for Site-Wide Alternative 3 and high for Site-Wide Alternative 4.

6.1.7 COST

Detailed descriptions of the costs for each alternative, itemization of individual components, and assumptions are provided in Appendix J. The remediation costs presented in this FS are for planning and comparative purposes only, and are accurate to the required level of CERCLA accuracy (plus 50% to minus 30%). A summary of the estimated costs is as follows:

Table 8-1: Comparison of Costs for Site-Wide Remedial Alternatives

Site-Wide Alternative	Estimated Total Present Worth Cost[a]	Estimated Total Non-Discounted Cost
Site-Wide Alternative 1–No Action	$0	$0
Site-Wide Alternative 2–Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35; Complete Soil Removal to the Soil PRG-GW and Off-Site Disposal; Monitored Natural Attenuation with Environmental Monitoring	Capital: $180.9 M O&M: $5.2 M Total: $186.1 M	Capital: $180.9 M O&M: $16.7 M Total: $197.6 M
Site-Wide Alternative 3–Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35; Complete Soil Removal to the Soil PRG-GW and Off-Site Disposal; Groundwater Recovery Using Extraction Wells and Rubblized Trench with *Ex Situ* Treatment, with Environmental Monitoring	Capital: $189.3 M O&M: $16.3 M Total: $205.6 M	Capital: $189.3 M O&M: $25.1 M Total: $214.4 M
Site-Wide Alternative 4–Decontamination of Building 1; Dismantlement and Off-Site Disposal of Buildings 2, 3, 4/9, 5, 6, 8, and 24; Complete Soil Removal to the Soil PRG-CW and Off-Site Disposal; Monitored Natural Attenuation with Environmental Monitoring	Capital: $104.4 M O&M: $5.2 M Total: $109.7 M	Capital: $104.4 M O&M: $81.6 M Total: $186.1 M

[a] Discount rate used is 3.5%. M=million

6.2 ELEMENTS IN COMMON FOR MOST ALTERNATIVES

Each of the alternatives with the exception of the no-action alternative incorporates the elements in the following sections.

6.2.1 MONITORING AND MITIGATIVE MEASURES

A mitigation action plan would be developed during remedial design to specify measures that would be taken during implementation of the remedial action to minimize risk to human health and the environment (e.g., environmental controls and contingency response actions). The primary monitoring and mitigative measures that would be used at the Guterl Site are described in the following sections. These measures would be effective in minimizing the potential adverse effects associated with implementation of the alternatives.

Construction Activities: Construction practices to control potential releases to the environment would include management and engineering practices. Erosion and sedimentation controls, such as hay bales and silt fences, would be used to prevent soil transport in surface water runoff. Wetting surface materials with water or dust control chemicals would mitigate fugitive dust impacts. Regular surface wetting can reduce the dust loads from construction sites and storage/staging piles by as much as 50%. Chemical wetting agents can further reduce the dust loads. In addition, storage/staging piles and inactive areas can be covered to reduce wind erosion. Equipment will be decontaminated before leaving the site.

Transportation: Wastes would be containerized and fitted with a cover and/or liner when transported over public roads, and during long distance transport via rail to the off-site disposal facility. Vehicles would be decontaminated and inspected before leaving contaminated areas.

Worker Protection: Activities would be conducted in accordance with approved health and safety plans. PPE, personal monitoring devices, and decontamination procedures would be used to minimize exposure to and the spread of contamination. The potential for worker exposure is mitigated through these measures. Monitoring for external exposure and/or breathing zone air sampling would be conducted at the site to ensure workers do not receive exposures that would result in adverse health effects. Personal monitoring devices and a medical monitoring program would be used to ensure workers do not receive exposures that would result in adverse health effects.

Protection of the General Public: Mitigation measures for controlling releases of material off site to protect the general public would include those identified in the preceding discussions of construction activities and transportation activities, especially the controls regarding control of surface water runoff and fugitive dust emissions. Access controls, including fencing and security personnel, would be used to restrict public access to construction areas.

6.2.2 SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

Implementation of any alternative would require the site to support remedial action activities and would involve the use of nonrenewable resources, such as construction materials, fuel, and petroleum-based products. Alternatives that include excavation and disposal would require the long-term commitment for waste disposal at an off-site facility or facilities. The short-term use of the site for remedial activities could adversely affect ATI Specialty Materials operations. Planning would be done before implementation of any alternative to reduce risks to the current operations.

Long-term effects on ATI Specialty Materials operations would also be taken into account when analyzing each alternative. The positive impact of the remediation on the local economy could be fairly significant. Whether a local or outside contractor performs the work, primary and mostly secondary jobs would be impacted. The remediation workers would be spending money in the local economy for the duration of the remediation, and if local operators are employed by the remedial contractor, then direct benefits to the community would occur.

6.3 AGENCY COORDINATION AND PUBLIC INVOLVEMENT

This section reviews actions that have been conducted and those that are planned to ensure regulatory agencies and the public have the appropriate opportunities to stay informed of progress on the Guterl Site remediation.

As described in Section 5.1.3, two of the nine NCP [40 CFR §300.430(f)(i)(C)] evaluation criteria are known as “modifying criteria.” These are state acceptance and community acceptance. These criteria provide a framework for obtaining the necessary agency coordination and public involvement in the remedy selection process.

6.3.1 STATE ACCEPTANCE

State acceptance considers comments received from NYSDEC regarding the alternatives being evaluated. Final comments will be received from the state after the PP is issued. These comments will be considered in the final selection of a remedy, and responses will be documented in the responsiveness summary of the subsequent ROD.

On May 23, 2016, USACE met with the NYSDEC in order to communicate the USACE planned path forward for the FS of the Guterl Site.

6.3.2 COMMUNITY ACCEPTANCE

Community acceptance considers community comments regarding the alternatives being considered. CERCLA 42 United States Code 9617(a) emphasizes early, constant, and responsive community relations. A community relations plan outlining the community relations program for the Guterl FUSRAP Site is in place. Community relations activities implemented by USACE through the plan include news releases, public meetings, information sessions, and meetings with elected officials, agency representatives and the community. USACE also receives and responds to comments and inquiries through correspondence, emails to fusrap@usace.army.mil and calls to 1-800-833-6390 (option 4). Similar to state agencies, final comments will be received from the community after the PP is issued. These comments will be considered in the final selection of a remedy and will be addressed in the responsiveness summary of the ROD.

CERCLA 42 United States Code 9617(a) requires that an Administrative Record be established "at or near the facility at issue." Relevant documents regarding the Guterl Site have been made available to the public for review. The Administrative Record for the project is available at the following locations:

Lockport Public Library
23 East Avenue
Lockport, New York 14095
716-433-5935

USACE FUSRAP Public Information Center
CERCLA Records Room (by appointment)
1776 Niagara Street
Buffalo, New York 14207
1-800-833-6390 (press "4" at the recorded message)

Key documents are also available at:
https://www.lrb.usace.army.mil/Missions/HTRW/FUSRAP/Guterl-Steel-Site/
The entire Administrative Record is available at:
https://www.lrb.usace.army.mil/Missions/HTRW/FUSRAP/Guterl-Steel-Site/Guterl-Admin-Record/

7.0 CONCLUSIONS

The primary purpose of this FS is to screen and evaluate remedial alternatives using the data collected during the RI and DGI, as well as other relevant information. The detailed and comparative analysis of alternatives presented in this FS provides the basis for the evaluation and the selection of the preferred alternative that will be presented in the PP.

The following four site-wide remedial alternatives were evaluated:

- **Site-Wide Alternative 1**—No Action
- **Site-Wide Alternative 2**—Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35; Complete Soil Removal to the Soil PRG-GW and Off-Site Disposal; Monitored Natural Attenuation with Environmental Monitoring.
- **Site-Wide Alternative 3**—Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35; Complete Soil Removal to the Soil PRG-GW and Off-Site Disposal; Groundwater Recovery Using Extraction Wells and Rubblized Trench with *Ex Situ* Treatment, with Environmental Monitoring.
- **Site-Wide Alternative 4**—Decontamination of Building 1; Dismantlement and Off-Site Disposal of Buildings 2, 3, 4/9, 5, 6, 8, and 24; Complete Soil Removal to the Soil PRG-CW and Off-Site Disposal; Monitored Natural Attenuation with Environmental Monitoring.

This FS evaluated and compared each remedial alternative using the following CERCLA criteria:

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

Two additional criteria, state acceptance and community acceptance, are not evaluated in this FS because they will be evaluated in the ROD after comments on the PP have been received. The following paragraphs briefly summarize which alternatives best satisfy each criteria.

Overall Protection of Human Health and the Environment: Site-Wide Alternative 1—No Action is not protective of human health. Site-Wide Alternatives 2, 3, and 4 are protective of human health and the environment for the site because the soil, building materials, and contents would be removed from the site and transported to an off-site facility for disposal. Site-Wide Alternative 2 and Site-Wide Alternative 4 remediate contaminated groundwater using MNA. Site-Wide Alternative 3, removes contaminated groundwater by extraction/treatment system.

Compliance with ARARs: Site-Wide Alternatives 2, 3, and 4 comply with ARARs. Following removal and disposal of soil, building materials, and contents, these alternatives would meet the release conditions of 10 CFR 20.1403. These alternatives would also meet MCLs for groundwater at the completion of the performance period. Site-Wide Alternative 1 does not meet the ARARs and therefore is not compliant.

Long-Term Effectiveness and Permanence: Site-Wide Alternatives 2 and 3 involve complete removal and decontamination of any building materials and contents with off-site disposal and provide the best long-term effectiveness and permanence for these media. Site-Wide Alternative 4 provides long-term effectiveness for the construction worker. Building 1 after decontamination and Building 35 will remain on site, all other building materials and contents will be removed and disposed off site under Site-Wide Alternative 4. For soil, Site-Wide Alternatives 2 and 3 remove soil to the soil PRG-GW which provides long-term effectiveness for the protection of groundwater by reducing the source of uranium in groundwater to a level that does not impact this media above the MCL. Site-Wide Alternative 3 removes and treats impacted groundwater providing effectiveness and permanence over Site-Wide Alternative 2, where uranium concentrations in the groundwater are allowed to naturally attenuate.

The decision of Building 24 applies to all Site-Wide Alternatives (except the no action alternative). FUSRAP-related contaminated soil underneath Building 24 is determined to be inaccessible, since the contaminants are located underneath an actively used building by the property owners. The dismantlement of Building 24 and the remediation of underlying soils is intended to be conducted at the time of the site-wide remedial action with the property owner's consent. If Building 24 is not available or the property owner does not consent to its dismantlement at the time of the site-wide remedial action, the inaccessible underlying soil and Building 24 will remain while the other buildings and contaminated soil are removed. Dismantlement of Building 24 will be deferred until a later date when the building is no longer actively used. If Building 24 becomes available prior to the completion of the site-wide remedial action then it would be dismantled and underlying soil removed at that time.

Once Building 24 and underlying soils were deemed accessible, the USACE would dismantle the building and excavate the soils to mitigate predicted groundwater impacts and preclude remedy modifications (i.e., long-term monitoring of Building 24 groundwater to ensure predictions are accurate for the below-MCL plume and associated effects on remedy durations).

If Building 24 remains in place, the contamination under Building 24 would sit dormant unless aerially exposed due to building removal, where the roof, walls and floor slab are removed to facilitate infiltration into groundwater. Once this residual soil was exposed to infiltrate groundwater and generated a small-scale uranium plume, the groundwater modeling indicated the contamination is diluted to below the 30 µg/L MCL in the aquifer within the excised area boundary due to the small footprint of soil impacts under Building 24. This below-MCL plume is predicted to persist approximately 150 years after the balance of site is remediated. Since the groundwater concentration does not exceed the MCL (the RAO for groundwater) and contributes minor inputs to the groundwater system, the residual plume will not affect the timeframe or performance of the preferred remedy. If Building 24 and soil were removed at the same time, the plume impact would not adjust the groundwater remediation timeframe indicated in the alternatives and modeling. The eventual removal of inaccessible soils below Building 24 will ensure remedial consistency (site cleaned up to a uniform standard) and minimize the risk to the beneficial use of groundwater should the prediction underestimate the residual plume.

For all alternatives, five-year reviews are expected to be required and are included in the cost estimates for the alternative. Five-year reviews may be required until contaminants on site are below levels that allow for UU/UE, unless the site achieves UU/UE after remedial action is completed.

Since there is no action under Site-Wide Alternative 1, there is no long-term effectiveness. Long-term effectiveness and permanence is rated as high for Site-Wide Alternative 2, high for Site-Wide Alternative 3, and moderate for Site-Wide Alternative 4.

Reduction in Toxicity, Mobility, or Volume through Treatment: Site-Wide Alternative 3 has the greatest reduction in toxicity, mobility, and volume through treatment because along with limited building decontamination, groundwater treatment is completed. Site-Wide Alternative 2 and Site-Wide Alternative 4 provide some reduction in toxicity with the limited decontamination of buildings/contents. Since there is no action under Site-Wide Alternative 1, no reduction in toxicity, mobility, or volume is provided.

Reduction of toxicity, mobility and volume through treatment is rated as low for Site-Wide Alternative 1, low for Site-Wide Alternative 2, moderate for Site-Wide Alternative 3, and low for Site-Wide Alternative 4.

Short-Term Effectiveness: Site-Wide Alternatives 2, 3, and 4 result in potential short-term risks to the worker and the community due to the removal and transport of impacted soil and building materials. There is some additional risk to the worker for Alternative 3 due to operation of the groundwater treatment plant and construction of the trench. Impacts to the worker may be mitigated through the proper use of PPE and routine engineering measures on site (e.g., dust control); while risks to the community may be mitigated by proper management and packaging of any impacted materials. Since there is no action under Site-Wide Alternative 1, there is no short-term risk.

FUSRAP-related contaminated soil underneath Building 24 is determined to be inaccessible, since the contaminants are located underneath an actively used building by the property owners. The dismantlement of Building 24 and the remediation of underlying soils is intended to be conducted at the time of the site-wide remedial action with the property owner’s consent. If Building 24 is not available or the property owner does not consent to its dismantlement at the time of the site-wide remedial action, the inaccessible underlying soil and Building 24 will remain while the other buildings and contaminated soil are removed. Dismantlement of Building 24 will be deferred until a later date when the building is no longer actively used. If Building 24 becomes available prior to the completion of the site-wide remedial action then it would be dismantled and underlying soil removed at that time.

Remedial timeframes to achieve the RAOs are also considered in the short-term effectiveness criterion. There is a large difference in time to achieve RAOs between these remedial alternatives, which influences the rating of each alternative for this individual analysis factor.

Site-Wide Alternative 4 has the longest remedial timeframe of approximately 660 years to achieve the RAO to comply with the groundwater MCL. Site-Wide Alternative 2 is modeled to achieve the RAOs in approximately 120 years and Site-Wide Alternative 3 will take approximately 30 years, to achieve RAOs, which, in comparison to longer timeframes, would increase the ratings for this analysis factor for this alternative.

Site-Wide Alternative 1 is rated high for short-term effectiveness. Site-Wide Alternative 2 is rated as moderate, Site-Wide Alternative 3 is rated as moderate, and Site-Wide Alternative 4 is rated as moderate for short-term effectiveness.

Implementability: Complete removal with off-site disposal of building materials, contents, and soil would be easy to implement administratively under Site-Wide Alternatives 2, 3, and 4. No significant problems related to obtaining approvals from the regulatory agencies or coordinating remediation activities with landowners are expected for these alternatives. In addition, confirmatory samples will be submitted to an off-site laboratory. For groundwater, Site-Wide Alternative 2 and Site-Wide Alternative 4 are rated highest in technical implementability because there are no actions required other than monitoring (MNA). The groundwater extraction in Site-Wide Alternative 3 is more difficult to implement due to the complexity of creating a rubblized trench to encompass the complex bedrock aquifer and the need to contain bedrock fractures during installation of the wells and trench system. Other activities are generally easy to implement using common equipment, materials, and supplies.

Site-Wide Alternative 3 has the potential to enhance the transport of non-FUSRAP VOCs in groundwater, which have been observed below the excised property. This may exacerbate a vapor intrusion issue within Building 17 and increase the risk to human health for building occupants. Challenges during the remedial design phase include effectively capturing the uranium plume in a reasonable timeframe, while minimizing transport of volatiles, especially under any current or future building where it has the potential to create a vapor intrusion pathway. Consequently, the rubblized trench would be located along the southern boundary of the excised property. Restriction of future site development of the excised area could occur due to the existence of the trench, extraction wells, and the groundwater treatment plant for the duration of the estimated 30-year O&M period.

Overall, implementability is rated as moderate for Site-Wide Alternative 2, low for Site-Wide Alternative 3, and high for Site-Wide Alternative 4. Since there is no action under Site-Wide Alternative 1, there are no activities to implement and it is rated high.

Cost: Site-Wide Alternative 1 has the lowest cost at zero dollars with no actions to implement. Site-Wide Alternative 2 has a present worth value estimate cost at $186.1 million. The present worth value estimate for Site-Wide Alternative 3 is $205.6 million. The present worth value estimate for Site-Wide Alternative 4 is $109.7 million.

8.0 PATH FORWARD

After completion of the FS, the next step in the CERCLA process is to prepare a PP to solicit public input on the remedial alternatives. The PP will present the alternatives evaluated in the FS and will identify the preferred alternative for remediating soil, building materials, contents, and groundwater at the Former Guterl Specialty Steel Site. The PP will be submitted to the public and regulators for review. The ROD will select the final remedy at the site. Comments on the PP received from state and federal agencies and the public will be evaluated and considered when preparing the ROD. The ROD will describe the CERCLA remedy selection process and provide a brief summary of the history, characteristics, risks, and alternatives for site remediation. The ROD will also include a responsiveness summary, addressing comments received on the PP.

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TABLES

FIGURES

APPENDICES

TABLES

Table ES-1
Comparison of Site-Wide Remedial Alternatives at the Guterl Site
Former Guterl Specialty Steel Corporation FUSRAP Site

NCP Evaluation Criteria	Site-Wide Alternative 1	Site-Wide Alternative 2	Site-Wide Alternative 3	Site-Wide Alternative 4
Threshold Criteria				
Overall Protection of Human Health and the Environment	Not Protective	Protective	Protective	Protective
Compliance with ARARs	Not Compliant	Compliant	Compliant	Compliant
Balancing Criteria				
Long-term Effectiveness and Permanence	Low	High	High	Moderate
Reduction in Toxicity, Mobility, and Volume Through Treatment	Low	Low	Moderate	Low
Short-term Effectiveness	High	Moderate	Moderate	Moderate
Implementability	High	Moderate	Low	High
Cost				
Capital Cost (non-discounted)	$0	$180.9 M	$189.3 M	$104.4 M
Present Worth Operations and Maintenance Cost	$0	$5.2 M	$16.3 M	$5.2 M
Total Present Worth Cost	$0	$186.1 M	$205.6 M	$109.7 M

Note: High represents a favorable rating for the specific criteria whereas Low represents the least favorable rating. Present Worth discount rate used is 3.5 percent. M=million

- Site-Wide Alternative 1–No Action
- Site-Wide Alternative 2–Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35; Complete Soil Removal to Soil PRG-GW and Off-Site Disposal; Monitored Natural Attenuation with Environmental Monitoring.
- Site-Wide Alternative 3–Dismantlement and Off-site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35; Complete Soil Removal to the Soil PRG-GW and Off-Site Disposal; Groundwater Recovery Using Extraction Wells and a Rubblized Trench with Ex Situ Treatment, with Environmental Monitoring.
- Site-Wide Alternative 4– Decontamination of Building 1; Dismantlement and Off-Site Disposal of Buildings 2, 3, 4/9, 5, 6, 8, and 24; Complete Soil Removal to the Soil PRG-CW and Off-Site Disposal; Monitored Natural Attenuation with Environmental Monitoring.

Table 2-1

Groundwater General Chemistry, Metals and Select Volatile Organic Compounds
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

		Shallow Aquifer			Deep Aquifer		
PARAMETER NAME	**UNITS**	**Minimum**	**Maximum**	**Average**	**Minimum**	**Maximum**	**Average**
ALKALINITY, TOTAL (As CaCO3)	MG/L	120	1,490	356.31	34.40	1,750	287.13
ALUMINUM	UG/L	1.20	2,580.00	43.41	1.60	840.00	87.62
ARSENIC	UG/L	0.21	58.00	2.05	0.76	10.00	3.88
BARIUM	UG/L	12.00	420.00	65.63	11.00	172.00	41.10
BROMIDE	MG/L	0.05	51.00	2.18	0.06	6.90	2.32
CADMIUM	UG/L	0.08	1.50	0.62	0.28	0.60	0.43
CALCIUM	UG/L	6,410	810,000	102,009	100,000	1,260,000	319,095
CHLORIDE (AS CL)	MG/L	1.80	5,100	267	170	5,750	716
CHROMIUM, TOTAL	UG/L	1.20	40.00	8.22	0.99	34.00	8.19
CIS-1,2-DICHLOROETHYLENE	UG/L	0.29	880.00	87.48	0.35	90	32.025
COBALT	UG/L	0.15	20.60	3.34	0.26	7.30	1.58
COPPER	UG/L	0.28	320.00	10.17	1.40	9.80	4.59
DISSOLVED OXYGEN	MG/L	0.00	5.76	0.80	0.18	9.12	2.23
FLUORIDE	MG/L	0.13	15.60	2.80	0.34	2.90	1.09
IRON	UG/L	28.70	15,000	1,226	44	1,400	327
MAGNESIUM	UG/L	1,290	430,000	42,601	34,100	586,000	111,990
MANGANESE	UG/L	1.20	1,300	287	0.60	489	48.94
NICKEL	UG/L	1.30	954.00	94.06	5.80	15.00	9.72
NITROGEN, NITRATE (AS N)	MG/L	0.01	4.80	0.63	0.01	44.80	5.63
OXIDATION REDUCTION POTENTIAL	MILLIVOLTS	-294.00	229.00	-21.58	-180.00	156.00	11.49
CORROSIVITY (PH)	SU	6.18	11.01	7.20	6.77	9.36	7.63
POTASSIUM	UG/L	1,100	37,000	4,144	2,800	25,000	10,444
SELENIUM	UG/L	0.48	210.00	8.40	3.20	22.00	9.43
SILVER	UG/L	0.20	0.64	0.34	--	--	--
SODIUM	UG/L	1,960	3,000,000	172,950	110,000	4,180,000	475,048
SPECIFIC CONDUCTANCE	MS/CM	0.43	17.10	1.78	1.50	18.51	3.92
SULFATE (AS SO4)	MG/L	1.80	2,600	104	42	2,900	906
TETRACHLOROETHYLENE(PCE)	UG/L	0.21	110.00	7.36	0.25	0.25	0.25
THALLIUM	UG/L	0.03	0.62	0.18	0.16	0.16	0.16
TOTAL DISSOLVED SOLIDS	MG/L	233	13,000	975	860	13,500	2,880
TRANS-1,2-DICHLOROETHENE	UG/L	0.20	5.60	1.21	0.28	0.6	0.418
TRICHLOROETHYLENE (TCE)	UG/L	0.36	360.00	46.20	0.28	21	6.752
TURBIDITY	NTU	-29.50	1,398.00	23.71	-4.10	1,682.00	136.28
VANADIUM	UG/L	0.35	10.00	1.68	0.62	1.70	1.20
VINYL CHLORIDE	UG/L	0.47	770.00	69.88	0.86	9.5	3.97
ZINC	UG/L	1.90	611	105.62	6.40	120	40.90

µg/L = micrograms per Liter
mg/L = milligrams per Liter
mS/cm = milli Siemens per centimeter
mV = millivolts
NTU = Nephelometric Turbidity Units
SU = Standard Units

Note 1: Average calculations are based upon one-half of the minimum detection limits for non-detected constituents
Note 2: Filtered metals results were used for all calculations.
Note 3: Only normal (N) samples were used for the calculations; field duplicates were not included.

Table 2-2
Number of Samples Exceeding Uranium[a] Background Values in Volumetric Building Material Samples During the Remedial Investigation[1]
Former Guterl Specialty Steel Corporation FUSRAP Site

Building Number	Number of Samples Collected	Number of Samples Exceeding Uranium Background Levels	Type of Material (Number of Samples)	Uranium Source
1[b]	3	0	--	--
2	10	2	Concrete (1)	Naturally Occurring
			Particle Board (1)	AEC
3	7	3	Concrete (2)	AEC
			Metal (1)	
4/9	4	0	--	--
5	2	0	--	--
6[c]	6	4	Brick (2)	Some of the uranium in one of the samples appears to be naturally occurring.
			Metal (1)	AEC
			Wood (1)	AEC
8[c]	2	2	Concrete (1)	AEC
			Brick (1)	
17[d]	0	--	--	--
24[e]	4	2	Concrete (2)	AEC
35	2	0	--	--

Notes:

[a] Radionuclides sampled include ^{226}Ra, ^{228}Ra, ^{228}Th, ^{230}Th, ^{232}Th, ^{232}U, ^{235}U and ^{238}U.

[b] There were no samples collected in the basement of Building 1.

[c] There were no samples collected inside Building 6 or Building 8. These results refer to samples collected outside the building.

[d] A radiological scanning survey was conducted in the laboratory; no other matrices were sampled. Laboratory work surfaces, floors, and common areas within the building interior were surveyed.

[e] Three dust samples were collected from the roof trusses of Building 24. Uranium concentrations in roof truss dust reported earlier (NLO, 1953) were confirmed.

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[1] This table was developed by comparing the data in Tables 3-36, 4-9, 4-14, 4-23, 4-34, 4-43, 4-44, 4-51, 4-62, and 4-70 to Table 4-14 of the Remedial Investigation Report.

Table 2-3
Number of Static Measurements Exceeding the Remedial Investigation Average Radionuclide Screening Value for Buildings[1] and Maximum Average Fixed Measurement for Each Building
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

Building Number	Number of Locations Measured	Number of Samples Exceeding Average Screening Level		Maximum Measured Surface Concentration (dpm/100 cm^2)
		Thorium	Uranium	
1[a]	225	20[b]	2	21,000
2	1,380	137 [b]	7	140,000
3	1,561	323 [b]	270	150,00
4/9	813	263[b]	29	31,000
5	38	15[b]	0	2,000
6[c]	43	4[b]	0	1,600
8[c]	71	0	11	50,000
17[d]	60	1[b]	0	1,700
24	541	105[b]	99	120,000
35	123	11[b]	0	2,900

Notes:

[a] There were no samples collected in the basement of Building 1.

[b] Sample exceeded the average thorium screening level but did not exceed the average uranium screening level.

[c] There were no samples collected inside Building 6 or Building 8. These results refer to samples collected on the exterior of each of the buildings.

[d] A radiological scanning survey was conducted in the laboratory; no other matrices were sampled. Laboratory work surfaces, floors, and common areas within the building interior were surveyed.

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[1] Data provided in Section 4.2 and Table 4-7 of the Remedial Investigation Report.

Table 2-4
Number of Removable Measurements Exceeding the Remedial Investigation Average Radionuclide Screening Value for Buildings[2] and Maximum Average Removable Measurement for Each Building
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

Building Name	Number of Locations Measured	Number of Samples Exceeding the Removable Screening Level		Maximum Measured Removable Surface Concentration (dpm/100 cm^2)
		Thorium	Uranium	
1[a]	225	0	0	60 ± 20
2	1,360	0	0	18 ± 13
3	1,348	1[b]	0	280 ± 50
4/9	902	0	0	27 ± 16
5	38	0	0	6 ± 9
6[c]	41	0	0	8 ± 10
8[c]	52	0	0	170 ± 40
17	30	0	0	8 ± 10
24	538	2[b]	0	250 ± 50
35	118	0	0	8 ± 10

Notes:

[a] There were no samples collected in the basement of Building 1.

[b] Sample exceeded the average thorium screening level but did not exceed the average uranium screening level.

[c] There were no samples collected inside Building 6 or Building 8. These results refer to samples collected outside the building.

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[2] Data provided in Section 4.2 and Table 4-7 of the Remedial Investigation Report.

Table 2-5
Present and Potential Future Risks for Each Investigative Area
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

INVESTIGATIVE AREA	PRESENT RISK[1] (trespassers)	POTENTIAL FUTURE RISK[1] (workers or residents)
IA01 (excised area including Building 24, building interiors, building materials, soils, utility water/sediments) *(EU's 1 through 9)*	**Increased Cancer: Yes** for trespassers exposed to soils in Building 8 **Dose Rate: Yes** for trespassers exposed to soils in Building 8	**Increased Cancer: Yes** for worker exposure **Dose Rate: Yes** for worker exposure
IA02 (building exterior areas soils, surface water) *(EU's 10 – 11)*	**Increased Cancer:** Not exceeding acceptable limit **Dose Rate:** Not exceeding acceptable limit	**Increased Cancer: Yes** for resident **Dose Rate:** Not exceeding acceptable limit
IA03 (landfill area soil, sediment) *(EU 12)*	**Increased Cancer:** Not exceeding acceptable limit **Dose Rate:** Not exceeding acceptable limit	**Increased Cancer: Yes** for resident **Dose Rate:** Not exceeding acceptable limit
IA04 ATI Property		
IA04A (soil, sediment) *(EU 13)*	**Increased Cancer:** Not exceeding acceptable limit **Dose Rate:** Not exceeding acceptable limit	**Increased Cancer: Yes** for resident **Dose Rate:** Not exceeding acceptable limit
IA04B (soil: see IA07 for groundwater) *(EU 14)*	**Increased Cancer:** Not exceeding acceptable limit **Dose Rate:** Not exceeding acceptable limit	**Increased Cancer:** Resident risk comparable to background for soil exposure **Dose Rate:** Not exceeding acceptable limit for soil exposure
IA04C (soil, sediment) *(EU 15)*	**Increased Cancer:** Not exceeding acceptable limit **Dose Rate:** Not exceeding acceptable limit	**Increased Cancer: Yes** for resident **Dose Rate:** Not exceeding acceptable limit
IA04D (soil, sediment: see IA07 for groundwater) *(EU 16)*	**Increased Cancer:** Not exceeding acceptable limit **Dose Rate:** Not exceeding acceptable limit	**Increased Cancer: Yes** for resident **Dose Rate:** Not exceeding acceptable limit
IA05 Railroad right of way		
IA05A (soil) *(EU 17)*	**Increased Cancer:** Not exceeding acceptable limit **Dose Rate:** Not exceeding acceptable limit	**Increased Cancer: Yes** for on-site worker and for resident **Dose Rate: Yes** for workers and for resident
IA05B (soil) *(EU 18)*	**Increased Cancer:** Not exceeding acceptable limit **Dose Rate:** Not exceeding acceptable limit	**Increased Cancer:** Resident risk comparable to background **Dose Rate:** Not exceeding acceptable limit

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[1] The risk is deemed unacceptable if a person, exposed to current site conditions, experiences an incremental lifetime cancer risk greater than 1 in 10,000 (USEPA, 1990). In addition, the risk is deemed unacceptable if a person, exposed to current site conditions, receives an annual dose rate of radiation greater than 25 mrem/year above background dose rates (25 mrem/year is the acceptable dose rate for a site with unrestricted use after the NRC license termination). (10 CFR 20 Subpart E)

INVESTIGATIVE AREA	PRESENT RISK[1] (trespassers)	POTENTIAL FUTURE RISK[1] (workers or residents)
IA06 Off-site properties not evaluated further in the Remedial Investigation		
IA07 Current groundwater concentrations and potential future modeled leaching of soil source term to groundwater could lead to unacceptable risks and doses if the groundwater served as a source of drinking water in the future. Site groundwater not assessed as separate unit; included in other geographic (soil) IA in which samples were located. Groundwater samples obtained below IA04B show greatest contamination.		
IA08 Site utilities (non-native sediment and surface water) not assessed as separate unit; included in other geographic (soil) IA in which samples were located. Some contamination was found within site utilities. Neither the carcinogenic risk or radiation doses exceed acceptable limits for non-native sediments and surface water.		
IA09 (Erie Canal sediment and surface water) *(EU 19)*	**Increased Cancer:** Not exceeding acceptable limit **Dose Rate:** Not exceeding acceptable limit	**Increased Cancer:** Not exceeding acceptable limit **Dose Rate:** Not exceeding acceptable limit
IA10 (private, adjacent lot 4.1) *(EU 20)*	**Increased Cancer:** Not exceeding acceptable limit **Dose Rate:** Not exceeding acceptable limit	**Increased Cancer:** Resident risk comparable to background **Dose Rate:** Not exceeding acceptable limit

[1] The risk is deemed unacceptable if a person, exposed to current site conditions, experiences an incremental lifetime cancer risk greater than 1 in 10,000 (USEPA, 1990). In addition, the risk is deemed unacceptable if a person, exposed to current site conditions, receives an annual dose rate of radiation greater than 25 mrem/year above background dose rates (25 mrem/year is the acceptable dose rate for a site with unrestricted use after the NRC license termination). (10 CFR 20 Subpart E)

TABLE 2-6: Summary of Risk Characterization Results for Each Exposure Unit
SELECTED CARCINOGENIC RISKS, RADIATION DOSES, AND HAZARD INDICES BY EU
REMEDIAL INVESTIGATION FORMER GUTERL SPECIALTY STEEL CORPORATION FUSRAP SITE

Scenario	Time (years)	Net EPC Total Dose (mrem/yr)	Total Cancer Risk	EPC Hazard Index	Time (years)	Net EPC Total Dose (mrem/yr)	Total Cancer Risk	Hazard Index	Time (years)	Net EPC Total Dose (mrem/yr)	Total Cancer Risk	Hazard Index	Time (years)	Net EPC Total Dose (mrem/yr)	Total Cancer Risk	Hazard Index	Time (years)	Net EPC Total Dose (mrem/yr)	Total Cancer Risk	Hazard Index	Time (years)	Net EPC Total Dose (mrem/yr)	Total Cancer Risk	Hazard Index
Exposure Unit 1 Building 1 - IA-01 Excised Building Interior																								
Juvenile Trespasser	0	0.10	3E-07	4.E-03	1	0.048	1E-08	NC	10	0.042	9E-09	NC	25	0.032	3E-09	NC	No soil media included in this EU, therefore no soil to groundwater leaching modeled for this EU. These times not modeled for exposure to building surfaces because they exceed typical useful lifetime of industrial buildings							
On-site Worker	0	12	7E-06	2.E-02	1	12	3E-06	NC	10	NC	NC	NC	25	8.6	1E-06	NC								
Construction Worker	0	**591**	5E-05	2.E-02	1	**591**	5E-05	NC	10	NC	NC	NC	25	0.00	0E+00	NC								
Exposure Unit 2 Building 2 - IA-01 Excised Building Interior																								
Juvenile Trespasser	0	0.48	5E-06	8.E-03	1	0.029	7E-09	NC	10	0.028	5E-09	NC	25	0.026	3E-09	NC	58	NC	NC	NC	1000	0.15	2E-06	NC
On-site Worker	0	14	**2E-04**	3.E-02	1	7.6	1E-06	NC	10	NC	NC	NC	25	7.0	7E-07	NC	58	NC	NC	NC	1000	2.3	9E-05	NC
Construction Worker	0	**470**	5E-05	8.E-02	1	**462**	4E-05	NC	10	NC	NC	NC	25	0.00	0E+00	NC	58	19	1E-05	NC	1000	2.9	4E-06	NC
Exposure Unit 3 Building 3 - IA-01 Excised Building Interior																								
Juvenile Trespasser	0	0.82	4E-06	8.E-03	1	0.61	4E-07	NC	10	0.40	2E-07	NC	25	0.056	3E-08	NC	58	NC	NC	NC	1000	0.039	1E-06	NC
On-site Worker	0	**120**	**2E-04**	3.E-02	1	**113**	7E-05	NC	10	NC	NC	NC	25	9.5	5E-06	NC	58	NC	NC	NC	1000	0.59	5E-05	NC
Construction Worker	0	**55**	2E-05	3.E-01	1	**45**	5E-06	NC	10	NC	NC	NC	25	0.00	0E+00	NC	58	**105**	4E-05	NC	1000	1.7	3E-06	NC
Exposure Unit 4 Building 4/9 - IA-01 Excised Building Interior																								
Juvenile Trespasser	0	0.31	3E-06	3.E-03	1	0.14	8E-08	NC	10	0.092	5E-08	NC	25	0.013	8E-09	NC	58	NC	NC	NC	1000	0.061	2E-06	NC
On-site Worker	0	**30**	**1E-04**	1.E-02	1	**26**	2E-05	NC	10	NC	NC	NC	25	2.2	1E-06	NC	58	NC	NC	NC	1000	0.93	6E-05	NC
Construction Worker	0	14	8E-06	4.E-02	1	10	1E-06	NC	10	NC	NC	NC	25	0.00	0E+00	NC	58	11	8E-06	NC	1000	1.3	3E-06	NC
Exposure Unit 5 Building 5 - IA-01 Excised Building Interior																								
Juvenile Trespasser	0	0.015	9E-09	5.E-09	1	0.015	8E-09	NC	10	0.010	5E-09	NC	25	0.0026	9E-10	NC	No soil media included in this EU, therefore no soil to groundwater leaching modeled for this EU. These times not modeled for exposure to building surfaces because they exceed typical useful lifetime of industrial buildings							
On-site Worker	0	3.0	2E-06	1.E-07	1	2.9	2E-06	NC	10	NC	NC	NC	25	0.57	2E-07	NC								
Construction Worker	0	25	3E-06	2.E-03	1	25	2E-06	NC	10	NC	NC	NC	25	24	3E-06	NC								
Exposure Unit 6 Building 6 - IA-01 Excised Building Interior																								
Juvenile Trespasser	0	3.8	3E-05	1.E-02	1	0.00	0E+00	NC	10	0.00	0E+00	NC	25	0.00	0E+00	NC	58	NC	NC	NC	1000	3.6	3E-05	NC
On-site Worker	0	**58**	**1E-03**	5.E-02	1	0.00	0E+00	NC	10	NC	NC	NC	25	0.00	0E+00	NC	58	NC	NC	NC	1000	**54**	**1E-03**	NC
Construction Worker	0	**84**	7E-05	2.E-01	1	0.00	0E+00	NC	10	NC	NC	NC	25	0.00	0E+00	NC	58	**117**	6E-05	NC	1000	**49**	4E-05	NC
Exposure Unit 7 Building 8 - IA-01 Excised Building Interior																								
Juvenile Trespasser	0	**48**	**3E-04**	**3.E+00**	1	0.50	3E-07	NC	10	0.33	2E-07	NC	25	0.048	3E-08	NC	58	NC	NC	NC	1000	0.72	6E-06	NC
On-site Worker	0	**765**	**1E-02**	**9.E+00**	1	**94**	6E-05	NC	10	NC	NC	NC	25	8.3	5E-06	NC	58	NC	NC	NC	1000	11	**2E-04**	NC
Construction Worker	0	**556**	**3E-04**	**2.E+01**	1	**60**	6E-06	NC	10	NC	NC	NC	25	0.00	0E+00	NC	58	**6481**	**2E-03**	NC	1000	**55**	2E-05	NC
Exposure Unit 8 Building 24 - IA-01 Excised Building Interior																								
Juvenile Trespasser	0	0.43	3E-06	3.E-03	1	0.33	2E-07	NC	10	0.22	1E-07	NC	25	0.030	2E-08	NC	58	NC	NC	NC	1000	0.042	1E-06	NC
On-site Worker	0	**65**	**1E-04**	1.E-02	1	**61**	4E-05	NC	10	NC	NC	NC	25	5.0	3E-06	NC	58	NC	NC	NC	1000	0.64	6E-05	NC
Construction Worker	0	19	1E-05	**9.E+00**	1	16	3E-06	NC	10	NC	NC	NC	25	16	3E-06	NC	58	10	8E-06	NC	1000	1.7	4E-06	NC
Exposure Unit 9 Building 35 - IA-01 Excised Building Interior																								
Juvenile Trespasser	0	0.19	3E-06	1.E-03	1	0.0048	3E-09	NC	10	0.0034	2E-09	NC	25	0.00089	3E-10	NC	58	NC	NC	NC	1000	0.087	2E-06	NC
On-site Worker	0	3.7	**1E-04**	3.E-03	1	0.95	5E-07	NC	10	NC	NC	NC	25	0.20	5E-08	NC	58	NC	NC	NC	1000	1.3	7E-05	NC
Construction Worker	0	17	1E-05	2.E-02	1	8.6	8E-07	NC	10	NC	NC	NC	25	0.00	0E+00	NC	58	15	1E-05	NC	1000	5.5	6E-06	NC
Exposure Unit 10 East of Buildings - IA-02 Excised Building Exterior Areas																								
Juvenile Trespasser	0	0.12	3E-06	2.E-03	These points in time were not modeled for this EU as it does not include building surfaces.												58	NC	NC	NC	1000	0.031	1E-06	NC
On-site Worker	0	1.8	**1E-04**	7.E-03													58	NC	NC	NC	1000	0.47	5E-05	NC
Construction Worker	0	5.1	8E-06	5.E-02													58	16	1E-05	NC	1000	2.1	4E-06	NC
Resident - Adult	0	15	**6E-04**	2.E-01													58	**162**	**2E-03**	NC	1000	6	**3E-04**	NC
Resident - Child	0	NA	NA	3.E-01																				
Exposure Unit 11 Between Buildings - IA-02 Excised Building Exterior Areas																								
Juvenile Trespasser	0	0.25	4E-06	1.E-02	These points in time were not modeled for this EU as it does not include building surfaces.												58	NC	NC	NC	1000	0.018	1E-06	NC
On-site Worker	0	3.1	**1E-04**	4.E-02													58	NC	NC	NC	1000	0.27	5E-05	NC
Construction Worker	0	5.3	8E-06	2.E-01													58	**38**	2E-05	NC	1000	1.0	3E-06	NC
Resident - Adult	0	18	**6E-04**	5.E-01													58	**436**	**4E-03**	NC	1000	4.98	**3E-04**	NC
Resident - Child	0	NA	NA	**1.E+00**																				
Exposure Unit 12 Inactive Hazardous Waste Disposal Site - IA-03 Inactive Hazardous Waste Disposal Area																								
Juvenile Trespasser	0	0.046	2E-06	2.E-03	These points in time were not modeled for this EU as it does not include building surfaces.												58	NC	NC	NC	1000	0.0055	1E-06	NC
On-site Worker	0	0.64	9E-05	6.E-03													58	NC	NC	NC	1000	0.082	4E-05	NC
Construction Worker	0	3.3	6E-06	1.E-01													58	**25**	1E-05	NC	1000	0.51	3E-06	NC
Resident - Adult	0	12	**5E-04**	5.E-01													58	**292**	**3E-03**	NC	1000	2.8	**2E-04**	NC
Resident - Child	0	NA	NA	7.E-01																				

TABLE 2-6: Summary of Risk Characterization Results for Each Exposure Unit
SELECTED CARCINOGENIC RISKS, RADIATION DOSES, AND HAZARD INDICES BY EU
REMEDIAL INVESTIGATION FORMER GUTERL SPECIALTY STEEL CORPORATION FUSRAP SITE

Scenario	Time (years)	Net EPC Total Dose (mrem/yr)	Total Cancer Risk	EPC Hazard Index	Time (years)	Net EPC Total Dose (mrem/yr)	Total Cancer Risk	Hazard Index	Time (years)	Net EPC Total Dose (mrem/yr)	Total Cancer Risk	Hazard Index	Time (years)	Net EPC Total Dose (mrem/yr)	Total Cancer Risk	Hazard Index	Time (years)	Net EPC Total Dose (mrem/yr)	Total Cancer Risk	Hazard Index	Time (years)	Net EPC Total Dose (mrem/yr)	Total Cancer Risk	Hazard Index
Exposure Unit 13 IA04A – part of IA04, Allegheny Ludlum Corporation Property																								
Juvenile Trespasser	0	0.12	3E-06	6.E-03	These points in time were not modeled for this EU as it does not include building surfaces.												58	NC	NC	NC	1000	0.11	2E-06	NC
On-site Worker	0	1.6	**1E-04**	2.E-02													58	NC	NC	NC	1000	1.7	8E-05	NC
Construction Worker	0	6.4	8E-06	2.E-01													58	**69**	2E-05	NC	1000	2.1	4E-06	NC
Resident - Adult	0	18	**6E-04**	5.E-01													58	**789**	**7E-03**	NC	1000	9.8	**3E-04**	NC
Resident - Child	0	NA	NA	**1.E+00**																				
Exposure Unit 14 IA04B – part of IA04, Allegheny Ludlum Corporation Property																								
Juvenile Trespasser	0	0.0024	2E-06	3.E-04	These points in time were not modeled for this EU as it does not include building surfaces.												58	NC	NC	NC	1000	0.000010	8E-07	NC
On-site Worker	0	0.035	6E-05	8.E-04													58	NC	NC	NC	1000	0.00015	3E-05	NC
Construction Worker	0	2.2	5E-06	1.E-01													58	3.7	5E-06	NC	1000	0.035	2E-06	NC
Resident - Adult	0	**32**	**6E-04**	**2.E+00**													58	**47**	**8E-04**	NC	1000	0.26	**2E-04**	NC
Resident - Child	0	NA	NA	**2.E+00**																				
Exposure Unit 15 IA04C – part of IA04, Allegheny Ludlum Corporation Property																								
Juvenile Trespasser	0	0.061	3E-06	9.E-04	These points in time were not modeled for this EU as it does not include building surfaces.												58	NC	NC	NC	1000	0.027	1E-06	NC
On-site Worker	0	0.85	9E-05	4.E-03													58	NC	NC	NC	1000	0.41	5E-05	NC
Construction Worker	0	2.2	6E-06	8.E-03													58	2.7	6E-06	NC	1000	0.82	3E-06	NC
Resident - Adult	0	6.1	**5E-04**	2.E-03													58	18	**6E-04**	NC	1000	2.2	**3E-04**	NC
Resident - Child	0	NA	NA	2.E-02																				
Resident - Adult																								
Exposure Unit 16 IA04D – part of IA04, Allegheny Ludlum Corporation Property																								
Juvenile Trespasser	0	0.12	3E-06	2.E-03	These points in time were not modeled for this EU as it does not include building surfaces.												58	NC	NC	NC	1000	0.077	2E-06	NC
On-site Worker	0	1.7	**1E-04**	5.E-03													58	NC	NC	NC	1000	1.2	7E-05	NC
Construction Worker	0	4.4	7E-06	8.E-02													58	9.6	8E-06	NC	1000	2.2	4E-06	NC
Resident - Adult	0	22	**7E-04**	**1.E+00**													58	**87**	**1E-03**	NC	1000	6.2	**3E-04**	NC
Resident - Child	0	NA	NA	**1.E+00**																				
Resident - Adult																								
Exposure Unit 17 IA05A – part of IA05, Railroad Right-of-Way																								
Juvenile Trespasser	0	7.1	5E-05	3.E-01	These points in time were not modeled for this EU as it does not include building surfaces.												58	NC	NC	NC	1000	1.4	1E-05	NC
On-site Worker	0	**104**	**2E-03**	8.E-01													58	NC	NC	NC	1000	21	**4E-04**	NC
Construction Worker	0	**75**	5E-05	**2.E+00**													58	**653**	**2E-04**	NC	1000	22	2E-05	NC
Resident - Adult	0	**166**	**3E-03**	8.E-01													58	**7368**	**6E-02**	NC	1000	**96**	**2E-03**	NC
Resident - Child	0	NA	NA	**8.E+00**																				
Exposure Unit 18 IA05B – part of IA05, Railroad Right-of-Way																								
Juvenile Trespasser	0	0.038	2E-06	1.E-04	These points in time were not modeled for this EU as it does not include building surfaces.												58	NC	NC	NC	1000	0.021	1E-06	NC
On-site Worker	0	0.57	9E-05	4.E-04													58	NC	NC	NC	1000	0.32	5E-05	NC
Construction Worker	0	0.90	5E-06	5.E-03													58	1.6	5E-06	NC	1000	0.43	3E-06	NC
Resident - Adult	0	2.9	**5E-04**	4.E-02													58	19	**6E-04**	NC	1000	1.1	**2E-04**	NC
Resident - Child	0	NA	NA	5.E-02																				
Exposure Unit 19 - IA-09, Erie Barge Canal																								
Juvenile Trespasser	0	0.0014	6E-08	5.E-05	These points in time were not modeled for this EU as it does not include building surfaces.												These points in time were not modeled because the EU does not include the soil to groundwater leaching pathway (soil is not an exposure medium in this EU).							
On-site Worker	0	NA	NA	NA																				
Construction Worker	0	NA	NA	NA																				
Resident - Adult	0	0.00072	9E-08	2.E-05																				
Resident - Child	0	NA	NA	2.E-04																				
Exposure Unit 20 - IA-10, Lot 4.1																								
Juvenile Trespasser	0	0.082	3E-06	3.E-04	These points in time were not modeled for this EU as it does not include building surfaces.												58	NC	NC	NC	1000	0.022	1E-06	NC
On-site Worker	0	1.2	1E-04	9.E-04													58	NC	NC	NC	1000	0.34	5E-05	NC
Construction Worker	0	0.96	5E-06	7.E-03													58	2.1	5E-06	NC	1000	0.25	3E-06	NC
Resident - Adult	0	2.7	**4E-04**	3.E-03													58	21	**6E-04**	NC	1000	0.78	**2E-04**	NC
Resident - Child	0	NA	NA	3.E-02																				

Notes:

- Dose and Risk from Appendix V tables. Hazard Index from Table 6-14.
- **Bolded** values exceed the target dose of 25mrem/yr, the target risk of 1x 10^{-4}, or the target hazard index of 1.
- Soil is surface soil for juvenile trespasser and on-site worker and total soil forconstruction worker and resident receptors.
- EU = Exposure Unit
- mrem/yr = millirem per year

-- = Media was not sampled or doesn't exist in this exposure unit.
NA = Not applicable; the receptor is assumed to not be exposed to this media.
NC = Not Calculated; this calculation is not performed for this receptor at this year.

Table 3-1
Preliminary Remediation Goals (PRGs) for Radionuclides in Soils
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

COC	CASRN	Weighted Average Site Background Concentration, pCi/g	Construction Worker[d]	Groundwater Protection
^{232}Th[a]	7440-29-1	0.644	6.6 pCi/g	Not separately defined[e]
^{238}U[b]	7440-61-1	0.74	23 pCi/g	3.66 pCi/g
Total U[c]	N/A	N/A	69 mg/kg	11 mg/kg

Notes: Values represent minimum of RESRAD calculated PRG at years 0 or 1,000 (year of peak dose per nuclide group). Based of 10 CFR 20.

[a] PRG-CW for ^{232}Th includes ^{228}Ra and ^{228}Th decay contribution to dose at time zero.

[b] A conversion factor of 0.333 was used to convert uranium mass to ^{238}U activity.

[c] PRG for Total U includes contribution to dose from ^{234}U, ^{235}U, and ^{238}U, assuming natural abundance of uranium isotopes (in ratio of ^{234}U (1): ^{235}U (0.046): ^{238}U (1).

[d] These cleanup goals represent activity levels above the average site background activity corresponding to 25 mrem/yr dose to a construction worker. Since a mixture of radionuclides (i.e. uranium and thorium) is present, the PRG-CW values for soil will utilize the following sum of ratios equation:

$$SOR = \frac{^{232}Th}{6.6} + \frac{^{234}U + ^{235}U + ^{238}U}{47}$$

[e] Removal of soil that exceeds the ^{238}U PRG-GW will include the removal of the collocated soil with activity concentrations that exceed the ^{232}Th Soil PRG-CW. ^{232}Th is not a COC for groundwater, a separate ^{232}Th PRG for soil is not required for groundwater protection.

Acronyms:

CASRN	Chemical Abstract Services Registry Number
COC	contaminant of concern
ROC	radionuclide of concern
mg/kg	milligrams per kilogram
N/A	not applicable
pCi/g	picocurie(s) per gram (amount of radioactivity)
PRG-CW	preliminary remediation goal – construction worker scenario
PRG-GW	preliminary remediation goal – groundwater protection scenario

Table 3-2a
Project-Specific Derived Concentration Guideline Levels (DCGL)
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

	DCGL[a]	
	Total[b]	**Removable**
Alpha (α) dpm/100 cm^2	2,391	240
Beta (β) dpm/100 cm^2	2,515	252

Table 3-2b
Conversion to Limit for Portable Survey Measurement Including Beta Backscatter and Geometry Factors
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

Particles as Detected by Detector at Assumed Efficiency of Detector[c]	
Alpha (α) dpm/100 cm^2	1,195
Beta (β) dpm/100 cm^2	1,509

Notes:
DCGLs are derived in Appendix H.
dpm= disintegrations per minute

[a] DCGLs developed by USACE Buffalo District to determine instrument response to limit dose to 25 mrem/year to an on-site construction worker.

[b] Fixed plus removable contamination (as measured by a static measurement or scan).

[c] Backscatter Factor (BF) = 1.2

Table 3-3
Building Construction Materials, Areas, and Volumes
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

Building Sections	Dimensions m (ft)			Area m^2 (ft^2)	Approximate Volume m^3 (yd^3)	Building Materials / Notes
	Height	Length	Width			
Building 1						
Floor	--	--	--	800 (8,800)	249 (325)	Thin gauge steel over trusses with plywood repair Area obtained directly from RI report.
West Wall	8 (25)	--	75 (250)	570 (6,200)	176 (230)	Base: masonry Upper: steel frame with corrugated iron and glass panels.
East Wall	8 (25)	--	75 (250)	570 (6,200)	176 (230)	
End Areas	separately calculated			150 (1,600)	46 (60)	
Interior Wall 1	10 (33)	--	6 (20)	60 (660)	19 (24)	Concrete block and corrugated iron.
Interior Wall 2	10 (33)	--	6 (20)	60 (660)	19 (24)	Plywood and wood studs.
Interior Wall 3	10 (33)	--	3 (10)	30 (330)	9 (12)	Corrugated iron panels.
Roof/Ceilings	--	75 (250)	15 (45)	1,000 (11,200)	316 (413)	Corrugated iron on steel trusses.
Building 1 Total				**3,300 (35,600)**	**1,000 (1,300)**	
Building 2						
Floor	--	--	--	6,300 (68,900)	1,951 (2,552)	Soil, concrete, and brick Area obtained directly from RI report.
West Wall	13 (43)	--	180 (600)	2,400 (25,800)	731 (956)	Base: masonry

Building Sections	Dimensions m (ft)			Area m^2 (ft^2)	Approximate Volume m^3 (yd^3)	Building Materials / Notes
	Height	Length	Width			
East Wall	13 (43)	--	180 (600)	2,400 (25,800)	731 (956)	Upper: steel frame with corrugated iron and glass panels.
East Wall Addition	6 (20)	--	150 (478)	880 (9,560)	271 (354)	
West Wall Addition	5 (15)	--	180 (600)	830 (9,000)	255 (333)	
End Areas	separately calculated			700 (7,600)	217 (283)	Base: masonry Upper: steel frame with corrugated iron, steel, glass, and aluminum composite material panels.
Roof	--	180 (600)	41 (135)	7,500 (81,000)	2,294 (3,000)	Corrugated iron on steel trusses.
Building 2 Total				**20,900 (227,700)**	**6,500 (8,400)**	
Building 3						
Floor	--	--	--	6,200 (67,400)	1,909 (2,496)	Soil, concrete, and brick Area obtained directly from RI report.
West Wall	10 (33)	--	180 (605)	1,800 (20,000)	565 (739)	Base: masonry Upper: steel frame with corrugated iron and glass panels.
East Wall	10 (33)	--	180 (605)	1800 (20,000)	565 (739)	
East Wall Addition	4 (12)	--	180 (605)	700 (7,300)	206 (269)	

Building Sections	Dimensions m (ft)			Area m^2 (ft^2)	Approximate Volume m^3 (yd^3)	Building Materials / Notes
	Height	Length	Width			
North end (note: south end open to Building 4/9)	separately calculated			420 (4,500)	128 (168)	Steel frame with corrugated iron and aluminum panels.
Roof	--	180 (605)	28 (92)	5,100 (55,700)	1,576 (2,061)	Corrugated iron on steel trusses.
Building 3 Total				**16,100 (174,800)**	**4,900 (6,500)**	
Building 4/9						
Floor	--	--	--	4,400 (47,400)	1,342 (1,756)	Soil, concrete, and brick Area obtained directly from RI Report.
South Wall	10 (34)	--	70 (240)	750 (8,200)	231 (302)	Base: masonry Upper: steel frame with corrugated iron, aluminum, and glass panels.
North Wall	10 (34)	--	70 (240)	750 (8,200)	231 (302)	
End Areas	separately calculated			1,300 (14,060)	398 (521)	
Roof	--	80 (250)	70 (240)	5,500 (60,000)	1,699 (2,222)	Steel trusses with corrugated iron, aluminum, and glass panels.
Building 4/9 Total				**12,700 (137,800)**	**3,900 (5,100)**	

Building Sections	Dimensions m (ft)			Area m^2 (ft^2)	Approximate Volume m^3 (yd^3)	Building Materials / Notes
	Height	Length	Width			
Building 5						
Floor	--	--	--	350 (3,800)	107 (140)	Soil with metal grate for personnel access Area obtained directly from RI report.
North Wall	6 (20)	--	45 (145)	270 (2,900)	82 (107)	Base: concrete block Upper: steel frame with glass and metal panels.
South Wall	5 (15)	--	45 (145)	200 (2,200)	62 (81)	
End Areas	5 (17.5)	--	7 (24)	40 (420)	12 (16)	
End Areas	5 (17.5)	--	7 (24)	40 (420)	12 (16)	
Roof	--	45 (145)	7 (24.5)	330 (3,600)	101 (132)	Steel trusses with corrugated iron and glass panels.
Building 5 Total				**1,200 (13,000)**	**400 (500)**	
Building 6						
Floor	--	--	--	1,400 (15,100)	427 (559)	Soil, concrete, brick, and metal plate Area obtained directly from RI report.
South Wall	10 (32)	--	50 (155)	460 (4,960)	140 (184)	Base: masonry Upper: steel frame with corrugated iron, aluminum, and glass panels.
End Areas	separately calculated			460 (5,040)	140 (187)	

Building Sections	Dimensions m (ft)			Area m^2 (ft^2)	Approximate Volume m^3 (yd^3)	Building Materials / Notes
	Height	Length	Width			
Roof	--	50 (155)	30 (100)	1,400 (15,500)	439 (574)	Steel trusses with corrugated iron, glass, and aluminum composite material panels.
Building 6 Total				**3,700 (40,600)**	**1,100 (1,500)**	
Building 17 Total[1]				**940 (10,237)**		
Building 8						
Floor	--	--	--	2,600 (27,900)	790 (1,033)	Soil, concrete, brick, and metal plate Area obtained directly from RI report.
South Wall	10 (32)	--	50 (163)	480 (5,200)	148 (193)	Base: masonry Upper: steel frame with corrugated iron, aluminum, and glass panels.
North Wall	10 (32)	--	50 (163)	480 (5,200)	148 (193)	
End Areas	separately calculated			930 (10,080)	285 (373)	
Roof	--	60 (200)	50 (163)	3,000 (32,600)	923 (1,207)	Steel trusses with corrugated iron, glass, and aluminum composite material panels.
Building 8 Total				**7,500 (81,000)**	**2,300 (3,000)**	

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[1] No additional information is available.

Building Sections	Dimensions m (ft)			Area m^2 (ft^2)	Approximate Volume m^3 (yd^3)	Building Materials / Notes
	Height	Length	Width			
Building 24 (area of RAD surveys only)						
Floor	--	--	--	5,300 (58,000)	1,643 (2,148)	Concrete with steel grate over trenches.
North Section Walls	9 (30)	--	80 (248)	700 (7,440)	211 (276)	Steel frame with corrugated aluminum and glass panels.
North Section Walls	9 (30)	--	80 (248)	700 (7,440)	211 (276)	
North End Areas	separately calculated			1,200 (12,520)	355 (464)	
South Section Wall	9 (30)	--	70 (214)	600 (6,420)	182 (238)	
South Section Wall	9 (30)	--	70 (214)	600 (6,420)	182 (238)	
South Section Wall	7 (24)	--	70 (214)	480 (5,100)	145 (190)	
South End Areas	separately calculated			930 (10,120)	287 (375)	
South Roof	--	65 (214)	50 (156)	3,100 (33,400)	945 (1,236)	Corrugated iron on steel trusses.
North Roof	--	80 (248)	50 (150)	3,400 (37,200)	1,054 (1,378)	
Northwest Addition Wall	--	23 (75)	7 (22)	150 (1,650)	47 (61)	Steel frame with corrugated iron panels.
Southeast Addition #1 Roof	--	27 (90)	3 (10)	80 (900)	25 (33)	Corrugated iron on steel trusses.
Southeast Addition #2 Roof	--	20 (62)	3 (10)	60 (620)	18 (23)	
Southwest Addition Wall	3 (10)	--	8 (25)	20 (250)	7 (9)	Concrete block and steel framing.
Southeast Addition #1 Wall	3 (10)	--	30 (90)	80 (900)	25 (33)	
Southeast Addition #2 Wall	3 (10)	--	20 (62)	60 (620)	18 (23)	
Southeast Addition #2 Ends	3 (10)	--	8 (25)	20 (250)	7 (9)	
Building 24 Total				**17,400** **(189,300)**	**5,400** **(7,000)**	

Building Sections	**Dimensions m (ft)**			**Area m^2 (ft^2)**	**Approximate Volume m^3 (yd^3)**	**Building Materials / Notes**
	Height	**Length**	**Width**			
Building 35						
Floor	--	--	--	300 (3,280)	93 (121)	Concrete Area obtained directly from RI report.
Bldg. 35	7 (22)	--	34 (110)	220 (2,420)	69 (90)	Base: masonry Upper: steel frame with aluminum composite material panels.
Bldg. 35	7 (22)	--	34 (110)	220 (2,420)	69 (90)	
End Areas	separately calculated			(1,900)	55 (71)	
East Wall Addition	3 (10)	--	20 (70)	65 (700)	20 (26)	Brick with steel frame.
Roof	--	34 (110)	15 (50)	500 (5,500)	156 (204)	Corrugated aluminum on steel trusses.
Building 35 Total				**1500 (16,200)**	**460 (600)**	
Total (all buildings)				**84,000 (916,000)**	**26,000 (34,000)**	

Table 3-4
Summary of Building Surface Locations Exceeding DCGLs
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

Building Number	Number of Locations Measured	Number of Locations Exceeding DCGLs	Percent of Samples Impacted Above DCGLs (%)
1[a]	225	9	4
2	1,380	68	5
3	1,571	510	32
4/9	813	211	26
5	28	0	0
6[b]	0	--	100[c]
8[b]	0	--	100[c]
17[d]	60	0	0
24	541	172	32
35	123	0	0

Notes:

[a] There were no samples collected in the basement of Building 1.

[b] There were no samples collected inside Building 6 or Building 8 due to elevated radiological exposure measurement.

[c] It was assumed that 100% percent of the surfaces will exceed the DCGLs.

[d] Of the 60 locations measured, none exceeded the DCGLs.

Table 3-5
Summary of Building Contents and their Potential for Contamination
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

Building Number	Total Volumes of Building Contents m^3 (yd^3)	Types of Material	Probability that Material is Impacted
1	27 (35)	Two smelters, three furnaces, miscellaneous wood and metal debris.	Low
2	760 (1,000)	Chemical vats[a], trolley rail, boilers, furnaces, silos, benches; and miscellaneous wood, metal, and paper debris.	Low to Medium
3	460 (600)	Furnaces and exhaust stacks, trolley rail, steel cylinders, hoods, grinders, cabinets; and miscellaneous wood, metal, and paper debris.	Medium to High
4/9	920 (1,200)	Furnaces and exhaust stacks, fume hoods, steel equipment, overhead crane, saws, electrical transformer; and miscellaneous wood, metal and paper debris.	Medium to High
5	200 (260)	Electrical equipment.	Low
6[b]	230 (300)	Furnaces, rolling mill, steel rolls, miscellaneous equipment and debris.	High
8[b]	150 (200)	Machinery: including furnaces, rolling mills, cooling beds, miscellaneous equipment and debris.	High
17[c]	--	--	--
24[c]	--	--	--
35	5 (7)	Shelves, overhead crane, and miscellaneous debris.	Low

Notes:

[a] Used in non-AEC processes.

[b] Detailed surveys were not conducted in Buildings 6 or 8 due to elevated radiological exposure measurements.

[c] A survey of building contents was not conducted in Buildings 17 and 24 because they are active facilities for ATI Specialty Materials.

Table 3-6
Identification of General Response Actions
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

General Response Action	Description	Comments
Land Use Controls	Restrict current and future resource use and access to prevent unauthorized exposure to contaminated media.	A feasible approach for preventing exposure to contamination until achieving RAOs. Often used in combination with other GRAs. **Retain**
Containment	Use of physical barriers to control precipitation infiltration and groundwater flow through source materials and the migration of contaminants.	May meet RAOs if implemented in combination with LUCs or other GRAs. **Retain**
Removal	Remove groundwater from the subsurface using pumps; excavation of soils, and demolition of buildings to reduce mobility of contaminated media.	A routine procedure using traditional methods. Combined with treatment and/or disposal, can meet RAOs. **Retain**
Treatment	Reduce toxicity, mobility, or the volume of contaminated media, and thus provide a greater degree of protection to human health and the environment.	Performed *in situ* or *ex situ*, can meet RAOs. Generally used in combination with LUC or LTM until RAOs are achieved. **Retain**
Disposal	Reduces the mobility of contaminated media by proper placement.	Performed in combination with removal can meet RAOs. **Retain**

Acronyms:

LTM: Long Term Monitoring
LUC: Land Use Controls
RAOs: Remedial Action Objectives
GRA: General Response Actions

Table 3-7
Identification of General Response Actions, Technology Types, and Process Options by Media
Former Guterl Specialty Steel Corporation FUSRAP Site

General Response Actions	Technology Types	Process Options	Applicable Media		
			Soil	Groundwater	Buildings
Land Use Controls (LUC)	Administrative and Legal Mechanisms	Proprietary Controls, Governmental Controls, Enforcement and Permit Tools, Informational Tools	X	X	X
	Physical Mechanisms	Site Access Restrictions, Permanent Markers/Signage	X	X	X
Containment	Capping	Native Soil, Clay, Synthetic Liner, Multi Layered, Asphalt, or Concrete	X	-	-
	Vertical Barriers	Sheet Pile, Slurry Walls, Grout Curtains, Jet-Grouting	X	X	-
	Hydraulic Containment	Wells, Trenches		X	
	Surface Barriers	Sealants, Impermeable Sheeting	-	-	X
Removal	Soil Excavation	Conventional Earth Moving Equipment	X	-	-
	Building Dismantlement	Conventional Dismantlement Equipment	-	-	X
	Groundwater Extraction	Vertical Wells, Horizontal Wells, Interceptor Trench, Rubblized Trench	-	X	-
Treatment	Physical/ Chemical	Encapsulation, Electrokinetic Separation, Stabilization/Solidification, Soil Flushing, SoilWashing, Oxidation/Reduction, Solvent Extraction, Neutralization	X	-	-
		Adsorption, Reverse Osmosis, Filtration/Ultra Filtration, Ion Exchange, Clarification/Coagulation, Permeable Reactive Barrier (PRB), Precipitation using Phosphate Compounds, Oxidation-Reduction (Redox) Alteration, Monitored Natural Attenuation (MNA)	-	X	-
	Biological	Phytoremediation, Enhanced Bioremediation	X	X	-
	Thermal	Vitrification, Incineration	X	-	-
	Physical/Chemical Decontamination	Vacuum, Grinder, Shaver, Spaller, Blasting, Scabbler, Strippable Coatings, Chemical Application	-	-	X

General Response Action	Technology Type	Process Options	Applicable Media		
			Soil	Groundwater	Buildings
Disposal	On-Site Disposal	On-Site Engineered Structure, Existing On-Site Landfill	X	-	X
		Injection Wells, Injection-Recirculation via Surface Pond	-	X	-
	Off-Site Disposal	Existing Licensed or Permitted Disposal Facility	X	-	X
		Publicly-Owned Treatment Works (POTW), Surface Water Discharge	-	X	-
		Recycling/Beneficial Reuse	X	-	X

Table 3-8
Detailed Screening of Technology Types and Process Options for Soil
Former Guterl Specialty Steel Corporation FUSRAP Site

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Screening Results
Land Use Controls (LUCs)	Administrative and Legal Mechanisms	Proprietary Controls, Governmental Controls, Enforcement and Permit Tools, Informational Tools	Rated low to moderate. Can be used to control the human exposure to contaminated soil and building structures and to prohibit the use of groundwater. The effectiveness is dependent on long-term commitment of funding and enforcement from the administering and responsible agencies.	Rated low. Site and adjoining property are currently zoned Industrial. Implementability is dependent on the cooperation of the property owner. If the remedial action achieves the RAOs once complete, and results in no risk to human health or the environment, LUCs would not be required.	Rated low to moderate. Costs vary widely. The lower bounding costs would only include legal and administrative fees, while the upper bounding would include capital costs.	**Retain**
	Physical Mechanisms	Site Access Restrictions, Permanent Markers/Signage	Rated low. Increase protection of over baseline conditions by limiting direct access to the site using passive or active security measures.	Rated high. Fencing and signs are currently in place.	Rated low to moderate. Includes capital and maintenance costs.	**Retain**

Table 3-8
Detailed Screening of Technology Types and Process Options for Soil
Former Guterl Specialty Steel Corporation FUSRAP Site

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Screening Results
Removal	Soil Excavation	Conventional Earth Moving Equipment	Highly effective in reducing mobility and volume of contaminants. Toxicity is not reduced, but the materials are removed and likely disposed of at a secure landfill.	Rated high. Easy in most areas; may be difficult due to proximity to and under buildings.	Low unit cost (dependent on soil volumes).	**Retain**
Treatment	Physical/Chemical Treatment	Ex Situ Stabilization/Solidification	Highly effective in stabilizing contaminants, but may increase volumes.	Rated high; may require treatability studies.	Rated moderate. Soil transportation and disposal costs would significantly increase.	**Retain**
		Ex Situ Soil Washing	Rated low. May not be effective at meeting cleanup levels due to the heterogeneous nature of site soils.	Rated moderate. Treatment of wash water may create limitations.	Rated moderate to high, due to treatment of soil and wastewater. Costs savings may be achieved by reducing soil disposal costs.	**Do Not Retain**
Disposal	Off-site Disposal	Existing Licensed or Permitted Disposal Facility	Highly effective. Reduces mobility. Volume and toxicity not decreased; however, material is in a controlled facility to limit exposure.	Rated high.	Low to high capital depending on classification Low O&M.	**Retain**
		Recycling/Beneficial Reuse	Highly effective if a facility can be identified that can recycle at the radionuclides of concern levels present.	Moderate to high.	Low capital. Low O&M.	**Retain**

Acronyms: FUSRAP (Formerly Utilized Sites Remedial Action Program), O&M (operation and maintenance), and RAOs (remedial action objectives)

Table 3-9
Detailed Screening of Technology Types and Process Options for Buildings
Former Guterl Specialty Steel Corporation FUSRAP Site

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Screening Results
Land Use Controls (LUCs)	Administrative and Physical Mechanisms	Proprietary Controls, Governmental Controls, Enforcement and Permit Tools, Informational Tools	Rated low to moderate. Can be used to control the human exposure to contaminated soil and building structures and to prohibit the use of groundwater. The effectiveness is dependent on long-term commitment of funding and enforcement from the administering and responsible agencies.	Rated low. Site and adjoining property are currently zoned industrial. Implementability is dependent on the cooperation of the property owner.	Rated low to moderate. Costs vary widely. The lower bounding costs would only include legal and administrative fees, while the upper bounding would include capital costs.	**Retain**
		Deed Restrictions/Easement	Rated low to moderate. The effectiveness is dependent on long-term commitment of funding and enforcement from the administering and responsible agencies, and property owners.	Rated low. Implementability is dependent on property owner cooperation. If the remedial action achieves the RAOs once complete, and results in no risk to human health or the environment, LUCs would not be required.	Rated low to moderate. Includes legal and administrative fees, capital and maintenance costs.	**Retain**

Table 3-9
Detailed Screening of Technology Types and Process Options for Buildings
Former Guterl Specialty Steel Corporation FUSRAP Site

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Screening Results
	Physical Mechanisms	Site Access Restrictions, Permanent Markers/ Signage	Rated low. Effective in limiting site access, but does not reduce risk. Increase protection of over baseline conditions by limiting direct access to the site using passive or active security measures.	Rated high. Fencing and signs are currently in place. Easy to maintain. If the remedial action achieves the RAOs once complete, and results in no risk to human health or the environment, LUCs would not be required.	Rated low to moderate depending on the years of operation.	**Retain**
Containment	Surface Barriers	Sealants, Impermeable Sheeting	Rated low. Effective in reduction of the mobility of radionuclides of concern and potential exposure in short term. Does not reduce volume and toxicity. Sealant only provides limited life.	Rated moderate. Requires maintenance and periodic re-application.	Low to moderate. Capital cost is low. Maintenance and re-application, low to moderate.	**Do Not Retain**
Removal	Dismantlement	Conventional Dismantlement Equipment (Mechanical, hand tools, size reduction sorting).	Highly effective, used in conjunction with a disposal option to remove contaminated materials from the site.	Rated high. Easy in most areas; can be difficult in areas with shared walls and foundations.	High for mechanical equipment. Low for hand equipment, size reduction and sorting.	**Retain**

Table 3-9
Detailed Screening of Technology Types and Process Options for Buildings
Former Guterl Specialty Steel Corporation FUSRAP Site

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Screening Results
Disposal	Off-site Disposal	Existing Licensed or Permitted Disposal Facility	Highly effective in reduction of mobility. Volume and toxicity not decreased; however, material is in a controlled facility to limit exposure.	Rated high.	Low to high depending on classification.	**Retain**
		Recycling/Beneficial Reuse	Highly effective for the reduction of waste volume for portions of buildings that may be removed, but are not impacted above approved limits for the recycling facility.	Rated moderate to high.	Low, depending on the degree of sorting of materials. Recycling/re-use cost credits may offset some project costs.	**Retain**

Table 3-9
Detailed Screening of Technology Types and Process Options for Buildings
Former Guterl Specialty Steel Corporation FUSRAP Site

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Screening Results
Treatment	Building Treatment (Physical/Mechanical)	Vacuuming	Moderately effective. Will reduce waste volume. Effective for removing loose, particulate matter. May be an effective supporting decontamination measure for removing radiological-impacted dust.	Rated high.	Rated low.	**Retain**
		Grinding, Shaving, Spalling	Rated low. Considered effective on sealed concrete surfaces. Since the limited amount of concrete in buildings at the site has not been maintained, effectiveness is rated low. May be useful on a limited basis.	Rated high.	Rated low cost for grinders and shavers; moderate for spallers.	**Retain.**
		Scabbling (includes floor and wall scabblers)	Rated low. May be useful on a limited basis, based on the limited amount and condition of the concrete.	Rated high. Easy to implement, but requires specialized personnel.	Low cost for floor scabblers. Wall scabbler cost low to moderate.	**Retain.**

Table 3-9
Detailed Screening of Technology Types and Process Options for Buildings
Former Guterl Specialty Steel Corporation FUSRAP Site

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Screening Results
		Blasting (includes steel shot, CO_2 pellets, grit, soft media and high pressure water)	Rated low to moderate. Effective in removing surface coatings. May not penetrate deep enough to remove all radiological contamination for concrete and brick. May be effective on metal surfaces.	Rated high.	Low to high depending on the blasting method.	**Retain** for use on metal surfaces.

Table 3-10
Detailed Screening of Technology Types and Process Options for Groundwater
Former Guterl Specialty Steel Corporation FUSRAP Site

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Screening Results
Land Use Controls (LUCs)	Administrative and Legal Mechanisms	Proprietary Controls, Governmental Controls, Enforcement and Permit Tools, Informational Tools	Rated low to moderate. Can be used to prohibit the use of groundwater. The effectiveness is dependent on long-term commitment of funding and enforcement from the administering and responsible agencies.	Rated low. Site and adjoining property are currently zoned industrial. Implementability is dependent on the cooperation of the property owner. If the remedial action achieves the RAOs once complete, and results in no risk to human health or the environment, LUCs would not be required.	Rated low to moderate. Costs vary widely. The lower bounding costs would only include legal and administrative fees, while the upper bounding would include capital costs.	**Retain**
	Physical Mechanisms	Site Access Restrictions, Permanent Markers/Signage	Rated low. Increase protection of over baseline conditions by limiting direct access to the site using passive or active security measures.	Rated high. Fencing and signs are currently in place. Easy to maintain.	Rated low to moderate. Includes capital and maintenance costs.	**Retain**
Containment	Vertical Barriers	Jet Grouting	Moderate to high effectiveness depending on how well the vertical fracture system can be defined and sealed. Jet grouting may be useful on a limited basis to seal fractures when combined with other technologies.	Low; need to identify fractures which control flow.	Rated moderate.	**Retain**
	Hydraulic Containment	Vertical Wells	Low to moderate effectiveness to control horizontal flow. Will not address vertical transport.	Low to moderate; need to address fracturing in deeper bedrock.	Rated high.	**Retain**

Table 3-10
Detailed Screening of Technology Types and Process Options for Groundwater
Former Guterl Specialty Steel Corporation FUSRAP Site

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Screening Results
Removal	Groundwater Extraction	Vertical/Horizontal Wells	Highly effective. Could effectively capture majority of contaminant mass assuming fracture zones in deeper bedrock are intersected.	Moderate; need to address fracturing in deeper bedrock. May require numerous wells screened at various depths.	Rated high.	**Retain**
		Interceptor Trench (Rubblized Trench)	Highly effective in enhancing the recovery of groundwater.	Rated moderate. Moderately complex, depending on site conditions. Skilled blasting professional required.	Rated high.	**Retain**
Treatment [(a)]	*Ex Situ*	Coagulation	Moderate to high effectiveness for uranium removal.	Rated high.	Rated moderate to high.	**Retain**
		Adsorption	Moderate effectiveness for metals removal. Efficiency may be reduced due to high total dissolved solids content.	Rated high.	Rated low	**Retain**

Table 3-10
Detailed Screening of Technology Types and Process Options for Groundwater
Former Guterl Specialty Steel Corporation FUSRAP Site

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Screening Results
Treatment [(a)] (cont.)	*Ex Situ* Treatment (cont.)	Ion Exchange	Rated high. Very effective for uranium removal.	Rated high.	Rated low.	**Retain**
		Reverse Osmosis	Rated high. Very effective for removing metals and volatile organic compounds (VOCs).	Rated high. Depending on retention times; fouling and degradation can occur.	Rated low.	**Retain**
		Filtration/Ultra Filtration	Rated high. Effective for removing uranium and some VOCs.	Rated high.	Rated low. Pre-treatment and maintenance will add significantly to the cost.	**Retain**
	In Situ	Monitored Natural Attenuation (MNA)	Rated high. Effective for predicting and monitoring the potential, ongoing, and decrease in risk. MNA, alone, is not effective at attaining maximum contaminant levels (MCLs) within a short timeframe (e.g., years to decades) but may achieve MCLs within a longer time period (e.g., decades to centuries). Rate to reduce concentrations will increase with source removal.	Moderate to difficult. Sampling is relatively easy to implement, but modeling conditions in a fractured bedrock could be difficult.	Low to moderate.	**Retain**
	In Situ	Oxidation-Reduction (Redox) Alteration	Rated moderate. Highly effective for uranium if low redox potentials can be established and maintained for an extended time frame.	Rated low. Implementation may be complex; may require pilot testing. May be difficult to maintain	Rated moderate.	**Not Retain**

Table 3-10
Detailed Screening of Technology Types and Process Options for Groundwater
Former Guterl Specialty Steel Corporation FUSRAP Site

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Screening Results
			Reapplications may be required to maintain conditions.	redox potential at the Guterl Site.		
Treatment [(a)] (cont.)	*In Situ* (cont.)	Precipitation Using Phosphate Compounds	Rated moderate to high. Groundwater is primarily in dolostone which is composed of calcium, magnesium, and carbonate. These geochemical conditions are conducive to the immobilization of the uranium via precipitation.	Rated low. The technology effectiveness is limited by achieving good subsurface mixing, which may be difficult, especially in the fractured bedrock and with the variable groundwater flow rates.	Rated moderate.	**Not Retain**
		Permeable Reactive Barrier (PRB)	Rated high. PRBs have been proven effective in the removal of uranium from contaminated groundwater.	Rated low. Fractured bedrock system would be conducive to bypassing the treatment barrier. Installation of a blast fractured trench would be necessary to effectively intercept the fracture zones. A blast fractured trench is not a standard technique used to construct a treatment wall. Can clog treatment media; may need replacement.	Rated high.	**Not Retain.**
Disposal	Off-Site Disposal	Discharge to Publically-Owned Treatment Works (POTW) or Surface Water Body.	Highly effective method to dispose of properly treated wastewater.	Rated high. Will need to meet substantive requirements and may require treatment.	Low to Moderate. Overall economics depends on disposal fee rate charged by POTW and on flow rate.	**Retain**

Table 3-10
Detailed Screening of Technology Types and Process Options for Groundwater
Former Guterl Specialty Steel Corporation FUSRAP Site

General Response Action	Technology Type	Process Options	Effectiveness	Implementability	Cost	Screening Results
Disposal (continued)	On-Site Disposal	Injection-Recirculation via Surface Pond	Rated low. Depends on the location, spacing, and permeability of bedrock fractures. Design of any discharge to the subsurface will need to consider impacts on groundwater remedial action (extraction, treatment areas) and fracture flow.	Rated as low. A detailed understanding of the flow system is required which is difficult in fractured bedrock present in the Site. Rigorous permitting process is required by the U.S. EPA.	Moderate to high.	**Retain**

(a) Although VOCs are not considered constituents of concern (COCs) under Formerly Utilized Sites Remedial Action Program (FUSRAP). Treatment for VOCs may be required in the treatment process to achieve disposal requirements for a POTW or NYSPDES discharge to surface water.

Acronyms:

FUSRAP	Formerly Utilized Sites Remedial Action Program
MCLs	maximum contaminant levels
MNA	monitored natural attenuation
NYSPDES	New York State Pollutant Discharge Elimination System
O&M	operation and maintenance
POTW	publically-owned treatment works
PRB	permeable reactive barrier
RAOs	remedial action objectives
Redox	oxidation reduction
ROCs	radionuclides of concern
VOCs	volatile organic compounds

Table 3-11
Estimated Volume of Contaminated Soil for Preliminary Remediation Goals

Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

PRG	***In Situ* Contaminated Soil Volume m^3 (yd^3)**	***Ex Situ*[a] Contaminated Soil Volume m^3 (yd^3)**
Construction Worker (PRG-CW)	3,800 (5,000)	4,940 (6,500)
Groundwater Protection (PRG-GW)	44,000 (58,000)	57,200 (75,400)

a. *Ex situ* contaminated soil volume estimates assumed a 1.3 times bulking factor from the *in situ* volume estimate to account for the increase in volume when naturally compacted soil is excavated.

Table 3-12
Estimated Volume of Uranium Impacted Groundwater

Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

Groundwater Unit	Area		Average Thickness Meters (ft)	Assumed Porosity (%)	Volume Impacted	
	Meters^2 (ft^2)	Hectares (Acres)			Meters^3 (ft^3)	Million Liters (Million Gallons)
Shallow Groundwater	156,500 (1,685,000)	15.7 (38.7)	5.2 (17)	25	204,000 (7,161,000)	204 (54)
Deep Groundwater	72,600 (782,000)	7.3 (18.0)	11.6 (38)	5	42,000 (1,486,000)	42 (11)

Table 4-1

Process Options Contained in the Building Alternatives
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

Response Action	Technology	Process Option	Alternative		
			B1	B2	B3
Removal	Dismantlement	Mechanical Equipment	NA	X	X
Treatment	Physical Treatment	Grinding and/or Scabbling	NA	X	X
		Vacuuming	NA	X	X
		Blasting	NA	X	X
Disposal	Off-Site Disposal	Existing Licensed or Permitted Disposal Facility	NA	X	X
		Recycling/Beneficial Reuse	NA	X	X

NA = Not Applicable to the No-Action Alternative (B1)

Table 4-2a

Approximate Waste Quantities – Building Structural Materials and Contents (Metric Units)
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

Building Number	**Percent of Surfaces Radiologically Impacted[1]**	**Building Structural Materials**						**Building Contents[2]**	
		Radiological Waste	**Radiological Waste with PCBs**	**Radiological Waste with Asbestos[3]**	**Hazardous[4] / Universal Waste**	**Recycle**	**Construction / Demolition Debris**	**Radiological Waste**	**Recycle**
	Waste Stream Assumption	75% of impacted surfaces	25% of impacted surfaces	100% of PACM	25% of non-impacted surfaces	50% of non-impacted surfaces	25% of non-impacted surfaces	Based on percentage of surfaces impacted	
1	4%	30 m^3	10 m^3	3 lm	240 m^3	480 m^3	240 m^3	1 m^3	30 m^3
2	5%	240 m^3	80 m^3	360 lm	1,530 m^3	3,050 m^3	1,530 m^3	40 m^3	730 m^3
3	32%	1,190 m^3	400 m^3	150 lm	850 m^3	1,690 m^3	850 m^3	150 m^3	310 m^3
4/9	26%	760 m^3	250 m^3	20 lm	720 m^3	1,440 m^3	720 m^3	240 m^3	680 m^3
5	0%	0 m^3	0 m^3	None noted	80 m^3	150 m^3	80 m^3	0 m^3	0 m^3
6	100%	860 m^3	290 m^3	40 lm	0 m^3	0 m^3	0 m^3	230 m^3	0 m^3
8	100%	1,720 m^3	570 m^3	120 lm	0 m^3	0 m^3	0 m^3	150 m^3	0 m^3
Total, Alternative B2[5]		4,800 m^3	1,600 m^3	700 lm	3,200 m^3	6,400 m^3	3,200 m^3	810 m^3	1,750 m^3
Total, Alternative B3[6]		4,800 m^3	1,600 m^3	700 lm	3,500 m^3	6,900 m^3	3,500 m^3	810 m^3	1,750 m^3

[1] Source: DGA Report, Section 6.1.4; and Section 3.7 of DGA report
[2] Source: DGA Report, Table 6-4
[3] Source: DGA Report, Table 6-5; and Section 2.6.2.4 of this DGA Report
[4] Includes PCBs classified as New York State hazardous waste
[5] Alternative B2 consists of Decontamination of Building 1; Dismantlement and Off-Site Disposal of Buildings 2, 3, 4/9, 5, 6, 8 and 24.
[6] Alternative B3 consists of Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24 and 35.

lm = linear meters
m^3 = cubic meters

Table 4-2b

Approximate Waste Quantities – Building Structural Materials and Contents (English Units)
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

Building Number	Percent of Surfaces Radiologically Impacted[1]	Building Structural Materials						Building Contents[2]	
		Radiological Waste	Radiological Waste with PCBs	Radiological Waste with Asbestos[3]	Hazardous[4] / Universal Waste	Recycle	Construction / Demolition Debris	Radiological Waste	Recycle
Waste Stream Assumption		75% of impacted surfaces	25% of impacted surfaces	100% of PACM	25% of non-impacted surfaces	50% of non-impacted surfaces	25% of non-impacted surfaces	Based on percentage of surfaces impacted	
1	4%	40 yd^3	10 yd^3	10 lf	310 yd^3	620 yd^3	310 yd^3	2 yd^3	33 yd^3
2	5%	320 yd^3	100 yd^3	1,200 lf	2,000 yd^3	4,000 yd^3	2,000 yd^3	50 yd^3	950 yd^3
3	32%	1,560 yd^3	520 yd^3	500 lf	1,100 yd^3	2,200 yd^3	1,100 yd^3	190 yd^3	410 yd^3
4/9	26%	990 yd^3	330 yd^3	70 lf	940 yd^3	1,900 yd^3	940 yd^3	310 yd^3	890 yd^3
5	0%	0 yd^3	0 yd^3	None noted	100 yd^3	200 yd^3	100 yd^3	0 yd^3	0 yd^3
6	100%	1,120 yd^3	380 yd^3	140 lf	0 yd^3	0 yd^3	0 yd^3	300 yd^3	0 yd^3
8	100%	2,250 yd^3	750 yd^3	400 lf	0 yd^3	0 yd^3	0 yd^3	200 yd^3	0 yd^3
Total, Alternative B2[5]		6,300 yd^3	2,100 yd^3	2,300 lf	4,200 yd^3	8,300 yd^3	4,100 yd^3	1,100 yd^3	2,300 yd^3
Total, Alternative B3[6]		6,300 yd^3	2,100 yd^3	2,300 lf	4,500 yd^3	9,000 yd^3	4,500 yd^3	1,100 yd^3	2,300 yd^3

[1] Source: DGA Report, Section 6.1.4; and Section 3.7 of DGA Report
[2] Source: DGA Report, Table 6-4
[3] Source: DGA Report, Table 6-5; and Section 2.6.2.4 of DGA Report
[4] Includes PCBs classified as New York State hazardous waste
[5] Alternative B2 consists of Decontamination of Building 1; Dismantlement and Off-Site Disposal of Buildings 2, 3, 4/9, 5, 6 8 and 24
[6] Alternative B3 consists of Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24 and 35.

lf = linear feet
yd^3 = cubic yards

Table 4-3

Process Options Contained in the Soil Alternatives
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

Response Action	**Technology**	**Process Option**	**Alternative**		
			S1	**S2**	**S3**
Removal	Soil Excavation	Mechanical Earth Moving Equipment and Hand Tools	NA	X	X
Disposal	Off-Site Disposal	Existing Licensed or Permitted Disposal Facility	NA	X	X

NA = Not Applicable to the No-Action Alternative

Table 4-4

Estimated Volume of Contaminated Soil for Soil Alternatives
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

Alternative	*In Situ* Volume of Soil	*Ex Situ* Volume of Soil (assumes a 30 percent bulking factor)
S1[1]	0	0
S2[2]	3,800 m^3 (5,000 yd^3)	5,000 m^3 (6,500 yd^3)
S3[3]	44,000 m^3 (58,000 yd^3)	57,200 m^3 (75,400 yd^3)

[1] Alternative S1 is a No-Action Alternative

[2] Alternative S2 consists of Complete Soil Removal to Soil PRG-CW and Off-Site Disposal

[3] Alternative S3 consists of Complete Soil Removal to Soil PRG-GW and Off-Site Disposal

m^3 = cubic meters

yd^3 = cubic yards

Table 4-5
Process Options Contained in the Groundwater Alternatives
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

Response Acton	**Technology**	**Process Option**	**Alternative**				
			G1	**G2**	**G3**	**G4**	**G5**
Land Use Controls	Engineering Controls Physical Mechanisms	Site Access Restrictions, Permanent Markers/Signage	NA	X	X	X	X
Removal	Groundwater Removal via Extraction Wells	Vertical Wells	NA			X	X
	Groundwater Removal via Trenches	Interceptor Trench (Rubblized Trench)	NA			X	X
Treatment	Ex-Situ Treatment	Ion Exchange (a)	NA			X	X
		Adsorption (a)	NA			X	X
Disposal	Off-Site Disposal	Discharge to Publicly-Owned Treatment Works	NA			X	X

NA = Not applicable to No-Action Alternative (G1)

(a) To be further evaluated using treatability study during the design phase.

Table 4-6

Estimated Volume of Contaminated Groundwater
Former Guterl Specialty Steel Corporation FUSRAP Site
Lockport, New York

Groundwater Unit	Area		Average Thickness Meters (Feet)	Assumed Porosity %	Volume Impacted	
	Square Meters (Square Feet)	Hectares (Acres)			Cubic Meters (Cubic Feet)	Liters (Gallons)
Shallow Groundwater	156,500 (1,685,000)	15.7 (38.7)	5.2 (17)	25	204,000 (7,161,000)	204×10^6 (54×10^6)
Deep Groundwater	72,600 (782,000)	7.3 (18.0)	11.6 (38)	5	42,000 (1,486,000)	42×10^6 (11×10^6)

Table 5-1
Summary of Detailed Analysis of Site-Wide Remedial Alternatives
Former Guterl Specialty Steel Corporation FUSRAP Site

NCP Evaluation Criteria	Site-Wide Alternative 1	Site-Wide Alternative 2	Site-Wide Alternative 3	Site-Wide Alternative 4
Overall Protection of Human Health and the Environment				
Human Health	Not Protective.	Protective. Dismantlement of buildings provides protection. Soil removal protects both human health and mitigates impacts to groundwater. Groundwater use restrictions provide protection from the use of impacted groundwater until concentrations naturally reduce to MCL.	Protective. Dismantlement of buildings provides protection. Soil removal protects both human health and mitigates impacts to groundwater. Groundwater removal and treatment combined with use restrictions is protective until MCLs are achieved.	Protective. Decontamination and dismantlement of buildings provides protection. Soil removal protects both human health and mitigates impacts to groundwater. Groundwater use restrictions provide protection from the use of impacted groundwater until concentrations naturally reduce to MCL.
Environment	Not protective if site conditions change in the future.	Protective. Although the action is designed to protect human health, removal of buildings and soil to PRG will also protect the environment.	Protective. Although the action is designed to protect human health, removal of buildings and soil to PRG will also protect the environment.	Protective. Although the action is design to protect human health, removal of buildings and soil to PRG will also protect the environment.
Compliance with ARARs				
ARARs	Does not comply.	Compliant. Achieves the unrestricted release conditions of 10 CFR 20.1402. Also achieves MCLs provided in 40 CFR 141.66(e).	Compliant. Achieves the unrestricted release conditions of 10 CFR 20.1402. Also achieves MCLs provided in 40 CFR 141.66(e).	Compliant. Achieves the unrestricted release conditions of 10 CFR 20.1402. Also achieves MCLs provided in 40 CFR 141.66(e).
Need for Waivers	Not applicable.	A waiver will not be required.	A waiver will not be required.	A waiver will not be required.

Table 5-1
Summary of Detailed Analysis of Site-Wide Remedial Alternatives
Former Guterl Specialty Steel Corporation FUSRAP Site

NCP Evaluation Criteria	Site-Wide Alternative 1	Site-Wide Alternative 2	Site-Wide Alternative 3	Site-Wide Alternative 4
Long-Term Effectiveness and Performance				
Magnitude of Remaining Risk	High. Potential human health risk to soil, buildings, and groundwater would remain on-site, and groundwater plume extends off-site.	Low for buildings which are removed and disposed of off-site. Low for soil since cleanup goal will achieve UU/UE. Moderate for groundwater since uranium MCL is not achieved until approximately 120 ±5 years.	Low for buildings which are removed and disposed of off-site. Low for soil since cleanup goal will achieve UU/UE. Low for groundwater, which is treated and disposed of off-site and because MCL is achieved in 30 ±5 years.	Low for buildings which are removed and disposed of offsite. Moderate for soil since cleanup goal may not achieve UU/UE. High for groundwater since uranium MCL is not achieved until approximately 660 ±5 years.
Adequacy of Controls	No controls are provided.	No controls for soil and buildings are required once removal/disposal is complete. Engineering controls are adequate until remedial action meets RAOs.	No controls for soil and buildings are required once removal/disposal are complete. Engineering controls are adequate until remedial action meets RAOs.	No controls for soil and buildings are required once removal/disposal is complete. Engineering controls are adequate until remedial action meets RAOs.
Reliability of Controls	No controls are provided.	Engineering LUCs for groundwater are reliable as long as roles and responsibilities are clearly defined and inspections are performed regularly to demonstrate that they are maintained. Routine monitoring will be conducted to evaluate geochemical conditions and document attenuation process. It is expected that MNA will provide a permanent solution in conjunction with source removal of soils.	Pump and treat for groundwater are reliable technologies but require long-term O&M to maintain optimal operation. Will provide a permanent solution in conjunction with source removal of soils.	Engineering LUCs for groundwater are reliable as long as roles and responsibilities are clearly defined and inspections are performed regularly to demonstrate that they are maintained. Routine monitoring will be conducted to evaluate geochemical conditions and document attenuation process. It is expected that MNA will provide a permanent solution in conjunction with source removal of soils.

Table 5-1
Summary of Detailed Analysis of Site-Wide Remedial Alternatives
Former Guterl Specialty Steel Corporation FUSRAP Site

NCP Evaluation Criteria	**Site-Wide Alternative 1**	**Site-Wide Alternative 2**	**Site-Wide Alternative 3**	**Site-Wide Alternative 4**
Long-Term Management	No long-term management is provided.	Short-term engineering LUCs until building/soil removal complete.	Short-term engineering LUCs until building/soil removal complete.	Short-term engineering LUCs until building/soil removal complete.
Reduction in Toxicity, Mobility, or Volume Through Treatment				
Reduction in Toxicity, Mobility, or Volume Through Treatment	None.	No treatment for soils. Limited decontamination of building contents may reduce volumes. Natural attenuation processes will reduce the mobility of the uranium in groundwater.	No treatment for soils. Limited decontamination of building contents may reduce volumes. Groundwater extraction and *ex situ* treatment would reduce toxicity, mobility, and volume of contaminated groundwater.	No treatment for soils. Limited decontamination of Building 1 and other building contents may reduce volumes. Natural attenuation processes will reduce the mobility of the uranium in groundwater.
Short-Term Effectiveness				
Protection of Community	Because no actions are performed, there is no short-term risk to the community.	Small additional short-term risk to community during excavation, building dismantlement, and transportation activities. However, risks will be minimized by using standard controls such as dust control and use of covered truck and rail cars for transport. No risk from groundwater activities.	Small additional short-term risk to community during excavation, building dismantlement, blasting, and transportation activities. However, risks will be minimized by using standard controls such as dust control and use of covered truck and rail cars for transport. No risk from groundwater activities.	Small additional short-term risk to community during excavation, building dismantlement, and transportation activities. However, risks will be minimized by using standard controls such as dust control and use of covered truck and rail cars for transport. No risk from groundwater activities.

Table 5-1
Summary of Detailed Analysis of Site-Wide Remedial Alternatives
Former Guterl Specialty Steel Corporation FUSRAP Site

NCP Evaluation Criteria	**Site-Wide Alternative 1**	**Site-Wide Alternative 2**	**Site-Wide Alternative 3**	**Site-Wide Alternative 4**
Protection of Site Workers	Because no actions are performed, there is no short-term risk to the site worker.	Excavation of contaminated soils and building dismantlement do pose risks to workers. Conformance with control and mitigation measures should protect workers.	Excavation of contaminated soils, building dismantlement, and the installation and operation of the groundwater extraction and treatment system do pose occupational risk to workers. Conformance with control and mitigation measures should protect workers.	Excavation of contaminated soils and building dismantlement do pose risks to workers. Conformance with control and mitigation measures should protect workers.
Environmental Impacts	Because no actions are performed, there is no short-term risk to the environment.	Impacts associated with excavation, dismantlement, and handling of contaminated materials will include dust generation and the effects of rainfall and runoff. Storm water management will be critical to minimize these effects.	Impacts associated with excavation, dismantlement, and handling of contaminated materials will include dust generation and the effects of rainfall and runoff. Storm water management will be critical to minimize these effects.	Impacts associated with excavation, dismantlement, and handling of contaminated materials will include dust generation and the effects of rainfall and runoff. Storm water management will be critical to minimize these effects.
Time until RAOs are achieved	RAOs would not be achieved.	RAOs achieved in 120 ±5 years.	RAOs achieved in 30 ±5 years.	RAOs achieved in 660 ±5 years.

Table 5-1
Summary of Detailed Analysis of Site-Wide Remedial Alternatives
Former Guterl Specialty Steel Corporation FUSRAP Site

NCP Evaluation Criteria	Site-Wide Alternative 1	Site-Wide Alternative 2	Site-Wide Alternative 3	Site-Wide Alternative 4
Implementability				
Technical	Not applicable because no action is taken.	Separation of clean and contaminated soil may be difficult. Easy to conduct groundwater monitoring necessary for MNA assessment.	Separation of clean and contaminated soil may be difficult. Potential limitation is using vertical wells to intercept fractures, especially in the deep zone where the fracture density is fairly low.	Separation of clean and contaminated soil may be moderately difficult. Easy to conduct groundwater monitoring necessary for MNA assessment. Decontamination of Building 1 may be difficult depending on the stability of the floor in work area. May require reinforcement.
Administrative	Not applicable because no action is taken.	Administratively feasible to implement. Difficulty will be dependent on the cooperation of the land owners establishing engineering controls.	Administratively feasible to implement. Need to coordinate blasting activities with local and/or state governments depending on proximity of rubblized trench to roadways and utilities. Difficulty will be dependent on the cooperation of the land owners establishing engineering controls.	Administratively feasible to implement. Difficulty will be dependent on the cooperation of the land owners establishing engineering controls.
Present Worth Cost (Non-Discounted Cost)[a]				
Total Cost Over RAO Period	$0 ($0)	$186.1 million ($197.6 million)	$205.6 million ($214.4 million)	$109.7 million ($186.1 million)

Table 5-1
Summary of Detailed Analysis of Site-Wide Remedial Alternatives
Former Guterl Specialty Steel Corporation FUSRAP Site

Notes:

- Site-Wide Alternative 1–No Action.
- Site-Wide Alternative 2–Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35; Complete Soil Removal to the Soil PRG-GW and Off-Site Disposal; Monitored Natural Attenuation with Environmental Monitoring.
- Site-Wide Alternative 3–Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35; Complete Soil Removal to the Soil PRG-GW and Off-Site Disposal; Groundwater Recovery Using Extraction Wells and a Rubblized Trench with *Ex Situ* Treatment, with Environmental Monitoring.
- Site-Wide Alternative 4–Decontamination of Building 1; Dismantlement and Off-Site Disposal of Buildings 2, 3, 4/9, 5, 6, 8, and 24; Complete Soil Removal to the Soil PRG-CW and Off-Site Disposal; Monitored Natural Attenuation with Environmental Monitoring

[a] Non-discount values do not consider the time value of money. In other words, each dollar earned in the future is assumed to have the same value as each dollar that was invested many years earlier.

ARAR = applicable or relevant and appropriate requirement
LUC = land use control
O&M = operation and maintenance
UU/UE = unrestricted use/unlimited exposure
FUSRAP = Formerly Utilized Sites Remedial Action Program
MCL = maximum contaminant level
PRG = preliminary remediation goal
$ = dollar
MNA = monitored natural attenuation
RAO = remedial action objective
% = percent

Table 6-1
Comparative Analysis of Site-Wide Remedial Alternatives
Former Guterl Specialty Steel Corporation FUSRAP Site

NCP Evaluation Criteria	Site-Wide Alternative 1	Site-Wide Alternative 2	Site-Wide Alternative 3	Site-Wide Alternative 4
Threshold Criteria				
Overall Protection of Human Health and the Environment	**Not Protective** Unacceptable risk to human and aquatic receptors from exposure to contaminated soil, buildings, and groundwater.	**Protective** Removal and off-site disposal of soil and buildings is a reliable and permanent solution. Low residual risk since the source of groundwater contamination would be removed.	**Protective** Removal and off-site disposal of soil and buildings is a reliable and permanent solution. Low residual risk since the source of groundwater contamination would be removed.	**Protective** Removal and off-site disposal of soil and buildings is a reliable and permanent solution. Moderate residual risk since some soils remain which may continue to impact groundwater.
Compliance with ARARs	**Not Compliant** Current concentrations of FUSRAP-related COCs in soil exceed ARAR-based PRGs.	**Compliant**	**Compliant**	**Compliant**
Long-Term Effectiveness and Permanence	**Low** Potential human health risk to soil, buildings, and groundwater would remain on-site, and groundwater plume extends off-site.	**High** Buildings and soil will be removed and disposed of off-site. For this alternative the soil cleanup level considers impacts to groundwater.	**High** Buildings and soil will be removed and disposed of off-site. Groundwater, is recovered, treated, and disposed of off-site. Use of a rubblized trench will increase the effectiveness for recovery of groundwater in fractured bedrock.	**Moderate** Buildings and soil will be removed and disposed of offsite. For this alternative the soil cleanup level considers impact to the construction worker. Soil will continue to impact the groundwater.

Table 6-1
Comparative Analysis of Site-Wide Remedial Alternatives
Former Guterl Specialty Steel Corporation FUSRAP Site

NCP Evaluation Criteria	**Site-Wide Alternative 1**	**Site-Wide Alternative 2**	**Site-Wide Alternative 3**	**Site-Wide Alternative 4**
Reduction in Toxicity, Mobility, or Volume Through Treatment	**Low**	**Low** No treatment for soils. Limited decontamination of building contents may reduce volumes. Natural attenuation processes will reduce the mobility of the uranium in groundwater, but not through treatment.	**Moderate** No treatment for soils. Limited decontamination of building contents may reduce volumes. Groundwater extraction and *ex situ* treatment would reduce toxicity, mobility, and volume of contaminated groundwater.	**Low** No treatment for soils. Limited decontamination of Building 1 and building contents may reduce volumes. Natural attenuation processes will reduce the mobility of the uranium in groundwater, but not through treatment.
Short-Term Effectiveness	**High** No additional health affect in short-term due to no action taken.	**Moderate** Short-term risk to community during excavation to PRG-GW, building dismantlement, and transportation activities. Higher risks due to additional soil volume excavated. However, risks will be minimized by using standard controls such as dust control and use of covered truck and rail cars for transport. No risk from groundwater activities. Moderate time to achieve RAOs (120 years).	**Moderate** Small additional short-term risk to community during excavation to PRG-GW, building dismantlement, blasting and transportation activities. Higher risks due to additional soil volume excavated. However, risks will be minimized by using standard controls such as dust control and use of covered truck and rail cars for transport. Additional risks from groundwater treatment. Potential to transport non-FUSRAP VOCs. Shortest time to achieve RAOs (30 years).	**Moderate** Short-term risk to community during excavation to PRG-CW, building dismantlement, and transportation activities. However, risks will be minimized by using standard controls such as dust control and use of covered truck and rail cars for transport. No risk from groundwater activities. Longest time to achieve RAOs (660 years).

Table 6-1
Comparative Analysis of Site-Wide Remedial Alternatives
Former Guterl Specialty Steel Corporation FUSRAP Site

NCP Evaluation Criteria	**Site-Wide Alternative 1**	**Site-Wide Alternative 2**	**Site-Wide Alternative 3**	**Site-Wide Alternative 4**
Implementability	**High** No action is taken.	**Moderate** Very easy to conduct groundwater monitoring necessary for MNA assessment. Excavation to PRG-GW is not well within field instrumentation detection limits, therefore, a guided excavation using field screening may be limited.	**Low** Rubblized trenches are more equipped to intercept fractures especially in the deep zone where the fracture density is fairly low. Installation would be difficult and expensive due to nature of contamination in the dolostone. Implementation must consider on- and off-site roads, utilities, property permissions, site workers and public safety. Potential to transport non-FUSRAP VOCs causing vapor intrusion within building 17. Excavation to PRG-GW is not well within field instrumentation detection limits, therefore, a guided excavation using field screening may be limited.	**High** Very easy to conduct groundwater monitoring necessary for MNA assessment. Decontamination of Building 1 may be difficult depending on the stability of the floor in work area (may require reinforcement). Excavation to PRG-CW is well within field instrumentation detection limits.
Present Worth Cost	Present Worth Capital: $0 Present Worth O&M: $0 Total Present Worth Cost: $0	Capital (non-discounted): $180.9 M Present Worth O&M: $5.2 M Total Present Worth Cost: $186.1 M	Capital (non-discounted): $189.3 M Present Worth O&M: $16.3 M Total Present Worth Cost: $205.6 M	Capital (non-discounted): $104.4 M Present Worth O&M: $5.2 M Total Present Worth Cost: $109.7 M

Table 6-1
Comparative Analysis of Site-Wide Remedial Alternatives
Former Guterl Specialty Steel Corporation FUSRAP Site

Note: High represents a favorable rating for the specific criteria whereas Low represents the least favorable rating.
M=million ($)
O&M = operation and maintenance
PRG-CW = Preliminary Remediation Goal-Construction Worker
PRG-GW = Preliminary Remediation Goal-Groundwater

- Site-Wide Alternative 1-No Action.
- Site-Wide Alternative 2-Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35; Complete Soil Removal to Soil PRG-GW and Off-Site Disposal; MNA with Environmental Monitoring.
- Site-Wide Alternative 3-Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24, and 35; Complete Soil Removal to the Soil PRG-GW and Off-Site Disposal; Groundwater Recovery Using Extraction Wells and Rubblized Trench with Ex Situ Treatment, with Environmental Monitoring.
- Site-Wide Alternative 4-Decontamination of Building 1; Dismantlement and Off-Site Disposal of Buildings 2, 3, 4/9, 5, 6, 8, and 24; Complete Soil Removal to the Soil PRG-CW and Off-Site Disposal; MNA with Environmental Monitoring.

Table 7-1
Remedial Timeframes for Groundwater Alternatives to Achieve MCL in Groundwater Former Guterl Specialty Steel Corporation FUSRAP Site

Groundwater Alternatives	O&M Timeframe (years)	Shallow Groundwater Timeframe (years)	Deep Groundwater Timeframe (years)
G1. No Action	>1,000	780	>1,000
G2. Soil Removal to PRG-CW (Soil Alternative S2) with MNA	660	430	660
G3. Soil Removal to PRG-GW (Soil Alternative S3) with MNA	120	50	120
G4. Soil Removal to PRG-CW (Soil Alternative S2) with rubblized trench/wells	580	500	580
G5. Soil Removal to PRG-GW (Soil Alternative S3) with rubblized trench/wells	30	30	30

Table 8-1
Comparison of Costs for Site-wide Remedial Alternatives

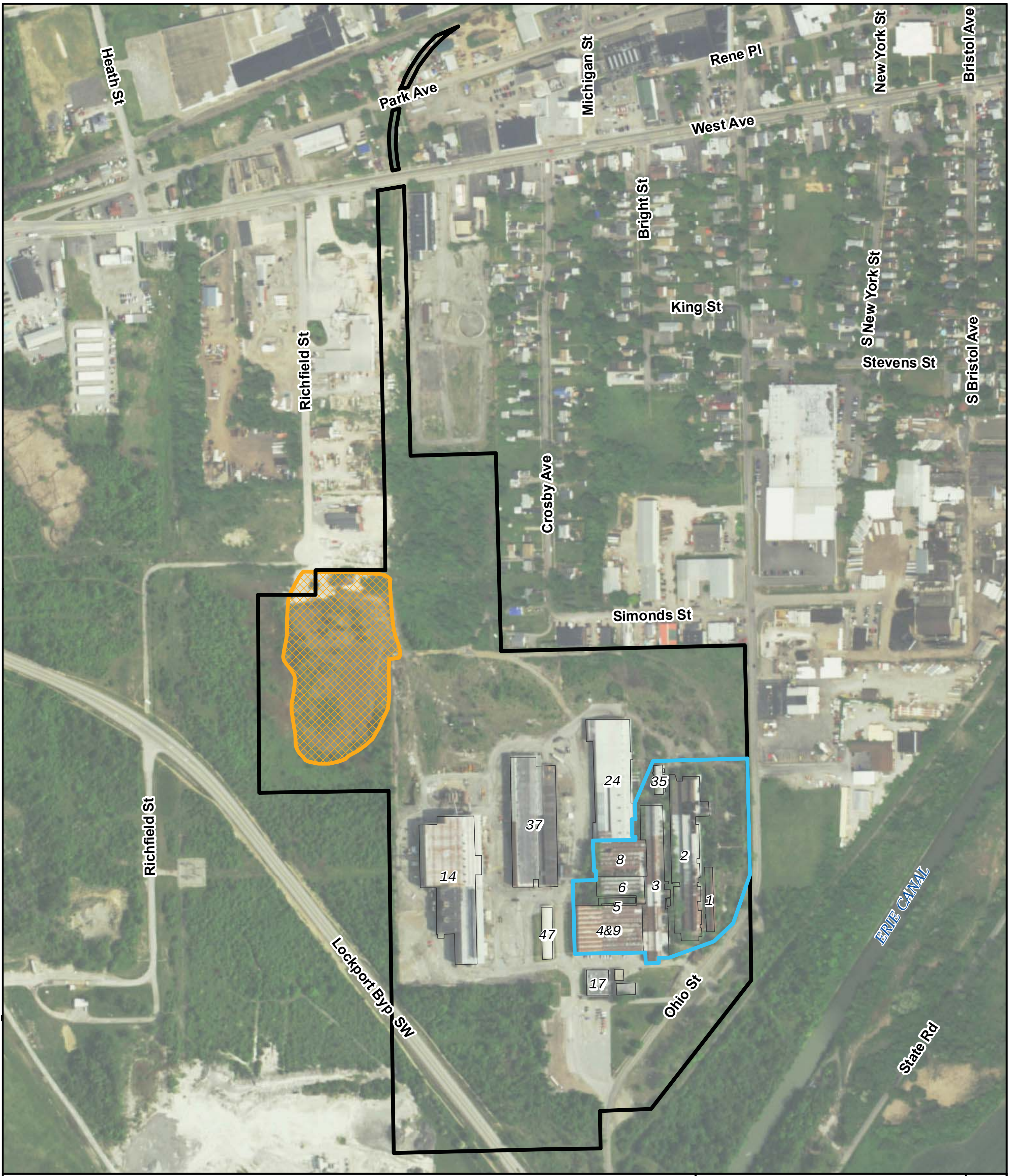
Site-Wide Alternative	Estimated Total Present Worth Cost[a]	Estimated Total Non-Discounted Cost
Site-Wide Alternative 1–No Action	$0	$0
Site-Wide Alternative 2–Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24 and 35; Complete Soil Removal to the Soil PRG-GW and Off-Site Disposal; Monitored Natural Attenuation with Environmental Monitoring	Capital: $180.9 M O&M: $5.2 M Total: $186.1 M	Capital: $180.9 M O&M: $16.7 M Total: $197.6 M
Site-Wide Alternative 3–Dismantlement and Off-Site Disposal of Buildings 1, 2, 3, 4/9, 5, 6, 8, 24 and 35; Complete Soil Removal to the Soil PRG-GW and Off-Site Disposal; Groundwater Recovery Using Extraction Wells and Rubblized Trench with *Ex Situ* Treatment, with Environmental Monitoring	Capital: $189.3 M O&M: $16.3 M Total: $205.6 M	Capital: $189.3 M O&M: $25.1 M Total: $214.4 M
Site-Wide Alternative 4–Decontamination of Building 1; Dismantlement and Off-Site Disposal of Buildings 2, 3, 4/9, 5, 6, 8, and 24; Complete Soil Removal to the Soil PRG-CW and Off-Site Disposal; Monitored Natural Attenuation with Environmental Monitoring	Capital: $104.4 M O&M: $5.2 M Total: $109.7 M	Capital: $104.4 M O&M: $81.6 M Total: $186.1 M

[a] Present Worth discount rate used is 3.5 percent
M=million ($)

FIGURES

LIST OF FIGURES

List of Figures (continued)



Legend

0 125 250 500 Feet

- ⬭ Excised Area Boundary
- ⬭ ATI Specialty Materials Boundary
- ▨ Inactive Hazardous Waste Disposal Site Footprint
- ⬭ Buildings

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SITE PLAN

GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NY

Date:	Scale:	Figure No. :
06/06/2017	1 inch = 500 feet	1-1

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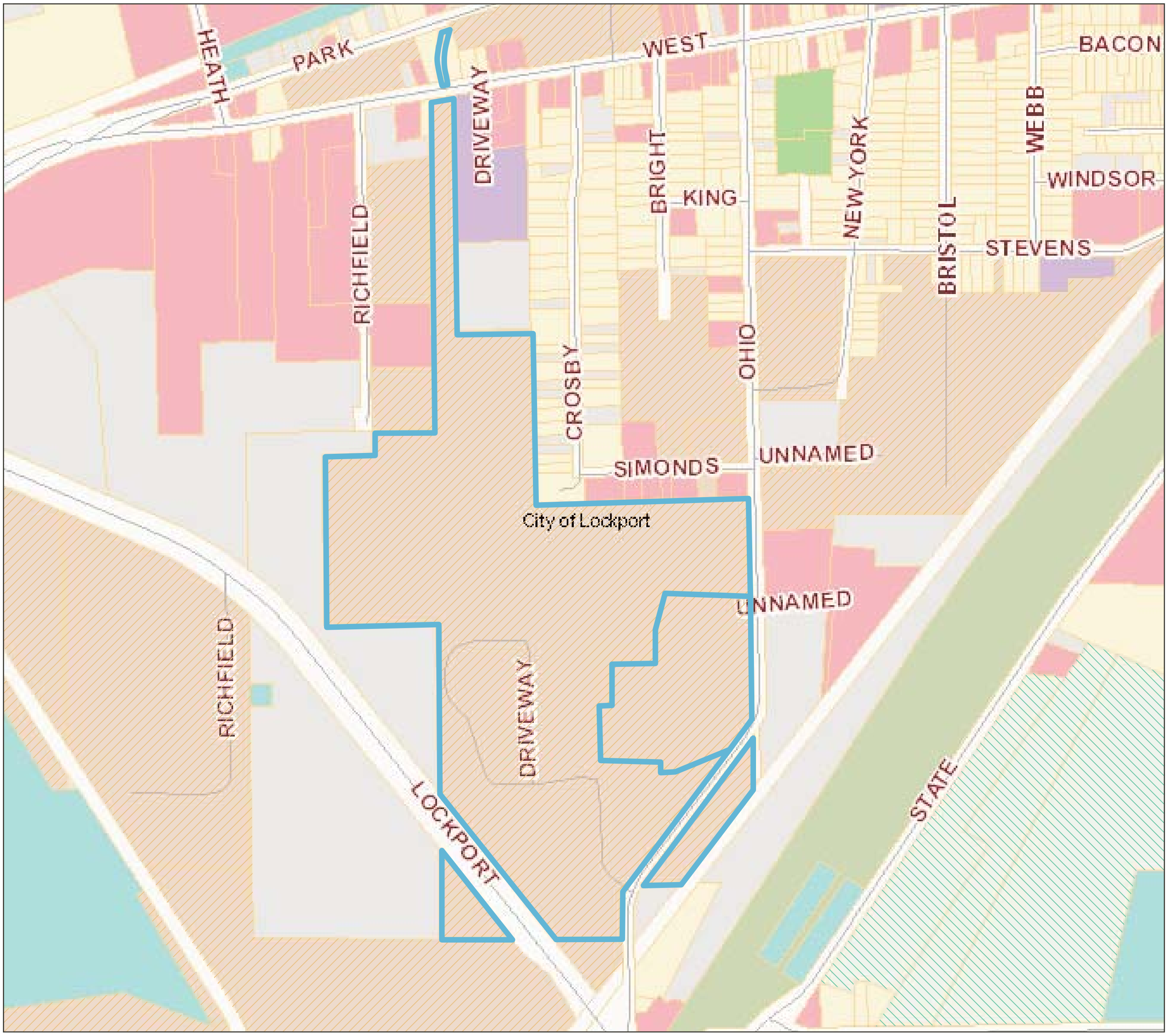

Image from Erie and Niagara County PAS-TAS
http://gis1.erie.gov/RoyaltonNYGIS/

FEET
0 500 1,000

— Site Boundary

Land Use

- ▨ Agricultural
- 🟨 Residential
- ⬜ Vacant Land
- 🟥 Commercial
- 🟩 Recreation and Entertainment
- 🟪 Community Services
- ▨ Industrial
- 🟦 Public Services
- 🟩 Wild, Forested, Conservation Lands

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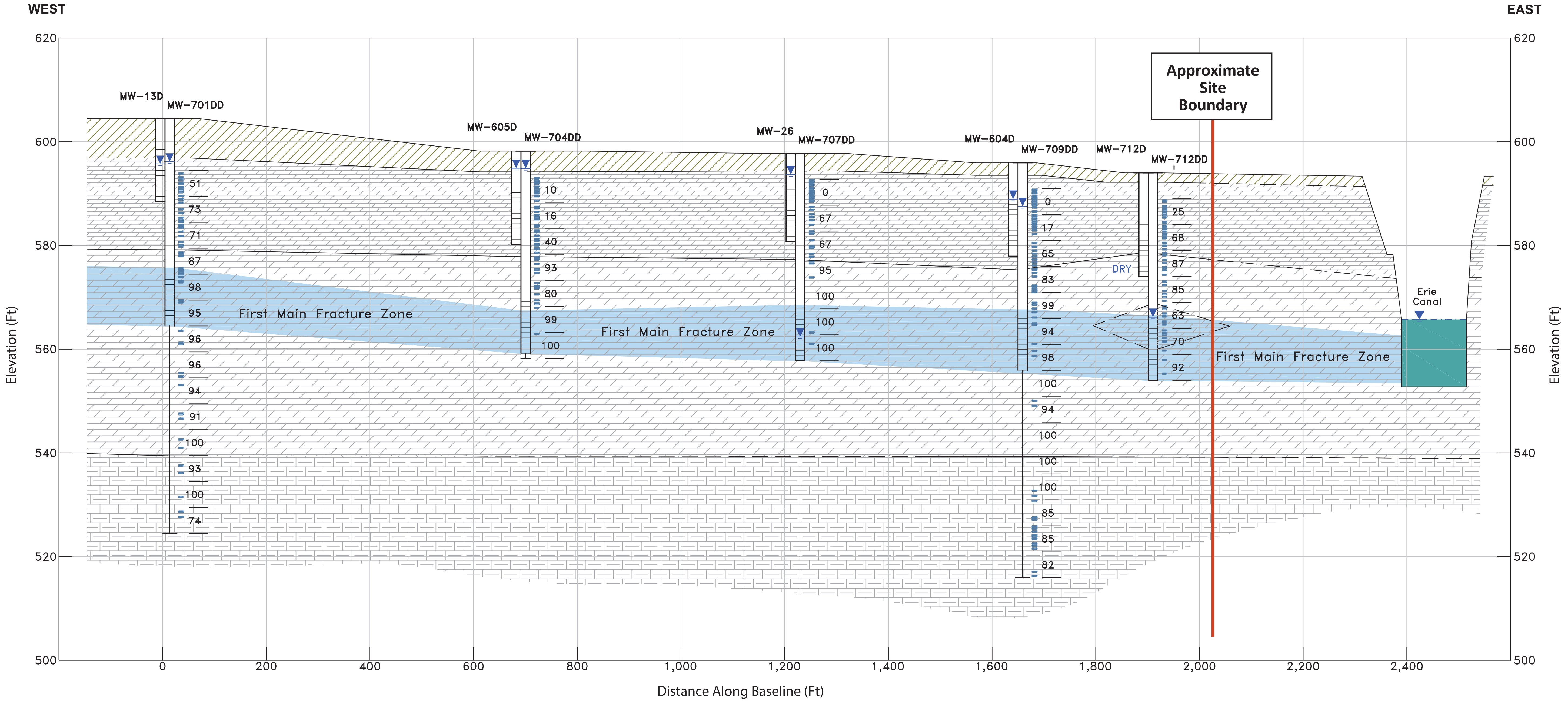
LAND USE FROM NIAGARA COUNTY GIS

GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NY

Date:
2/24/12

Figure No.:
1-2

s-140416-12/11-w



ZONE OF GREATER FRACTURES CONTAINED WITHIN LOWER FRACTURE ROCK THAT IS NOT OBSERVED IN ADJACENT BORINGS.

LEGEND:

MONITORING WELL

▼ WATER LEVEL, AUGUST 2011

SCREENED INTERVAL

BOTTOM OF BORING

= 23 FRACTURES / RQD (%)

▨ OVERBURDEN SOIL

▤ FRACTURED DOLOSTONE, RQD <80% SHALLOW FLOW ZONE

▤ DOLOSTONE, RQD >80%

▤ SHALEY DOLOSTONE

🟦 FIRST MAIN FRACTURE ZONE AND DEEP GROUNDWATER ZONE

NOTES

1) CANAL WATER LEVEL AND BOTTOM REFERENCED FROM AUGUST 2011 GAUGE READING AT LOCK 35, APPROXIMATELY 1.75 MILES DOWNSTREAM.

2) RQD=ROCK QUALITY DESIGNATION. A DEGREE OF FRACTURING IN A ROCK CORE (%) WHERE THE VALUE IS INVERSELY RELATED TO LENGTH OF ROCK BROKEN BY FRACTURES. FEW FRACTURES HAVE HIGH RQD% (FEW BLUE DASHES), MULTIPLE FRACTURES (MANY BLUE DASHES) HAVE LOW RQD%.

20'
VERTICAL SCALE
0
0
200'
HORIZONTAL SCALE

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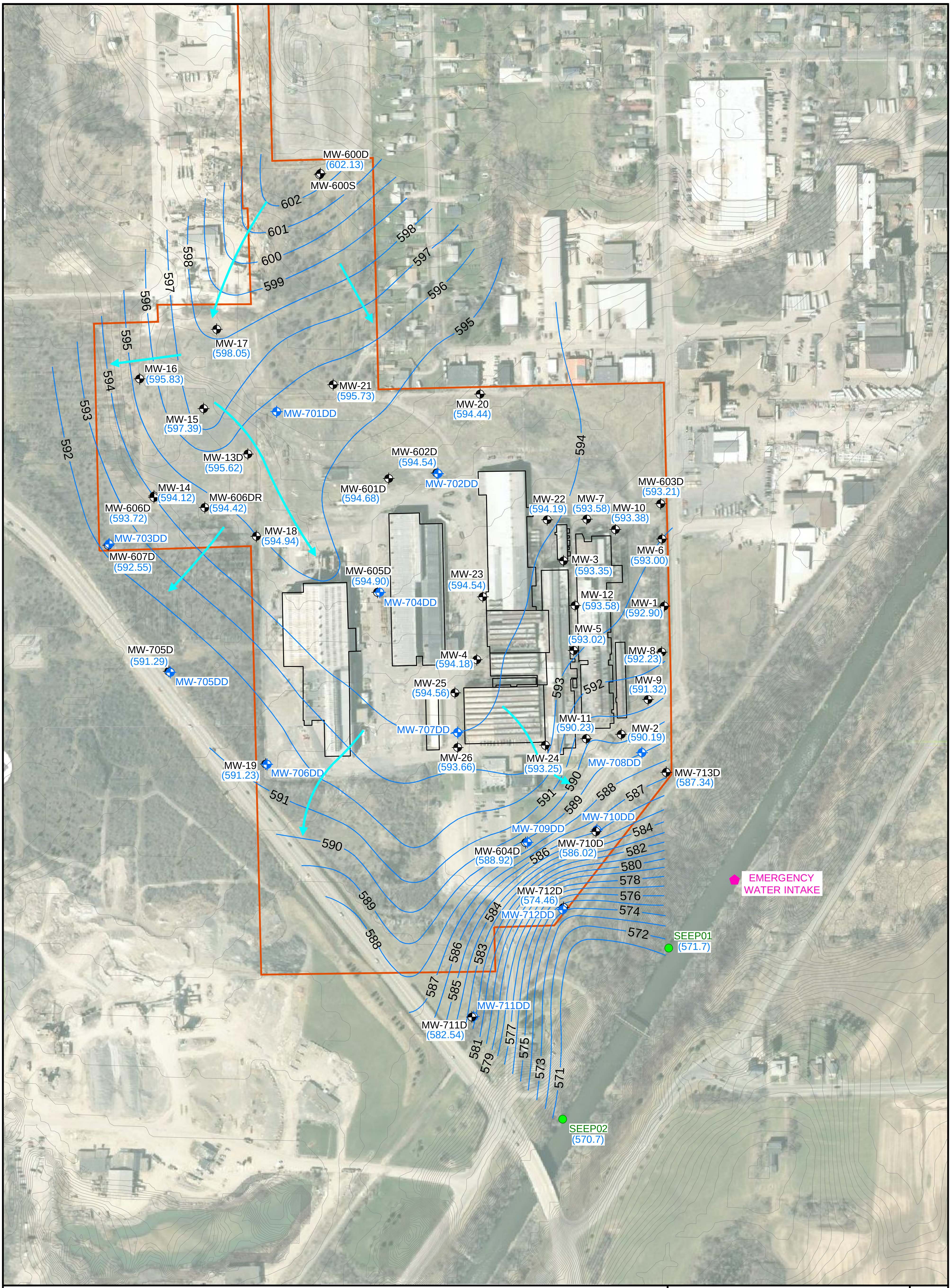
GEOLOGIC CROSS SECTION ACROSS THE SITE - WEST TO EAST

GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NEW YORK

Date:	Scale:	Figure No.:
1/5/2012	AS SHOWN	2-1

File: O:\Project\140416\140416-B2_2-1.dwg



LEGEND:

⌖	SHALLOW WELL LOCATION	▭	GUTERL SITE BOUNDARY
⌖	DEEP WELL LOCATION	(583.68)	GROUNDWATER ELEVATION (FEET MSL)
●	SEEP LOCATION	—586—	GROUNDWATER CONTOUR
⬟	EMERGENCY WATER INTAKE	→	GROUNDWATER FLOW PATH (INFERRED)
—	SURFACE ELEVATION (1FT CONTOUR)		

0 75 150 300
Feet

NOTE: CANAL WATER LEVEL WAS 565.7 FEET AT 10:00 AM ON 8/8/2011. CANAL BOTTOM IS APPROXIMATELY 552.7 FEET. CANAL WATER ELEVATION WAS REFERENCED FROM GAUGE READING AT LOCK 35, APPROXIMATELY 1.75 MILES DOWNSTREAM.

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POTENTIOMETRIC SURFACE MAP
SHALLOW WELLS
AUGUST 3, 2011

GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NEW YORK

Date:	Scale:	Figure No.:
1/6/2012	1 inch = 300 feet	2-2

File: O:\project\140416\140416-B8.dwg

LEGEND:

⊕	SHALLOW WELL LOCATION
⊕	DEEP WELL LOCATION
●	SEEP LOCATION
⬟	EMERGENCY WATER INTAKE
—	SURFACE ELEVATION (1FT CONTOUR)
▭	GUTERL SITE BOUNDARY
(583.68)	GROUNDWATER ELEVATION (FEET MSL)
—586—	GROUNDWATER CONTOUR
→	GROUNDWATER FLOW PATH (INFERRED)

0 75 150 300 Feet

NOTE: WELL MW-707DD WAS NOT USED FOR CONTOURING BECAUSE IT DOES NOT INTERSECT WATER PRODUCING FRACTURES.

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POTENTIOMETRIC SURFACE MAP
DEEP WELLS
AUGUST 3, 2011

GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NEW YORK

Date:	Scale:	Figure No.:
1/6/2012	1 inch = 300 feet	2-3

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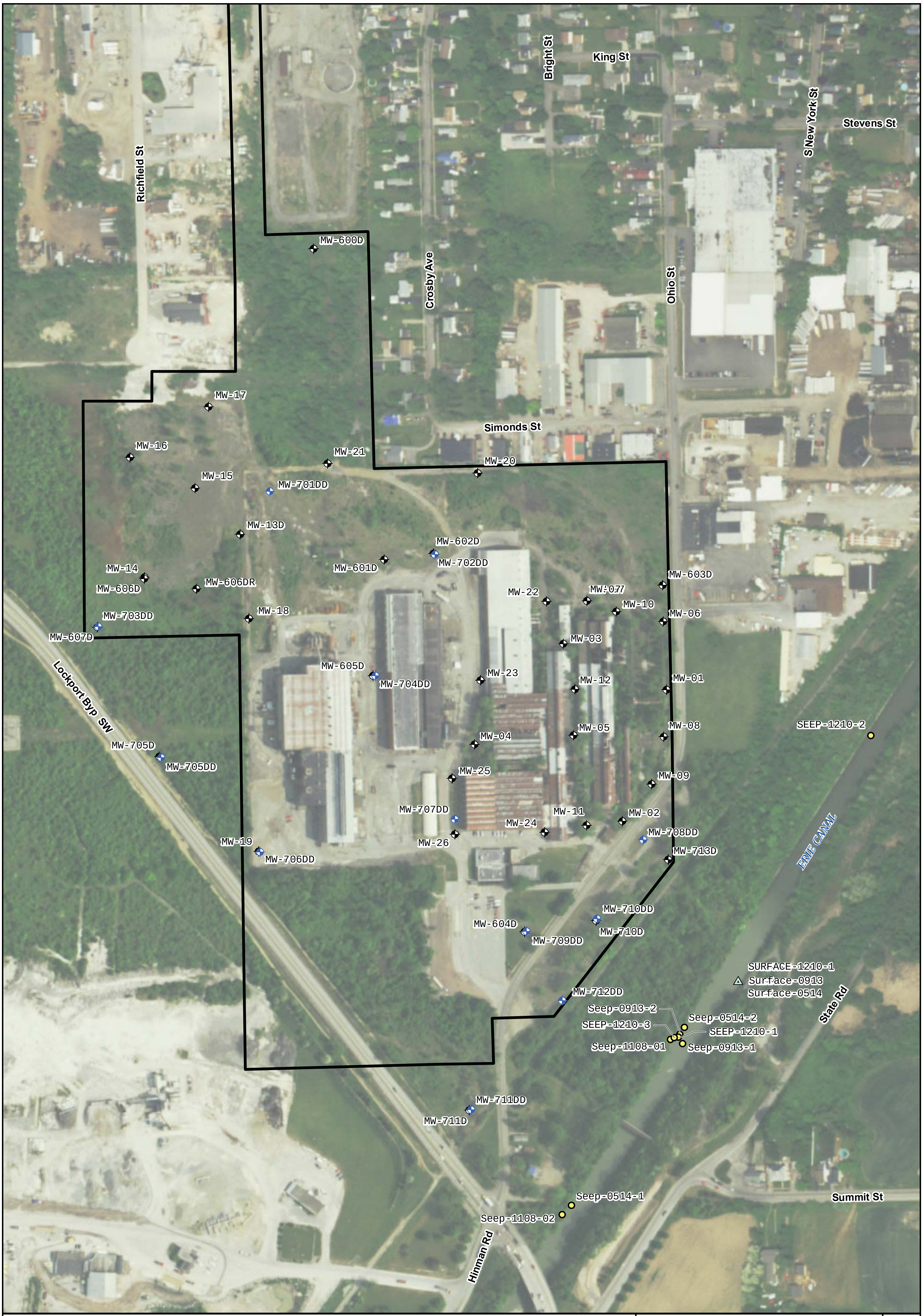

Legend

- 🔷 Deep Monitoring Well
- ◆ Shallow Monitoring Well
- ○ Seep Sample Location
- △ Surface Water Sample Location
- ⬭ Site Boundary

0 75 150 300 Feet

Sample Year

Seep-1205-02

Sample Month

Sample Number

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GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NY

USACE ENVIRONMENTAL MONITORING
LOCATIONS FOR 2007 - 2017

Date:	Scale:	Figure No. :
10/18/2017	1 inch = 300 feet	2-4

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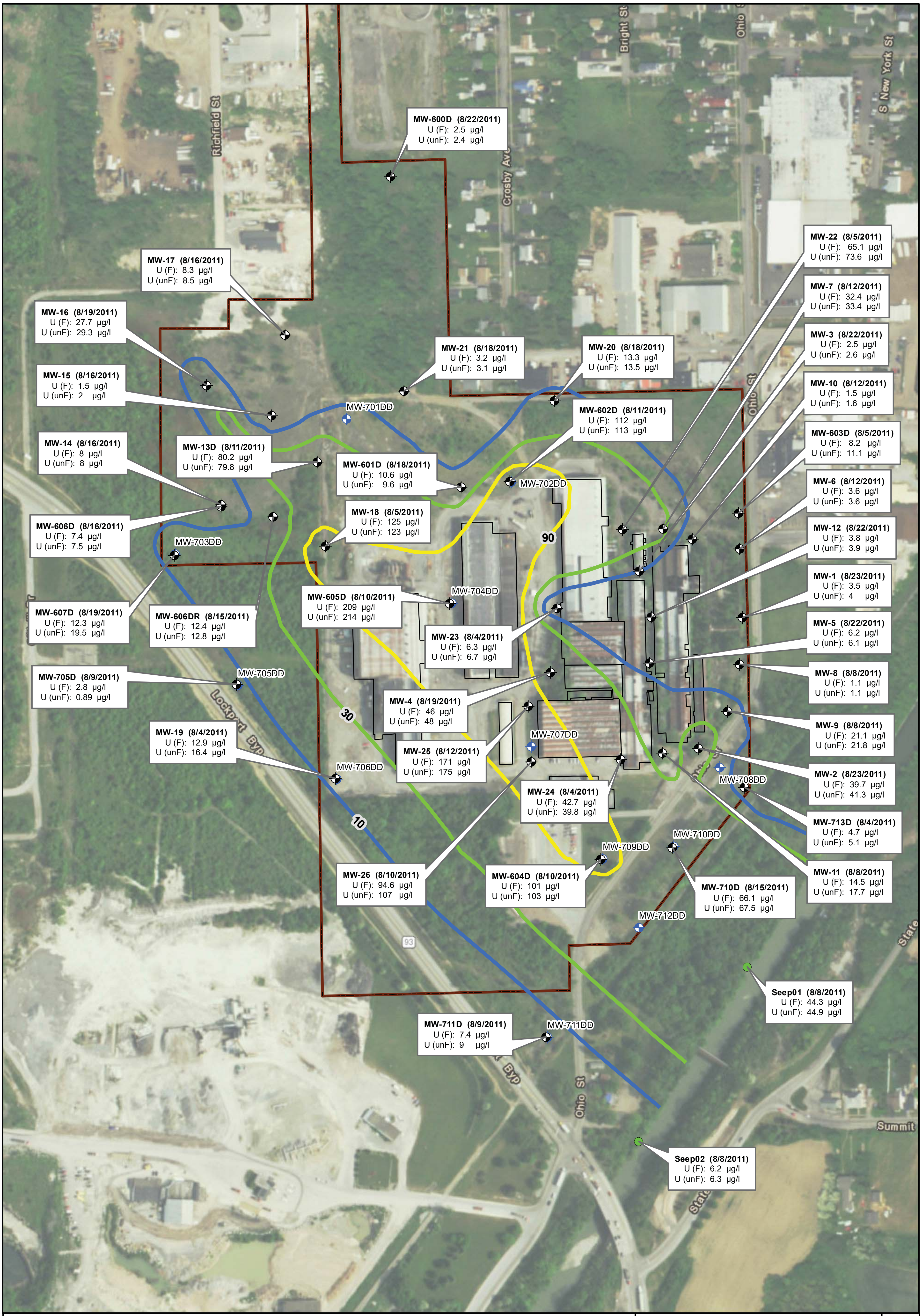

Legend

- ✥ SHALLOW WELL LOCATION
- ✥ DEEP WELL LOCATION
- ● SEEP SAMPLE
- ▬ EXTENT OF GROUNDWATER 10 µg/l
- ▬ EXTENT OF GROUNDWATER 30 µg/l
- ▬ EXTENT OF GROUNDWATER 90 µg/l
- ☐ BUILDINGS
- ☐ SITE BOUNDARY

U (F) = TOTAL URANIUM FILTERED
U (unF) = TOTAL URANIUM UNFILTERED
µg/l = MICROGRAMS PER LITER

NOTE: ALTHOUGH THE U (F) AND U (unF) VALUES ARE GENERALLY SIMILAR, IN CASE OF DISCREPANCY THE U (F) VALUES ARE USED FOR CONTOURING. SURFACE WATER SAMPLES WERE NOT USED TO DRAW CONTOURS.

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TOTAL URANIUM IN SHALLOW GROUNDWATER
(AUGUST 2011)

GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NY

Date:	Scale:	Figure No. :
06/06/2017	1 inch = 300 feet	2-5

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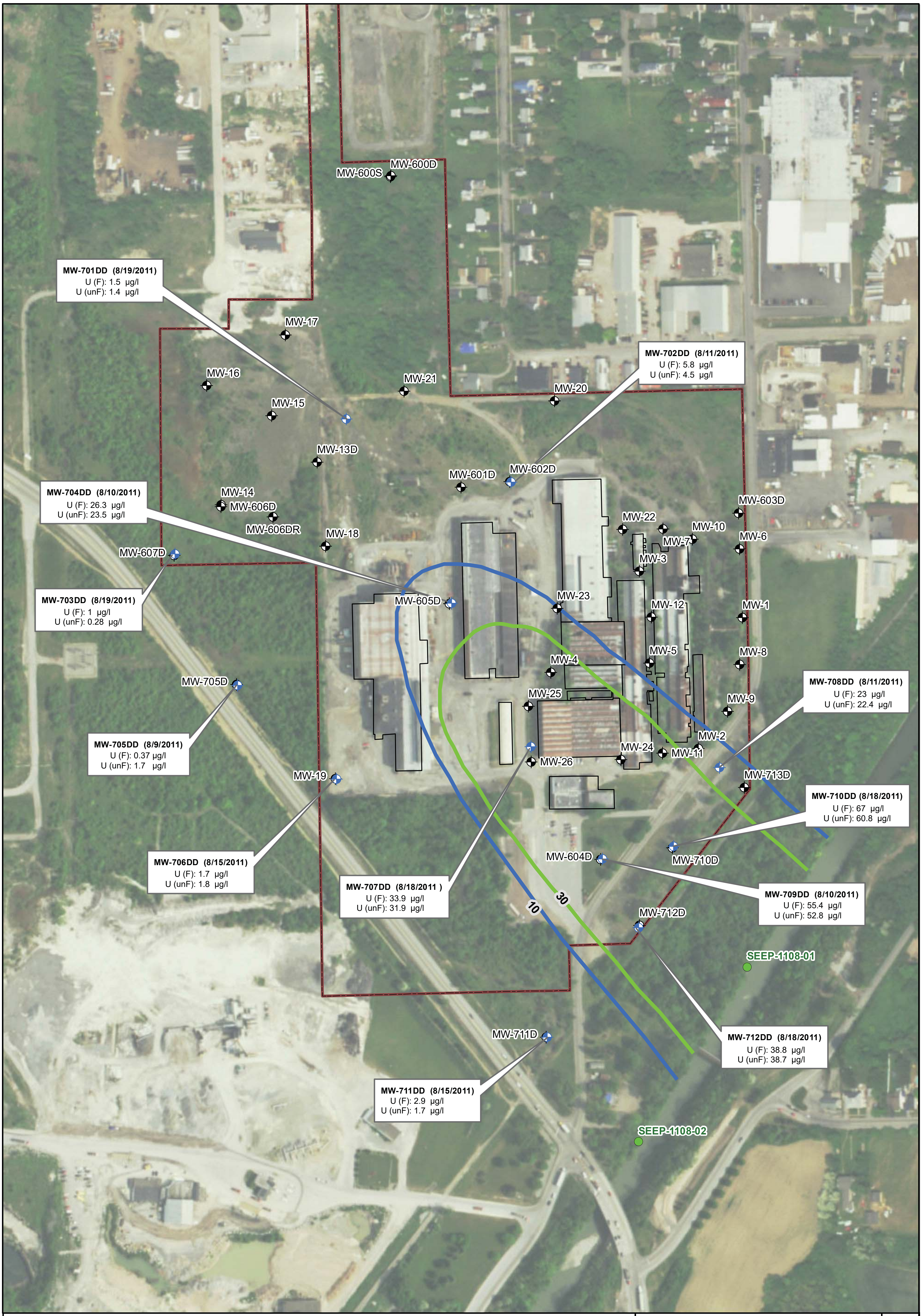

Legend

- ⌖ DEEP WELL LOCATION
- ⌖ SHALLOW WELL LOCATION
- ● SEEP LOCATION
- ▬ EXTENT OF GROUNDWATER 10 µg/l
- ▬ EXTENT OF GROUNDWATER 30 µg/l
- ☐ BUILDINGS
- ☐ SITE BOUNDARY

0 75 150 300 Feet

U (F) = TOTAL URANIUM FILTERED
U (unF) = TOTAL URANIUM UNFILTERED
µg/l = MICROGRAMS PER LITER

NOTE: ALTHOUGH THE U (F) AND U (unF) VALUES ARE GENERALLY SIMILAR, IN CASE OF DISCREPANCY THE U (F) VALUES ARE USED FOR CONTOURING. SURFACE WATER SAMPLES WERE NOT USED TO DRAW CONTOURS.

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TOTAL URANIUM IN DEEP GROUNDWATER
(AUGUST 2011)

GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NY

Date:	Scale:	Figure No. :
06/06/2017	1 inch = 300 feet	2-6

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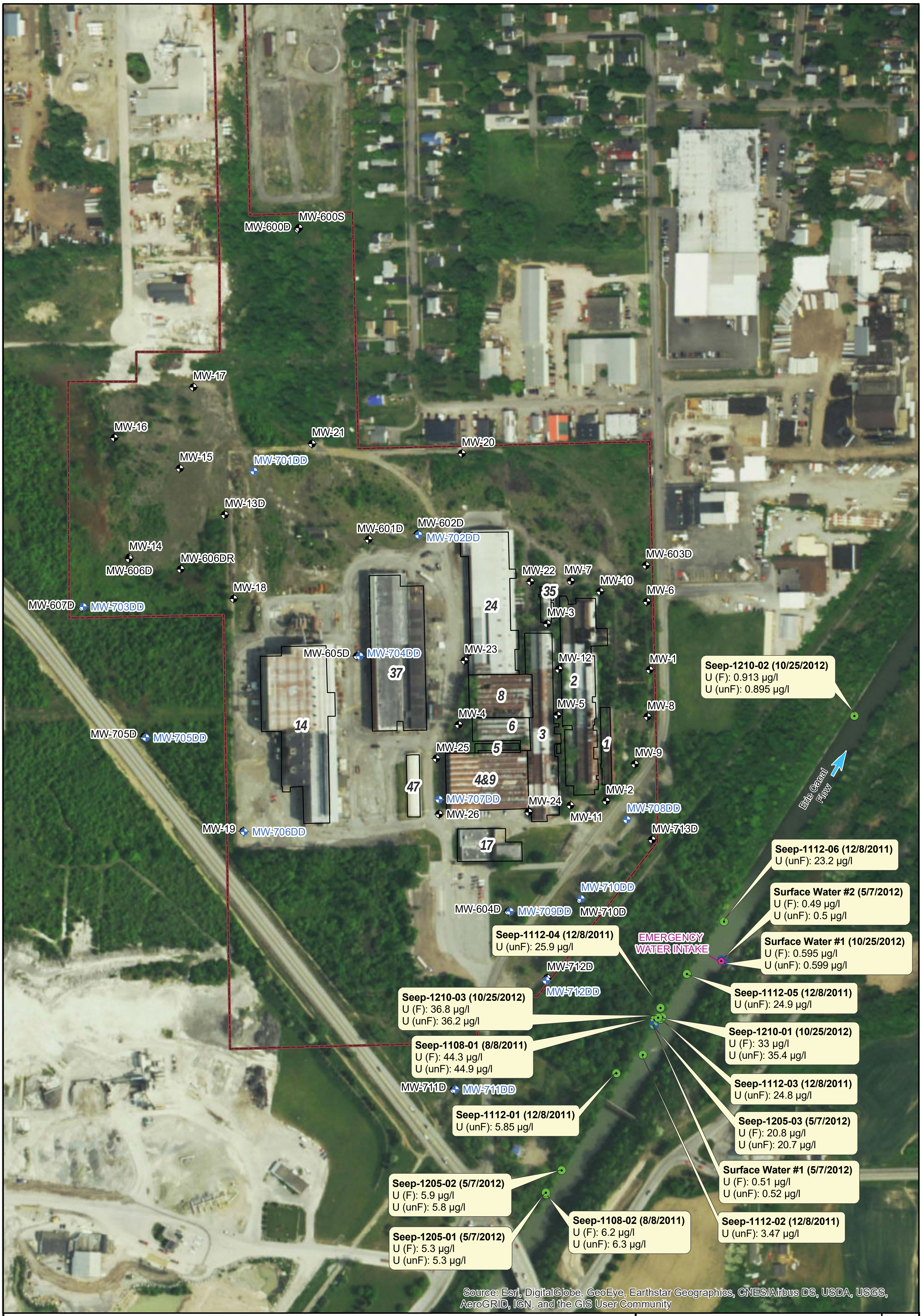

Seep-1210-02 (10/25/2012)
U (F): 0.913 µg/l
U (unF): 0.895 µg/l

Seep-1112-06 (12/8/2011)
U (unF): 23.2 µg/l

Surface Water #2 (5/7/2012)
U (F): 0.49 µg/l
U (unF): 0.5 µg/l

Seep-1112-04 (12/8/2011)
U (unF): 25.9 µg/l

Surface Water #1 (10/25/2012)
U (F): 0.595 µg/l
U (unF): 0.599 µg/l

Seep-1112-05 (12/8/2011)
U (unF): 24.9 µg/l

Seep-1210-03 (10/25/2012)
U (F): 36.8 µg/l
U (unF): 36.2 µg/l

Seep-1210-01 (10/25/2012)
U (F): 33 µg/l
U (unF): 35.4 µg/l

Seep-1108-01 (8/8/2011)
U (F): 44.3 µg/l
U (unF): 44.9 µg/l

Seep-1112-03 (12/8/2011)
U (unF): 24.8 µg/l

Seep-1112-01 (12/8/2011)
U (unF): 5.85 µg/l

Seep-1205-03 (5/7/2012)
U (F): 20.8 µg/l
U (unF): 20.7 µg/l

Surface Water #1 (5/7/2012)
U (F): 0.51 µg/l
U (unF): 0.52 µg/l

Seep-1205-02 (5/7/2012)
U (F): 5.9 µg/l
U (unF): 5.8 µg/l

Seep-1108-02 (8/8/2011)
U (F): 6.2 µg/l
U (unF): 6.3 µg/l

Seep-1112-02 (12/8/2011)
U (unF): 3.47 µg/l

Seep-1205-01 (5/7/2012)
U (F): 5.3 µg/l
U (unF): 5.3 µg/l

Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

- ⬟ Emergency Water Intake
- ◕ Surface Water Sample Location
- ● Seep Sample Location
- ⌖ Deep Well Location
- ⌖ Shallow Well Location
- ☐ Guterl Buildings
- ▭ Guterl Site Boundary

Seep-Surface Water Station (Sample Date)
U(F): Dissolved Uranium Filtered Result (µg/l)
U(unF): Total Uranium Unfiltered Result (µg/l)

µg/l = micrograms per liter

Sample Year
Seep-1205-02
Sample Month
Sample Number

0 75 150 300 Feet

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SEEPS AND SURFACE WATER
SAMPLING RESULTS, 2011-2012

GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NY

Date:	Scale:	Figure No. :
10/18/2017	1 inch = 300 feet	2-7

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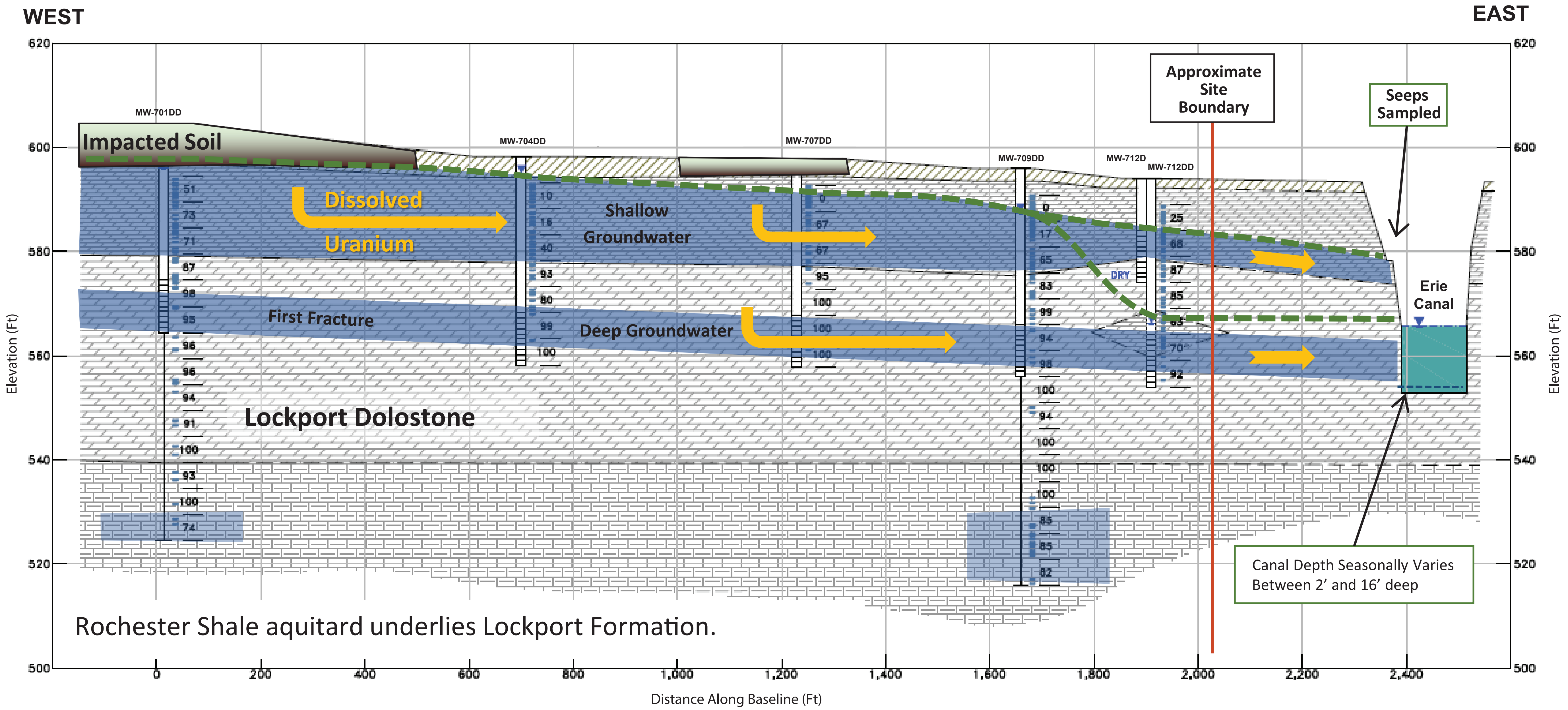

LEGEND:

MONITORING WELL

WATER LEVEL, AUGUST 2011

SCREENED INTERVAL

BOTTOM OF BORING

▨ OVERBURDEN SOIL

▨ FRACTURED DOLOSTONE, RQD <80%
SHALLOW FLOW ZONE

▨ DOLOSTONE, RQD >80%

▨ SHALEY DOLOSTONE

▨ WATER BEARING ZONES

SEEP FLOW

23 FRACTURES / RQD (%)

DISSOLVED URANIUM

◇ ZONE OF GREATER FRACTURES CONTAINED WITHIN LOWER FRACTURE ROCK THAT IS NOT OBSERVED IN ADJACENT BORINGS.

NOTES

1) CANAL WATER LEVEL AND BOTTOM REFERENCED FROM AUGUST 2011 GAUGE READING AT LOCK 35, APPROXIMATELY 1.75 MILES DOWNSTREAM.

2) RQD = ROCK QUALITY DESIGNATION. A DEGREE OF FRACTURING IN A ROCK CORE (%) WHERE THE VALUE IS INVERSELY RELATED TO LENGTH OF ROCK BROKEN BY FRACTURES. FEW FRACTURES HAVE HIGH RQD% (FEW BLUE DASHES), MULTIPLE FRACTURES (MANY BLUE DASHES) HAVE LOW RQD%.

3) IMPACTED SOILS: <2 – 9 FT THICK FILL MIXED WITH REWORKED NATIVE SOIL OVERLYING 0 – 4 FT THICK GLACIOLACUSTRINE AND/OR TILL DEPOSITS.

VERTICAL SCALE 20' 0

0 200'
HORIZONTAL SCALE

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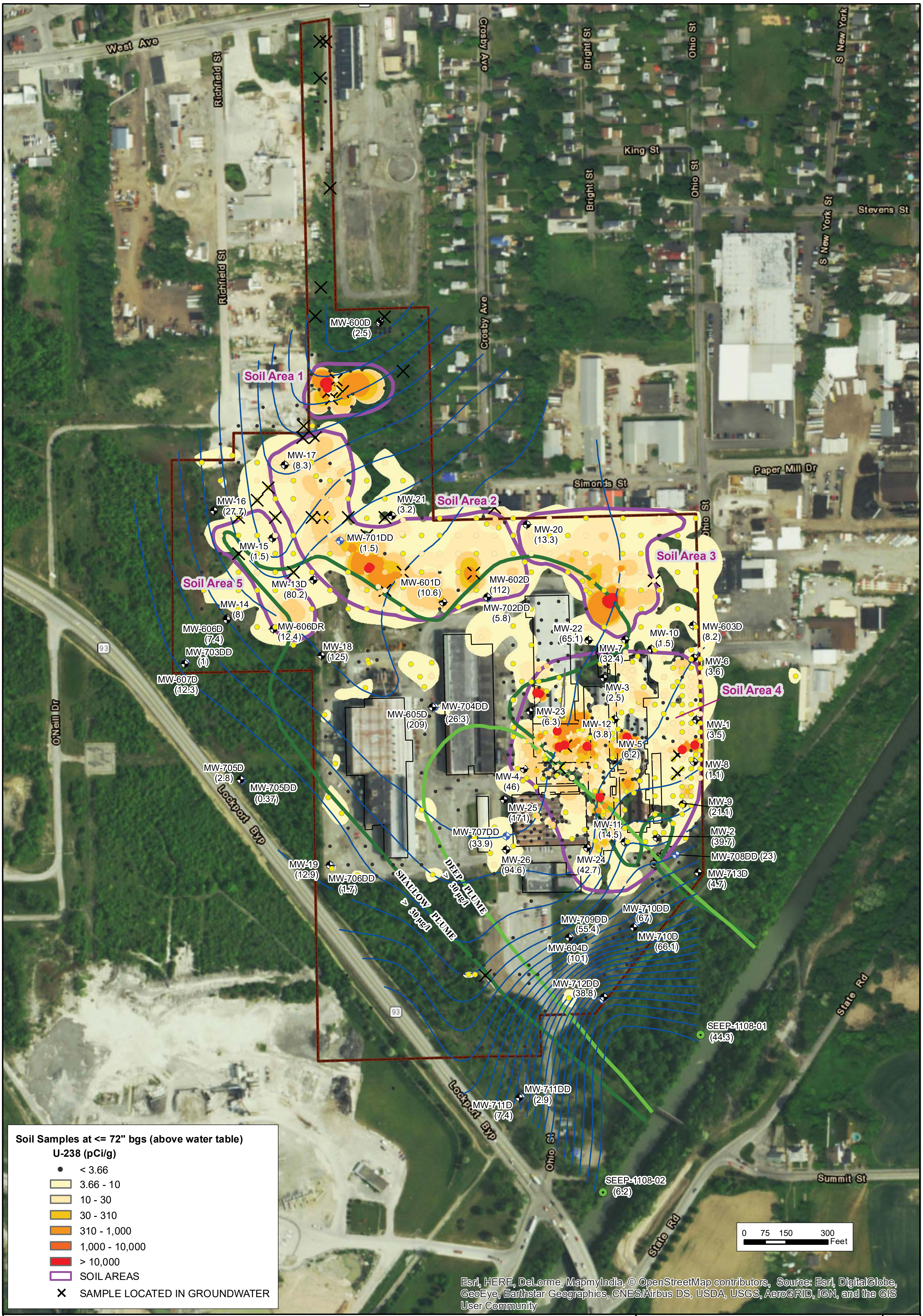
GEOLOGIC CROSS SECTION ACROSS THE SITE - WEST TO EAST

FIGURE 2-8
REVISED CONCEPTUAL MODEL

GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NEW YORK



Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community

Legend

⯐	SHALLOW WELL LOCATION
⯐	DEEP WELL LOCATION (MW-708DD)
⊙	SEEP LOCATION
▭	GUTERL SITE BOUNDARY
▭	GUTERL BUILDINGS
—	DEEP PLUME > 30 µg/l
—	SHALLOW PLUME > 30 µg/l
—	SHALLOW GROUNDWATER CONTOUR
→	SHALLOW GROUNDWATER FLOW PATH (INFERRED)
(80.2)	AUGUST 2011 TOTAL URANIUM CONCENTRATIONS (FILTERED, µg/l)

NOTES:
1) ALL SOIL DATA TAGGED AS "REPORTABLE" IN THE DATABASE, AND OVERLYING THE WATER TABLE IS USED.

2) SOIL DATA DEEPER THAN FOLLOWING NOT USED:
- I. AREA 1 - 66 INCHES (AVERAGE DTW = 64.4 INCHES)
- II. AREA 2 - 72 INCHES (AVERAGE DTW = 69.5 INCHES)
- III. AREA 3 - 54 INCHES (AVERAGE DTW = 54.0 INCHES)
- IV. AREA 4 - 54 INCHES (AVERAGE DTW = 51.96 INCHES)
- V. AREA 5 - 66 INCHES (AVERAGE DTW = 64.56 INCHES)
- VI. OUTSIDE SOIL AREAS – 72 INCHES

3) DTW = DEPTH TO GROUNDWATER

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GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NY

RELATIONSHIP BETWEEN TOTAL URANIUM
IN GROUNDWATER AND IN SOIL COLUMN
(AUGUST, 2011)

Date:	Scale:	Figure No. :
8/07/2013	1 inch = 333 feet	2-9

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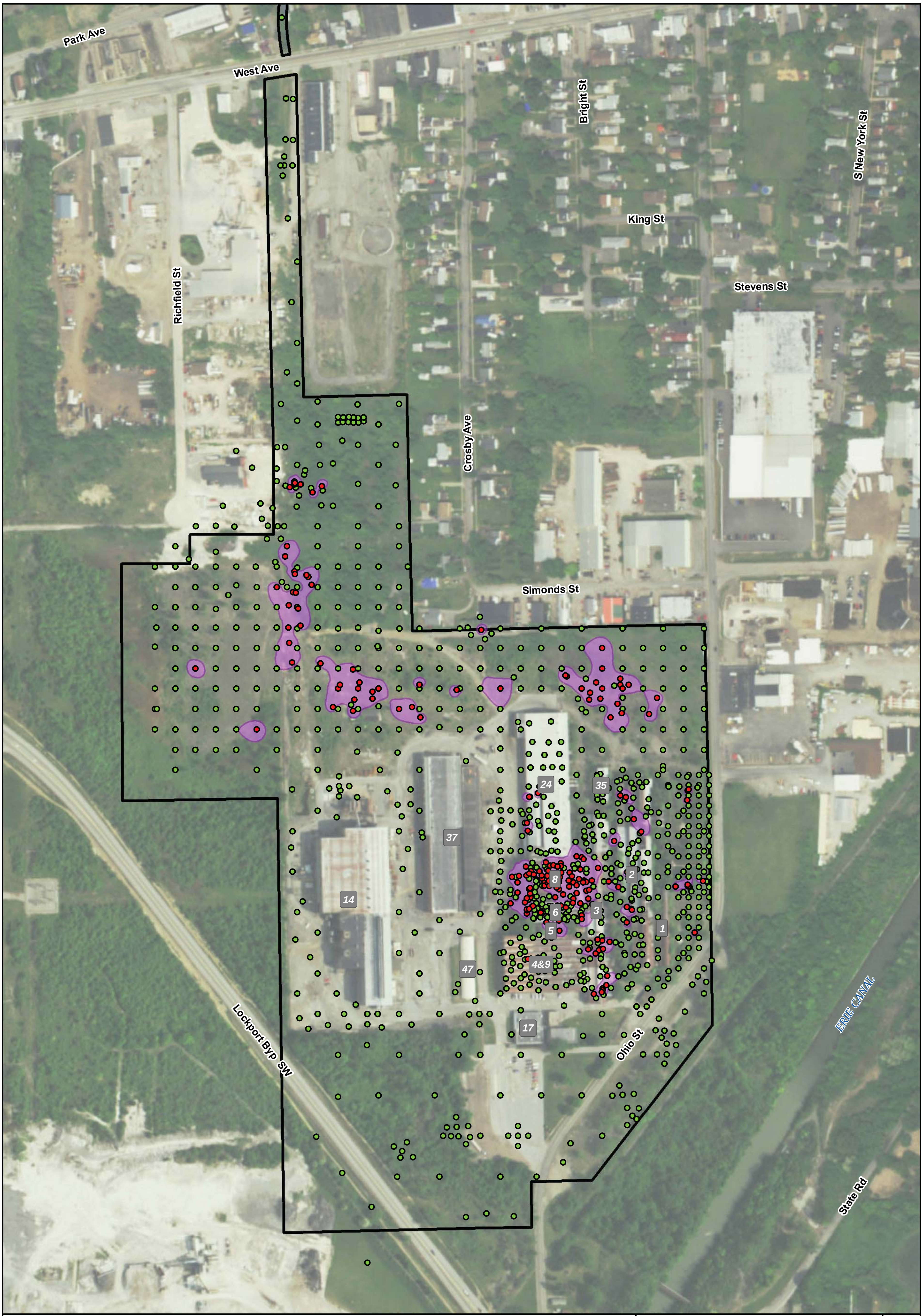

Legend

Sum of Ratio

● SOR < 1

● SOR > 1

▨ Estimated Extent of Contaminated Soil

○ Site Boundary

0 75 150 300 Feet

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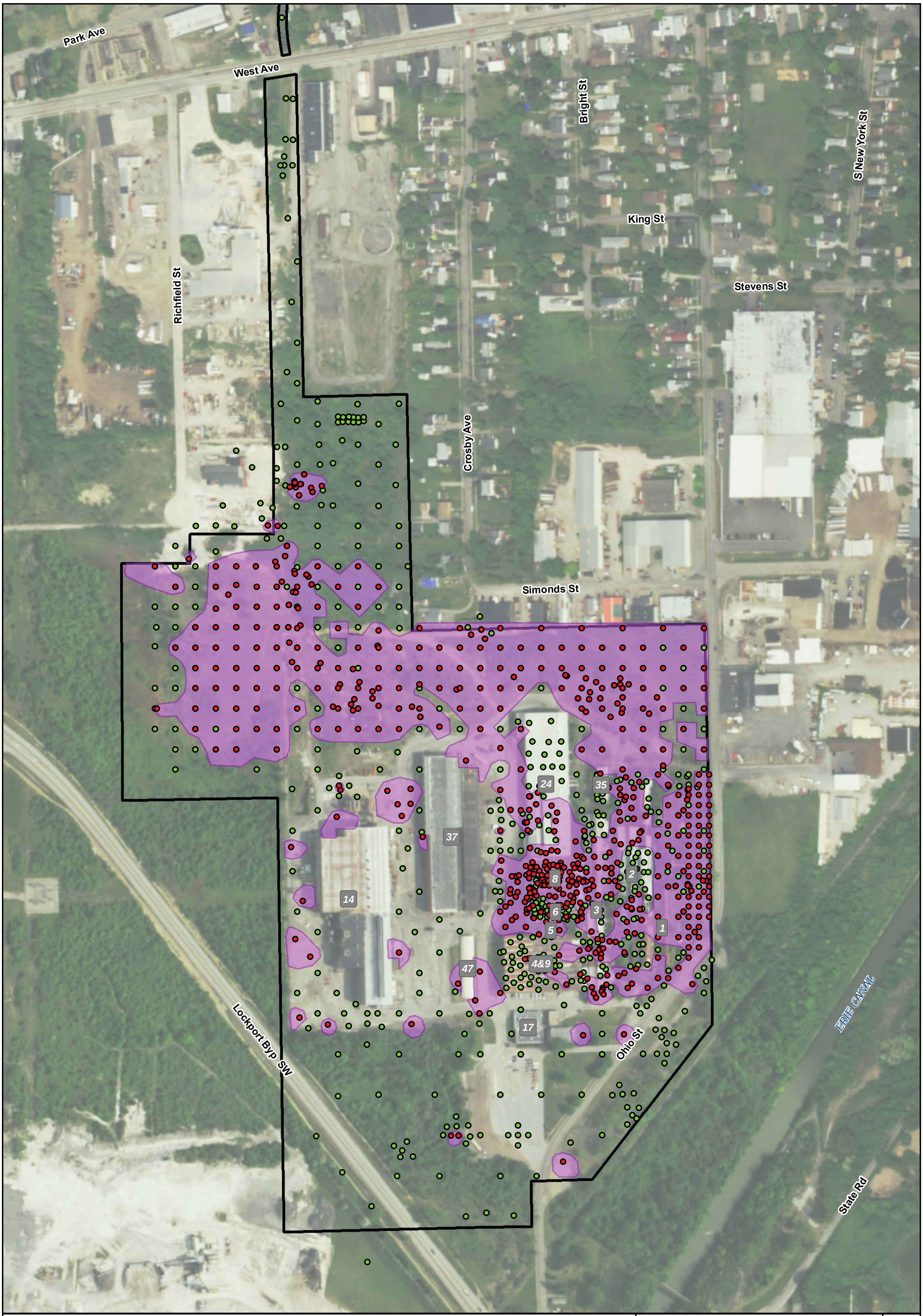
GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NY

VOLUME ESTIMATE - 50% PROBABILITY
FOOTPRINT AND SOR COMPARED TO
THE PRG FOR CONSTRUCTION WORKER

Date:	Scale:	Figure No. :
10/18/2017	1 inch = 300 feet	3-1

Document Path: K:\Guterl\GIS\ArcMap\Soil\2015\300115FS_F3-1.mxd Date: 10/18/2017 Time: 7:23:59 AM



Legend

U-238 Concentrations in Soil

- 🟢 < 3.7 pci/g
- 🔴 > 3.7 pci/g
- 🟪 Estimated Extent of U-238 in Soil
- ○ Site Boundary

0 75 150 300
Feet

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GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NY

VOLUME ESTIMATE - 50% PROBABILITY FOOTPRINT AND SOIL URANIUM CONCENTRATIONS COMPARED TO THE PRG FOR GROUNDWATER PROTECTION

Date:	Scale:	Figure No. :
10/18/2017	1 inch = 300 feet	3-2

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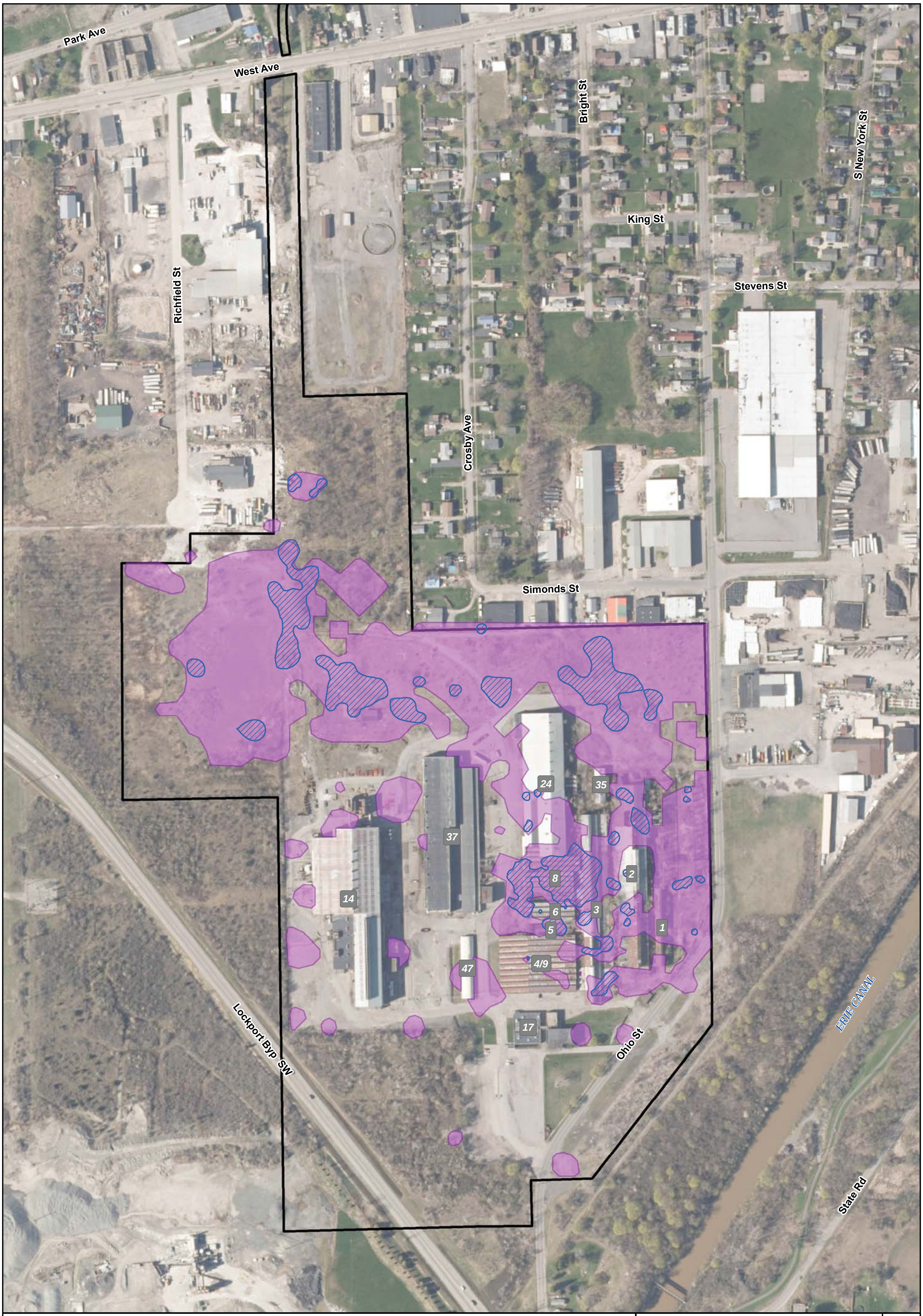

Legend

▨ Estimated Extent of Contaminated Soil Based on the Construction Worker PRG

● Estimated Extent of Contaminated Soil Based on the Protection of Groundwater PRG

○ Site Boundary

0 75 150 300
Feet

Notes:
1) Protection of Groundwater PRG: U-238 - 3.7 pCi/g
2) Construction Worker PRG (based on SOR Values):
U-238 - 23 pCi/g and Th-232 - 6.6 pCi/g.

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GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NY

VOLUME ESTIMATE - COMPARISON OF THE 50% PROBABILITY FOOTPRINTS FOR THE CONSTRUCTION WORKER AND PROTECTION OF GROUNDWATER PRGs

Date:	Scale:	Figure No. :
10/18/2018	1 inch = 300 feet	3-3

Document Path: K:\Guterl\GIS\ArcMap\Soil\2018\181003FS_F3-3.mxd Date: 10/18/2018 Time: 9:04:03 AM

Document Path: K:\Guterl\GIS\ArcMap\Buildings\2015\180515_SamplingLocations.mxd

Legend

Sampling Locations

- ● Floor Scan Location
- ● Lower Wall Scan Location (< 2 meters)
- ● Upper Wall Scan Location (> 2 meters)
- ○ Ceiling Scan Location
- ● Misc. Scan Location

Railroad

Buildings

NOTE:
No measurements were taken in the interior of Building 6 and 8, due to elevated radiological exposure measurements.

0 50 100 200
Feet

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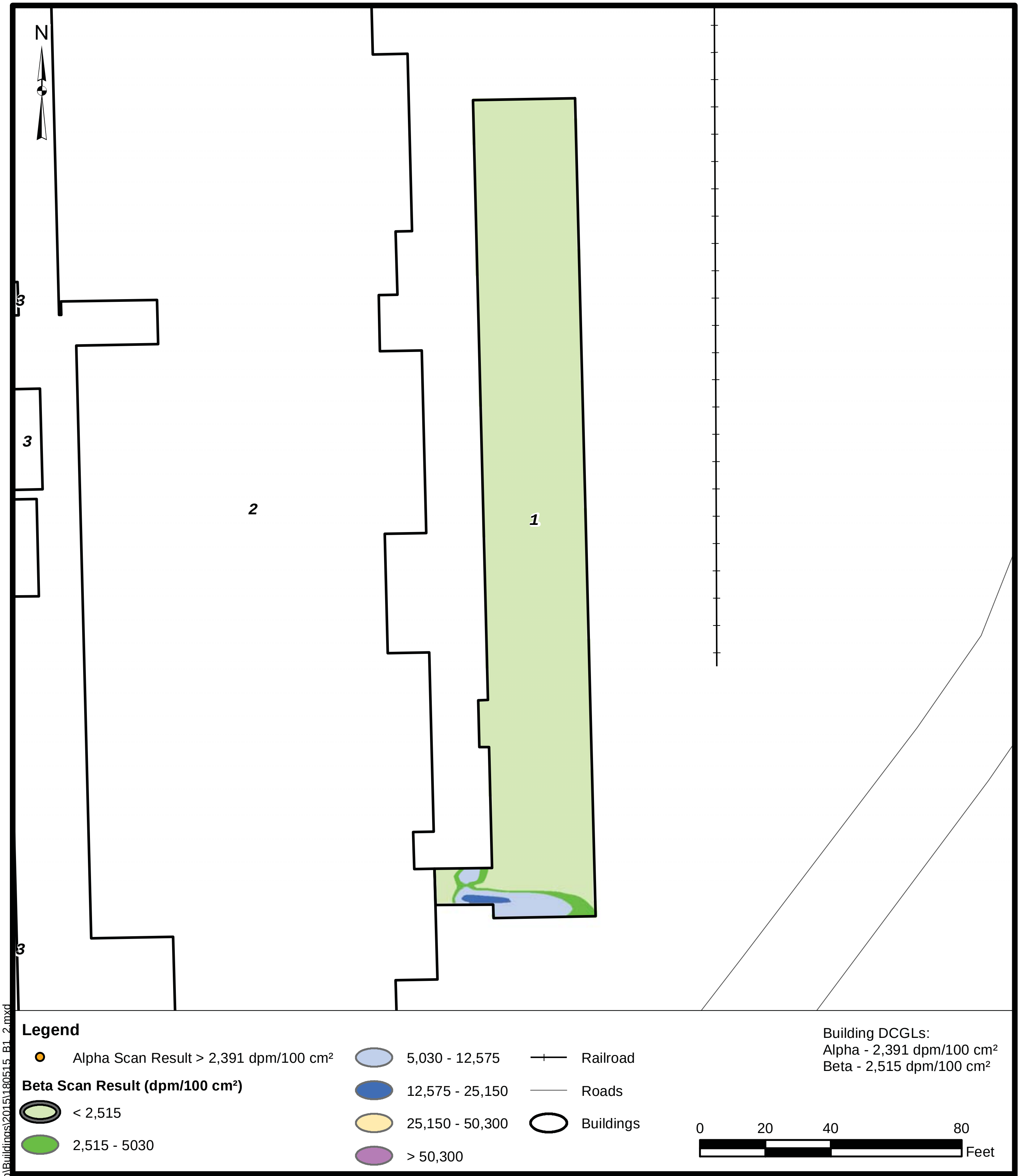
U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
BUFFALO, NY

REMEDIAL INVESTIGATION ALPHA AND BETA
STATIC SCAN LOCATIONS

Document Name: 180515_SamplingLocations.mxd
Drawn By: H5TDESPM
Date Saved: 20 May 2015
Time Saved: 1:55:55 PM

GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NEW YORK

FIGURE 3-4



U.S. ARMY ENGINEER DISTRICT
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BUFFALO, NY

ALPHA AND BETA STATIC SCAN RESULTS FOR BUILDING 1 - LOWER SURFACE

Document Name: 180515_B1_2.mxd
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Date Saved: 22 Jun 2015
Time Saved: 12:50:32 PM

GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NEW YORK

FIGURE 3-5

Document Path: K:\Guterl\GIS\ArcMap\Buildings\2015\180515_B1_2.mxd

Legend

● Alpha Scan Result > 2,391 dpm/100 cm²

Beta Scan Result (dpm/100 cm²)

⬭	< 2,515
⬭	2,515 - 5030
⬭	5,030 - 12,575
⬭	12,575 - 25,150
⬭	25,150 - 50,300
⬭	> 50,300
—+—	Railroad
——	Roads
⬭	Buildings

Lower Surfaces are surfaces below 2m.
Upper Surfaces are surfaces above 2m.

0 40 80 160
Feet

Building DCGLs:
Alpha - 2,391 dpm/100 cm²
Beta - 2,515 dpm/100 cm²

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BUFFALO, NY

ALPHA AND BETA STATIC SCAN RESULTS FOR BUILDING 2

Document Name: 180515_B2_2.mxd
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Date Saved: 22 Jun 2015
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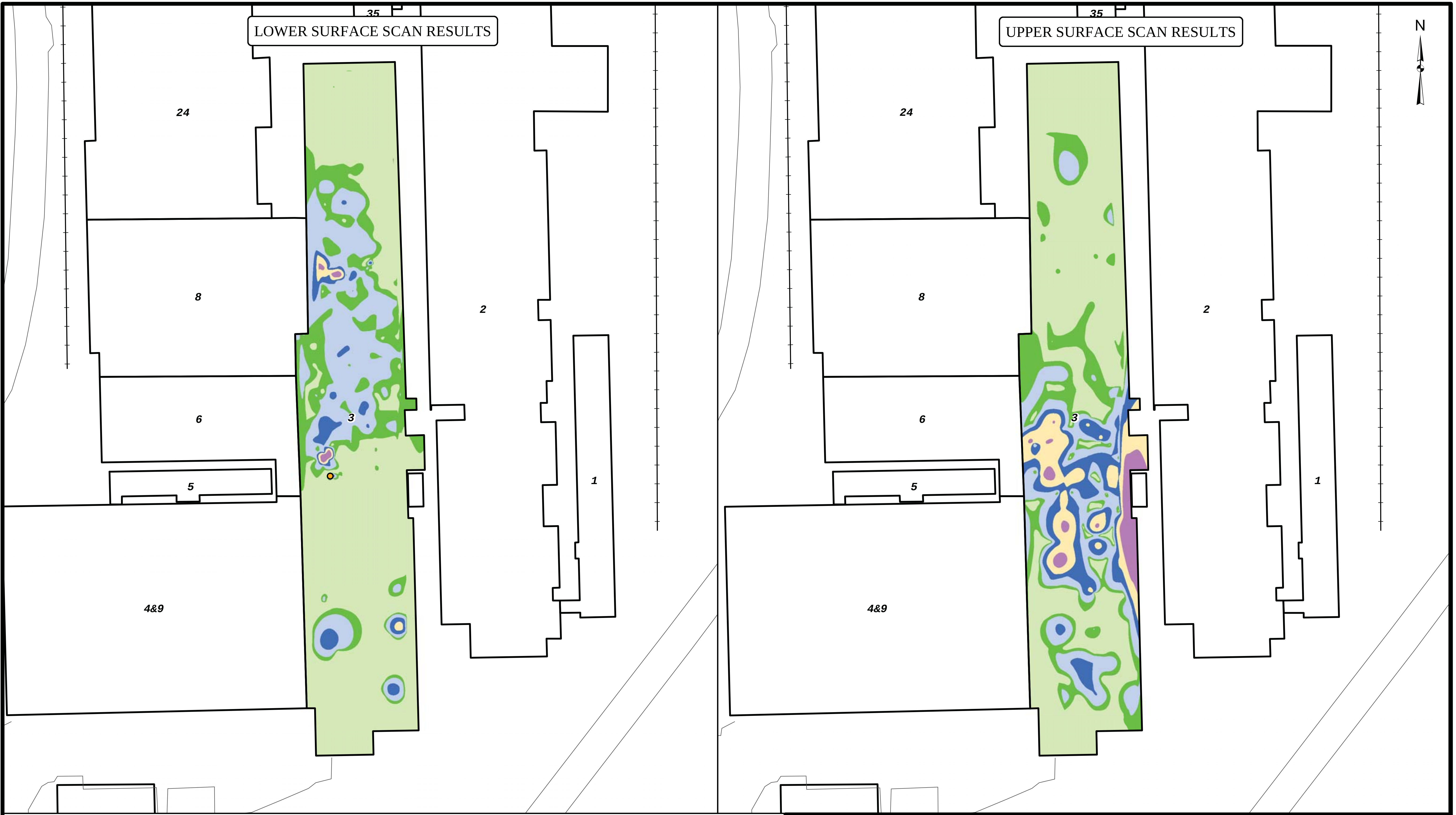
GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NEW YORK

FIGURE 3-6

Document Path: K:\Guterl\GIS\ArcMap\Buildings\2015\180515_B2_2.mxd



Legend

● Alpha Scan Result > 2,391 dpm/100 cm²

Beta Scan Result (dpm/100 cm²)

🟩	< 2,515
🟩	2,515 - 5030
🟦	5,030 - 12,575
🟦	12,575 - 25,150
🟨	25,150 - 50,300
🟪	> 50,300
─┼─	Railroad
──	Roads
⬭	Buildings

Lower Surfaces are surfaces below 2m.
Upper Surfaces are surfaces above 2m.

Building DCGLs:
Alpha - 2,391 dpm/100 cm²
Beta - 2,515 dpm/100 cm²

0 40 80 160
Feet

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CORPS OF ENGINEERS
BUFFALO, NY

ALPHA AND BETA STATIC SCAN RESULTS
FOR BUILDING 3

Document Name: 180515_B3_2.mxd
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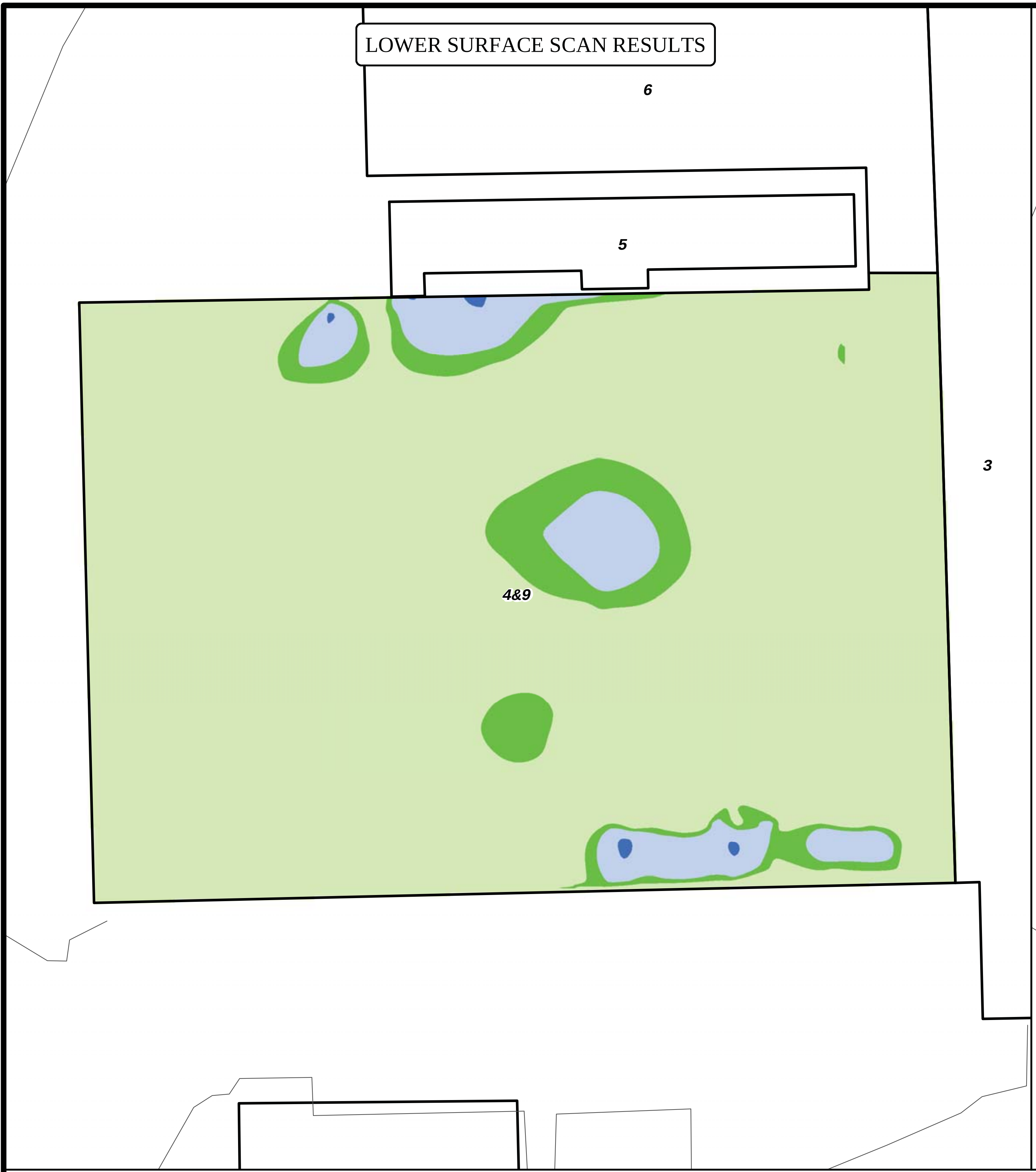
GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NEW YORK

FIGURE 3-7

Document Path: K:\Guterl\GIS\ArcMap\Buildings\2015\180515_B3_2.mxd



Legend

Beta Scan Result (dpm/100 cm²)

🟩	< 2,515
🟩	2,515 - 5030
🟦	5,030 - 12,575
🟦	12,575 - 25,150
🟨	25,150 - 50,300
🟪	> 50,300
—+—	Railroad
——	Roads
○	Buildings

Lower Surfaces are surfaces below 2m.
Upper Surfaces are surfaces above 2m.

Building DCGLs:
Alpha - 2,391 dpm/100 cm²
Beta - 2,515 dpm/100 cm²

0 20 40 80 Feet

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ALPHA AND BETA STATIC SCAN RESULTS
FOR BUILDING 4 & 9

Document Name: 180515_B49_2.mxd
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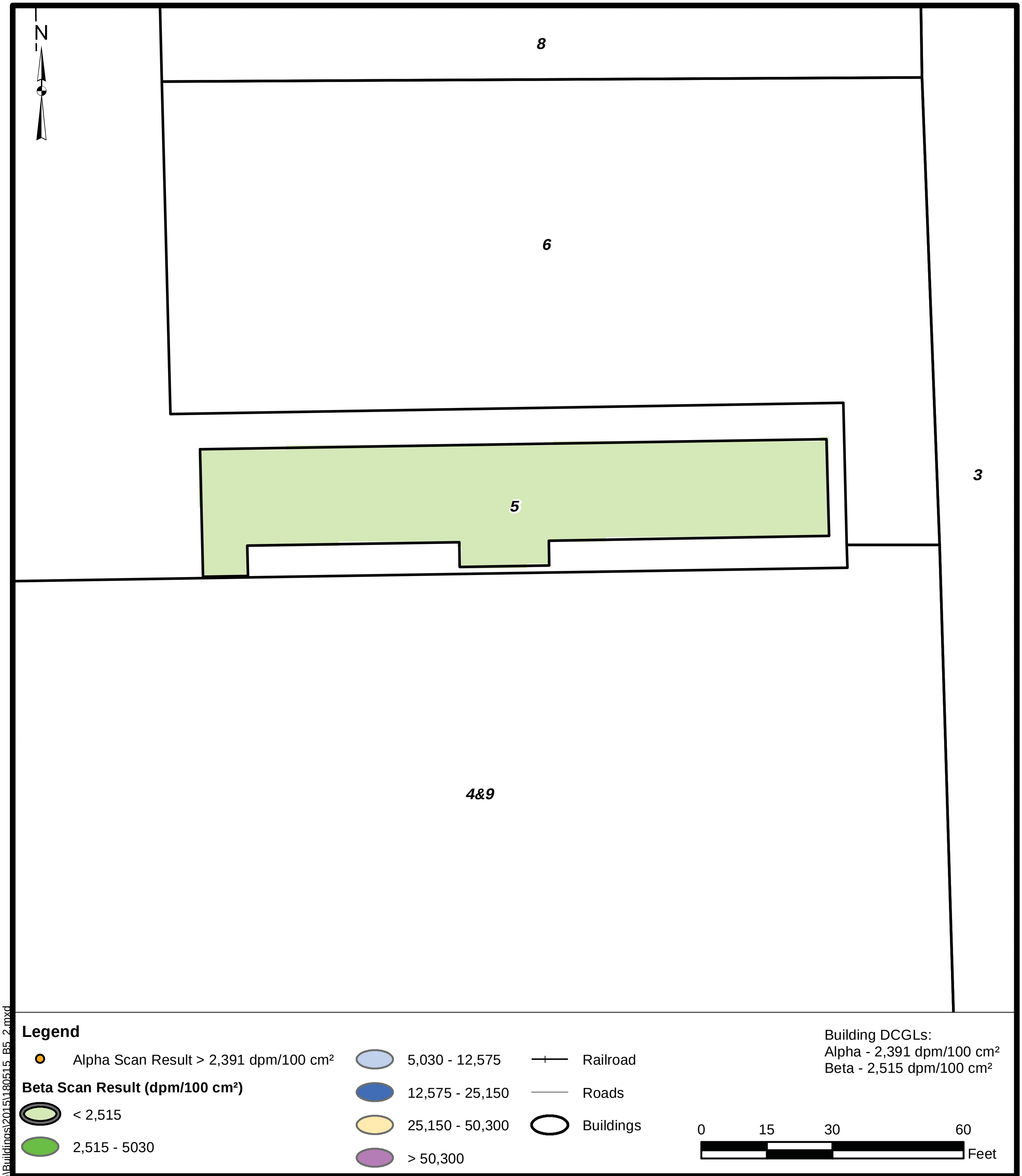
Date Saved: 20 May 2015
Time Saved: 2:53:38 PM

GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NEW YORK

FIGURE 3-8

Document Path: K:\Guterl\GIS\ArcMap\Buildings\2015\180515_B49_2.mxd



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ALPHA AND BETA STATIC SCAN RESULTS FOR BUILDING 5 - UPPER SURFACE

Document Name: 180515_B5_2.mxd
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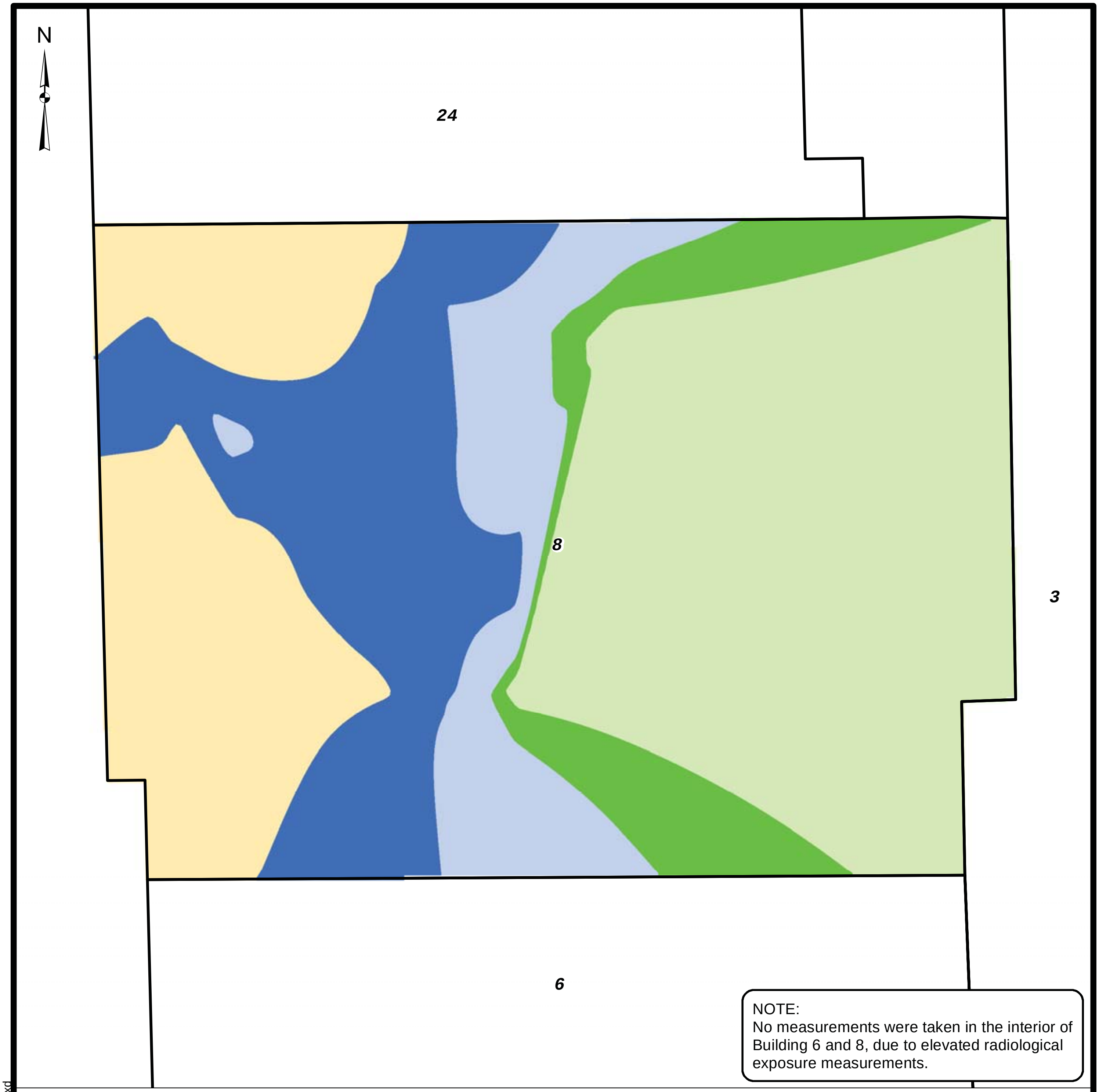
GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NEW YORK

FIGURE 3-9

Document Path: K:\Guterl\GIS\ArcMap\Buildings\2015\180515_B5_2.mxd



NOTE:
No measurements were taken in the interior of Building 6 and 8, due to elevated radiological exposure measurements.

Legend

● Alpha Scan Result > 2,391 dpm/100 cm²

Beta Scan Result (dpm/100 cm²)

- ⬭ < 2,515
- 🟩 2,515 - 5030
- ⬭ 5,030 - 12,575
- 🟦 12,575 - 25,150
- 🟨 25,150 - 50,300
- 🟪 > 50,300

—+— Railroad

—— Roads

⬭ Buildings

Building DCGLs:
Alpha - 2,391 dpm/100 cm²
Beta - 2,515 dpm/100 cm²

0 15 30 60
Feet

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ALPHA AND BETA STATIC SCAN RESULTS FOR BUILDING 8 - LOWER SURFACE

Document Name: 180515_B8_2.mxd
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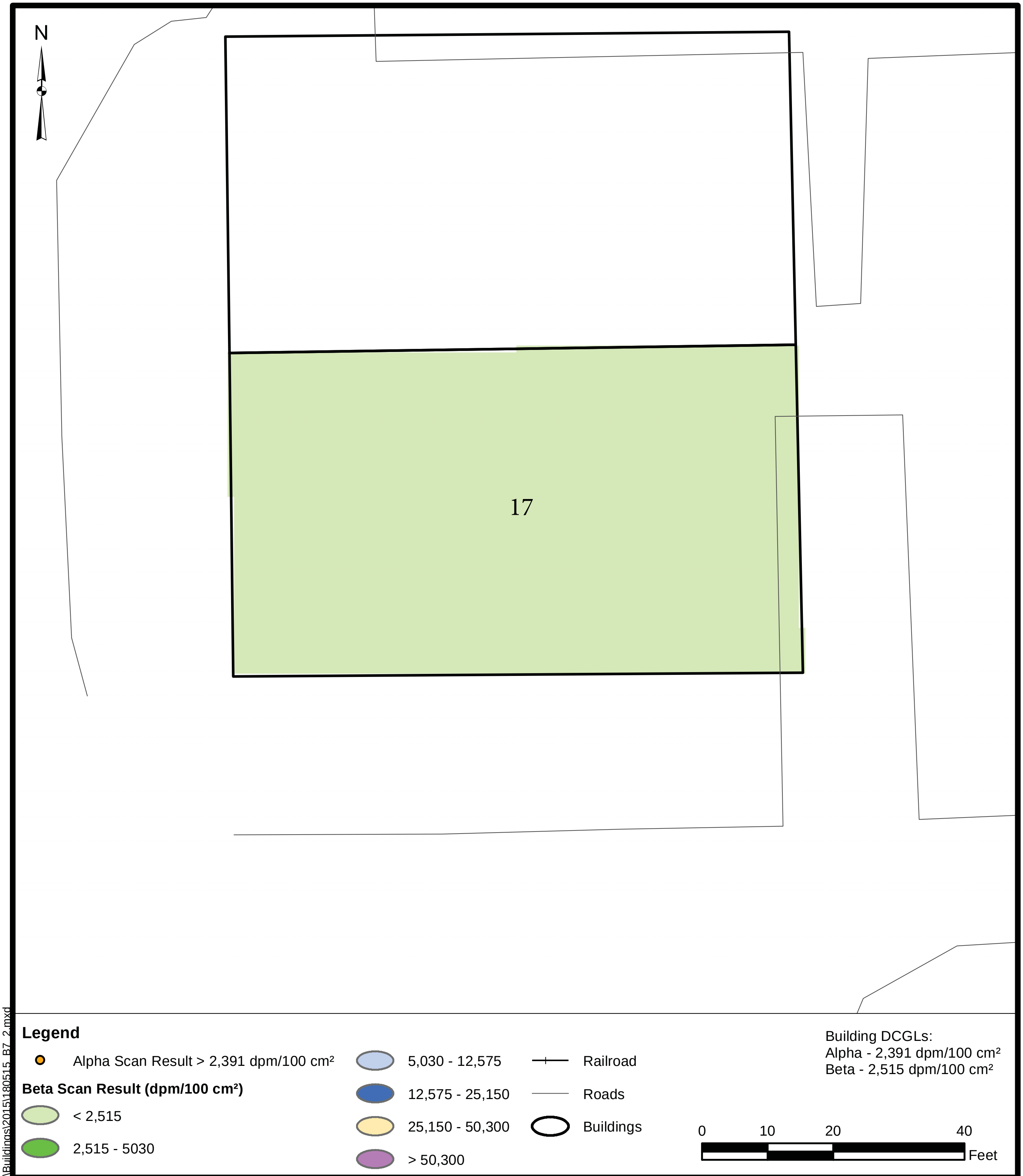
GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NEW YORK

FIGURE 3-10

Document Path: K:\Guterl\GIS\ArcMap\Buildings\2015\180515_B8_2.mxd



Legend

● Alpha Scan Result > 2,391 dpm/100 cm²

Beta Scan Result (dpm/100 cm²)

- 🟩 < 2,515
- 🟩 2,515 - 5030
- 🟦 5,030 - 12,575
- 🟦 12,575 - 25,150
- 🟨 25,150 - 50,300
- 🟪 > 50,300
- —+— Railroad
- —— Roads
- ○ Buildings

Building DCGLs:
Alpha - 2,391 dpm/100 cm²
Beta - 2,515 dpm/100 cm²

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ALPHA AND BETA STATIC SCAN RESULTS FOR BUILDING 17 - LOWER SURFACE

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Time Saved: 1:06:11 PM

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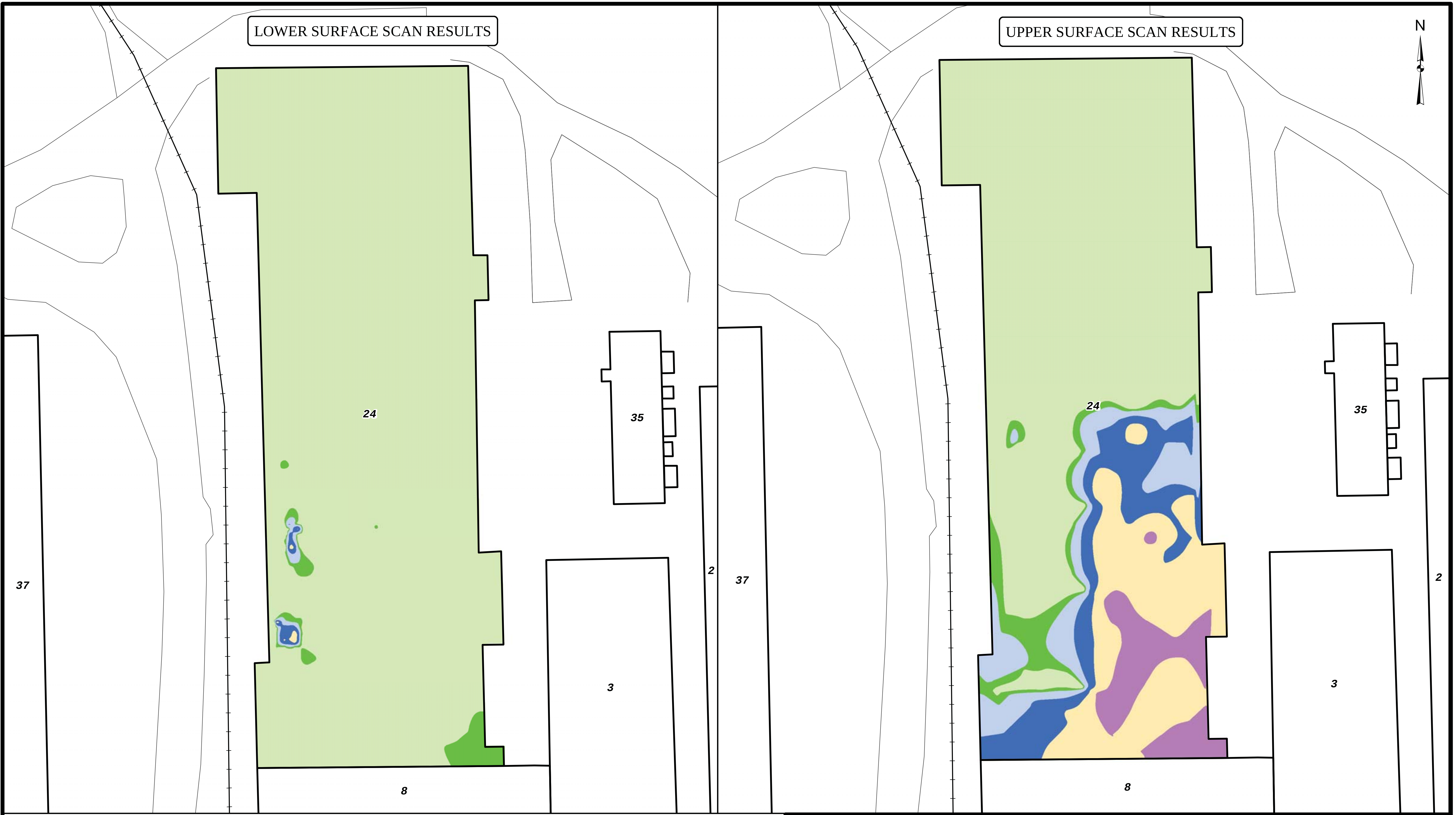
FIGURE 3-11

Document Path: K:\Guterl\GIS\ArcMap\Buildings\2015\180515_B7_2.mxd



Legend

● Alpha Scan Result > 2,391 dpm/100 cm²

Beta Scan Result (dpm/100 cm²)

- ⬭ < 2,515
- ⬭ 2,515 - 5030
- ⬭ 5,030 - 12,575
- ⬭ 12,575 - 25,150
- ⬭ 25,150 - 50,300
- ⬭ > 50,300

Railroad

Roads

Buildings

Lower Surfaces are surfaces below 2m.

Upper Surfaces are surfaces above 2m.

Building DCGLs:
Alpha - 2,391 dpm/100 cm²
Beta - 2,515 dpm/100 cm²

0 20 40 80 Feet

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ALPHA AND BETA STATIC SCAN RESULTS
FOR BUILDING 24

Document Name: 180515_B24_2.mxd
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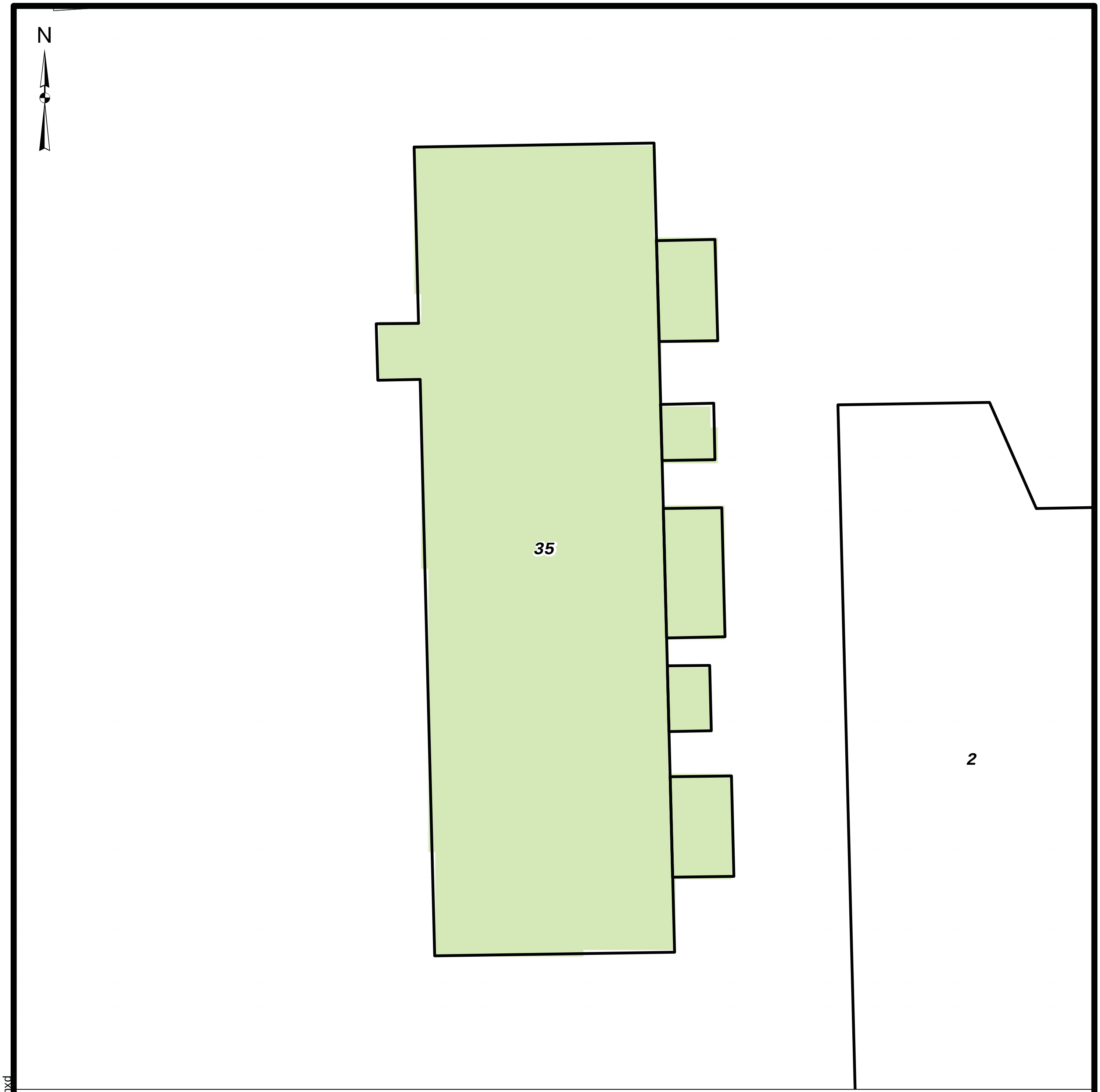
GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NEW YORK

FIGURE 3-12

Document Path: K:\Guterl\GIS\ArcMap\Buildings\2015\180515_B24_2.mxd



Legend

● Alpha Scan Result > 2,391 dpm/100 cm²

Beta Scan Result (dpm/100 cm²)

- ⬭ < 2,515
- ⬭ 2,515 - 5030
- ⬭ 5,030 - 12,575
- ⬭ 12,575 - 25,150
- ⬭ 25,150 - 50,300
- ⬭ > 50,300

- ┼ Railroad
- — Roads
- ⬭ Buildings

Building DCGLs:
Alpha - 2,391 dpm/100 cm²
Beta - 2,515 dpm/100 cm²

0 10 20 40
Feet

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BUFFALO, NY

ALPHA AND BETA STATIC SCAN RESULTS FOR BUILDING 35 - LOWER SURFACE

Document Name: 180515_B35_2.mxd
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Date Saved: 20 May 2015
Time Saved: 2:52:31 PM

GUTERL SPECIALTY STEEL CORPORATION
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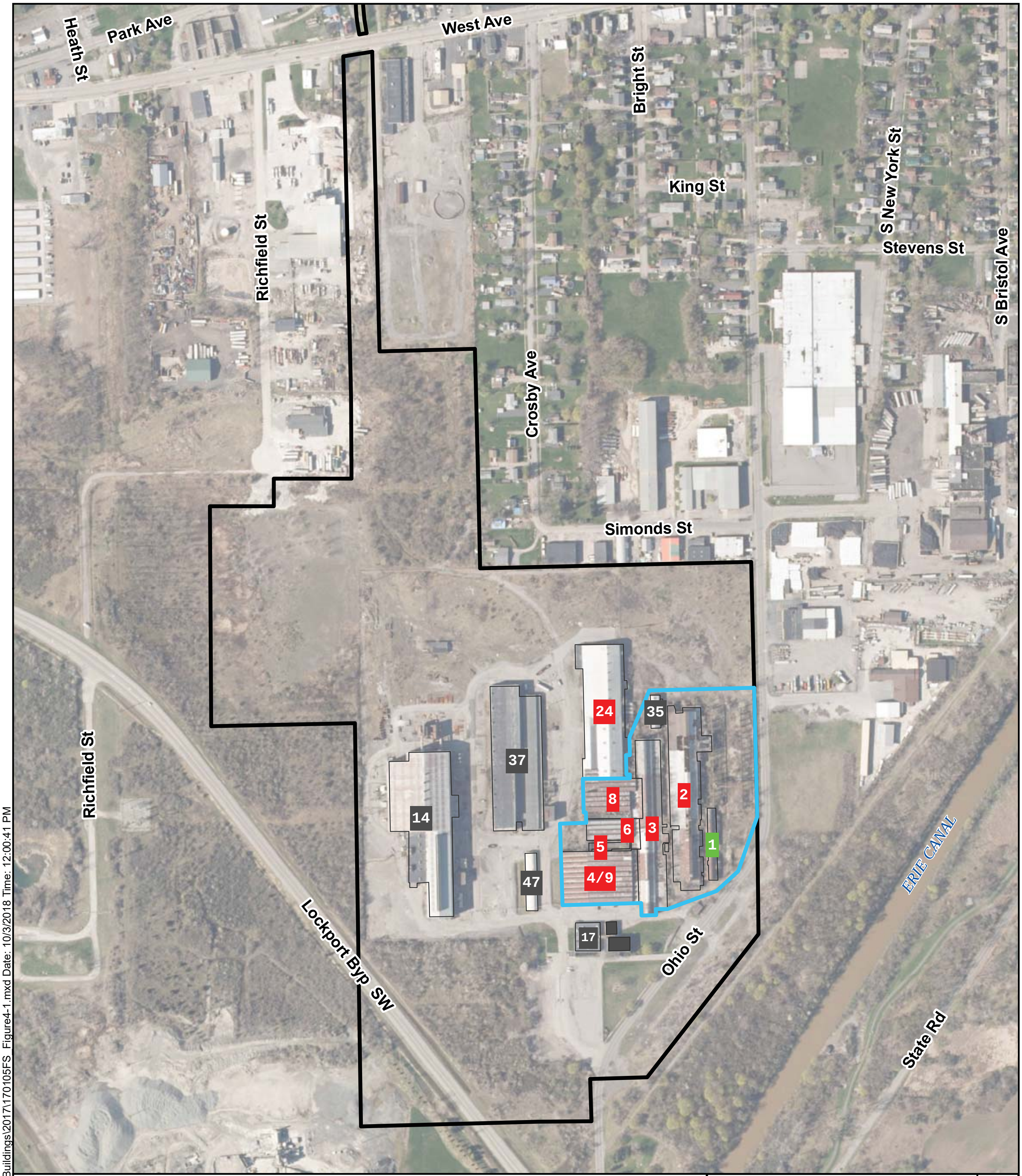
FIGURE 3-13

Document Path: K:\Guterl\GIS\ArcMap\Buildings\2015\180515_B35_2.mxd



0 112.5 225 450
Feet

Legend

- Excised Area Boundary
- ATI Specialty Materials Boundary
- Buildings
- 🟩 1 Buildings Identified for Decontamination
- 🟥 2 Buildings Identified for Complete Dismantlement
- ⬛ Buildings Not Addressed

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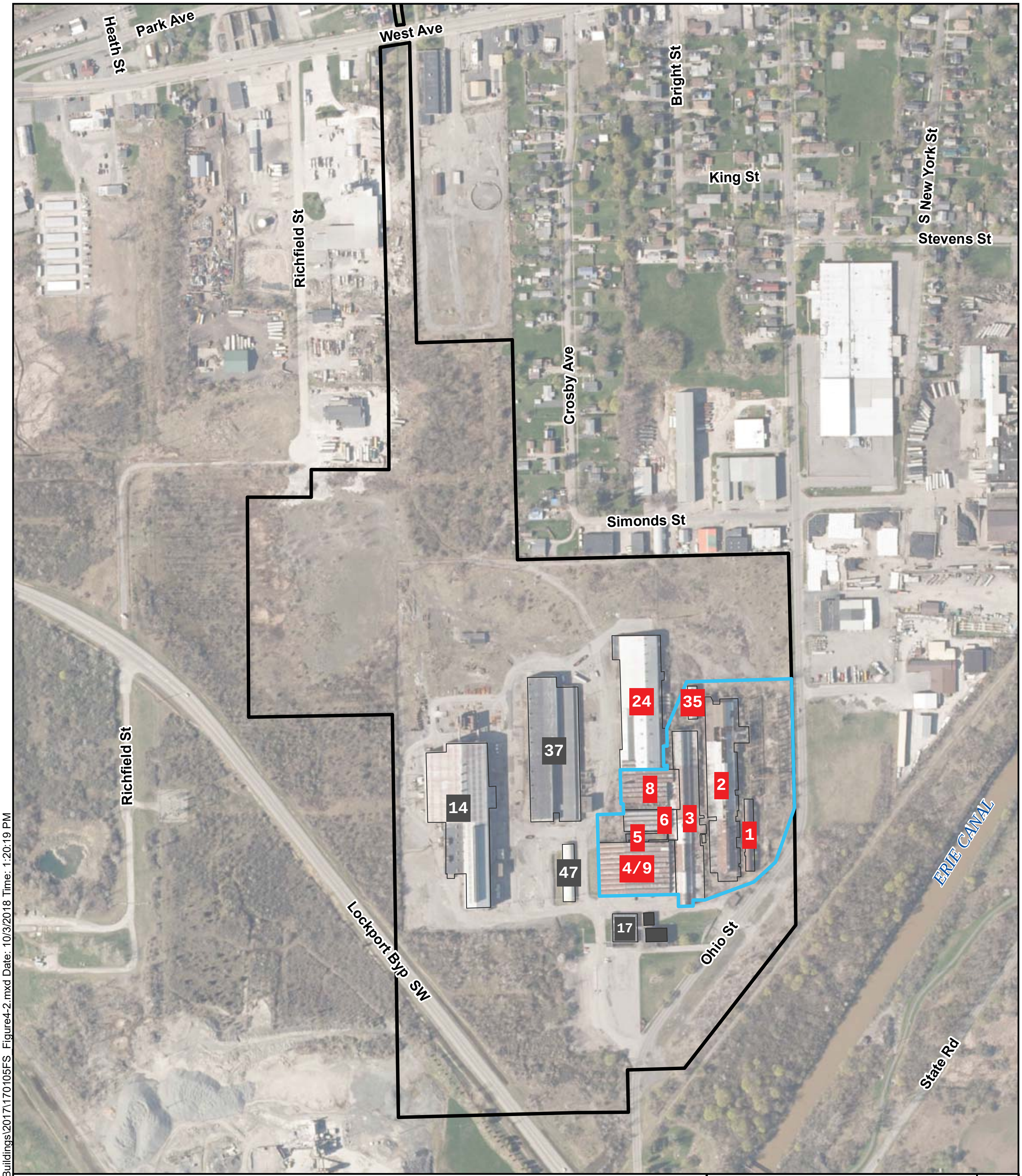
Buffalo District
BUILDING STRONG ®

BUILDING ALTERNATIVE B2
DECONTAMINATE BUILDING 1 AND
DISMANTLEMENT OF BUILDINGS 2, 3, 4/9, 5, 6,
8 AND 24 AND OFF-SITE DISPOSAL

GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NY

Date:	Scale:	Figure No. :
10/3/2018	1 inch = 450 feet	4-1

Document Path: K:\Guterl\GIS\ArcMap\Buildings\2017\170105FS_Figure4-1.mxd Date: 10/3/2018 Time: 12:00:41 PM



Legend

○ Excised Area Boundary

○ ATI Specialty Materials Boundary

○ Buildings

🟥 1 Buildings Identified for Complete Dismantlement

■ Buildings Not Addressed

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Buffalo District
BUILDING STRONG®

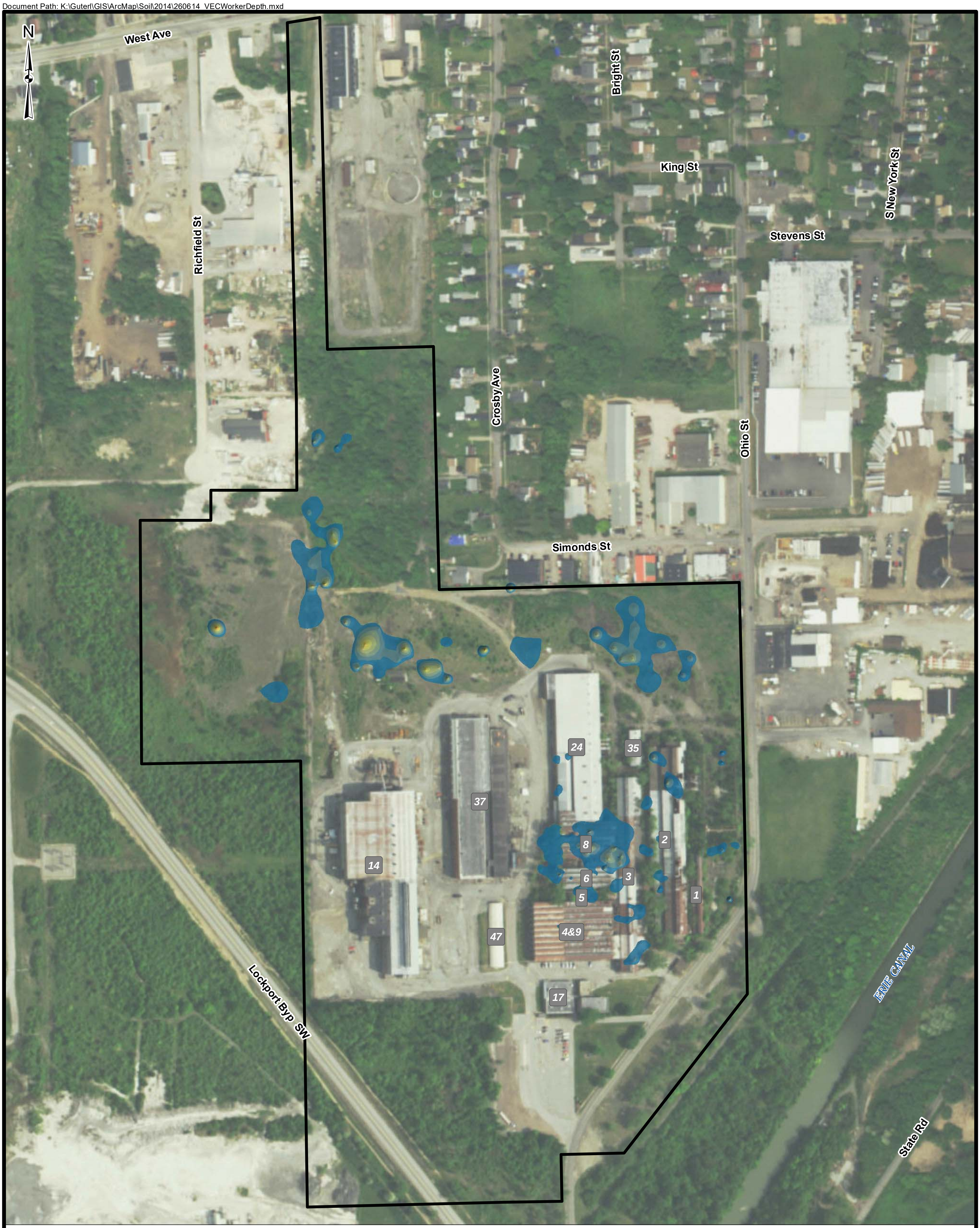
BUILDING ALTERNATIVE B3
DISMANTLEMENT OF BUILDINGS 1, 2, 3, 4/9, 5, 6, 8,
24 AND 35 AND OFF-SITE DISPOSAL

GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NY

Date:	Scale:	Figure No. :
10/3/2018	1 inch = 450 feet	4-2

Document Path: K:\Guterl\GIS\ArcMap\Buildings\2017\170105FS_Figure4-2.mxd Date: 10/3/2018 Time: 1:20:19 PM

Document Path: K:\Guterl\GIS\ArcMap\Soil\2014\260614_VECWorkerDepth.mxd



Legend

Depth of Contaminated Soils (ft bgs)

● <= 1
● 1 - 2
● 2 - 3
● 3 - 4
● 4 - 5
● 5 - 6
● 6 - 7
● 7 - 8
● 8 - 9
● > 9

○ Site Boundary

Total Volume - 5,013.1 yd³

0 150 300 600 Feet

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ALTERNATIVE S2
COMPLETE SOIL REMOVAL TO THE CONSTRUCTION WORKER PRG AND OFF-SITE DISPOSAL

Document Name: 260614_VECWorkerDepth.mxd
Drawn By: H5TDESPM
Date Saved: 15 Aug 2016
Time Saved: 2:19:07 PM

GUTERL SPECIALTY STEEL CORPORATION
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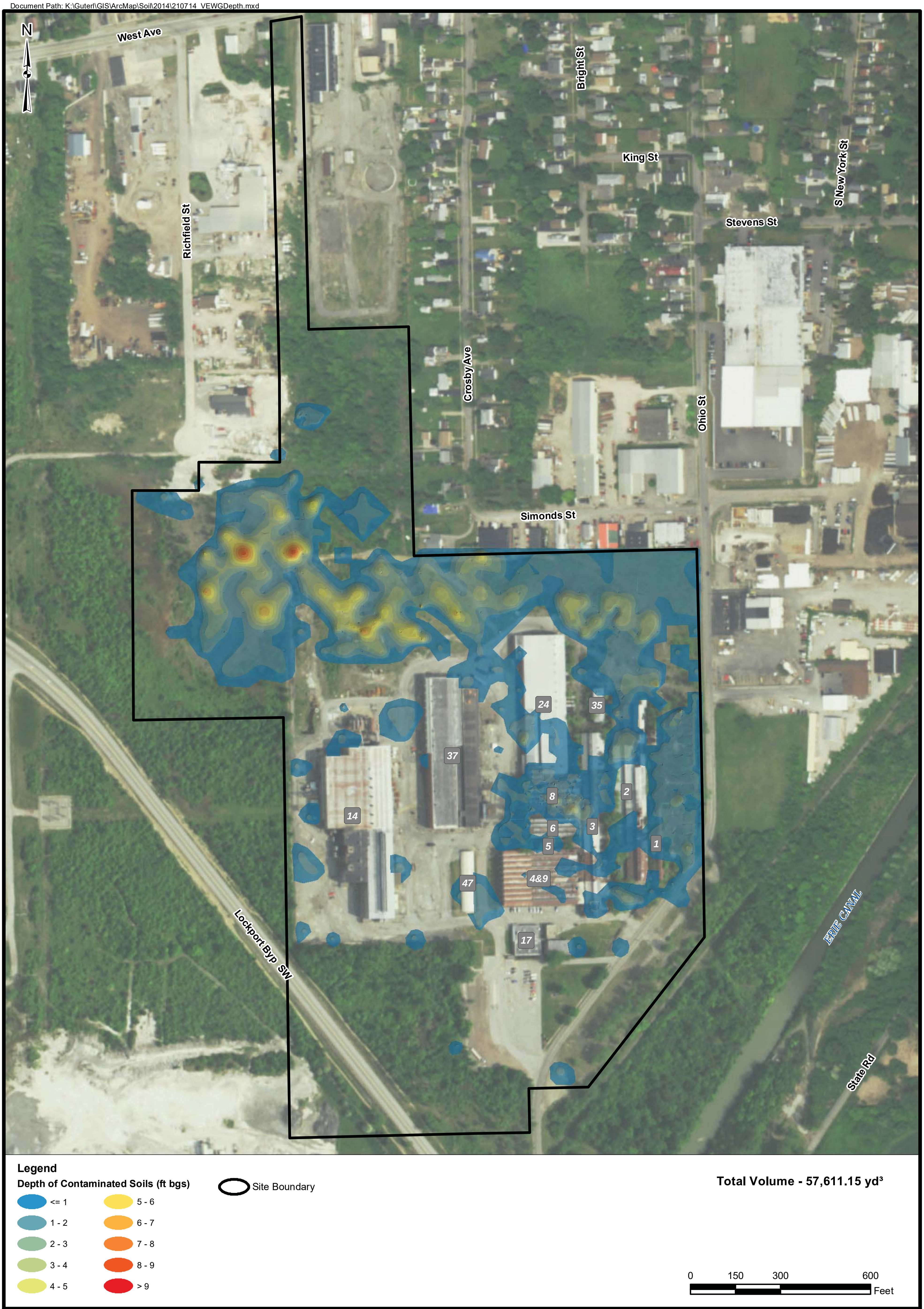
FIGURE 4-3

Document Path: K:\Guterl\GIS\ArcMap\Soil\2014\210714_VEWGDepth.mxd



Total Volume - 57,611.15 yd^3

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ALTERNATIVE S3
COMPLETE SOIL REMOVAL TO THE GROUNDWATER PROTECTION PRG AND OFF-SITE DISPOSAL

Document Name: 210714_VEWGDepth.mxd
Drawn By: H5TDESPM
Date Saved: 21 Jul 2014
Time Saved: 10:44:55 AM

GUTERL SPECIALTY STEEL CORPORATION
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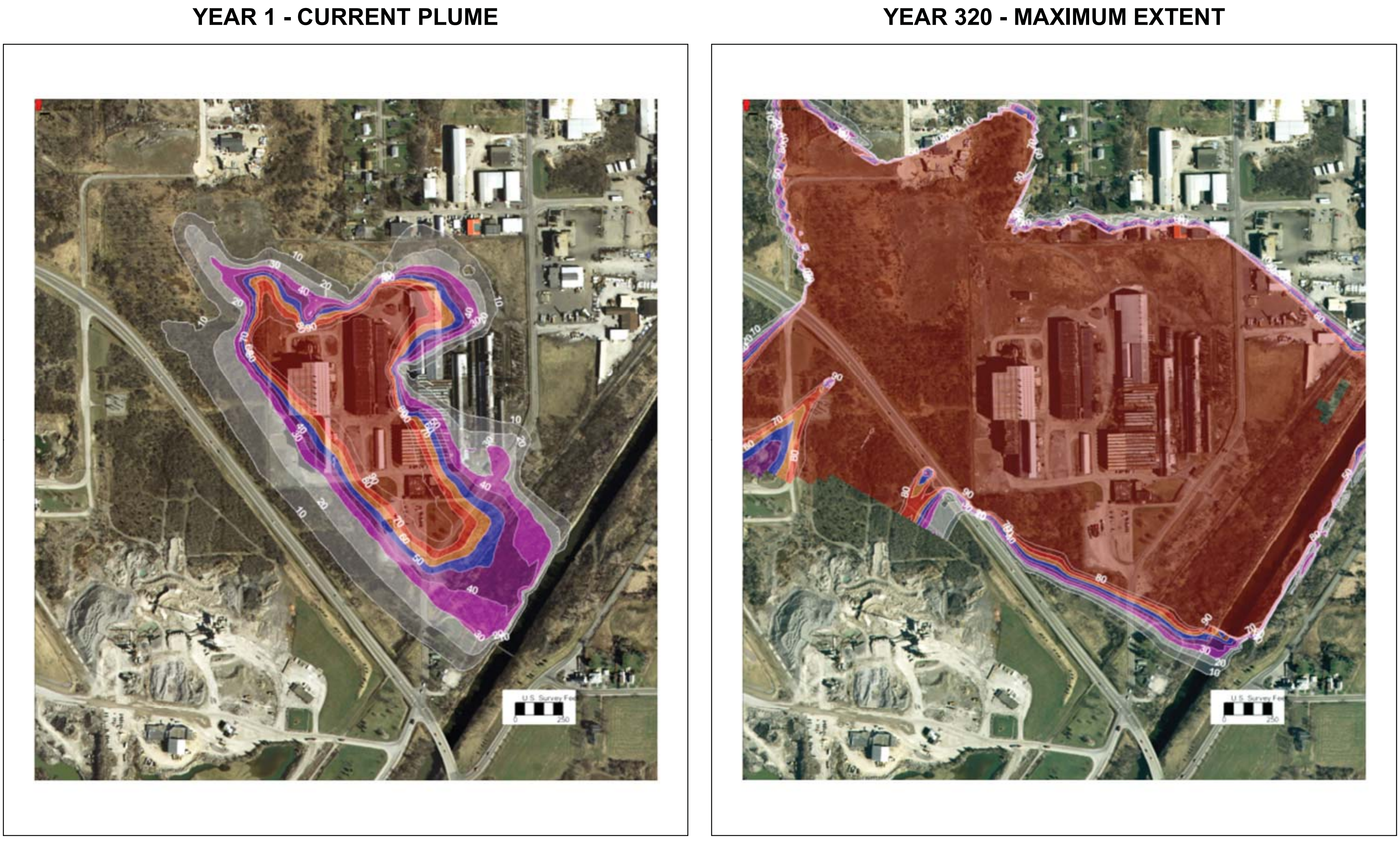
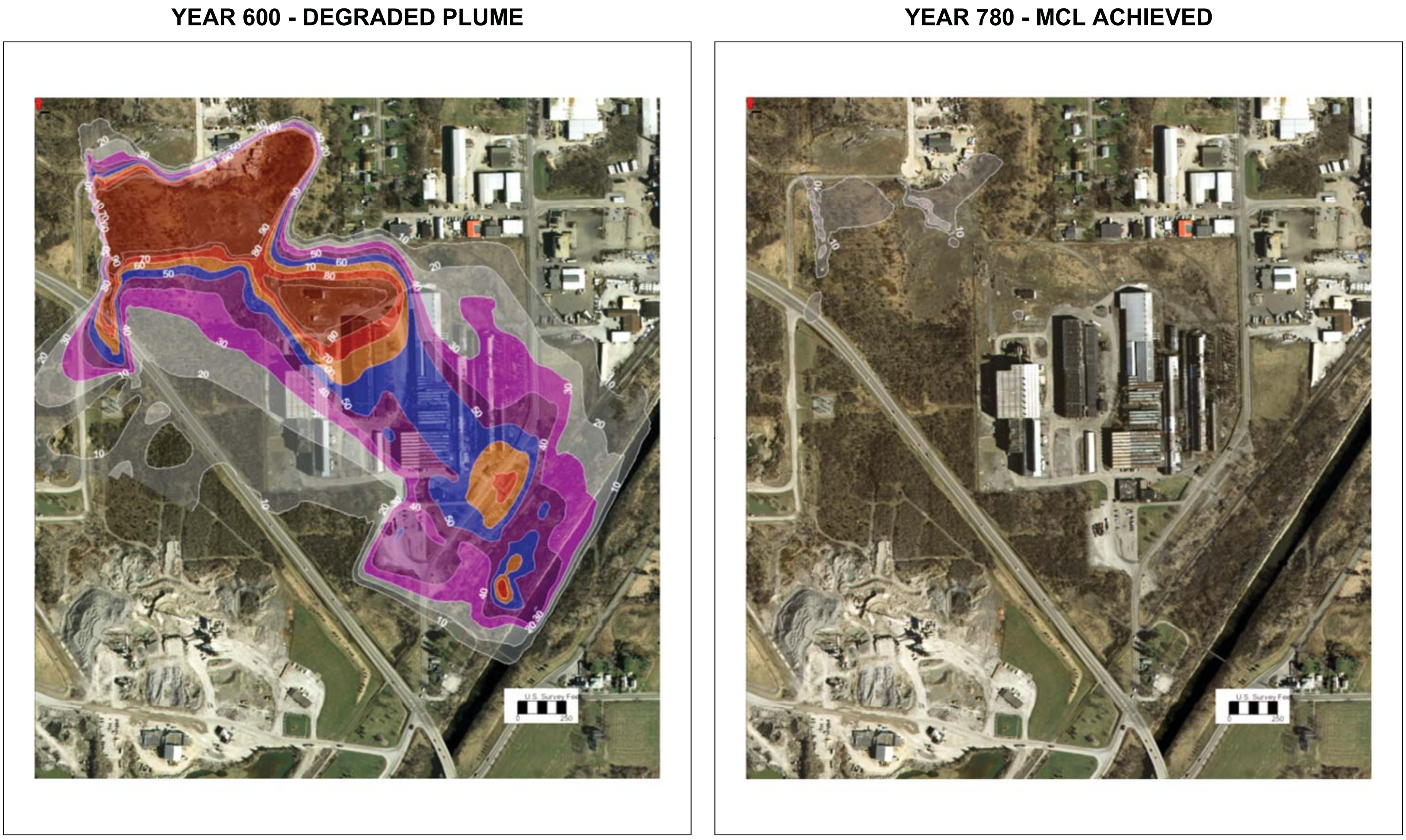
FIGURE 4-4

Document Path: K:\Guterl\GIS\ArcMap\Groundwater\2017\070620_FSFig4-5.mxd


YEAR 1 - CURRENT PLUME

YEAR 320 - MAXIMUM EXTENT


YEAR 600 - DEGRADED PLUME

YEAR 780 - MCL ACHIEVED

Legend

Uranium (ug/L) 300 180 90 60 30 10

N

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ALTERNATIVE G1
NO ACTION PLUME PREDICTION
SHALLOW AQUIFER

Document Name: 070620_FSFig4-5.mxd
Drawn By: H5TDESPM
Date Saved: 20 Jun 2017
Time Saved: 1:32:25 PM

GUTERL SPECIALTY STEEL CORPORATION
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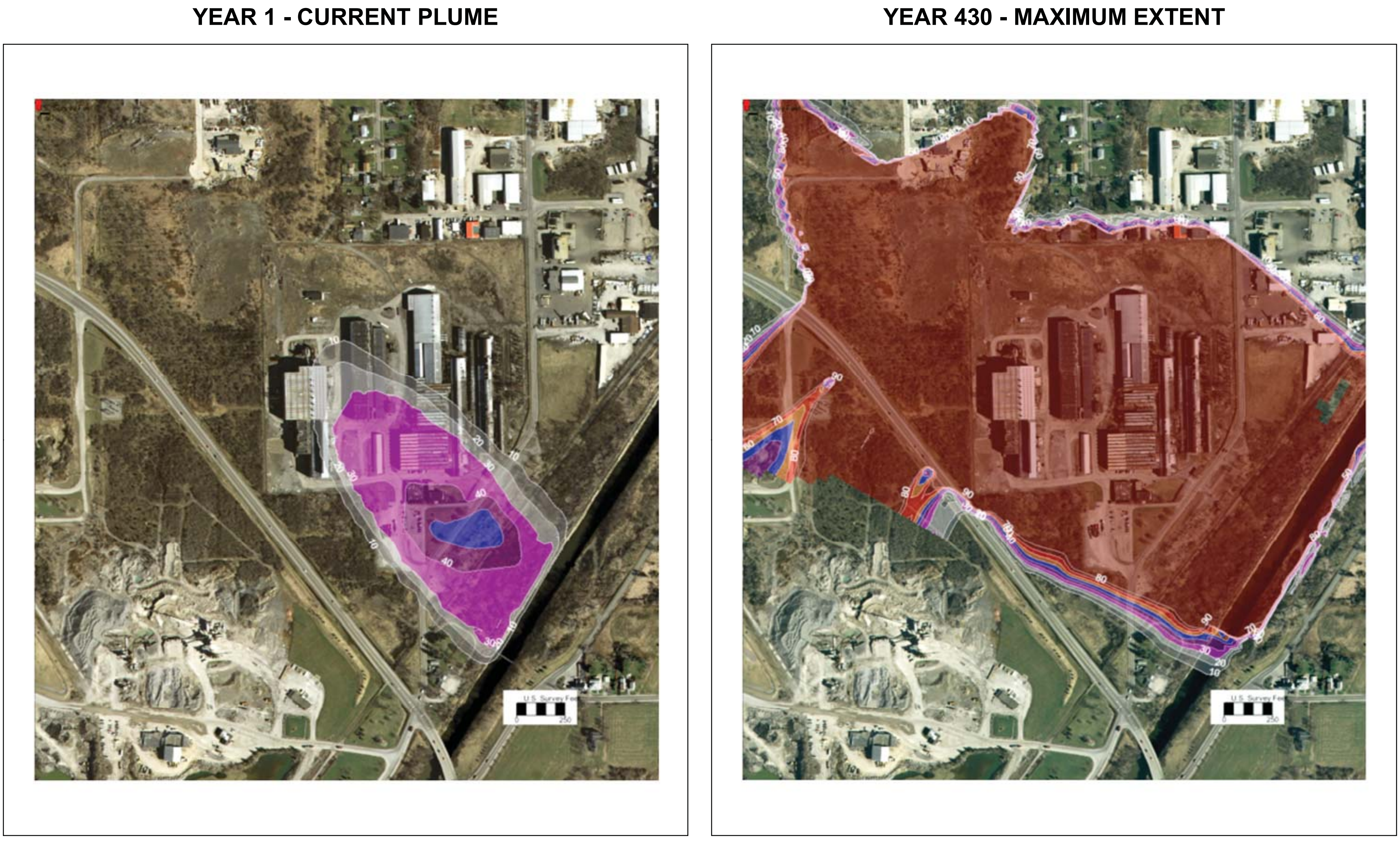
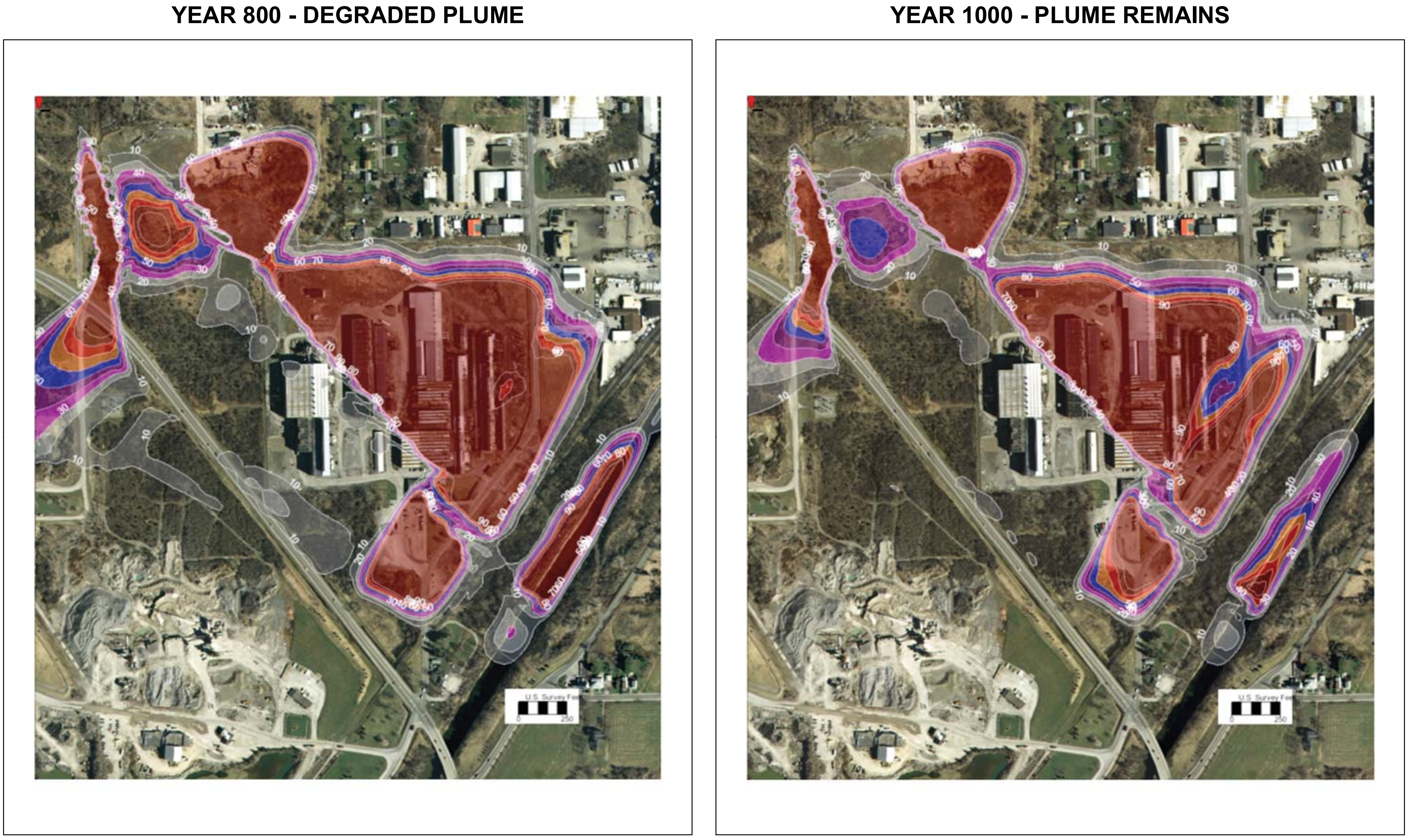
FIGURE 4-5

Document Path: K:\Guterl\GIS\ArcMap\Groundwater\2017\070620_FSFig4-6.mxd



YEAR 1 - CURRENT PLUME

YEAR 430 - MAXIMUM EXTENT



YEAR 800 - DEGRADED PLUME

YEAR 1000 - PLUME REMAINS

Legend

Uranium (ug/L) 300 180 90 60 30 10

N

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ALTERNATIVE G1
NO ACTION PLUME PREDICTION
DEEP AQUIFER

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Drawn By: H5TDESPM
Date Saved: 20 Jun 2017
Time Saved: 1:35:44 PM

GUTERL SPECIALTY STEEL CORPORATION
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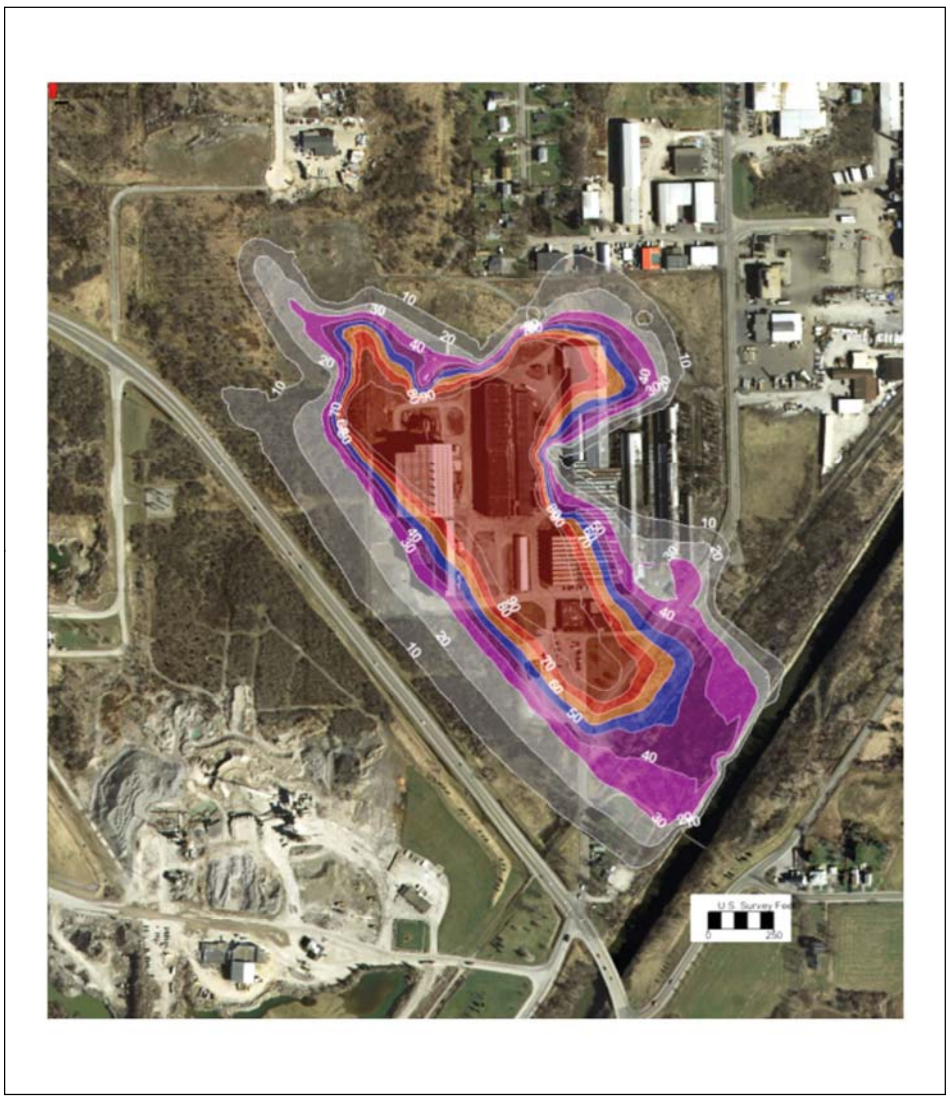
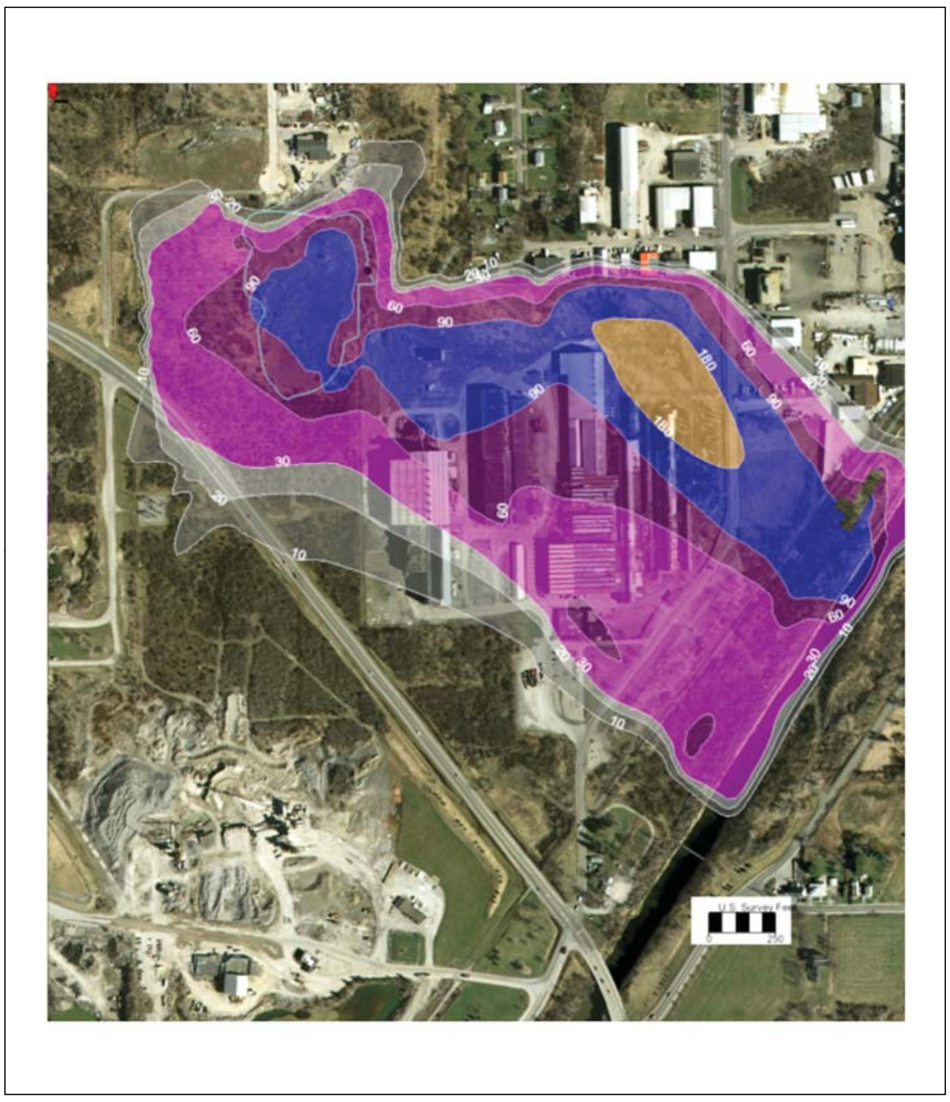
FIGURE 4-6

Document Path: K:\Guterl\GIS\ArcMap\Groundwater\2017\070620_FSFig4-7.mxd

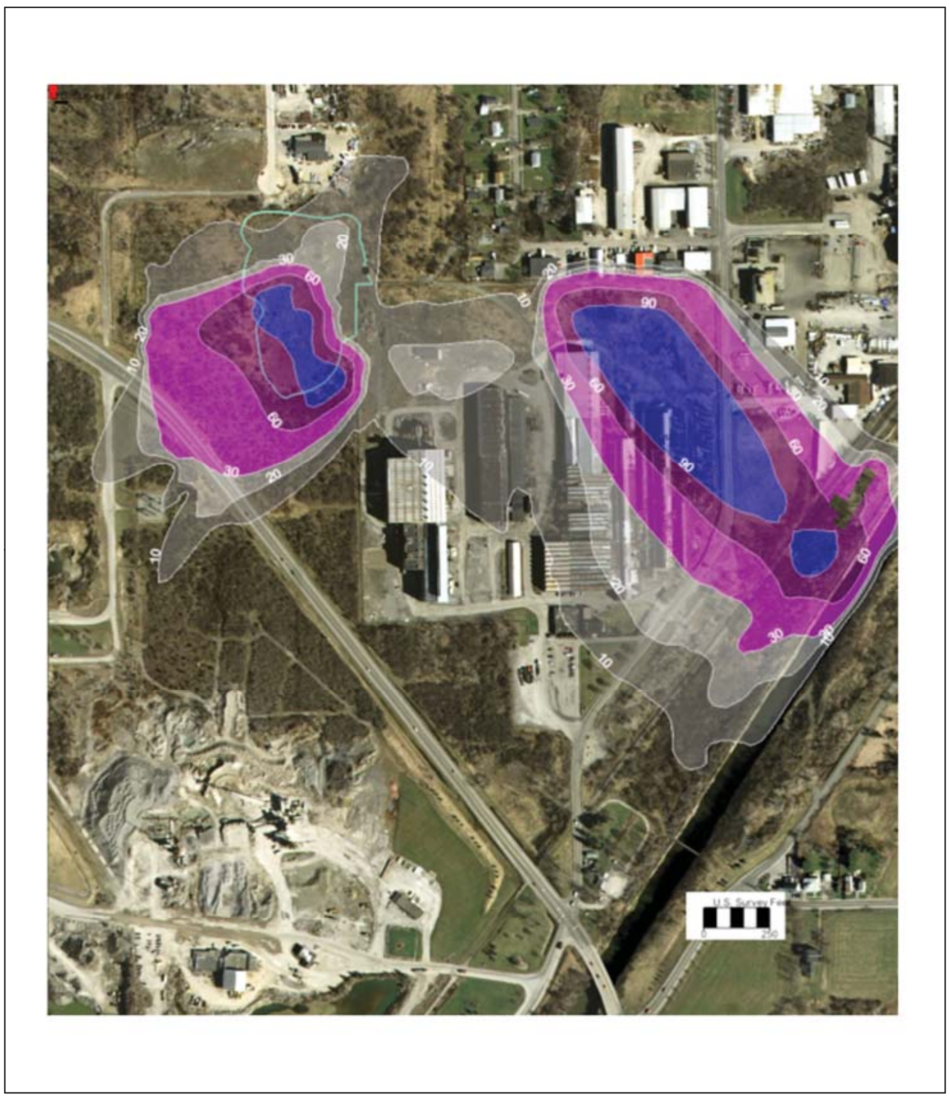
YEAR 1 - CURRENT PLUME



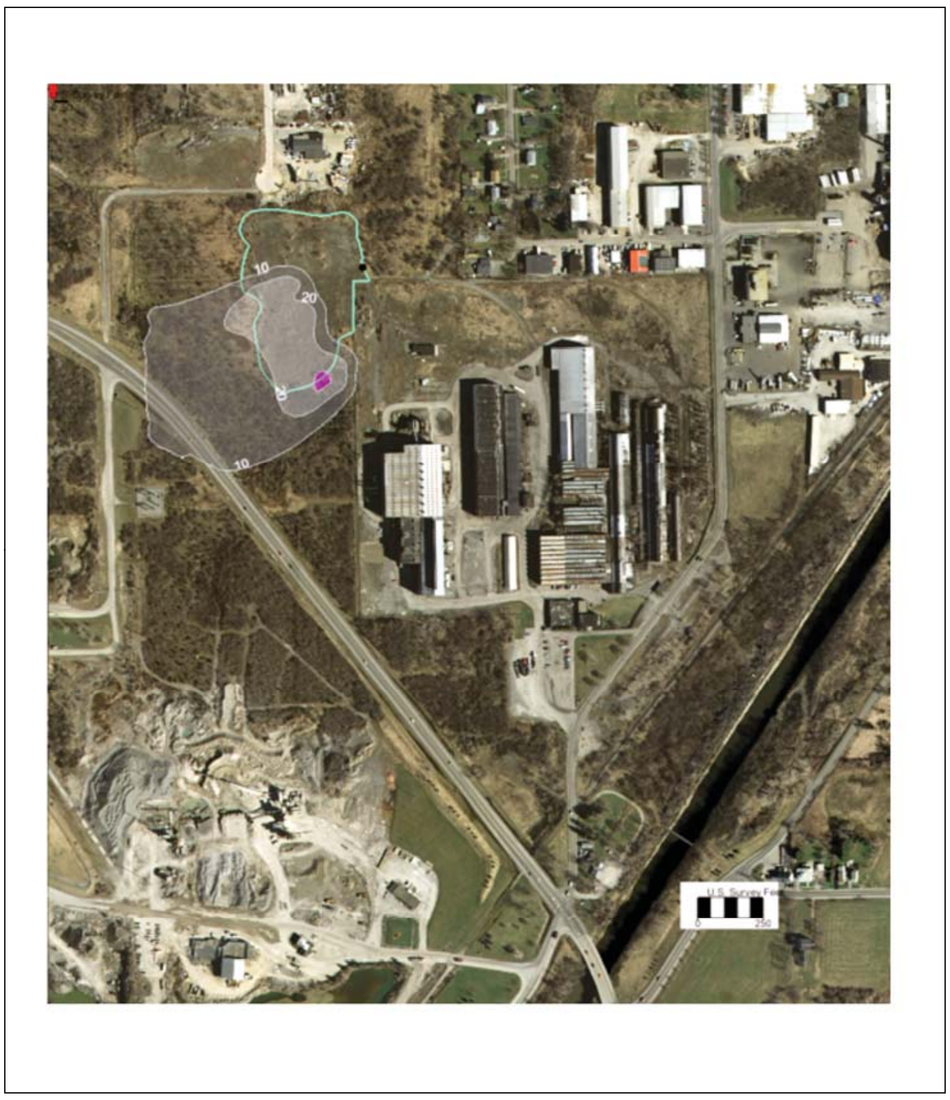
YEAR 50 - MAXIMUM EXTENT



YEAR 200 - DEGRADED PLUME



YEAR 430 - MCL ACHIEVED



Legend

Uranium (µg/L) 300 180 90 60 30 10

N

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ALTERNATIVE G2
CONSTRUCTION WORKER PRG AND MNA
SHALLOW AQUIFER

Document Name: 070620_FSFig4-7.mxd
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GUTERL SPECIALTY STEEL CORPORATION
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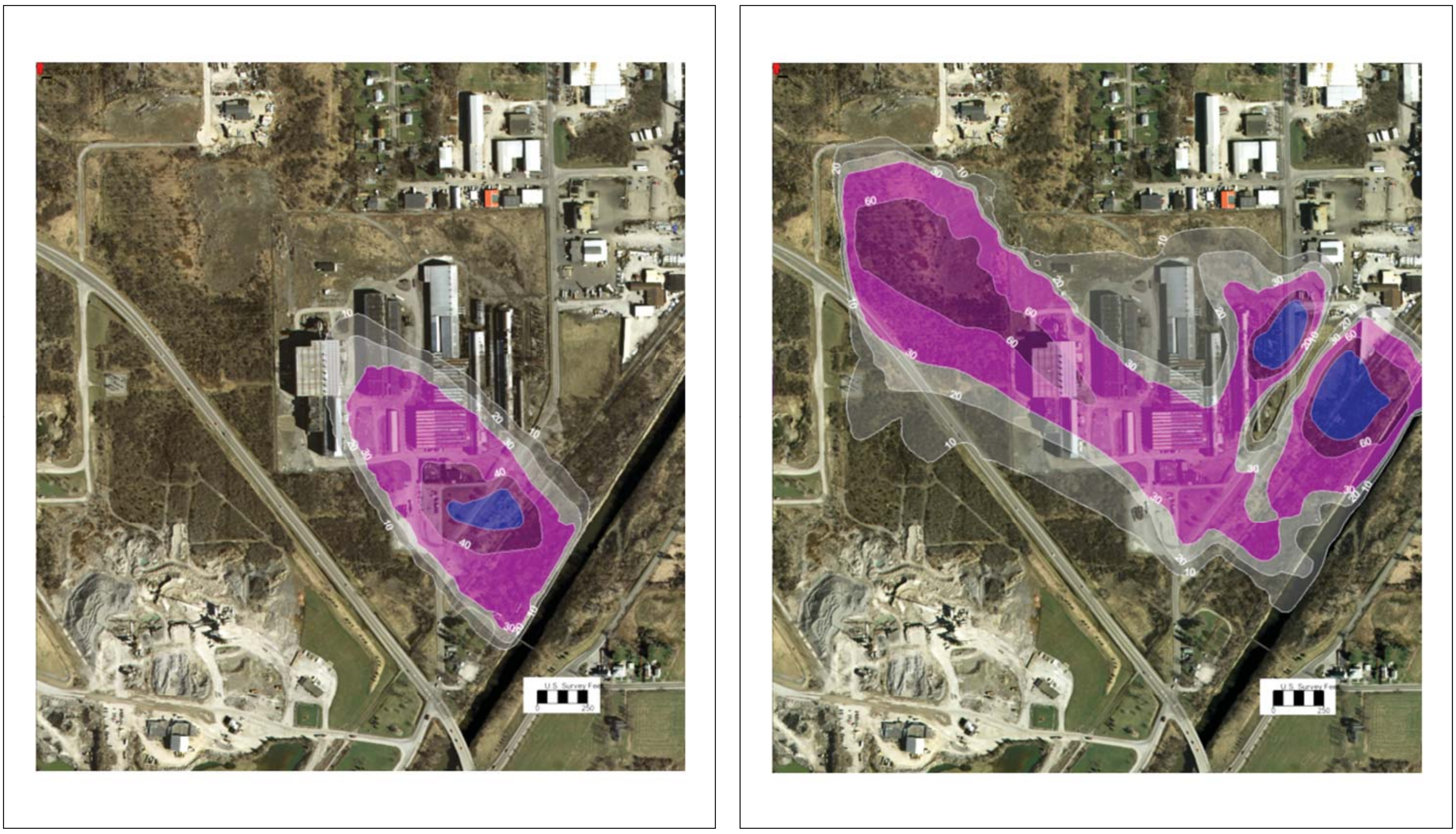
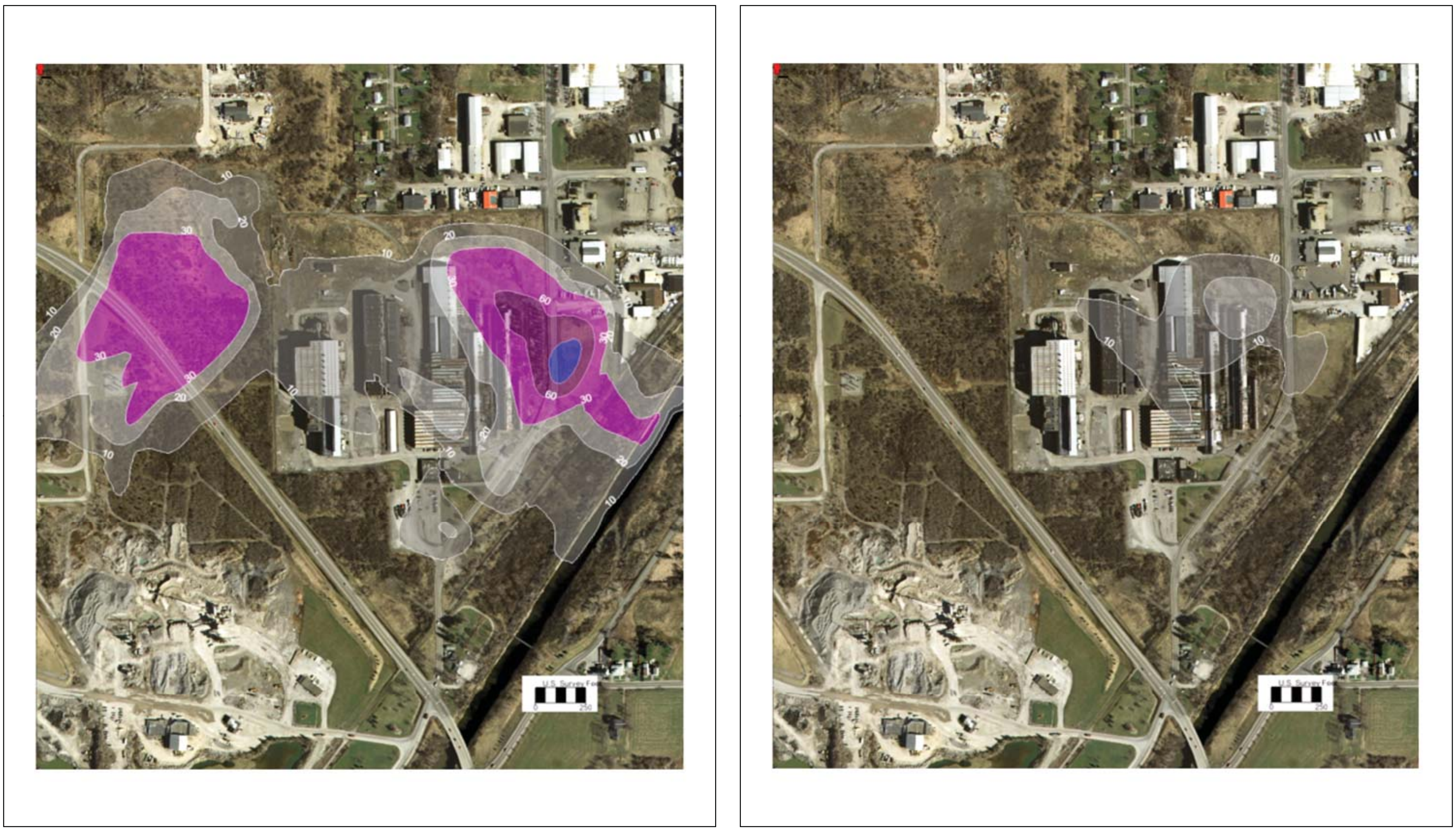
FIGURE 4-7

Document Path: K:\Guterl\GIS\ArcMap\Groundwater\2017\070620_FSFig4-8.mxd



YEAR 1 - CURRENT PLUME

YEAR 100 - MAXIMUM EXTENT



YEAR 300 - DEGRADED PLUME

YEAR 660 - MCL ACHIEVED

Legend

Uranium (µg/L) 300 180 90 60 30 10

N

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ALTERNATIVE G2
CONSTRUCTION WORKER PRG AND MNA
DEEP AQUIFER

Document Name: 070620_FSFig4-8.mxd
Drawn By: H5TDESPM
Date Saved: 20 Jun 2017
Time Saved: 1:47:58 PM

GUTERL SPECIALTY STEEL CORPORATION
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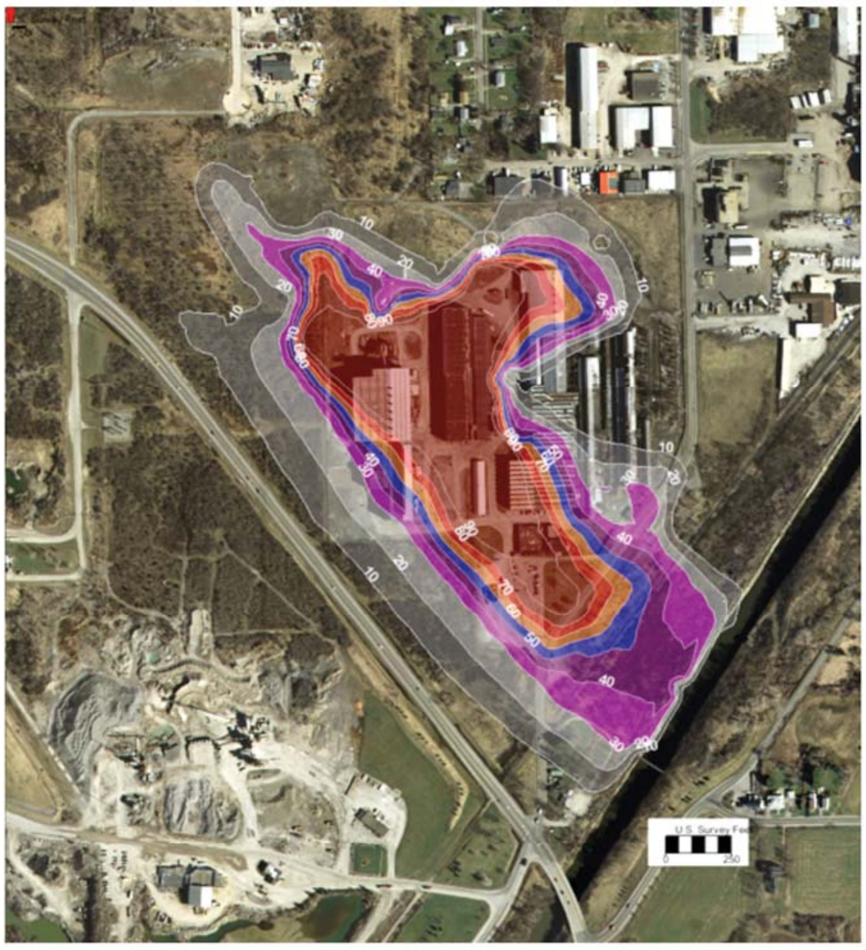
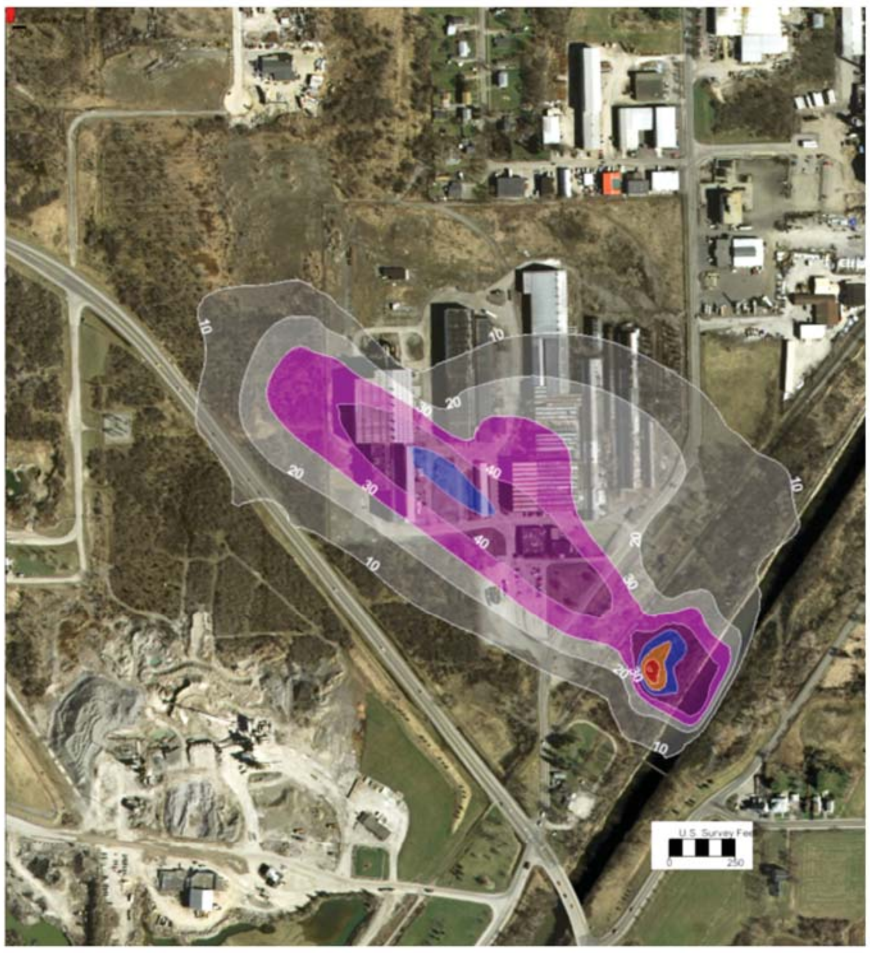
FIGURE 4-8

Document Path: K:\Guterl\GIS\ArcMap\Groundwater\2017\070620_FSFig4-9.mxd

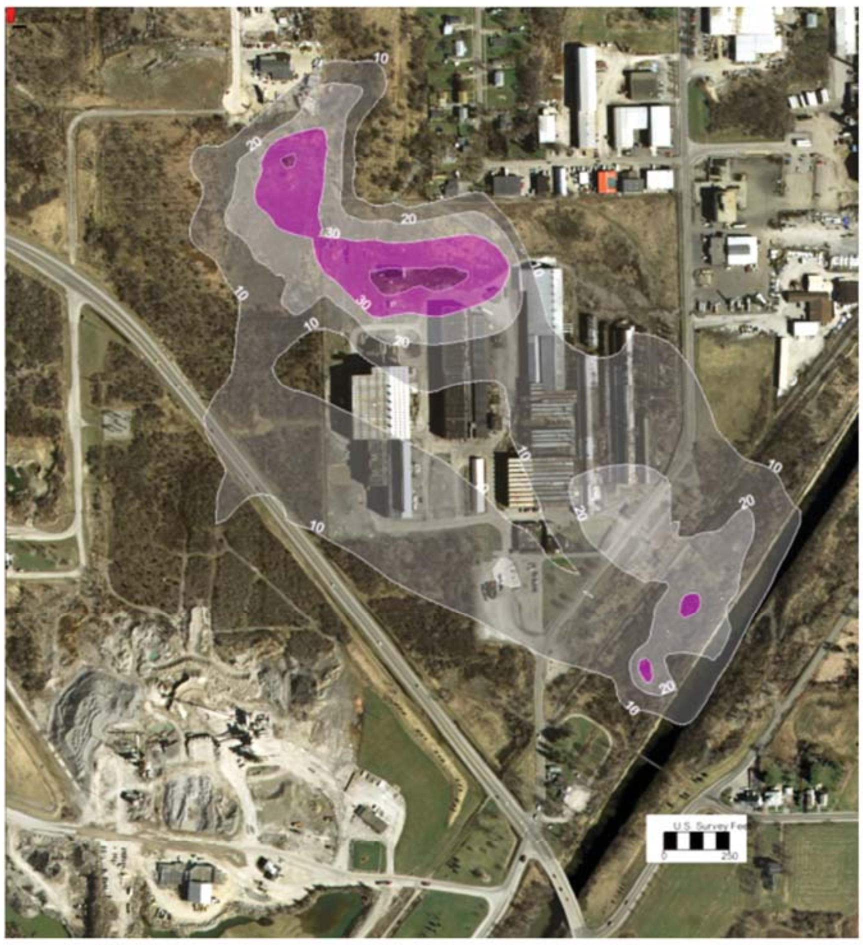
YEAR 1 - CURRENT PLUME



YEAR 10 - DEGRADED PLUME



YEAR 20 - DEGRADED PLUME



YEAR 50 - MCL ACHIEVED

Legend

Uranium (µg/L) 300 180 90 60 30 10

N

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ALTERNATIVE G3
GROUNDWATER PROTECTION PRG AND MNA
SHALLOW AQUIFER

Document Name: 070620_FSFig4-9.mxd
Drawn By: H5TDESPM
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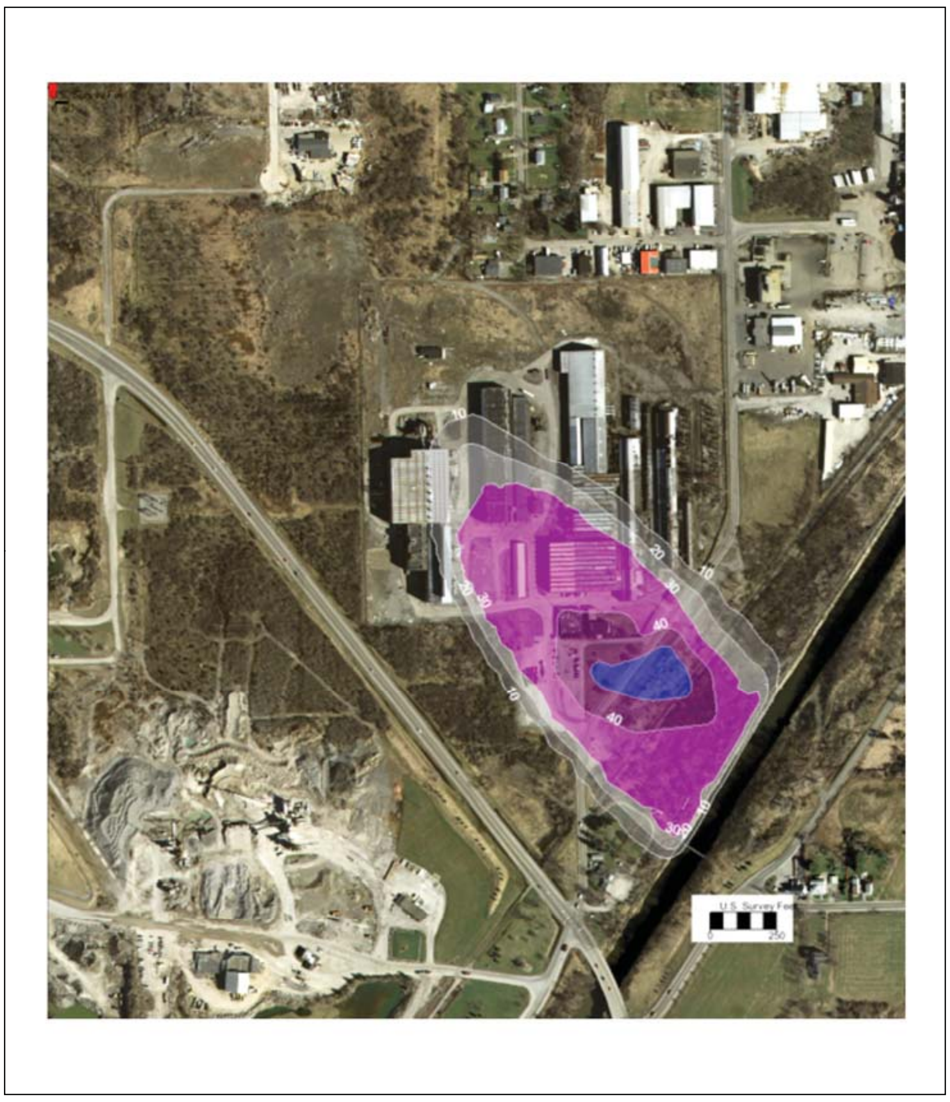
Time Saved: 1:52:32 PM

GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NEW YORK

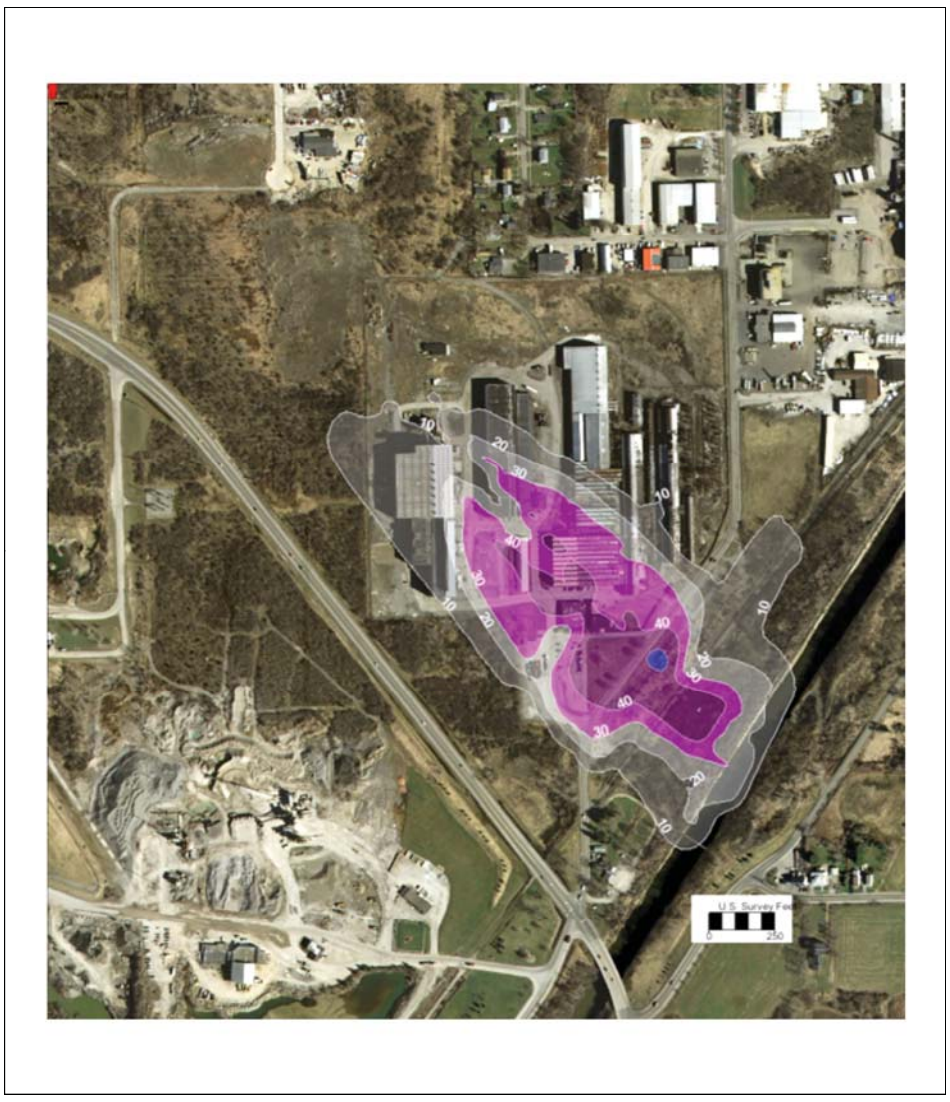
FIGURE 4-9

Document Path: K:\Guterl\GIS\ArcMap\Groundwater\2017\070620_FSFig4-10.mxd

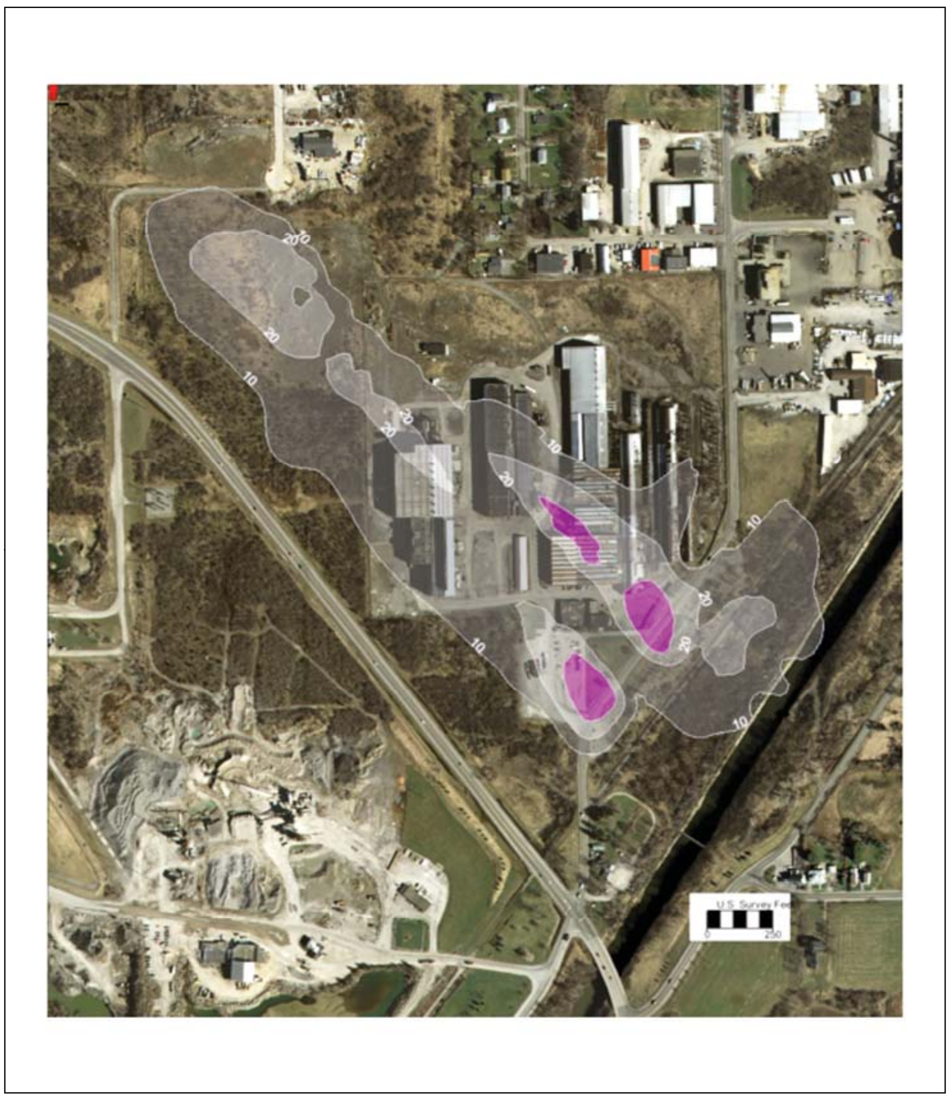
YEAR 1 - CURRENT PLUME



YEAR 10 - DEGRADED PLUME



YEAR 60 - DEGRADED PLUME



YEAR 120 - MCL ACHIEVED

Legend

Uranium (µg/L) 300 180 90 60 30 10

N

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ALTERNATIVE G3
GROUNDWATER PROTECTION PRG AND MNA
DEEP AQUIFER

Document Name: 070620_FSFig4-10.mxd
Drawn By: H5TDESPM
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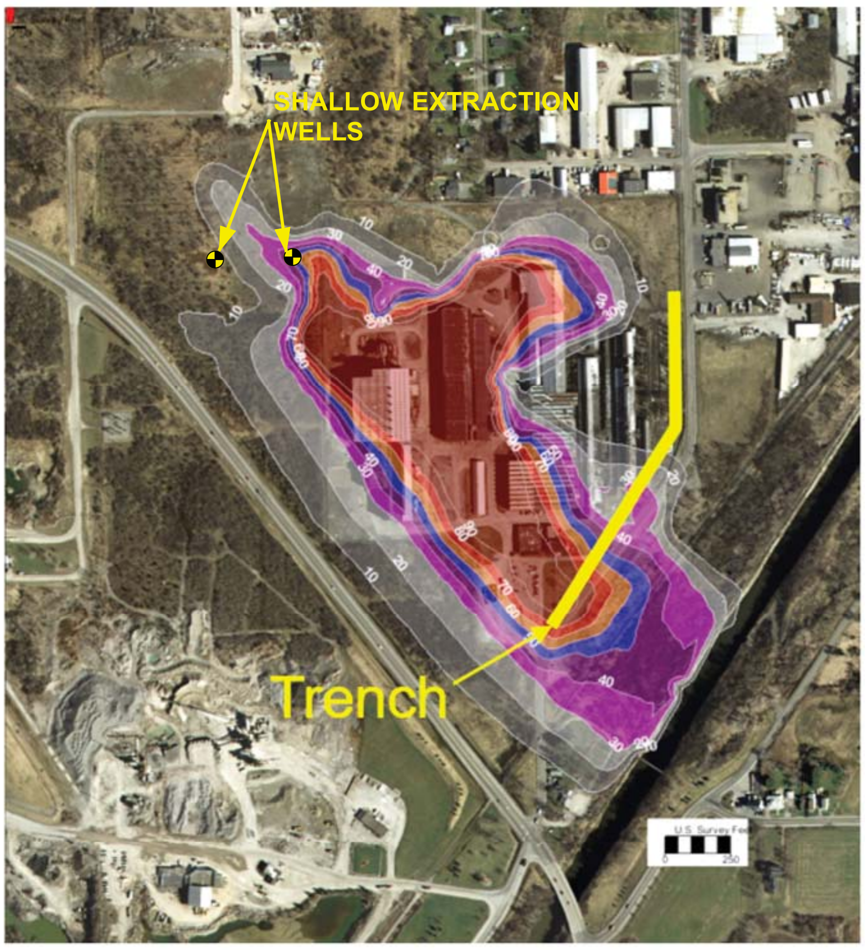
Time Saved: 1:54:44 PM

GUTERL SPECIALTY STEEL CORPORATION
LOCKPORT, NEW YORK

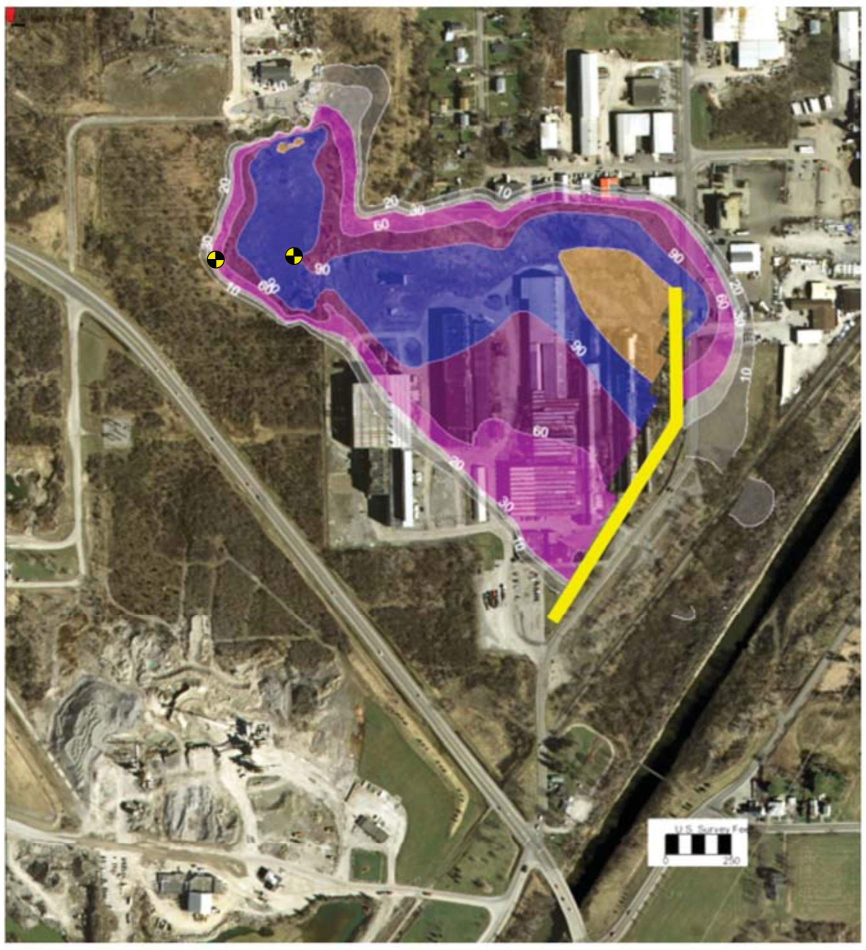
FIGURE 4-10

Document Path: K:\Guterl\GIS\ArcMap\Groundwater\2017\070620_FSFig4-11.mxd

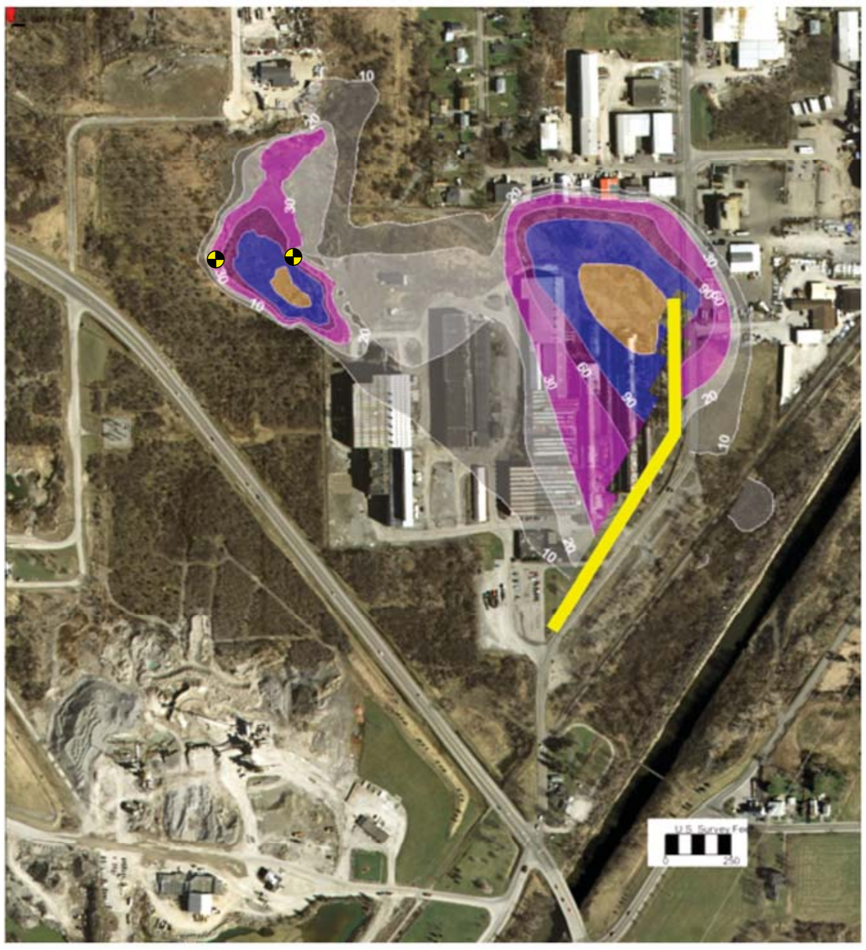
YEAR 1 - CURRENT PLUME



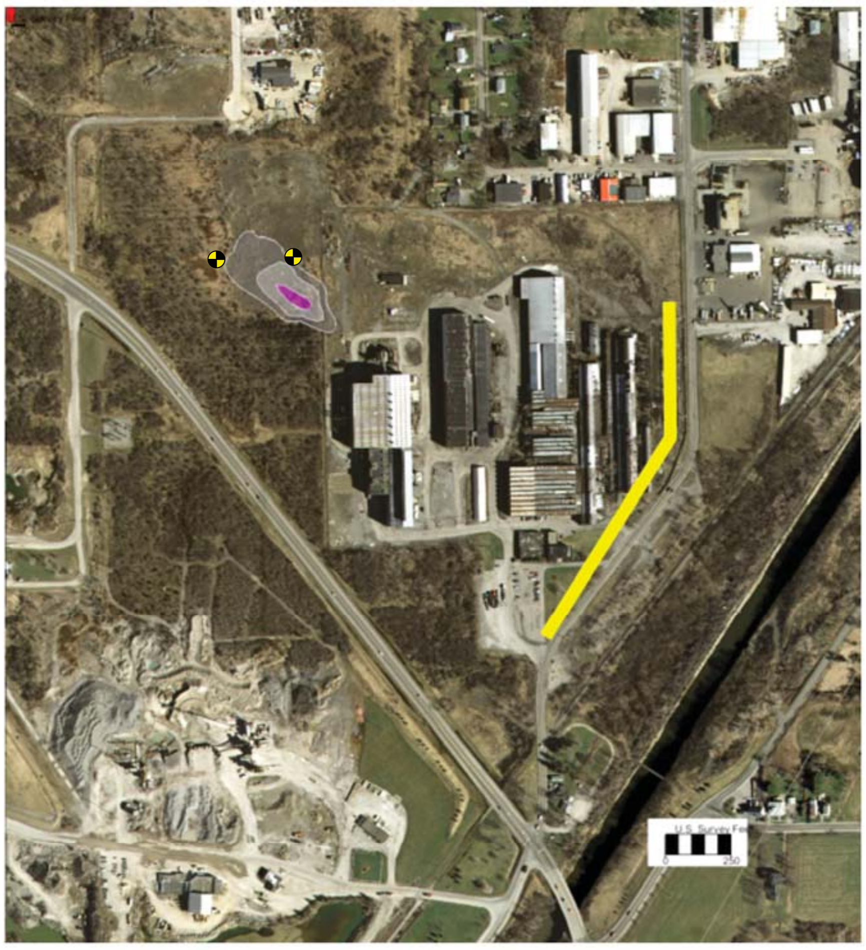
YEAR 40 - MAXIMUM EXTENT



YEAR 160 - DEGRADED PLUME



YEAR 500 - MCL ACHIEVED



Legend

Uranium (µg/L) 300 180 90 60 30 10

● Extraction Well

▬ Rubblized Trench

N

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CORPS OF ENGINEERS
BUFFALO, NY

ALTERNATIVE G4
CONSTRUCTION WORKER PRG, RUBBLIZED TRENCH AND EXTRACTION WELLS
SHALLOW AQUIFER

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FIGURE 4-11

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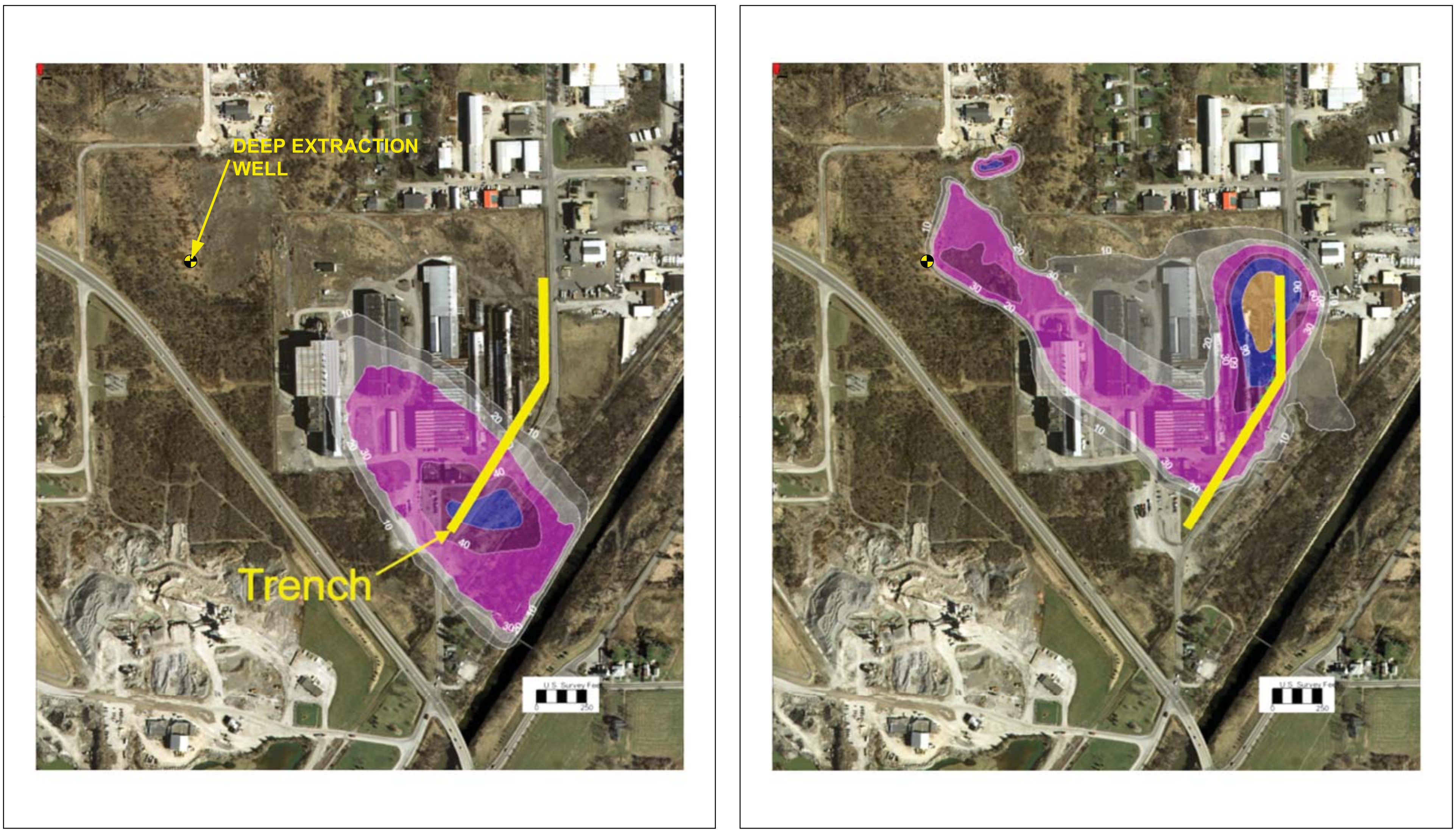
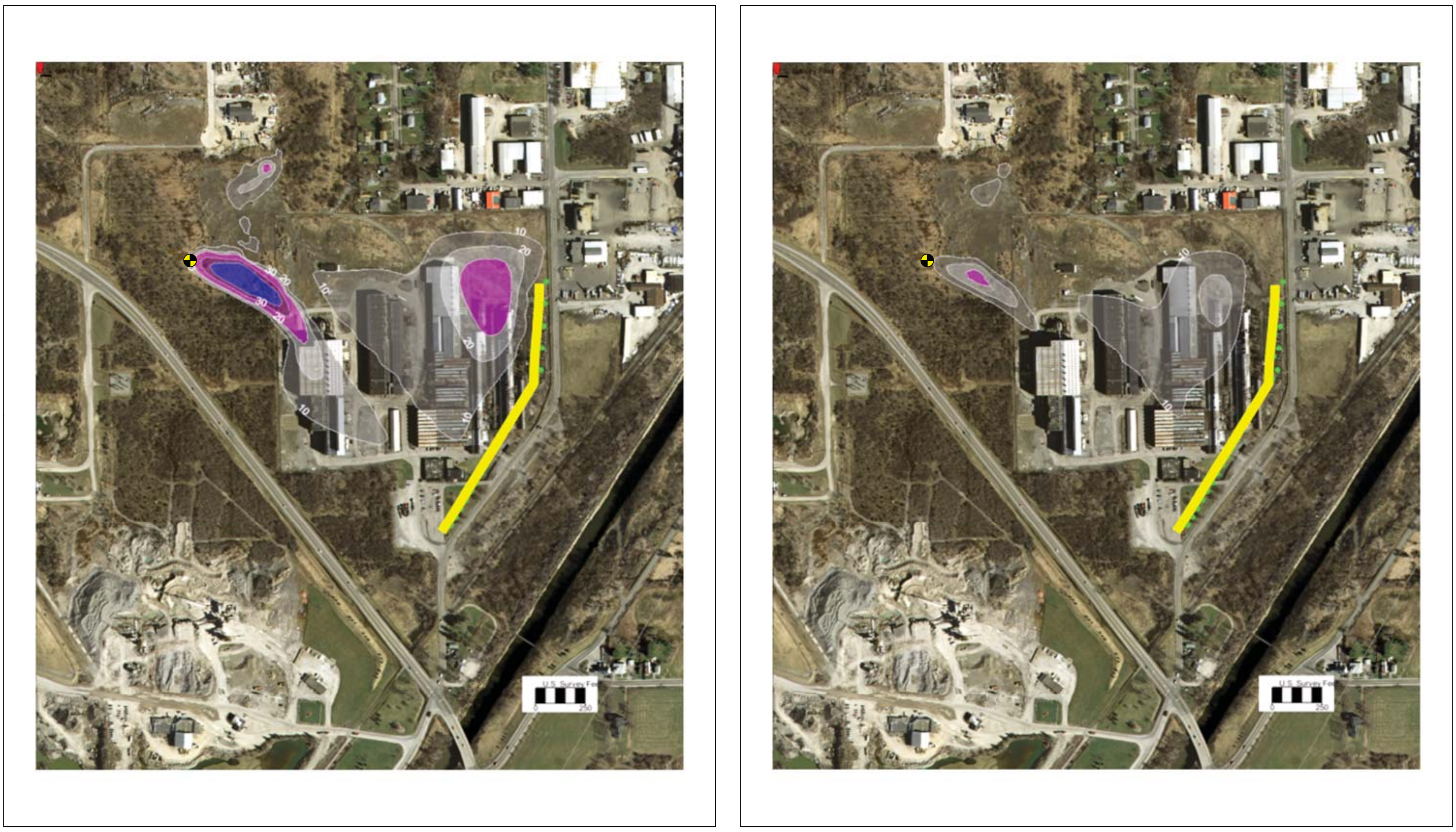

YEAR 1 - CURRENT PLUME

YEAR 100 - MAXIMUM EXTENT


YEAR 400 - DEGRADED PLUME

YEAR 580 - MCL ACHIEVED

Legend

Uranium (µg/L) 300 180 90 60 30 10

● Extraction Well

▬ Rubblized Trench

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CONSTRUCTION WORKER PRG, RUBBLIZED TRENCH AND EXTRACTION WELLS
DEEP AQUIFER

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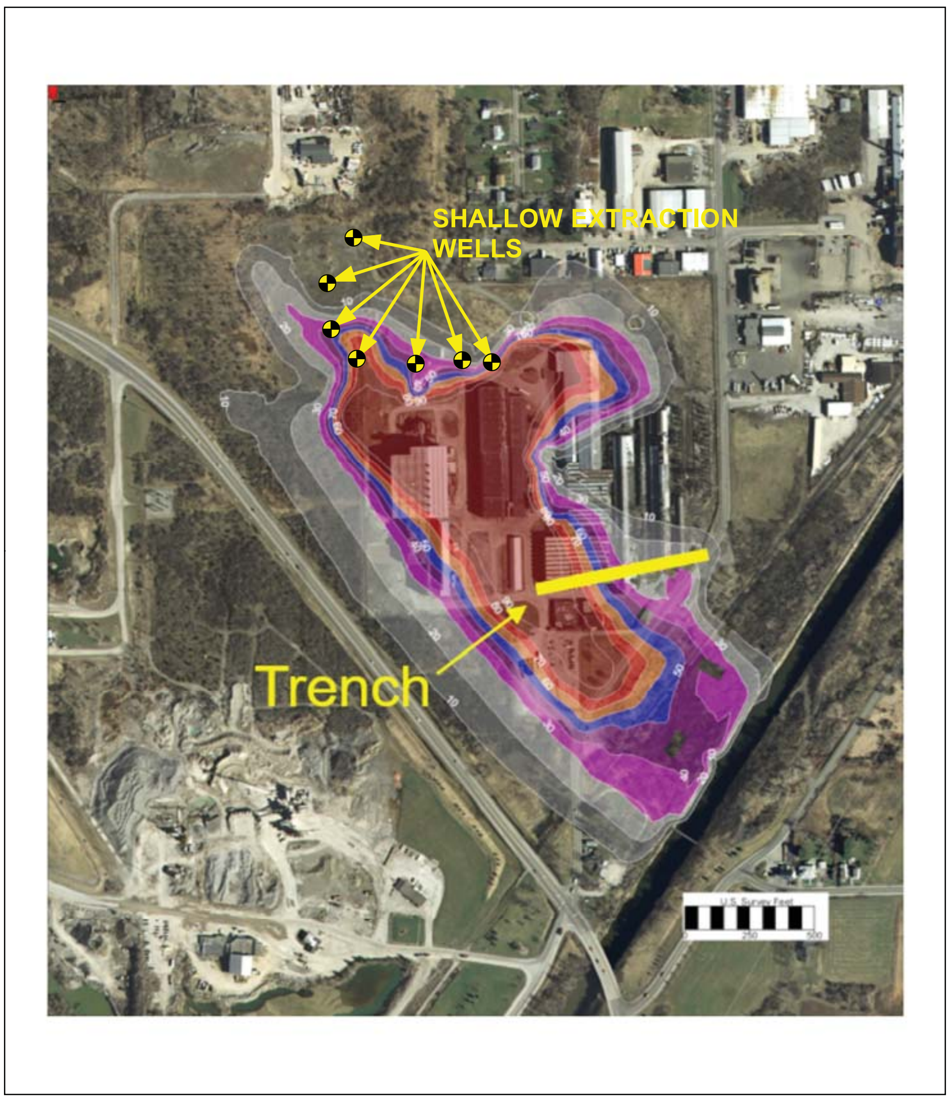
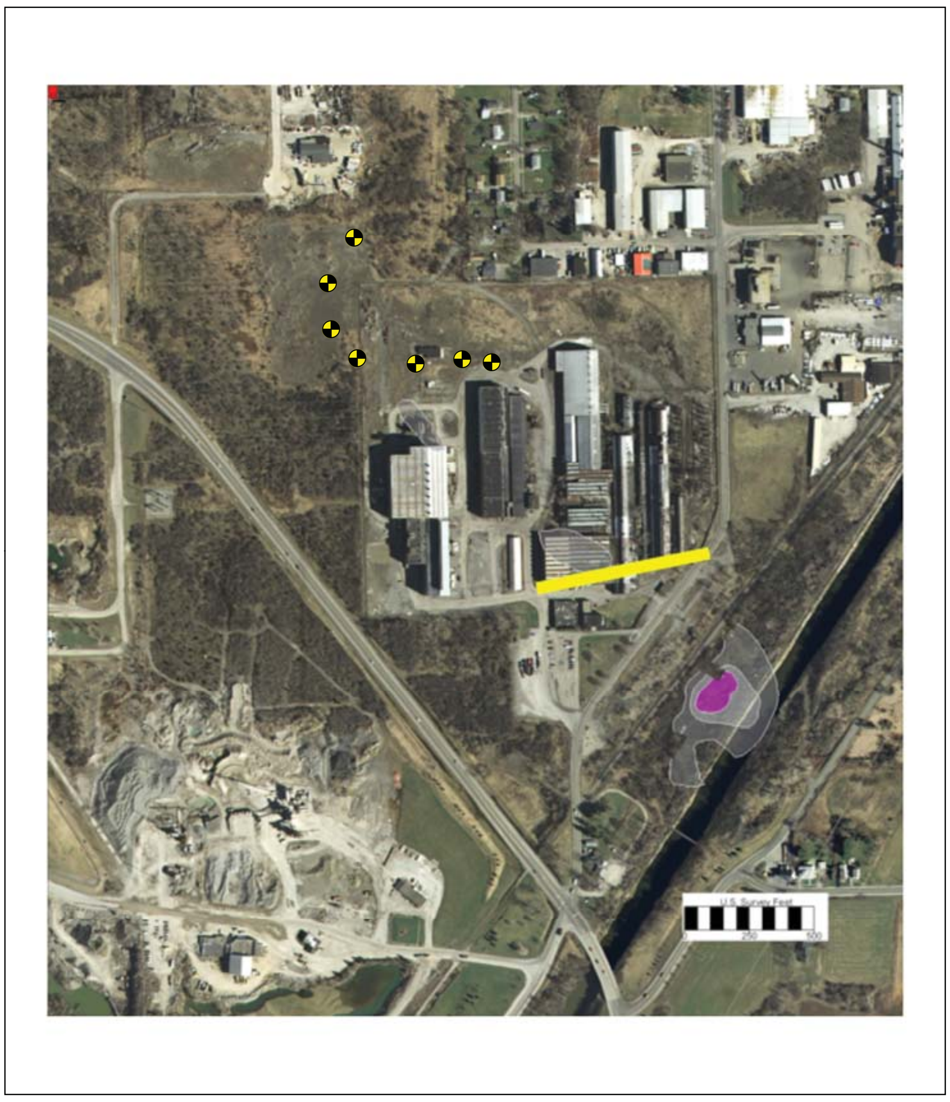
FIGURE 4-12

Document Path: K:\Guterl\GIS\ArcMap\Groundwater\2017\070620_FSFig4-13.mxd

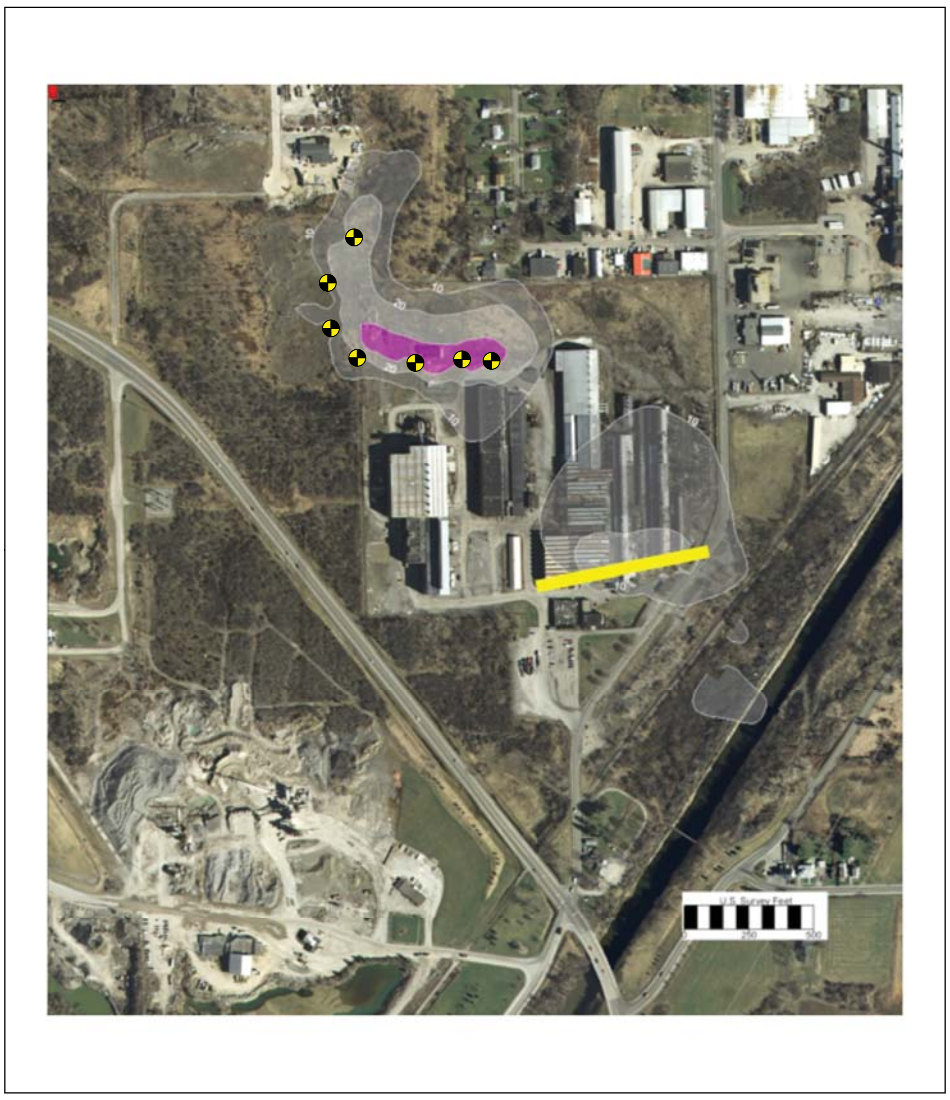
YEAR 1 - CURRENT PLUME



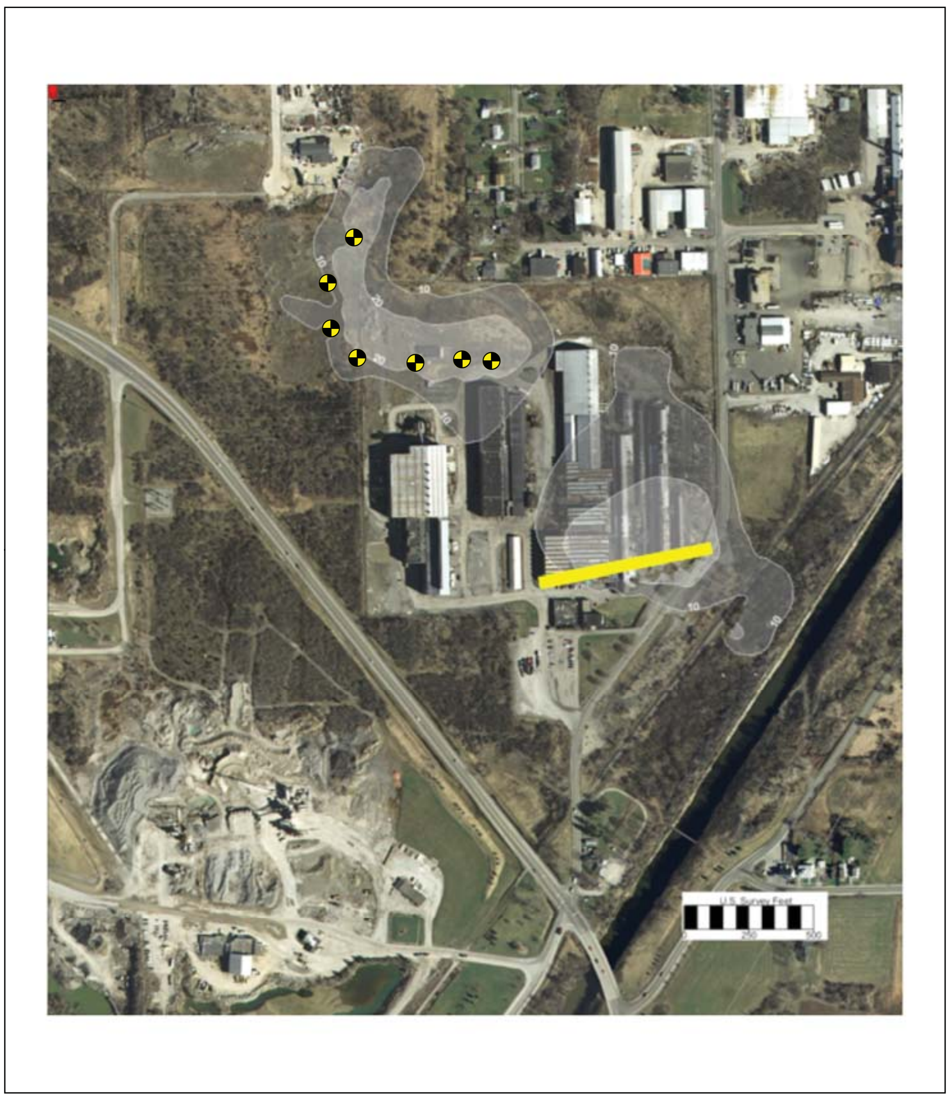
YEAR 10 - DEGRADED PLUME



YEAR 20 - DEGRADED PLUME



YEAR 30 - MCL ACHIEVED



Legend

Uranium (ug/L) 300 180 90 60 30 10

● Extraction Well

▬ Rubblized Trench

N

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ALTERNATIVE G5
GROUNDWATER PROTECTION PRG, RUBBLIZED TRENCH AND EXTRACTION WELLS
SHALLOW AQUIFER

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FIGURE 4-13

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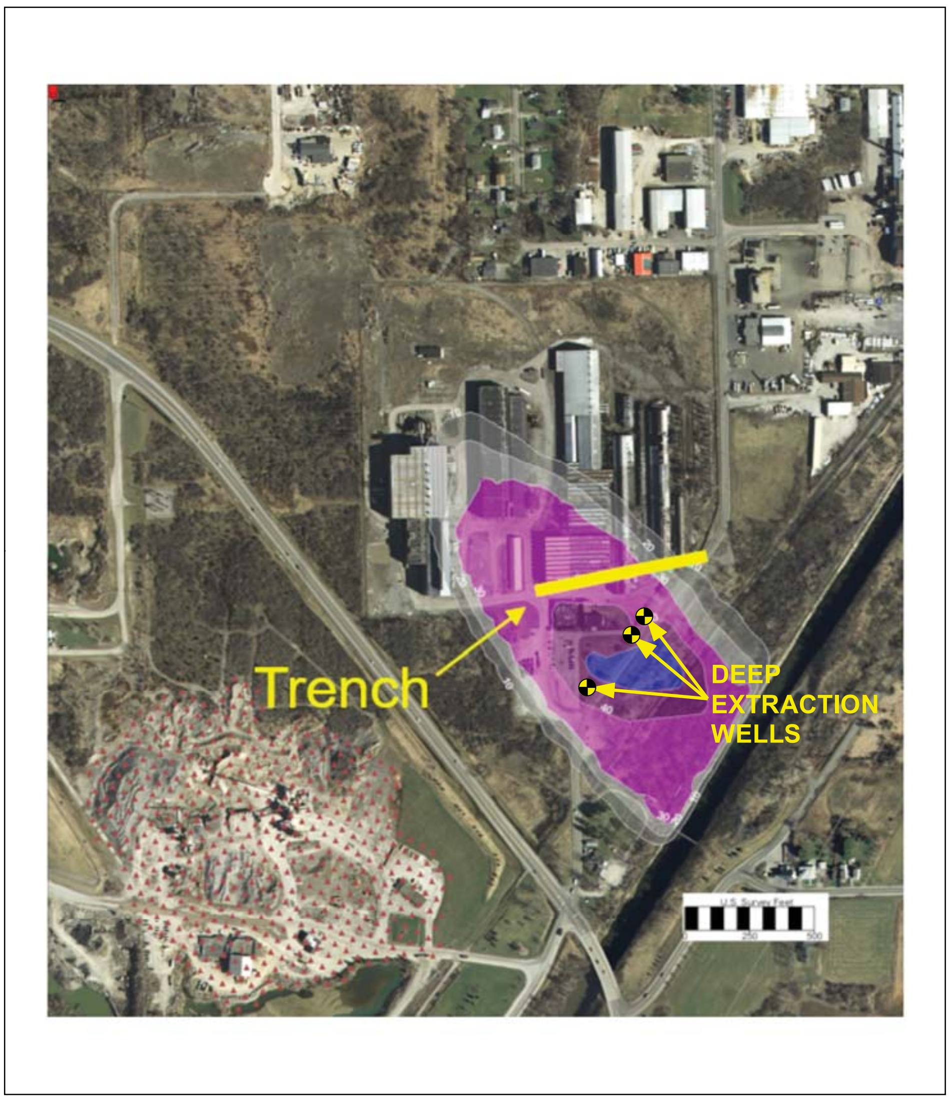
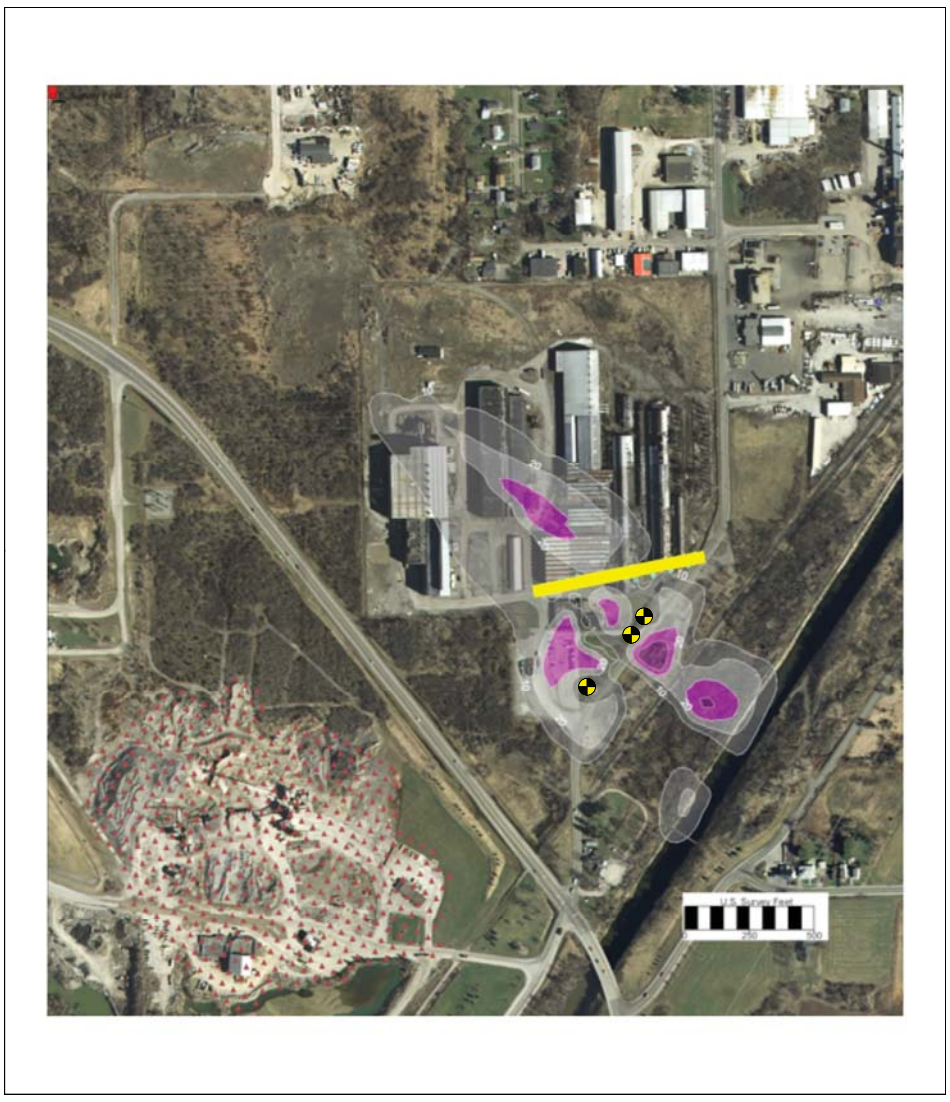
YEAR 1 - CURRENT PLUME



YEAR 10 - DEGRADED PLUME



YEAR 20 - DEGRADED PLUME

YEAR 30 - MCL ACHIEVED

Legend

Uranium (µg/L) 300 180 90 60 30 10

● Extraction Well

▬ Rubblized Trench

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ALTERNATIVE G5
GROUNDWATER PROTECTION PRG, RUBBLIZED TRENCH AND EXTRACTION WELLS
DEEP AQUIFER

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FIGURE 4-14