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FINAL FOCUSED FEASIBILITY STUDY FOR SITE 5, SITE 9 AND SITE 21 NSTC GREAT LAKES IL

10/1/2013

TETRA TECH

Focused Feasibility Study

for

Site 5 - Transformer Storage Boneyard, Site 9 - Camp Moffett Ravine Fill Area, and Site 21 - Buildings 1517/1506 Area

Naval Station Great Lakes

Great Lakes, Illinois

Naval Facilities Engineering Command
Midwest

Contract Numbers N62470-08-D-1001, N62467-04-D-0055, and N62472-03-D-0057

Contract Task Orders F275, 510, and C064

October 2013

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FOCUSED FEASIBILITY STUDY

SITE 5 - TRANSFORMER STORAGE BONEYARD, SITE 9 - CAMP MOFFETT RAVINE FILL AREA, AND SITE 21 - BUILDINGS 1517/1506 AREA

NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command Midwest
201 Decatur Avenue, Building 1A
Great Lakes, Illinois 60088

Submitted by:
Tetra Tech
234 Mall Boulevard, Suite 260
King of Prussia, Pennsylvania 19406

CONTRACT NUMBER N62470-08-D-1001, N62467-04-D-0055, & N62472-03-D-0057
CONTRACT TASK ORDERS F275, 510, and C064

OCTOBER 2013

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

SECTION **PAGE NO.**

TABLE OF CONTENTS (Continued)

SECTION **PAGE NO.**

APPENDICES

TABLES

NUMBER

FIGURES

NUMBER

LIST OF ACRONYMS AND ABBREVIATIONS

ARAR	Applicable or Relevant and Appropriate Requirement
ATSDR	Agency for Toxic Substances and Disease Registry
bgs	Below ground surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-Term Environmental Action Navy
CNS	Central nervous system
COC	Chemical of concern
CO_2e	Carbon dioxide equivalents
cPAH	Carcinogenic polynuclear aromatic hydrocarbon
CSF	Cancer Slope Factor
CVS	Cardiovascular system
cy	Cubic yard
DO	Dissolved oxygen
DOT	Department of Transportation
DPT	Direct Push Technology
FFS	Focused Feasibility Study
GHG	Greenhouse gas
GRA	General Response Action
HHRA	Human health risk assessment
HI	Hazard Index
HQ	Hazard Quotient
IAC	Illinois Administrative Code
IAS	Initial Assessment Study
I/C	Industrial/commercial
ICMP	Illinois Coastal Management Program
IDW	Investigation-derived waste
Illinois EPA	Illinois Environmental Protection Agency
ILCR	Incremental Lifetime Cancer Risk
ISCO	In-situ chemical oxidation
LUC	Land Use Control
LUCIP	LUC Implementation Plan
MCL	Maximum Contaminant Level

mg/kg	Milligram(s) per kilogram
MMBTU	Million British Thermal Units
MOA	Memorandum of Agreement
µg/kg	Microgram(s) per kilogram
NAVFAC Midwest	Naval Facilities Engineering Command, Field Division Midwest
NCP	National Oil and Hazardous Substance Pollution Contingency Plan (also called the National Contingency Plan)
ng/kg	Nanograms per kilogram
NO_x	Nitrogen oxides
NPW	Net present worth
NSGL	Naval Station Great Lakes
O&M	Operation and maintenance
ORC™	Oxygen Release Compound™
ORP	Oxidation-reduction potential
OSHA	Occupational Safety and Health Act
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
PCP	Pentachlorophenol
PEF	Particulate Emissions Factor
PM_{10}	Particulate matter with a diameter of 10 micrometers or less
PPE	Personal Protective Equipment
PRG	Preliminary Remediation Goal
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RD	Remedial Design
RfD	Reference Dose
RI/RA	Remedial Investigation/Risk Assessment
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SOx	Sulfur oxides
SVOC	Semivolatile organic compound
TACO	Tiered Approach to Corrective Action Objectives
TBC	To Be Considered (criterion)
TEQ	toxicity equivalents
Tetra Tech	Tetra Tech, Inc.

UECA	Uniform Environmental Covenants Act
UIC	Underground Injection Control
µg/L	micrograms per liter
USC	United States Code
USEPA	United States Environmental Protection Agency
VOC	Volatile organic compound

1.0 INTRODUCTION

This Focused Feasibility Study (FFS) Report was prepared by Tetra Tech, Inc. (Tetra Tech) for Site 5 - Transformer Storage Boneyard, Site 9 - Camp Moffett Ravine Fill Area, and Site 21 - Buildings 1517/1506 Area at the United States Naval Station Great Lakes (NSGL) located in Lake County, Great Lakes, Illinois, under Contract Task Orders F275, 510, and C064, respectively. Figure 1-1 shows the general location of NSGL, and Figure 1-2 shows the locations of the sites at NSGL. The three sites are addressed in one document because of their proximity to each other and their similar geology, hydrogeology, and contamination. The FFS was completed under Comprehensive Long-Term Environmental Action Navy (CLEAN) IV Contract Numbers N62470-08-D-1001, N62467-04-D-0055, and N62472-03-D-0057. The FFS was prepared in accordance with the United States Environmental Protection Agency's (USEPA's) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Guidance for Conducting Remedial Investigations and Feasibility Studies (1988).

1.1 GENERAL

1.1.1 Location and Description

NSGL is located in Lake County, along the shore of Lake Michigan (see Figure 1-1). It is bounded on the north by the city of North Chicago, on the south side by the Veterans Administration Hospital and Shore Golf Course and Country Club, on the east by Lake Michigan, and on the west by U.S. Route 41 (Skokie Highway).

Sites 5, 9, and 21 are located adjacent to each other at the northern end of NSGL (see Figure 1-2).

1.1.2 Remedial Investigations

Remedial investigations (RIs) were conducted in 2009 and 2010. An additional sampling event was conducted at Site 5 in 2012. In Sections 1.2, 1.3 and 1.4, the RI Reports are briefly summarized for Site 5 (Tetra Tech, 2013b), Site 9 (Tetra Tech, 2013a), and Site 21 (Tetra Tech, 2012), respectively. More detailed information is available in the RI Report for each site.

1.1.3 Human Health Risk Assessments

Site-specific Human Health Risk Assessments (HHRAs), which were conducted using the results of the RIs at the three sites, identified contaminants as chemicals of concern (COCs) in soil and in groundwater based on non-cancer Hazard Indices (HIs) greater than 1, or Incremental Lifetime Cancer Risks (ILCRs) greater than $1x10^{-4}$. COCs and HHRAs for Sites 5, 9 and 21 are summarized in Sections 1.2, 1.3 and 1.4, respectively.

1.2 SITE 5 - TRANSFORMER STORAGE BONEYARD

1.2.1 Location and Description

Site 5 is located south of Building 1517 at Site 21, and covers an area of approximately 2 acres. Currently the site contains a road salt storage dome, sand and gravel stockpiles, and equipment and vehicles for road maintenance (see Figure 1-3).

1.2.2 History

From 1945 to 1985, Site 5 was primarily used as a storage area for out-of-service transformers, including some that contained polychlorinated biphenyl (PCB) oils. Lead-insulated cable, heavy equipment, and other miscellaneous scrap metal and materials were also stored at the site. The area may also have been used as a location for cleaning out and painting dumpsters and roll-off boxes.

1.2.3 Nature and Extent of Contamination

The nature and extent of contamination in the media at Site 5 are summarized below. No information has been identified to indicate the presence of listed hazardous waste at the site. Based on the analytical data from the site and the analysis of the investigation-derived waste (IDW), the contaminant concentrations do not suggest the soil and groundwater would be characteristically hazardous.

Surface Soil – In the 2010 investigation, 24 surface soil samples were collected at Site 5. In the 2012 investigation, five additional locations were sampled and analyzed for volatile organic compounds (VOCs).

- Sixteen VOCs were detected in surface soil samples. Seven of these VOCs [benzene, carbon disulfide, carbon tetrachloride, chloroform, ethylbenzene, tetrachloroethene (PCE), and total xylenes] had concentrations higher than the minimum USEPA screening criteria; however, none of these concentrations were greater than the Illinois Environmental Protection Agency (Illinois EPA) Tiered Approach to Corrective Action Objectives (TACO) or Non-TACO criteria.

- Twenty-three semi-volatile organic compounds (SVOCs), including 19 polynuclear aromatic hydrocarbons (PAHs), were detected in surface soil samples. Five of the detected PAHs [2-methylnaphthalene, benzo(k)fluoranthene, carbazole, chrysene, and naphthalene] had concentrations greater than the minimum USEPA screening criteria, but lower than the minimum TACO criteria. Five of the PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene] had concentrations greater than both the minimum USEPA criteria and the minimum TACO criteria. The presence of PAHs is believed to be the result of the use of asphalt to pave the site and residuals from historical coal storage near the site.

- Three PCBs (Aroclor-1242, Aroclor-1254, and Aroclor-1260) were detected in surface soil samples at concentrations higher than the minimum USEPA screening criteria. The maximum concentration of total Aroclor in surface soil was greater than the minimum USEPA screening criterion, but lower than the minimum TACO criteria.

- Twenty-three metals were detected in surface soil samples. Fifteen metals (aluminum, antimony, arsenic, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, mercury, selenium, thallium, and vanadium) had concentrations greater than the minimum USEPA screening criteria. The maximum concentrations of iron and mercury also exceeded the minimum TACO criteria.

Subsurface Soil – In the 2010 investigation, 47 subsurface soil samples were collected from 24 locations at Site 5. In the 2012 investigation, five additional locations were sampled and analyzed for VOCs.

- Seventeen VOCs were detected in subsurface soil samples. The maximum concentrations of benzene, carbon disulfide, carbon tetrachloride, chloroform, ethylbenzene, methylene chloride, tetrachloroethene, and total xylenes exceeded the minimum USEPA screening criteria. Benzene was detected at concentrations greater than the minimum TACO criterion.

- Twenty-five SVOCs, including nineteen PAHs, were detected in subsurface soil samples. Three of the PAHs (chrysene, dibenzofuran, and naphthalene) had concentrations greater than the minimum USEPA screening criteria. Seven of the PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, carbazole, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene] had concentrations exceeding both the minimum USEPA screening criteria and the minimum TACO criteria. The presence of PAHs is believed to be the result of the use of asphalt to pave the site and residuals from historical coal storage near the site.

- Two PCBs (Arochlor-1254 and Aroclor-1260) were detected in subsurface soil samples at concentrations greater than the minimum USEPA screening criteria. However, the maximum concentration of total Aroclor was below the minimum USEPA screening criteria.

- Twenty-three metals were detected in subsurface soil samples. Fourteen metals (aluminum, antimony, arsenic, barium, cadmium, chromium, cobalt, iron, lead, manganese, mercury, selenium, thallium, and vanadium) had concentrations greater than the minimum USEPA screening criteria. The maximum concentrations of manganese and mercury also exceeded the minimum TACO criteria.

Groundwater – In the 2010 investigation, five groundwater monitoring wells were installed and sampled at Site 5. In addition, monitoring well NTC21-MW06 from Site 21 was used to assess the presence of groundwater contamination. In the 2012 investigation, four new monitoring wells were installed. The new wells along with three existing wells were sampled and analyzed for VOCs.

- Six VOCs were detected in groundwater samples. The concentrations of carbon tetrachloride and chloroform in monitoring well NTC05-MW05 located in the northeast corner of the site were higher than both the minimum USEPA screening criteria and the minimum TACO criteria. In the 2012 investigation, carbon tetrachloride and chloroform were only detected in one well, NTC05-MW05. The carbon tetrachloride concentration exceeded the USEPA Maximum Contaminant Level (MCL).

- Eleven SVOCs, including seven PAHs, were detected in groundwater samples. One PAH [benzo(a)pyrene] had concentrations greater than the minimum USEPA screening criterion, but lower than the minimum TACO criterion.

- Twenty metals were detected in groundwater samples. Arsenic and cobalt had concentrations greater than the minimum USEPA screening criteria, but lower than the minimum TACO criteria. Barium, iron and manganese were detected at concentrations greater than both the minimum USEPA screening criteria and the minimum TACO criteria. The barium concentration exceeded the USEPA MCL.

1.2.4 Human Health Risk Assessment

The retained COCs and HHRA results for Site 5 are summarized below.

Chemicals of Concern

- Surface Soil - Arsenic, iron, carcinogenic PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene], and manganese for residential exposure.

- Subsurface Soil - Carcinogenic PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene], arsenic, and manganese for residential exposure.

- Groundwater - Carbon tetrachloride, barium, cobalt, iron, and manganese for potable use.

Summary of Noncarcinogenic Risks

Pathway-specific Reasonable Maximum Exposure (RME) HIs were less than or equal to 1 for occupational/maintenance workers and trespassers in the study area. For this reason, adverse noncarcinogenic health effects are not anticipated for these receptors at Site 5.

Per the Risk Assessment Work Plan, the HIs were calculated using the USEPA Particulate Emissions Factor (PEF). For the construction worker receptor, this resulted in a pathway-specific surface soil inhalation RME HI of 4.3, and a subsurface soil inhalation RME HI of 7.8 from exposure to arsenic and manganese in soil. However, it was collectively determined by the Navy, Illinois EPA, and Tetra Tech that the USEPA PEF was overly conservative for this site and not a realistic representation of Site 5. Therefore, a site-specific determination was made to use the Illinois EPA TACO PEF to calculate the HIs for the construction worker inhalation pathway. The Illinois EPA TACO PEF is less conservative than the USEPA PEF; however, it is still considered protective.

This recalculation resulted in soil organ and pathway-specific RME HIs (including the inhalation pathway) of less than 1 for construction workers for arsenic and manganese. These calculations and risk summaries of the construction worker inhalation pathway are presented in Appendix A, and in Table 1-1. Therefore, adverse noncarcinogenic health effects are not anticipated for the construction worker receptor at Site 5.

Pathway-specific RME HIs were greater than 1 for future child residents. Manganese for residential exposure is the primary pathway of concern in soil. Further examination of these results reveals that the organ-specific HI for the central nervous system (CNS) and the individual Hazard Quotient (HQ) for manganese was the risk driver.

The exceedances of 1 by organ-specific HIs and individual contaminants indicate that adverse noncarcinogenic health effects are possible under the conditions established in the exposure assessment for future child residents.

Summary of Carcinogenic Risks

RME cancer risk estimates for construction workers, occupational/maintenance workers, and adolescent trespassers for Site 5 do not exceed the target USEPA and Illinois EPA Tier 3 cancer risk range ($1x10^{-4}$ to $1x10^{-6}$). However, RME cancer risk estimates for occupational/maintenance workers and adolescent trespassers exceed the Illinois EPA Tier 1 and Tier 2 risk goal ($1x10^{-6}$). The baseline risk assessment is consistent with a Tier 3 Evaluation, and with a Tier 3 Evaluation, the risk range of $1x10^{-4}$ to $1x10^{-6}$ may be acceptable if the specific requirements of 35 Illinois Administrative Code (IAC) 742.915 (i) are also met.

The total site (soil plus groundwater) RME cancer risk estimate for total future residents (adult plus child) exceeds the target USEPA cancer risk range ($1x10^{-4}$ to $1x10^{-6}$) and the Illinois EPA risk goal ($1x10^{-6}$). The major contributors to cancer risk at Site 5 under this scenario are carcinogenic PAHs (cPAHs) and arsenic in soil. Carbon tetrachloride in groundwater contributes to risk if groundwater (with the result from NTC05-MW05) were to be used for 30 years by residents as drinking water.

1.2.5 Industrial/Commercial and Construction Worker TACO Exceedances

Although no unacceptable risks to industrial/commercial (I/C) and construction workers were identified in the HHRA, several samples had concentrations of COCs that were greater than TACO criteria for I/C and construction workers exposure. Concentrations greater than I/C TACO criteria for benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene were detected in both surface and subsurface soil. Concentrations greater than construction worker exposure criteria for benzo(a)pyrene were detected in subsurface soil only. The presence of these PAHs is believed to be the result of the use of asphalt to pave the site and residuals from historical coal storage near the site.

1.3 SITE 9 - CAMP MOFFETT RAVINE FILL AREA

1.3.1 Location and Description

Site 9 is located south of Site 5. Three former ravines (observed in historical maps and aerial photographs) were located in the area currently overlain by buildings and parking areas (see Figure 1-4). The area of the former ravines was approximately 1.5 acres. The elevation of the site is not believed to have changed much since the ravines were filled.

Site 9 was originally identified as “Site 9 - Camp Moffett Disposal Area.” This identification of the site as a disposal area was based on the Initial Assessment Study (IAS) findings, and the presumption that Pettibone Creek ravines were historically filled with galley waste in the process of developing the site for use. However, investigation of Site 9 showed no evidence of landfilling or a disposal area. Limited amounts of ash, bricks, and slag were observed within the fill soil. Therefore, in order to eliminate the misconception that any significant waste had been placed at this site, its name was changed to remove the term “disposal area,” and to more appropriately describe the project area as a ravine fill. For the purpose of this report, Site 9 will be identified as “Site 9 – Camp Moffett Ravine Fill Area.”

1.3.2 History

Site 9 was acquired by the Navy in 1918. The property was transferred to the Veterans Administration in 1924 to be part of their hospital area. In 1942, the Navy occupied this area by permit until the Veterans Administration transferred the property back to the Navy in 1950. Since 1950, the Navy has used this area for training.

Historical photographs, drawings, and topographic maps of the area suggest that the site was once a narrow V-shaped ravine and a former tributary of Pettibone Creek. Filling of the ravines for site development likely started in 1942. There is no information to suggest that hazardous waste disposal occurred at the Camp Moffett Ravine Fill Area; however, NSGL personnel stated that various wastes and materials were placed in a hole where the three fingers of the former ravine converge in the area along the east side of Camp Moffett.

1.3.3 Nature and Extent of Contamination

The nature and extent of contamination in the media at Site 9 are summarized below. No information has been identified to indicate the presence of listed hazardous waste at the site. Based on the analytical data from the site and the analysis of the IDW, the contaminant concentrations do not suggest the soil and groundwater would be characteristically hazardous.

Subsurface Soil – Thirty-eight subsurface soil samples were collected from 22 locations at Site 9.

- Thirteen VOCs were detected in subsurface soil samples. PCE was detected in one sample, and its concentration exceeded both the minimum USEPA screening criterion and the minimum TACO criteria. Benzene and ethylbenzene had concentrations higher than the minimum USEPA screening criteria, but lower than the minimum TACO criteria. Although detected in 27 samples, relatively higher concentrations of benzene were found in a limited number of samples collected from: the courtyard, slightly south of where the three fingers of the ravine merge, at depths ranging from 8 to 16 feet below ground surface (bgs); and in the area along the northern finger of the ravine at depths of 4 to 6 feet bgs.

- Twenty-seven SVOCs, including seventeen PAHs, were detected in subsurface soil samples. N-nitrosodiphenylamine, benzo(a)pyrene, benzo(b)fluoranthene, and dibenzo(a,h)anthracene had concentrations greater than both the minimum USEPA screening criteria and the minimum TACO criteria. The maximum concentrations of 4-chloroaniline, benzo(a)anthracene, benzo(k)fluoranthene, indeno(1,2,3-cd)pyrene, and naphthalene were greater than the minimum USEPA screening criteria, but lower than the minimum TACO criteria. Exceedances of benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene, and naphthalene were widespread throughout Site 9, with relatively higher concentrations detected in a limited number of samples.

- One PCB, Aroclor-1242, was detected in one subsurface soil sample. Its concentration was higher than the minimum USEPA screening criteria, but lower than the minimum TACO criteria.

- Fifteen pesticides were detected in subsurface soil samples. Six of these pesticides (4,4'-DDD, beta-BHC, delta-BHC, dieldrin, gamma-BHC, and gamma-Chlordane) were detected in a limited number of subsurface soil samples at concentrations higher than the minimum USEPA screening criteria, but lower than the minimum TACO criteria. In addition, alpha-BHC had concentrations greater than both the minimum USEPA screening criteria and the minimum TACO criteria.

- Dioxin/furan concentrations exceeding minimum USEPA screening values were detected in a few subsurface soil samples collected from the courtyard (slightly south of where the three fingers of the ravine merge), and from the southern finger of the ravine. However, the maximum dioxin toxicity equivalent (TEQ) concentration of 8.9 nanograms per kilogram (ng/kg) was less than the screening level of 50 ng/kg TEQ for residential soil (ATSDR, 2008 and USEPA, 2013) and 664 ng/kg TEQ for commercial/industrial soil (USEPA, 2013).

- Twenty-two metals were detected in subsurface soil samples. Arsenic, cobalt, nickel, selenium, and silver had concentrations greater than the minimum USEPA screening criteria, but lower than the minimum TACO criteria. Aluminum, antimony, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, and zinc had concentrations greater than both the minimum USEPA screening criteria and the minimum TACO criteria. However, high concentrations of metals were limited to two sample locations at and slightly south of the area where the three fingers of the ravine merge. The borings at these locations contained ash and slag that suggest the fill in this area may be from the former Chicago Hardware Foundry Company historically located due east of the site.

Groundwater – Eight groundwater samples were collected at Site 9.

- Four VOCs were detected in groundwater samples. Chloroform had a concentration higher than both the minimum USEPA screening criterion and the minimum TACO criterion in one well slightly west of where the three ravines merge.

- Fifteen SVOCs were detected in groundwater samples. Five of these were PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene] which were detected at concentrations greater than the minimum USEPA screening criteria in two groundwater samples: one located in the northern finger of the ravine and the other slightly west of where the three ravines merge. However, these PAH concentrations were lower than the minimum TACO criteria.

- Six pesticides and one herbicide were detected in groundwater samples, but none of them had concentrations greater than the minimum regulatory screening criteria.

- No PCBs were detected in groundwater samples.

- Dioxins/furans were detected in one groundwater well located in the southern finger of the ravine. Its TEQ concentration was greater than the minimum USEPA screening criterion.

- Eighteen metals were detected in groundwater samples. Iron, lead, and manganese had concentrations greater than both the minimum USEPA screening criteria and the minimum TACO criteria. Arsenic, barium, cobalt, and selenium were detected at concentrations higher than the minimum USEPA screening criteria, but lower than the minimum TACO criteria. However, relatively higher concentrations of metals were detected in a limited number of samples collected from or near the where the three ravines merge. Arsenic was detected in one well at a concentration greater than the USEPA MCL. The lead concentration at one monitoring well exceeded the Illinois EPA TACO and 35 IAC 620 criterion (7.5 µg/L) but was less than the USEPA MCL (15 µg/L).

1.3.4 Human Health Risk Assessment

The retained COCs and HHRA results for Site 9 are summarized below.

Chemicals of Concern

- Subsurface Soil - Arsenic, manganese, TCDD TEQ, and cPAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene] for residential exposure.

- Groundwater - Arsenic, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, and dibenzo(a,h)anthracene for potable use.

Summary of Noncarcinogenic Risks

Pathway-specific RME HIs were less than or equal to 1 for occupational/maintenance workers and future adult residents in the study area. For this reason, adverse noncarcinogenic health effects are not anticipated for these receptors at Site 9.

Per the Risk Assessment Work Plan, the HIs were calculated using the USEPA PEF. For the construction worker receptor, this resulted in a pathway-specific inhalation RME HI of 7.7 from exposure to manganese and arsenic in subsurface soil. However, it was collectively determined by the Navy, Illinois EPA, and Tetra Tech that the USEPA PEF was overly conservative for this site and not a realistic representation of Site 9. Therefore, a site-specific determination was made to use the Illinois EPA TACO PEF to calculate the HIs for the construction worker inhalation pathway. The Illinois EPA TACO PEF is less conservative than the USEPA PEF, however it is still considered protective.

This recalculation resulted in organ and pathway-specific RME HIs (including the inhalation pathway) of less than 1 for construction workers for manganese and arsenic. These calculations and risk summaries of the construction worker inhalation pathway are presented in Appendix A and in Table 1-1. Therefore, adverse noncarcinogenic health effects are not anticipated for the construction worker receptor at Site 9.

Pathway-specific RME HIs were greater than 1 for future child residents. For future child residents, ingestion of soil is the primary pathway of concern in the RME scenario. Further examination of these results reveals that the organ-specific HI for the cardiovascular system (CVS) and the individual HQ for arsenic were the risk drivers.

The exceedances of 1 by organ-specific HIs and individual contaminants indicate that adverse noncarcinogenic health effects are possible under the conditions established in the exposure assessment for future child residents.

Summary of Carcinogenic Risks

RME cancer risk estimates for construction workers and occupational/maintenance workers for Site 9 do not exceed the target USEPA cancer risk range ($1x10^{-4}$ to $1x10^{-6}$). However, RME cancer risk estimates for future construction workers and occupational/maintenance workers exceed the Illinois EPA risk goal ($1x10^{-6}$). The baseline risk assessment is consistent with a Tier 3 Evaluation, and with a Tier 3 Evaluation, the risk range of $1x10^{-4}$ to $1x10^{-6}$ may be acceptable if the specific requirements of 35 IAC 742.915 (i) are also met.

The total site (excluding the domestic use of groundwater) RME cancer risk estimates for total future residents (adult and child) are within the target USEPA cancer risk range ($1x10^{-4}$ to $1x10^{-6}$), but exceed the Illinois EPA risk goal ($1x10^{-6}$). The major contributors to cancer risk at Site 9 under this scenario are arsenic and cPAHs in subsurface soil. However, it is probable that PAHs at the site are attributed to background.

The total site (soil and groundwater) RME cancer risk estimate for total future residents (adult and child) exceeds the target USEPA cancer risk range ($1x10^{-4}$ to $1x10^{-6}$) and the Illinois EPA risk goal ($1x10^{-6}$). The major contributors to cancer risk at Site 9 under this scenario are arsenic and cPAHs in subsurface soil.

1.3.5 I/C and Construction Worker TACO Exceedances

Although no unacceptable risks to I/C and construction workers were identified in the HHRA, several samples had concentrations of COCs that were greater than TACO criteria for I/C and construction workers exposure. Concentrations greater than the I/C TACO criterion for lead were detected in subsurface soil only. Concentrations greater than construction worker exposure criteria for lead and arsenic were detected in subsurface soil only.

1.4 SITE 21 - BUILDINGS 1517/1506 AREA

1.4.1 Location and Description

Site 21 is located north of Site 5 and covers an area of approximately 7 acres. Site 21 contains several buildings and parking lots, and is almost entirely covered with buildings and pavement (see Figure 1-5). Building 1517 is currently used for equipment storage. A storage building is located south of Building 1517 and is used by the paint, plumbing, and electrical shops and others. A temporary hazardous waste storage area is also located next to Building 1517 at the southwest corner. Building 1506, which is located in the northwestern portion of Site 21, houses offices along with the garage and fueling station for base support and government vehicles.

Site 21 was originally identified as “Site 21 – Building 1517 Landfill.” This identification of the site as a landfill was based on the presumption that drainage ravines were historically filled with soil and waste in the process of developing the site for use, similar to what had reportedly occurred at Site 9. However, investigation of the site showed no evidence of landfilling. Therefore, in order to eliminate the misconception that waste has been placed at this site, its name was changed to remove the term “landfill” and to more appropriately describe the project area. For the purpose of this report, Site 21 will be identified as “Site 21 – Buildings 1517/1506 Area.”

1.4.2 History

The area north of Building 1517 may have been used to store waste or scrap material on concrete pads next to rail spurs from the 1930s to 1940s. These materials may have been hauled away by railcar, or the waste materials may have been sent to an incinerator, which was located in the northwest portion of the site until 1964. From the time prior to 1950 until the 1960s or 1970s, the site was used as a coal stockpile area, which covered most of Site 21 north of Building 1517.

Building 1517 was historically associated with the salvage operations at NSGL. Building 1506 was built in 1993, and since then has been used to house offices along with the garage and fueling station for base support and government vehicles. In 1991, oil-contaminated soil was found during the installation of a water main in the northwestern corner of the site. The contaminated soil was excavated and disposed of off-site at that time.

1.4.3 <u>Nature and Extent of Contamination</u>

The nature and extent of contamination in the media at Site 21 is summarized below. No information has been identified to indicate the presence of listed hazardous waste at the site. Based on the analytical data from the site and the analysis of the IDW, the contaminant concentrations do not suggest the soil and groundwater would be characteristically hazardous.

Surface Soil – Twenty-two surface soil samples were collected at Site 21.

- Ten VOCs were detected in surface soil samples. Benzene and PCE were detected at concentrations higher than the minimum USEPA screening criteria, but lower than the minimum TACO criteria. The maximum concentration of benzene was detected in a surface soil sample located slightly northwest of the fueling area.

- Twenty-five SVOCs were detected in surface soil samples. 2-methylnaphthalene, bis(2-ethylhexyl)phthalate, chrysene, and naphthalene had concentrations greater than the minimum USEPA screening criteria, but lower than the minimum TACO criteria. Benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, carbazole, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene had concentrations greater than both the minimum USEPA screening criteria and the minimum TACO criteria. The presence of PAHs is believed to be the result of the use of asphalt to pave the site and the use of the site as a former coal storage area.

- Nineteen pesticides were detected in surface soil samples. Three pesticides (alpha-BHC, dieldrin, and gamma-BHC) had concentrations greater than both the minimum USEPA screening criteria and the minimum TACO criteria. Nine pesticides (4,4'-DDD, 4,4'-DDE, 4,4'-DDT, alpha-chlordane, beta-BHC, delta-BHC, endrin, gamma-chlordane, and heptachlor epoxide) had concentrations greater than the minimum USEPA screening criteria, but lower than the minimum TACO criteria.

- One PCB (Arochlor-1260) was detected in surface soil samples at concentrations higher than the minimum USEPA screening criteria but lower than the minimum TACO criteria.

- Three herbicides were detected in surface soil samples, of which 2,4-D was found at a concentration higher than the minimum USEPA screening criterion, but lower than the minimum TACO criterion at one location.

- Seventeen dioxins/furans were detected in surface soil samples; thirteen of them were detected at concentrations greater than the minimum USEPA screening criteria. These dioxins/furans were detected in two surface soil samples: one located slightly southeast of Building 1517, and the other directly north of Building 1516.

- Twenty-one metals were detected in surface soil samples, of which antimony, arsenic, chromium, iron, lead, manganese, and nickel were detected at concentrations greater than both the minimum USEPA screening criteria and the minimum TACO/non-TACO criteria. In addition, barium, beryllium, cadmium, cobalt, copper, mercury, and zinc had concentrations greater than the minimum USEPA screening criteria, but lower than the minimum TACO criteria. However, most of the detected metals at relatively high concentrations were limited to samples collected slightly southwest of Building 1517.

Subsurface Soil – Twenty-two subsurface soil samples were collected from 22 locations at Site 21.

- Fifteen VOCs were detected in subsurface soil samples; three of them (benzene, ethylbenzene, and PCE) were detected at concentrations greater than the minimum USEPA screening criteria, but lower than the minimum TACO criteria. Compared to a few exceedances of ethylbenzene and PCE, exceedances of benzene were more widespread, but higher concentrations of benzene were limited to samples collected from the southeast corner of the site at depths ranging from 5 to 7 feet bgs.

- Twenty-five SVOCs were detected in subsurface soil samples. Seven of these SVOCs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, carbazole, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene] were detected at concentrations greater than both the minimum USEPA screening criteria and the minimum TACO criteria. In addition, 2-methylnaphthalene, chrysene, and naphthalene had concentrations greater than the minimum USEPA screening criteria, but lower than applicable minimum TACO criteria. However, high concentrations of these contaminants were limited to samples collected in the northwest corner and the northeast corner of the site. The presence of PAHs is believed to be the result of the use of asphalt to pave the site and the use of the site as a former coal storage area.

- Two PCBs (Aroclor-1242 and Aroclor-1260) were detected in subsurface soil samples at concentrations exceeding the minimum USEPA screening criteria.

- Eighteen pesticides were detected in subsurface soil samples, of which alpha-BHC and dieldrin were detected at concentrations greater than both the minimum USEPA screening criteria and the minimum TACO criteria. In addition, 4,4-DDD, 4,4'-DDE, 4,4'-DDT, aldrin, alpha-chlordane, beta-BHC, delta-BHC, gamma-BHC, gamma-chlordane, and heptachlor epoxide had concentrations greater than the minimum USEPA screening criteria, but lower than the minimum TACO criteria. However, high concentrations of these pesticides were limited to samples collected from the southern and eastern portions of the site.

- Two herbicides were detected in subsurface soil samples, of which 2,4-D was detected at a concentration higher than the minimum USEPA screening criterion, but lower than the minimum TACO criterion in one sample.

- Fifteen dioxins/furans were detected in subsurface soil samples; six of them were detected at concentrations greater than the minimum USEPA screening criteria in one sample collected from the northwest corner of the site, which is the former location of an incinerator.

- Twenty-one metals were detected in subsurface soil samples throughout the site, of which antimony, arsenic, barium, beryllium, cadmium, cobalt, copper, iron, lead, mercury, selenium, and zinc were detected at concentrations greater than the minimum USEPA screening criteria, but lower than the minimum TACO criteria. In addition, manganese was detected at concentrations greater than both the minimum USEPA screening criteria and the minimum TACO criteria. However, most of the detected metals at elevated concentrations were limited to a few samples collected from the northeast corner of the site and the area adjacent to Building 1517.

Groundwater – Six groundwater samples were collected at Site 21.

- Six VOCs were detected in groundwater samples; two of them (benzene and PCE) were detected at concentrations higher than the minimum USEPA screening criteria, but lower than the minimum TACO criteria in one groundwater sample collected from a monitoring well in the northwest corner of the site, which is the former location of an incinerator.

- Twelve SVOCs were detected in groundwater samples; three of them [benzo(a)anthracene, benzo(a)pyrene, and benzo(b)fluoranthene] were detected at concentrations greater than the minimum USEPA screening criteria, but lower than the minimum TACO criteria in two wells: one located on the east side of the site and the other directly south of Building 1517. In addition, pentachlorophenol (PCP) was detected at a concentration greater than the minimum USEPA screening criteria, the USEPA MCL, and the minimum TACO criteria in one well located in the northwest corner of the site, which is the former location of an incinerator.

- Three pesticides were detected in groundwater samples; only one pesticide, delta-BHC, was detected at a concentration higher than the minimum USEPA screening criterion, but lower than the minimum TACO criterion in one well located in the southwest corner of the site near Building 1505.

- Four herbicides were detected in groundwater samples, but none of them had concentrations higher than the minimum screening criteria.

- No PCBs or dioxins/furans were detected in groundwater.

- Nineteen metals were detected in groundwater samples throughout the site, of which arsenic and cobalt were detected at concentrations greater than the minimum USEPA screening criteria, but lower than the minimum TACO criteria. Iron and manganese were detected at concentrations greater than both the minimum USEPA screening criteria and the minimum TACO criteria. However, elevated concentrations of these metals were limited to two wells: one located north of Building 7801 and the other directly south of Building 1517.

1.4.4 Human Health Risk Assessment

The retained COCs and HHRA results for Site 21 are summarized below.

Chemicals of Concern

- Surface Soil – carcinogenic PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene], arsenic, and iron for residential exposure.

- Subsurface Soil – carcinogenic PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene], arsenic, cobalt, and iron for residential exposure.

- Groundwater - Arsenic, cobalt, iron, manganese, and pentachlorophenol for potable use.

Summary of Noncarcinogenic Risks

Pathway-specific RME HIs were less than or equal to 1 for occupational/maintenance workers, trespassers and future adult residents in the study area. For this reason, adverse noncarcinogenic health effects are not anticipated for these receptors at Site 21.

Per the Risk Assessment Work Plan, the HIs were calculated using the USEPA PEF. For the construction worker receptor, this resulted in a pathway-specific surface soil inhalation RME HI of 12, and a subsurface soil inhalation RME HI of 9 from exposure to manganese in soil. However, it was collectively determined by the Navy, Illinois EPA, and Tetra Tech that the USEPA PEF was overly conservative for this site and not a realistic representation of Site 21. Therefore, a site-specific determination was made to use the Illinois EPA TACO PEF to calculate the HIs for the construction worker inhalation pathway. The Illinois EPA TACO PEF is less conservative than the USEPA PEF, however it is still considered protective.

This recalculation resulted in soil organ and pathway-specific RME HIs (including the inhalation pathway) of less than 1 for construction workers for manganese. These calculations and risk summaries of the construction worker inhalation pathway are presented in Appendix A and in Table 1-1. Therefore, adverse noncarcinogenic health effects are not anticipated for the construction worker receptor at Site 21.

Pathway-specific RME HIs were greater than 1 for future child residents. Arsenic, iron, and cobalt for residential exposure to ingestion of soil are the primary pathways of concern. Further examination of these results reveals that the organ-specific HI for the central nervous system, gastrointestinal system, CVS, and kidney; and the individual HQ for arsenic and iron were the risk drivers.

The exceedances of 1 by organ-specific HIs and individual contaminants indicate that adverse noncarcinogenic health effects are possible under the conditions established in the exposure assessment for future child residents.

Summary of Carcinogenic Risks

RME cancer risk estimates for construction workers, adolescent trespassers, and occupational/maintenance workers for Site 21 do not exceed the target USEPA cancer risk range ($1x10^{-4}$ to $1x10^{-6}$). While RME cancer risk estimates for these receptors exceed the Illinois EPA risk goal ($1x10^{-6}$) for TACO Tier 1 and 2, the baseline risk assessment is consistent with a Tier 3 Evaluation. With a Tier 3 Evaluation, the risk range of $1x10^{-4}$ to $1x10^{-6}$ may be acceptable if the specific requirements of 35 IAC 742.915 (i) are also met.

The total site (excluding the domestic use of groundwater) RME cancer risk estimates for total future residents (adult and child) exceed the target USEPA and Illinois EPA TACO Tier 3 cancer risk range ($1x10^{-4}$ to $1x10^{-6}$) and the Illinois EPA TACO Tier 1 and 2 risk goal ($1x10^{-6}$). The major contributors to cancer risk at Site 21 under this scenario are primarily arsenic and cPAHs in surface and subsurface soil.

The total site (soil and groundwater) RME cancer risk estimate for total future residents (adult and child) exceeds the target USEPA and Illinois EPA TACO Tier 3 cancer risk range ($1x10^{-4}$ to $1x10^{-6}$), and the Illinois EPA TACO Tier 1 and 2 risk goal ($1x10^{-6}$). The major contributors to cancer risk at Site 21 under this scenario are arsenic and cPAHs in subsurface and surface soil and pentachlorophenol, arsenic, and cPAHs in groundwater.

1.4.5 I/C and Construction Worker TACO Exceedances

Although no unacceptable risks to I/C and construction workers were identified in the HHRA, several samples had concentrations of COCs that were greater than TACO criteria for I/C and construction workers exposure. Concentrations greater than I/C TACO criteria for benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, dibenzo(a,h)anthracene, and indeno(1,2,3-cd)pyrene were detected In both surface and subsurface soil. Concentrations greater than construction worker exposure criteria for benzo(a)pyrene were detected In surface soil, and for benzo(a)pyrene, naphthalene, and arsenic in subsurface soil. The presence of the PAHs is believed to be the result of the use of asphalt to pave the site and the use of the site as a former coal storage area.

1.5 GROUNDWATER RISK MANAGEMENT

NSGL and the communities surrounding the base use a public water supply that obtains water from Lake Michigan. The silt and pebbly clay in the surficial aquifer has insufficient permeability to allow free groundwater movement, and is not considered to be a favorable source of groundwater. Therefore, direct exposure to groundwater is not expected to occur at any of the three sites under current and/or future land uses. NSGL is an active Navy facility and is expected to remain active for the foreseeable future. In accordance with NSGL Base Instruction 11130.1, dated September 29, 2003, use of groundwater and surface water runoff within all geographical areas of the base, for any purpose, is strictly prohibited without prior written approval. Groundwater underlying NSGL is not used for drinking water and is not expected to be used in the future. In addition, per the City of North Chicago Ordinance 11-7-2, the use of groundwater as a potable water supply is prohibited.

The RI HHRA is based on the conservative assumption that groundwater is used for drinking. Note that groundwater cannot be used because of the current institutional controls (Base Instruction and the North Chicago ordinance) and physical limitations (low yield). Therefore, the groundwater is not a potable water source, and the groundwater will be evaluated accordingly in the FFS.

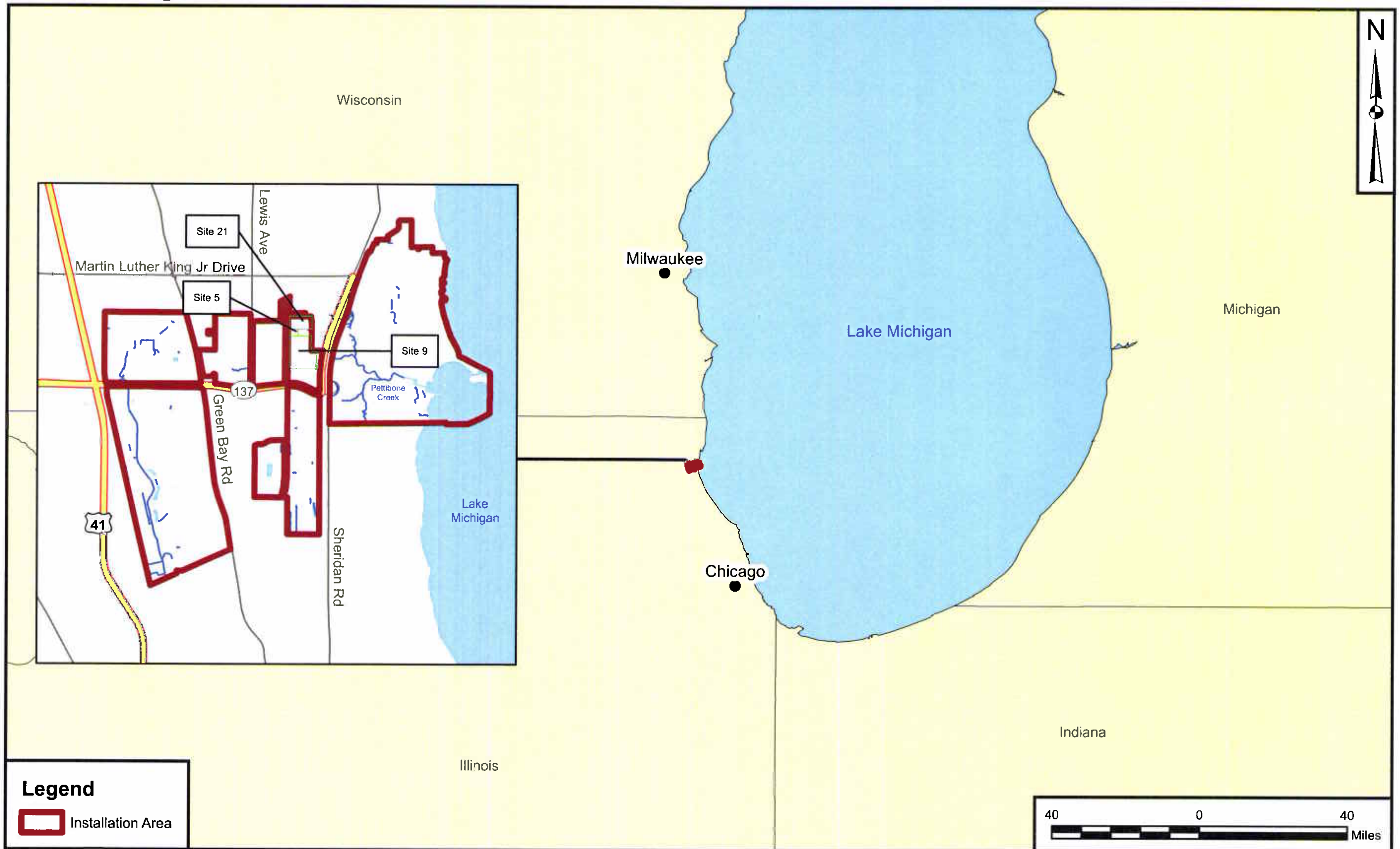
TABLE 1-1

SUMMARY OF INHALATION HI CALCULATIONS FOR CONSTRUCTION WORKER
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

	Inhalation Surface Soil RME HI for Construction Worker	Inhalation Subsurface Soil RME HI for Construction Worker
Site 5		
Previous HI using USEPA PEF	4.3	7.8
New HI using Illinois EPA TACO PEF	0.04	0.08
Site 9		
Previous HI using USEPA PEF	NA	7.7
New HI using Illinois EPA TACO PEF	NA	0.08
Site 21		
Previous HI using USEPA PEF	12	9
New HI using Illinois EPA TACO PEF	0.12	0.1

Illinois EPA TACO Particulate Emissions Factor used to calculate the HIs for the inhalation exposure for the construction worker pathway.
HI - Hazard index.
Illinois EPA - Illinois Environmental Protection Agency.
NA - Not applicable.
PEF - Particulate Emissions Factor
RME - Reasonable Maximum Exposure
TACO - Tiered Approach to Corrective Action Objectives
USEPA - United States Environmental Protection Agency.

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\GENERAL LOCATION MAP.MXD 10/19/12 KM



DRAWN BY J. ENGLISH	DATE 06/08/09	GENERAL LOCATION MAP SITES 5, 9, AND 21 NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS	CONTRACT NUMBER	CTO NUMBER F275, 510 & C064
CHECKED BY J. LOGAN	DATE 10/19/12		APPROVED BY	DATE 10/8/13
REVISED BY	DATE		APPROVED BY	DATE
SCALE AS NOTED		NAVFAC	FIGURE NO. 1-1	REV 0

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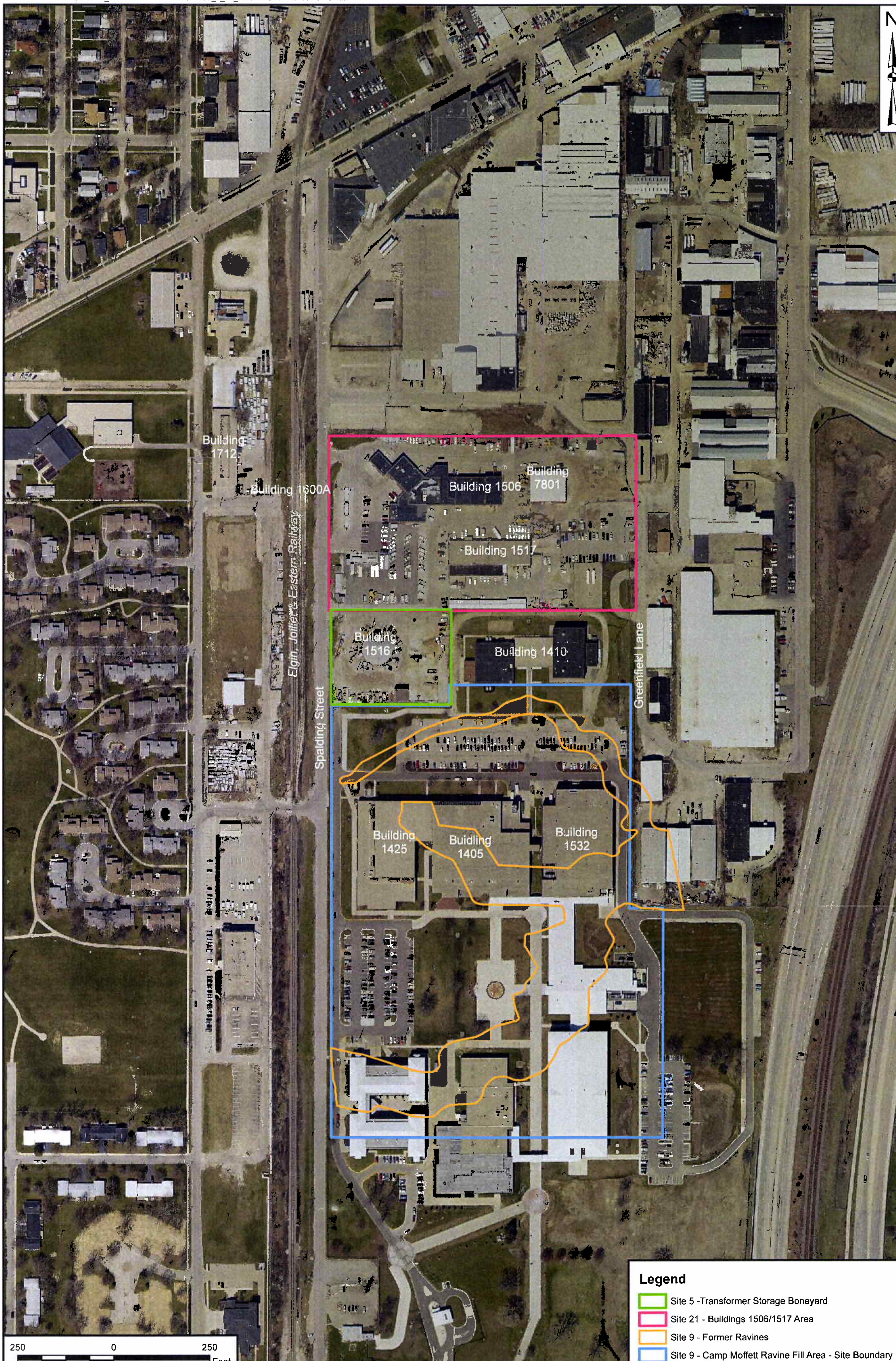

DRAWN BY K. MOORE	DATE 02/17/09	NAVFAC	SITE VICINITY MAP SITES 5, 9, AND 21 NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS	CONTRACT NUMBER —
CHECKED BY J. LOGAN	DATE 10/19/12			CTO NUMBER F275, 510 & C064
REVISED BY —	DATE —			APPROVED BY [signature] DATE 10/8/13
SCALE AS NOTED				APPROVED BY — DATE —
				FIGURE NO. 1-2 REV 0

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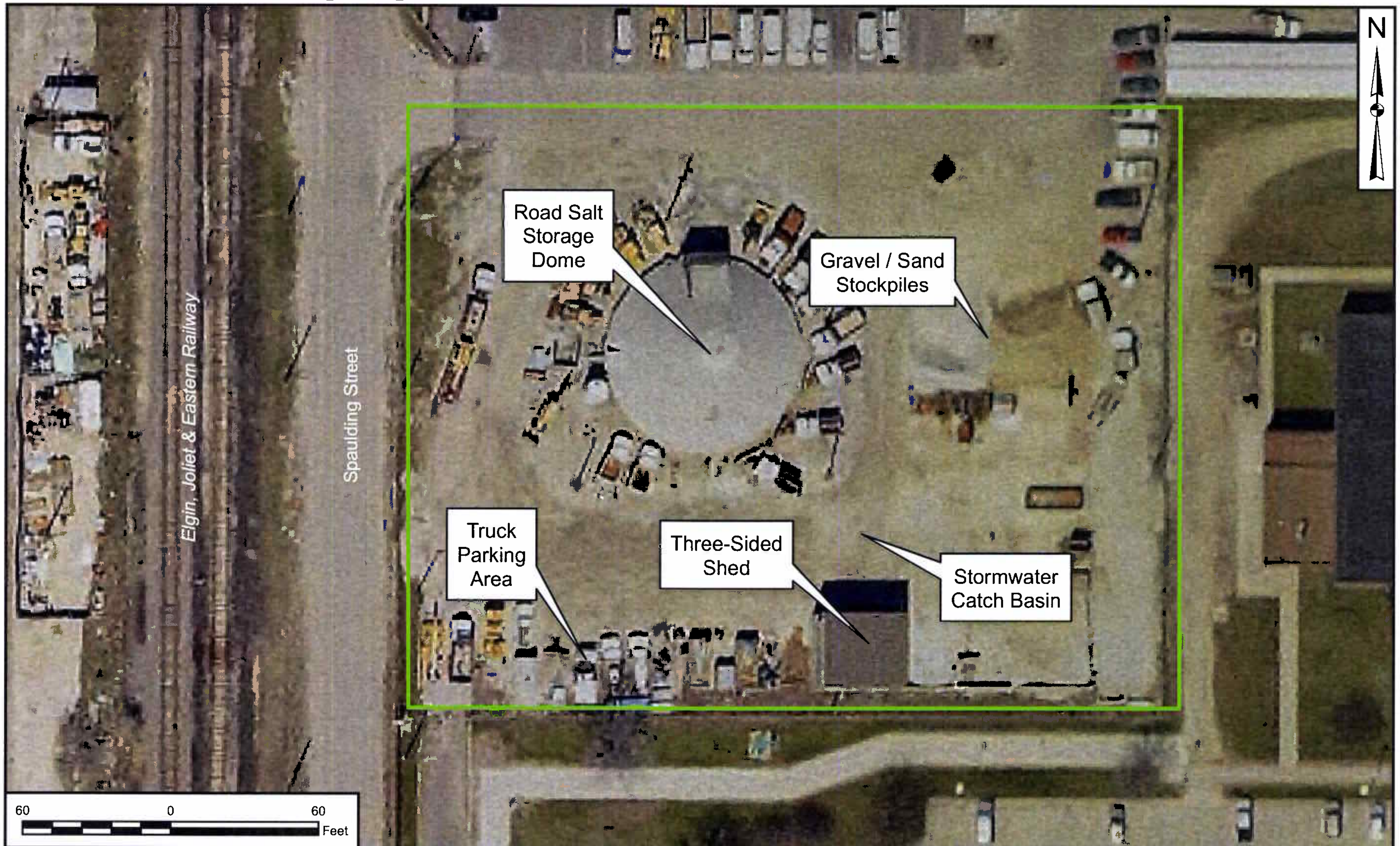
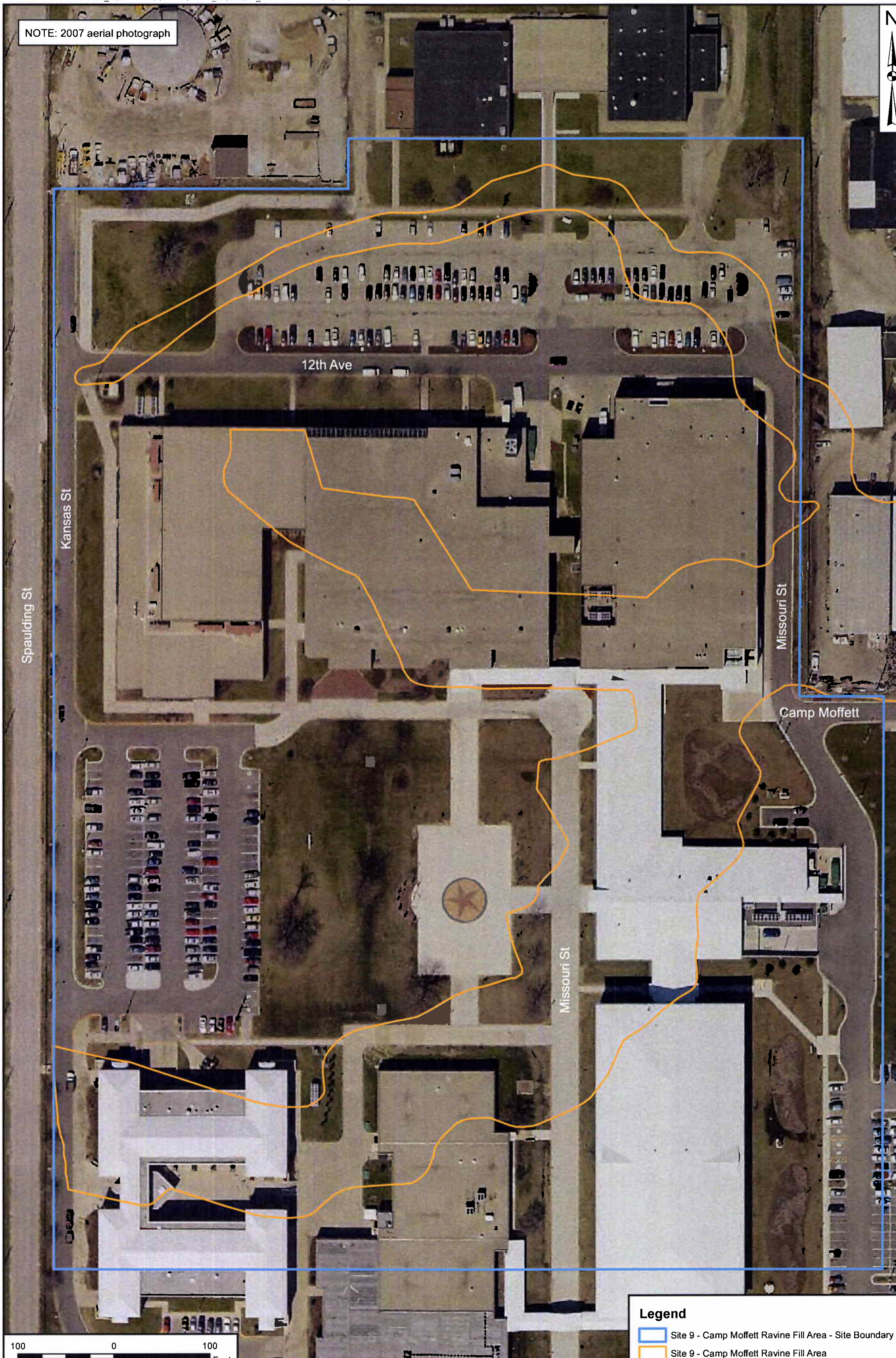


DRAWN BY J. ENGLISH	DATE 06/08/12	NAVFAC	SITE LAYOUT MAP SITE 5 - TRANSFORMER STORAGE BONEYARD NAVAL STATION GREAT LAKES GREAT LAKES, ILLINOIS	CONTRACT NUMBER — / CTO NUMBER F275
CHECKED BY L. WANG	DATE 09/24/12			APPROVED BY [signature] / DATE 10/8/13
REVISED BY J. NOVAK	DATE 09/24/12			APPROVED BY — / DATE —
SCALE AS NOTED				FIGURE NO. 1-3 / REV 0

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE09_DISPOSAL_AREA.MXD 09/24/13 DC



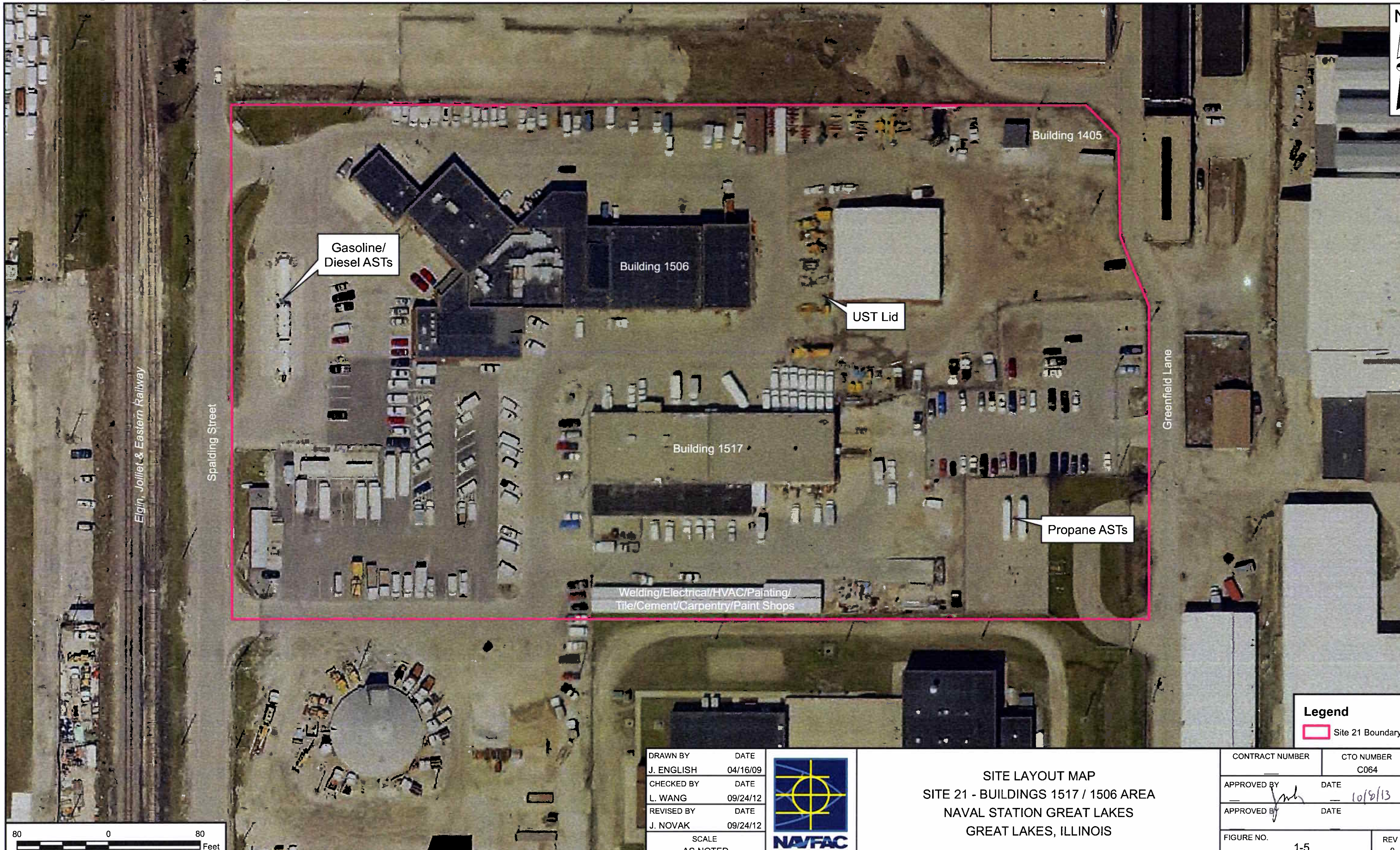
DRAWN BY	DATE
K. MOORE	01/29/09
CHECKED BY	DATE
B. DAVIS	09/24/13
REVISED BY	DATE
D. COUCH	09/24/13
SCALE	
AS NOTED	

NAVFAC

SITE LAYOUT MAP
SITE 9 - CAMP MOFFETT RAVINE FILL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	0510
APPROVED BY	DATE 10/8/13
APPROVED BY	DATE
FIGURE NO. FIGURE 1-4	REV 0

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE21_LOCATION_CURRENT_ALT.MXD 09/24/12 JN



DRAWN BY	DATE
J. ENGLISH	04/16/09
CHECKED BY	DATE
L. WANG	09/24/12
REVISED BY	DATE
J. NOVAK	09/24/12
SCALE	
AS NOTED	

NAVFAC

SITE LAYOUT MAP
SITE 21 - BUILDINGS 1517 / 1506 AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	C064
APPROVED BY	DATE 10/8/13
APPROVED BY	DATE
FIGURE NO. 1-5	REV 0

2.0 REMEDIAL ACTION OBJECTIVES AND GENERAL RESPONSE ACTIONS

This section presents the remedial action objectives (RAOs) for Sites 5, 9, and 21. The objectives and goals for the remedial action at each site provide the basis for selecting RAOs and identifying remedy technologies to address unacceptable exposure scenarios that may be encountered. This section also presents general response actions (GRAs) for contaminated media at each site. GRAs are categories of actions that could be implemented to satisfy or address a component of the RAOs for each site. Lastly, this section provides an estimate of the area and volume of contaminated media to be addressed at each site.

2.1 REMEDIAL ACTION OBJECTIVES

RAOs are medium-specific goals that define the objectives of conducting remedial actions to protect human health and the environment. The RAOs specify the COCs, potential exposure routes and receptors, and acceptable ranges of contaminant concentrations [i.e., preliminary remediation goals (PRGs)] for the site. Section 2.1.1 presents the RAOs developed for each site. PRGs are discussed in Section 2.2.

2.1.1 Statement of Remedial Action Objectives

Site-specific RAOs specify COCs, media of interest, exposure pathways, and cleanup goals or acceptable contaminant concentrations. The RAOs for this FFS were developed based on the current land use as industrial/commercial property and future potential land use as residential property, with the goal of protecting the public from potential current and future health risks. The RAOs were also developed in consideration of the existing prohibitions on groundwater use.

The following RAOs were developed for Sites 5, 9, and 21:

RAO 1: Prevent residential exposure through ingestion, dust inhalation, and dermal contact to contaminated surface soil (Sites 5 and 21) and subsurface soil (Sites 5, 9, and 21) with COC concentrations exceeding PRGs.

RAO 2: Prevent industrial/commercial and construction worker exposure through ingestion, dust inhalation, and dermal contact to contaminated surface soil (Sites 5 and 21) and subsurface soil (Sites 9 and 21) with COC concentrations exceeding TACO criteria.

RAO 3: Return the groundwater resource to beneficial use, if practicable, and address human health risks associated with groundwater consumption.

2.1.2 Applicable or Relevant and Appropriate Requirements and To Be Considered Criteria

Applicable requirements are cleanup standards, standards of control, or other substantive environmental protection requirements, criteria, or limitations promulgated under federal 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.

If a requirement is not applicable, it still may be relevant and appropriate. Relevant and appropriate requirements are those cleanup standards that address problems or situations sufficiently similar to those encountered at the CERCLA site. A requirement that is relevant and appropriate may not meet one or more jurisdictional prerequisites for applicability but still make sense at the site, given the circumstances of the site and the release.

When a requirement is deemed relevant and appropriate, it must be complied with as if it were applicable. However, there are significant differences between the identification and analysis of the two types of requirements. Applicability is a legal and jurisdictional determination, while the determination of relevant and appropriate relies on professional judgment, considering environmental and technical factors at the site. Also, there is more flexibility when determining relevant and appropriate. A requirement may be relevant in that it covers situations similar to those at the site, but may not be appropriate; therefore, may not be well suited to the site. In some situations, only portions of a requirement or regulation may be judged relevant and appropriate; however, if a requirement is applicable, all substantive parts must be followed.

2.1.2.1 Chemical-Specific ARARs and TBCs

Federal and state chemical-specific applicable or relevant and appropriate requirements (ARARs) and to be considered criteria (TBCs) are listed in Table 2-1.

The Illinois EPA TACO Tier 1 Soil Remediation Objectives were retained as TBCs. The Tier 1 TACO for residential and I/C properties does not regulate activities at a site or mandate fixed cleanup standards; rather, TACO provides methodologies for meeting the requirements of programs to which it is applied [Illinois Pollution Control Board No. R97-12 [A], p.1 (Illinois EPA, 2007)]. The applicability section of TACO provides that a person "may elect to proceed under this Part" [35 IAC 742.105(a)]. This language is permissive, not a requirement. Therefore, TACO is not enforceable by its own terms, but relies upon the language of the governing program for its enforceability. Because TACO is not enforceable unto itself, TACO cannot be an ARAR as defined in the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) and must be treated as TBC guidance.

The concentrations of several COCs were greater than their I/C and/or construction worker exposure TACO criteria, but were still within the USEPA acceptable risk range. The I/C and construction worker exposure TACO criteria will be considered in the evaluation of the alternatives.

Groundwater standards for Class I groundwater listed in 35 IAC 620 were retained as chemical-specific ARARs. However, because of the existing groundwater use restrictions, groundwater cannot be used as drinking water. Therefore, MCLs are not relevant because they are only used for drinking water. Similarly, Illinois EPA TACO values are not pertinent because the groundwater use restrictions prevent exposure to the groundwater. The TACO values are risk-based, and the restrictions eliminate the exposure pathway, which eliminates the risk.

2.1.2.2 Location-Specific ARARs and TBCs

As noted in Table 2-2, there are no Federal and state location-specific ARARs and TBCs.

The Illinois Coastal Management Program (ICMP) was evaluated as a location-specific TBC. In January 2012, National Oceanic and Atmospheric Administration approved the ICMP, which was prepared according to the federal Coastal Zone Management Act. The ICMP identifies a framework of existing programs, laws, and policies that bring state agencies into a comprehensive network. The ICMP does not provide any additional rules or regulations. The CERCLA process, which identifies ARARs and TBCs through input from both USEPA and state agencies, will identify the enforceable policies that would be identified using the ICMP process. Because the ICMP process would be duplicative, administrative, and provide no additional substantive requirements, the ICMP could be excluded from the ARAR/TBC list.

Several other potential location-specific ARARs were considered, including 35 IAC 703.184 which addresses siting information under the Resource Conservation and Recovery Act (RCRA) permit program, 35 IAC 724.118 which addresses location standards for hazardous waste treatment, storage, and disposal facilities, 35 IAC 811.102 which addresses location standards for new solid waste landfills, 35 IAC 811.302 which addresses locations standards for putrescible and chemical waste landfills, and Section 22.19a and 22.19b of the Illinois Environmental Protection Act which address sanitary landfills and waste disposal sites located within 100-year flood plains. None of the sites were RCRA-permitted facilities, hazardous waste management or disposal facilities, or solid waste disposal facilities (including sanitary landfills and putrescible and chemical waste landfills), so none of these potential requirements are applicable. The results of chemical analyses are very low and do not suggest the presence of waste which generally have high contaminant concentrations. Similarly, visual observations of subsurface samples did not indicate the presence of significant quantities of debris and waste which would be typical of a disposal site. Therefore, because of the absence of waste, none of the potential location-specific ARARs are appropriate. Thus, there are no location-specific ARARs.

2.1.2.3 Action-Specific ARARs

Action-specific ARARs and TBCs are those regulations, criteria, and guidance that must be complied with or taken into consideration during on-site implementation of GRAs. Action-specific ARARs and TBC criteria are technology- or activity-based controls or restrictions on activities related to management of hazardous substances. Action-specific ARARs pertain to implementing a given remedy. Action-specific ARARs and TBCs are listed along with appropriate actions in Table 2-3.

2.2 PRELIMINARY REMEDIAL GOALS

2.2.1 <u>Residential Soil PRGs</u>

PRGs were developed for the Sites to establish target cleanup goals for remedial actions to reduce COC concentrations in soil, and mitigate the unacceptable risks to human health. Final cleanup goals for the selected remedial actions will be documented in the Record of Decision (ROD).

PRGs can be developed based on chemical-specific ARARs, when available, or risk-based factors. In addition, the presence of COCs in background locations is also considered in developing the PRGs. The following describes the approach taken to select Residential PRGs for surface soil and subsurface soil. The re-evaluation of the risk for the Construction Worker scenario using Illinois EPA PEF values indicates that there is no unacceptable risk. Therefore, PRGs that are protective of Construction Workers do not need to be calculated.

As noted in Section 1.3.3, the maximum TCDD TEQ (8.9 ng/kg) at Site 9 was significantly less than the screening level for residential exposure of 50 ng/kg. Therefore, TCDD TEQ was not considered further and a PRG for TCDD TEQ was not developed.

Surface Soil - Residential

The surface soil PRG selection process for inorganics is the same as for PAHs. The following potential PRGs were considered:

- TACO – Residential Inhalation.
- TACO – Residential Ingestion.
- ICLR 10^{-5} Risk-based PRG using USEPA methods (considered 10^{-4} to 10^{-6}, but generally found to be protective).
- Non-carcinogenic risk (HI = 1) Risk-based PRG using USEPA methods.
- Background (Illinois EPA).

These values fall into the TBC category, so none of the criteria are given any priority for being either applicable or relevant and appropriate. Because of Navy policy, clean-up criteria are not to be set at values less than background. So, any of the potential PRGs that are less than background are eliminated from further consideration. If this eliminates the other PRGs, then the background value is selected as the PRG. The PRGs for surface soil were selected as described below.

Metals: Select the lower of the Residential Inhalation TACO and Residential Ingestion TACO as the PRG. If background is higher than the minimum TACO, then select background as the PRG.

Exceptions:

- Iron has no TACO values. The only other value developed was the HI risk-based value of 55,000 mg/kg. (Background is 15,900 mg/kg.)

- If the maximum lead concentration is greater than 400 mg/kg, then lead will be included as a COC with a PRG of 400 mg/kg.

PAHs: The lower of the Residential Inhalation TACO and Residential Ingestion TACO will be selected as the PRG. If background is higher than the minimum TACO, then background will be selected as the PRG.

Actual application of PRGs does allow for the use of site-wide evaluations of contaminant concentrations. Therefore, PRGs do not necessarily represent a “not to exceed” concentration.

Subsurface Soil - Residential

The subsurface soil PRG selection process for inorganics is different from that for PAHs. Specifically, the Illinois EPA PAH background data cannot be used for subsurface soil. The following potential PRGs were considered:

- TACO – Residential Inhalation.
- TACO – Residential Ingestion.
- ILCR 10^{-5} Risk-based PRG using USEPA methods.
- Non-carcinogenic risk (HI = 1) Risk-based PRG using USEPA methods.
- Background (Illinois EPA) – Inorganics only.

These values fall into the TBC category, so none of the criteria are given any priority for being either applicable or relevant and appropriate. Because of Navy policy, clean-up criteria are not to be set at values less than background. So, any of the potential PRGs that are less than background are eliminated from further consideration. If this eliminates the other PRGs, then the background value is selected as the PRG. The PRGs for subsurface soil were selected as described below.

Metals: The lower of the Residential Inhalation TACO and Residential Ingestion TACO will be the PRG. If background is higher than the minimum TACO, then background will be selected as the PRG.

Exceptions:

- Iron has no TACO values. The only other value developed was the HI risk-based value of 55,000 mg/kg.

- Cobalt has a TACO value of 2,400 mg/kg and a HI risk-based value of 24 mg/kg. In this case, the lower value (24 mg/kg) will be selected.

- If the maximum lead concentration is greater than 400 mg/kg, then lead will be included as a COC, with a PRG of 400 mg/kg.

PAHs: Use the PRGs based on an ILCR of 10-5.

Actual application of PRGs does allow for the use of site-wide evaluations of contaminant concentrations. Therefore, PRGs do not necessarily represent a “not to exceed” concentration. For selection of PAH subsurface soil PRGs, this FFS utilizes $1x10^{-5}$ target concentrations based on a comparison to acceptable PAH background surface soil risk levels.

Tables 2-4, 2-5, and 2-6 summarize the development and selection of the residential soil PRGs for Sites 5, 9, and 21, respectively.

2.2.2 I/C and Construction Worker Exposure Soil PRGs

Although there were no unacceptable risks associated with I/C and construction worker exposure scenarios to soil, the corresponding TACO values for the COCs identified in the surface and subsurface soil are retained as PRGs. Table 2-7 summarizes the I/C and construction worker exposure soil PRGs for COCs at Sites 5, 9, and 21.

2.2.3 Groundwater PRGs

Groundwater PRGs were developed based on groundwater standards in 35 IAC 620, Federal MCLs, and Illinois EPA TACO values. Based on current site information, the groundwater is assumed to be classified as Class I under 35 IAC 620. Existing administrative restrictions on groundwater use and low yield prevent the effective use of groundwater as a drinking water source, so although MCLs and TACOs have been considered, exposure routes are not complete and they were not used to select PRGs.

Table 2-8 summarizes the development and selection of the groundwater PRGs for Sites 5, 9, and 21.

2.2.4 Summary of Exceedances of PRGs

For Site 5, exceedances of residential PRGs in surface soil are shown on Figure 2-1, and exceedances of I/C and construction worker TACO criteria in surface soil are shown on Figure 2-2. Exceedances of residential PRGs in subsurface soil are shown on Figure 2-3, and exceedances of I/C and construction worker TACO criteria in subsurface soil are shown on Figure 2-4. Exceedances of groundwater PRGs are shown on Figure 2-5.

For Site 9, exceedances of residential PRGs in subsurface soil are shown on Figure 2-6, and exceedances of I/C and construction worker TACO criteria in subsurface soil are shown on Figure 2-7. Exceedances of groundwater PRGs are shown on Figure 2-8.

For Site 21, exceedances of residential PRGs in surface soil are shown on Figure 2-9, and exceedances of I/C and construction worker TACO criteria in surface soil are shown on Figure 2-10. Exceedances of residential PRGs in subsurface soil are shown on Figure 2-11, and exceedances of I/C and construction worker TACO criteria in subsurface soil are shown on Figure 2-12. Exceedances of groundwater PRGs are shown on Figure 2-13.

2.3 GENERAL RESPONSE ACTIONS

GRAs are broadly defined remedial approaches that may be used (by themselves or in combination with one or more others) to attain the RAOs. Because the HHRA identified potential noncarcinogenic risks that exceeded the HI of 1 and carcinogenic risks that exceeded 1 x 10^{-4}, the following GRAs for soil were developed at Sites 5, 9, and 21:

- No Action – No direct action to be taken to remediate the site.
- Limited Action [i.e., Land Use Controls (LUCs)].
- Containment.
- Excavation and Disposal of Contaminated Soil.

For groundwater, the following GRAs were developed:

- No Action – No direct action to be taken to remediate the site.
- Limited Action (i.e., LUCs and Monitoring).
- Treatment.

2.4 ESTIMATED VOLUME OF CONTAMINATED MEDIA

Figures 2-1 and 2-3 show the locations of COC concentrations greater than residential PRGs at Site 5 in surface soil and subsurface soil, respectively. Figure 2-6 shows the locations of COC concentrations greater than residential PRGs in subsurface soil at Site 9. Figures 2-9 and 2-11 show the locations of COC concentrations greater than residential PRGs at Site 21 in surface soil and subsurface soil, respectively. The figures were used to estimate the extent of contamination and volume of contaminated soil at each site (see Appendix B).

The depth of contamination is based on the results of the surface and subsurface soil sampling. At Site 5, contaminants are present in the surface and subsurface soil, generally to a depth of approximately 4 feet bgs, and the estimated volume of contaminated soil is 4,000 cubic yards (cy). At Site 9, there is no contaminated soil in the surface soil interval, but there is contaminated soil at several subsurface intervals, and the estimated volume of contaminated soil is 10,000 cy. At Site 21, contaminants are present in the surface and subsurface soil, generally to a depth of approximately 4 feet bgs, and the estimated volume of contaminated soil is 3,000 cy.

Because of the limited extent of soil with contaminant concentrations greater than I/C and construction worker exposure criteria, no volume was calculated on this basis. Similarly, groundwater with contaminant concentrations greater than PRGs have only been identified in one well at each site. No plumes have been delineated, so the volume of contaminated groundwater has not been calculated.

TABLE 2-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs and TBCs
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken	5	9	21
Federal							
Cancer Slope Factors (CSFs)	-	To Be Considered	These are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants. Slope factors are developed by EPA from health effects assessments. Carcinogenic effects present the most up-to-date information on cancer risk potency. Potency factors are developed by EPA from Health Effects Assessments of evaluation by the Carcinogenic Assessment Group.	Used to compute the individual incremental cancer risk resulting from exposure to carcinogenic contaminants in site media. Risks due to carcinogens as assessed with slope factors will be addressed through excavation and off-site disposal and/or land use controls (LUCs).	X	X	X
Reference Doses (RfDs)	-	To Be Considered	Guidance used to compute human health hazard resulting from exposure to non-carcinogens in site media. RfDs are considered to be the levels unlikely to cause significant adverse health effects associated with a threshold mechanism of action in human exposure for a lifetime.	Used to calculate potential non-carcinogenic hazards caused by exposure to contaminants. Hazards due to noncarcinogens with EPA RfDs will be addressed through excavation and off-site disposal and/or land use controls (LUCs).	X	X	X

TABLE 2-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs and TBCs
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken	5	9	21
Federal (continued)							
Guidelines for Carcinogen Risk Assessment	EPA/630/P-03/001F (March 2005)	To Be Considered	Guidance for assessing cancer risk.	Used to calculate potential carcinogenic risks caused by exposure to contaminants. Hazards due to carcinogens assessed through this guidance will be addressed through excavation and off-site disposal and/or land use controls (LUCs).	X	X	X
Supplemental Guidance for Assessing Susceptibility from Early-Life Exposure to Carcinogens	EPA/630/R-03/003F (March 2005)	To Be Considered	Guidance of assessing cancer risks to children.	Used to calculate potential carcinogenic risks to children caused by exposure to contaminants. Carcinogenic risks to children assessed through this guidance will be addressed through excavation and off-site disposal and/or land use controls (LUCs).	X	X	X

TABLE 2-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs and TBCs
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken	5	9	21
State							
Illinois EPA Tiered Approach to Corrective Action Objectives (TACO) - Tier 1 Soil Remediation Objectives	35 IAC 742.505 (a)(1) and (a)(2) - (Tier 1 Soil Remediation Objectives); 742.1012 - (Institutional Controls, Federally Owned Property); Section 742.Table G and Table H – Background Soil Concentrations	To Be Considered	This Part sets forth procedures for evaluating the risk to human health posed by environmental conditions and developing remediation objectives that achieve acceptable risk levels, and to provide for the adequate protection of human health and the environment based on the risks to human health posed by environmental conditions while incorporating site related information. A Tier 1 evaluation compares the concentration of contaminants detected at a site to the corresponding tabulated remediation objectives for residential and industrial/commercial properties.	These values were considered during soil PRG development, but none were selected as PRGs. Naval Station Great Lakes is in Metropolitan area where TACO background values apply, which were used as PRGs if greater than risk-based PRGs.	X	X	X

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken	5	9	21
Illinois EPA Tiered Approach to Corrective Action Objectives (TACO) - Tier 3 Evaluation	35 IAC 742 Subpart I (Tier 3 Evaluation); 742.1012 - (Institutional Controls, Federally Owned Property); Section 742.Table G and Table H – Background Soil Concentrations	To Be Considered	This Part sets forth procedures for evaluating the risk to human health posed by environmental conditions and developing remediation objectives that achieve acceptable risk levels, and to provide for the adequate protection of human health and the environment based on the risks to human health posed by environmental conditions while incorporating site related information. Tier 3 sets forth a flexible framework to develop remediation objectives outside of the requirements of Tiers 1 and 2, specifically target cancer risk ranging between 1 in 1,000,000 and 1 in 10,000 at the point of human exposure or a target hazard quotient greater than 1.	This methodology was used to develop soil PRGs, but none were selected as PRGs. Naval Station Great Lakes is in Metropolitan area where TACO background values apply, which were used as PRGs if greater than risk-based PRGs.	X	X	X

TABLE 2-1

FEDERAL AND STATE CHEMICAL-SPECIFIC ARARs and TBCs
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken	5	9	21
Illinois EPA Groundwater Quality Regulations	35 IAC 620 Subpart B (Groundwater Classification); 620.410 (Groundwater Quality Standards for Class I: Potable Resource Groundwater); 620.450(a) (Alternative Groundwater Quality Standards - Groundwater Quality Restoration Standards)	Applicable	These regulations prescribe various aspects of groundwater quality, including method of classification of groundwater, standards for quality of groundwaters, and conditions for alternative standards.	These standards will be used as PRGs for groundwater. The alternative standards may be implemented, if needed.	X	X	X

TABLE 2-2

FEDERAL AND STATE LOCATION-SPECIFIC ARARs and TBCs
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken	5	9	21
Federal							
There are no federal location-specific ARARs.					X	X	X
State							
There are no State location-specific ARARs.					X	X	X

TABLE 2-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs and TBCs
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken	5	9	21
Federal							
There are no federal action-specific ARARs.							
State							
Identification and Listing of Hazardous Waste	35 IAC 721 Subparts C and D	Applicable	Identifies those solid wastes that are subject to regulation as hazardous wastes.	These regulations would apply when determining whether or not a solid waste, such as contaminated soil is hazardous, either by being listed or exhibiting a hazardous characteristic.	X	X	X
Standards Applicable to Generators of Hazardous Waste	35 IAC 722.111 and Subpart C	Applicable	Characterization of waste is required to determine if it is a hazardous waste. Subpart C Establishes manifesting, pre-transport, and accumulation requirements for hazardous waste.	If contaminated soil is determined to be hazardous, these regulations would apply.	X	X	X
Fugitive Particulate Dust	35 IAC 212 Subpart K	Applicable	No person shall cause or allow the emission of fugitive particulate matter from any process, including any material handling or storage activity, that is visible by an observer looking generally toward the zenith at a point beyond the property line of the source.	Control of dust during excavation and handling of soil would be implemented to prevent material from becoming airborne.	X	X	X

TABLE 2-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs and TBCs
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken	5	9	21
State (continued)							
Illinois Urban Manual (2010)	None	To be considered	The standards and associated materials describe best management practices for controlling non-point source pollution impacts that affect ecosystems in existing communities and developing areas. The manual includes BMPs for soil erosion and sediment control; stormwater management; and special area protection.	Soil excavation activities would need to meet these requirements.	X	X	X
Solid Waste Regulations	35 IAC 807.305(c) (Final Cover)	Relevant and Appropriate	Requires a compacted layer of not less than two feet of suitable material shall be placed of a solid waste landfill at closure.	The uncontaminated surface soil, asphalt pavement of the roads, and foundations and buildings over the ravine fill meets this requirement.		X	
Solid Waste Regulations	35 IAC 807.502 (Closure Standards)	Relevant and Appropriate	Requires site closure in a manner that minimizes the need for further maintenance and controls, minimizes, or eliminates post-closure releases.	Land use controls will be developed to provide for inspection of the cover.		X	

TABLE 2-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs and TBCs
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken	5	9	21
Standards for New Solid Waste Landfills	35 IAC 811.110(g)(1) (Deed notation)	Relevant and Appropriate	Requires that the owner or operator shall record a notation on the deed to the landfill facility property.	The site is currently owned by the Navy, and there are no plans for property conveyance. In the event that the property is to be transferred, a notation will be made on the deed to indicate the presence of the ravine fill at Site 9.		X	
Underground Injection Control Operating Requirements	35 IAC 730.151; 730.110(c)	Applicable	Sets forth technical criteria and standards for the Underground Injection Control (UIC) Program.	These regulations apply to installation and abandonment of wells used for underground injection of oxidizing chemical. Wells for in-situ chemical oxidation injection would be Class V wells.	X	X	X
Uniform Environmental Covenants Act (UECA)	765 Illinois Compiled Statutes (ILCS) 122	Applicable	Ensures that land use restrictions, mandated environmental monitoring requirements, and a wide range of common engineering controls designed to control the potential environmental risk of residual contamination will be recorded in the land records and effectively enforced indefinitely.	If the property is transferred to a non-federal owner, then LUCs will be recorded in the deed through this act.	X	X	X

TABLE 2-3

FEDERAL AND STATE ACTION-SPECIFIC ARARs and TBCs
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Requirement	Citation	Status	Synopsis	Evaluation/Action To Be Taken	5	9	21
Special Waste Classifications	35 IAC 808.121 (Generator Obligations), 35 IAC 808.110 (Definitions), 35 IAC 809.103 (Definitions)	Applicable	Defines “special waste" and requires those who generate waste shall determine whether the waste is a special waste. Special wastes include all hazardous wastes and wastes resulting from the treatment of contaminated media.	Wastes generated during remediation will be evaluated to determine if they are special wastes or certified that the soil waste meets the exemptions. Wastes determined to be special wastes will be transported and disposed of according to the special waste regulations.	X	X	X

TABLE 2-4

PRELIMINARY REMEDIATION GOALS - SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

COC	Background[1]	TACO Residential Inhalation[2]		TACO Residential Ingestion[3]		Risk Based PRGs					Surface Soil							Subsurface Soil						
						Target Cancer Risk Level			Non-Carcinogenic Risk		Maximum		Average Positive	PRG Selection				Maximum		Average Positive	PRG Selection			
						1E-06	1E-05	1E-04	HI =1	Target Organ				PRG	Basis	ILCR	HI				PRG	Basis	ILCR	HI
Residential Exposure																								
Metals (mg/kg)																								
ARSENIC	13	750	C	13		0.39	3.9	39	22	Skin	12		5.64	**13**	TACO Ingestion	3E-05	0.6	16		7.18	**13**	TACO Ingestion	3E-05	0.6
IRON	15,900	NC		NC		NA	NA	NA	55,000	Gastrointestinal system	66,000		20,379	**55,000**	HI=1	NA	1	-		-	-	-	-	-
MANGANESE	636	69,000	N	1,600	N	NA	NA	NA	1,830	Central Nervous System	940		441	**1,600**	TACO Ingestion	NA	0.9	1,800		743	**1,600**	TACO Ingestion	NA	1
Polynuclear Aromatic Hydrocarbons (ug/kg)																								
BENZO(A)ANTHRACENE	1,800	NC		900	C	150	1,500	15,000	NA	NA	6,100		1,080	**1,800**	Background	1E-05	NA	22,000		661	**1,500**	ILCR=1E-5	1E-05	NA
BENZO(A)PYRENE	2,100	NC		90	C	15	150	1,500	NA	NA	12,000		1,655	**2,100**	Background	1E-04	NA	18,000		618	**150**	ILCR=1E-5	1E-05	NA
BENZO(B)FLUORANTHENE	2,100	NC		900	C	150	1,500	15,000	NA	NA	14,000		2,198	**2,100**	Background	1E-05	NA	22,000		813	**1,500**	ILCR=1E-5	1E-05	NA
BENZO(K)FLUORANTHENE	1,700	NC		9,000	C	1500	15,000	150,000	NA	NA	5,800		874	**9,000**	TACO Ingestion	6E-06	NA	11,000		363	**15,000**	ILCR=1E-5	1E-05	NA
DIBENZO(A,H)ANTHRACENE	420	NC		90	C	15	150	1,500	NA	NA	2,300		393	**420**	Background	3E-05	NA	3,700	J	131	**150**	ILCR=1E-5	1E-05	NA
INDENO(1,2,3-CD)PYRENE	1,600	NC		900	C	150	1,500	15,000	NA	NA	9,700		1,323	**1,600**	Background	1E-05	NA	12,000		418	**1,500**	ILCR=1E-5	1E-05	NA

Notes:
1 - PAH background values are not applicable to subsurface soil.
2 - Section 742 Table A, Tier 1, Soil Remediation Objectives - Residential/Industrial/Commercial (Ingestion or Inhalation)(Online, 2013).
3 - Soil Remediation Objectives for Residential/Industrial/Commercial properties, Non-TACO Chemicals (2013).

C = Carcinogen.
COC = Chemical of Concern.
HI = Hazard Index.
ILCR = Incremental Lifetime Cancer Risk.
J = Estimated Value.
N = Non-carcinogen.
NA = Not Available/Not Applicable.
NC = No Criteria.

TABLE 2-5

PRELIMINARY REMEDIATION GOALS - SOIL - SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

COC	Background[1]	TACO Residential Inhalation[2]		TACO Residential Ingestion[3]		Risk Based PRGs					Subsurface Soil						
						Target Cancer Risk Level			Non-Carcinogenic Risk		Maximum		Average Positive	PRG Selection			
						1E-06	1E-05	1E-04	HI =1	Target Organ				PRG	Basis	ILCR	HI
Residential Exposure																	
Metals (mg/kg)																	
ARSENIC	13	750	C	13		0.39	3.9	39	22	Skin	115	J	15.3	**13**	TACO Ingestion	3E-05	0.590909
LEAD	36	NA		400		NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	15,000		595	**400**	TACO Ingestion	NA	NA
MANGANESE	636	69,000	N	1,600	N	NA	NA	NA	1,830	Central Nervous System	1,090	J	620	**1,600**	TACO Ingestion	NA	1
Polynuclear Aromatic Hydrocarbons (ug/kg)																	
BENZO(A)ANTHRACENE	1,800	NC		900	C	150	1,500	15,000	NA	NA	490		119	**1,500**	ILCR=1E-5	1E-05	NA
BENZO(A)PYRENE	2,100	NC		90	C	15	150	1,500	NA	NA	540		173	**150**	ILCR=1E-5	1E-05	NA
BENZO(B)FLUORANTHENE	2,100	NC		900	C	150	1,500	15,000	NA	NA	1,100		261	**1,500**	ILCR=1E-5	1E-05	NA
DIBENZO(A,H)ANTHRACENE	420	NC		90	C	15	150	1,500	NA	NA	240		39.1	**150**	ILCR=1E-5	1E-05	NA
INDENO(1,2,3-CD)PYRENE	1,600	NC		900	C	150	1,500	15,000	NA	NA	660		149	**1,500**	ILCR=1E-5	1E-05	NA

Notes:
1 - PAH background values are not applicable to subsurface soil.
2 - Section 742 Table A, Tier 1, Soil Remediation Objectives - Residential/Industrial/Commercial (Ingestion or Inhalation)(Online, 2013).
3 - Soil Remediation Objectives for Residential/Industrial/Commercial properties, Non-TACO Chemicals (2013).
4 - Lead risk is calculated using a blood lead model. The PRGs for lead based on this model are 418 mg/kg for residential users, 1,962 mg/kg for industrial workers, and 1,881 mg/kg for construction workers.

C = Carcinogen.
COC = Chemical of Concern.
HI = Hazard Index.
ILCR = Incremental Lifetime Cancer Risk.
J = Estimated Value.
N = Non-carcinogen.
NA = Not Available/Not Applicable.
NC = No Criteria.

TABLE 2-6

PRELIMINARY REMEDIATION GOALS - SOIL - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

COC	Background[1]	TACO Residential Inhalation[2]		TACO Residential Ingestion[3]		HHRA Based PRGs					Surface Soil							Subsurface Soil						
						Target Cancer Risk Level			Non-Carcinogenic Risk		Maximum		Average Positive	PRG Selection				Maximum		Average Positive	PRG Selection			
						1E-06	1E-05	1E-04	HI =1	Target Organ				PRG	Basis	ILCR	HI				PRG	Basis	ILCR	HI
Residential Exposure																								
Metals (mg/kg)																								
ARSENIC	13	750	C	13		0.39	3.9	39	22	Skin	48.4	J	12	**13**	TACO Ingestion	3E-05	0.6	85	J	12.1	**13**	TACO Ingestion	3E-05	0.6
COBALT	8.9	NC		4700	N	NA	NA	NA	24	Thyroid	-	-	-	-	-	-	-	23.8		8.9	**24**	HI=1	NA	1
IRON	15,900	NC		NC		NA	NA	NA	55,000	Gastrointestinal system	69,500	J	26,762	**55,000**	HI=1	NA	1	65,800	J	26,966	**55,000**	HI=1	NA	1
LEAD	36	NA		400		NA[4]	NA[4]	NA[4]	NA[4]	NA[4]	428		101	**400**	TACO Ingestion	NA	NA	-		-	**-**	-	-	-
Polynuclear Aromatic Hydrocarbons (ug/kg)																								
BENZO(A)ANTHRACENE	1,800	NC		900	C	150	1500	15,000	NA	NA	22,000	J	1,894	**1,800**	Background	1E-05	NA	32,000		2,140	**1,500**	ILCR=1E-5	1E-05	NA
BENZO(A)PYRENE	2,100	NC		90	C	15	150	1,500	NA	NA	38,000	J	3,334	**2,100**	Background	1E-04	NA	27,000		2,702	**150**	ILCR=1E-5	1E-05	NA
BENZO(B)FLUORANTHENE	2,100	NC		900	C	150	1500	15,000	NA	NA	59,000	J	4,383	**2,100**	Background	1E-05	NA	41,000		3,090	**1,500**	ILCR=1E-5	1E-05	NA
BENZO(K)FLUORANTHENE	1,700	NC		9,000	C	1,500	15,000	150,000	NA	NA	21,000	J	1,736	**9,000**	TACO Ingestion	6E-06	NA	14,000		1,136	**15,000**	ILCR=1E-5	1E-05	NA
CHRYSENE	2,700	NC		88,000	C	15,000	150,000	1,500,000	NA	NA	31,000	J	2,491	**88,000**	TACO Ingestion	6E-06	NA	34,000		2,091	**150,000**	ILCR=1E-5	1E-05	NA
DIBENZO(A,H)ANTHRACENE	420	NC		90	C	15	150	1,500	NA	NA	1,100		326	**420**	Background	3E-05	NA	3,300		441	**150**	ILCR=1E-5	1E-05	NA
INDENO(1,2,3-CD)PYRENE	1,600	NC		900	C	150	1,500	15,000	NA	NA	36,000	J	3,039	**1,600**	Background	1E-05	NA	16,000		1,707	**1,500**	ILCR=1E-5	1E-05	NA

Notes:
1 - PAH background values are not applicable to subsurface soil.
2 - Section 742 Table A, Tier 1, Soil Remediation Objectives - Residential/Industrial/Commercial (Ingestion or Inhalation)(Online, 2013).
3 - Soil Remediation Objectives for Residential/Industrial/Commercial properties, Non-TACO Chemicals (2013).
4 - Lead risk is calculated using a blood lead model. The PRGs for lead based on this model are 418 mg/kg for residential users, 1,962 mg/kg for industrial workers, and 1,881 mg/kg for construction workers.

C = Carcinogen.
COC = Chemical of Concern.
HI = Hazard Index.
ILCR = Incremental Lifetime Cancer Risk.
J = Estimated Value.
N = Non-carcinogen.
NA = Not Available/Not Applicable.
NC = No Criteria.

TABLE 2-7

TACO CRITERIA FOR INDUSTRIAL/COMMERCIAL AND CONSTRUCTION WORKER EXPOSURE - SOIL - SITES 5, 9, AND 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

COC	Background(1)	TACO Industrial/ Commercial Inhalation(2)	TACO Industrial/ Commercial Ingestion(2)	TACO Construction Worker Inhalation(2)	TACO Construction Worker Ingestion(2)	Site Applicability					
						Site 5		Site 9		Site 21	
						Applies?	Max	Applies?	Max	Applies?	Max
Metals (mg/kg)											
ARSENIC	13	1,200	NC	25,000	61	X	16	X	115	X	85
COBALT	8.9	NC	120,000	NC	12,000					X	24
LEAD	36	NC	800	NC	700			X	15,000	X	428
MANGANESE	636	91,000	41,000	8,700	4,100	X	1,800	X	1,090		
IRON	15,900	NC	NC	NC	NC	X	66,000			X	69,500
Polynuclear Aromatic Hydrocarbons (ug/kg)											
BENZO(A)ANTHRACENE	1,800	NC	8,000	NC	170,000	X	22,000	X	490	X	32,000
BENZO(A)PYRENE	2,100	NC	800	NC	17,000	X	18,000	X	540	X	38,000
BENZO(B)FLUORANTHENE	2,100	NC	8,000	NC	170,000	X	22,000	X	1,100	X	59,000
BENZO(K)FLUORANTHENE	1,700	NC	78,000	NC	1,700,000	X	11,000	X	410	X	21,000
CHRYSENE	2,700	NC	780,000	NC	17,000,000	X	20,000	X	500	X	34,000
DIBENZO(A,H)ANTHRACENE	420	NC	800	NC	17,000	X	3,700	X	240	X	3,300
INDENO(1,2,3-CD)PYRENE	1,600	NC	8,000	NC	170,000	X	12,000	X	660	X	36,000

Notes:
1 - PAH background values are not applicable to subsurface soil.
2 - Section 742 Appendix B, Table B Tier 1 Soil Remediation Objectives for Industrial/Commercial Properties (Online, 2013).
X - Criterion for this contaminant needs to be considered in development of alternatives.
Max - Maximum concentration in soil (surface and subsurface soil)

COC = Chemical of Concern.
NC = No Criteria.

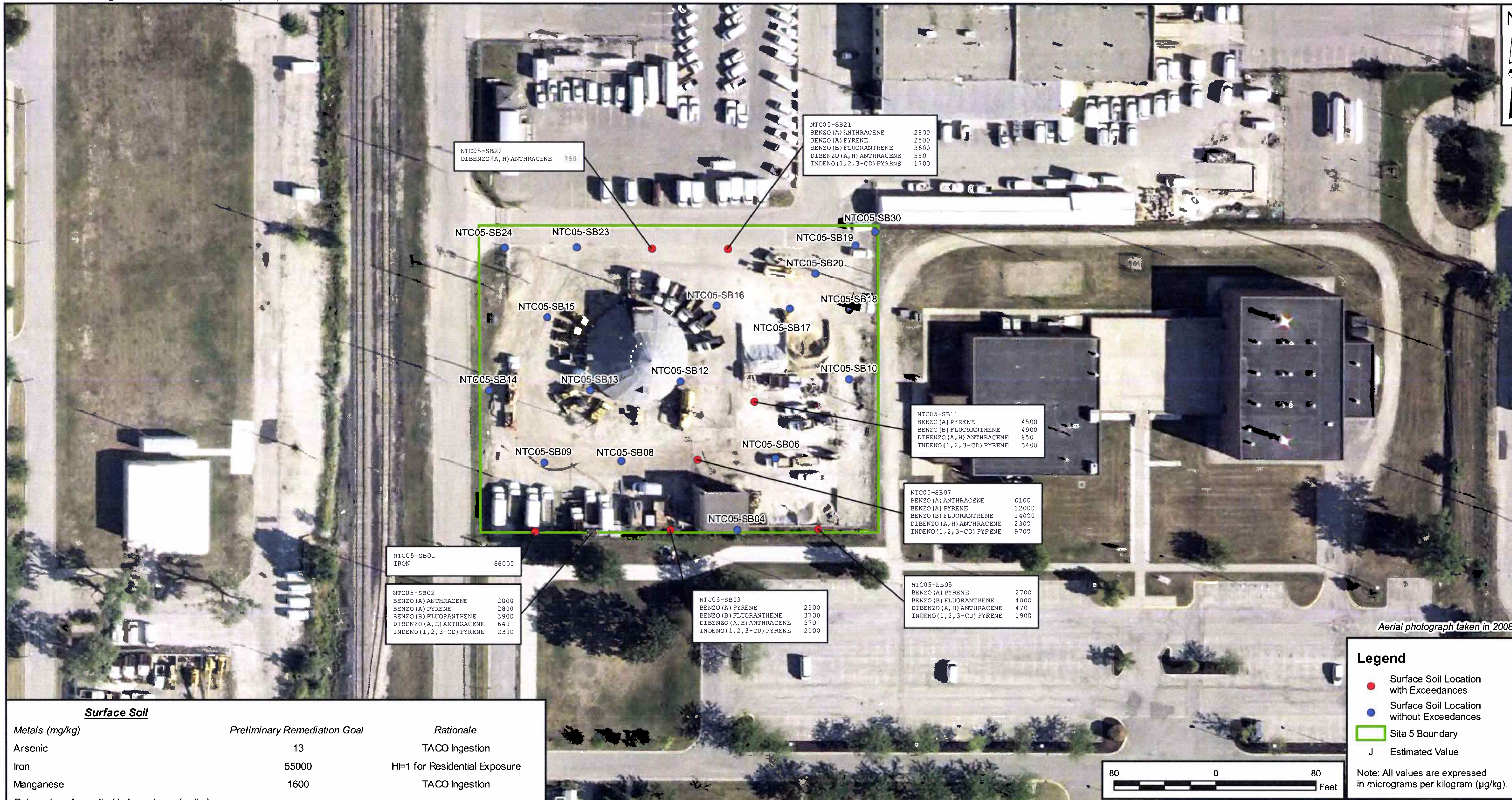
TABLE 2-8

PRELIMINARY REMEDIATION GOALS - GROUNDWATER - SITES 5, 9, AND 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

COC	Federal MCL, ug/L	Illinois EPA Class I TACO, ug/L	Illinois EPA Class II TACO, ug/L	Illinois EPA Residential Indoor Inhalation TACO, ug/L	Illinois EPA Industrial/ Commercial Indoor Inhalation TACO, ug/L	Illinois EPA Class I GW Standard, ug/L	Illinois EPA Class II GW Standard, ug/L	Maximum, ug/L	Selected PRG, ug/L	Rationale	Site
CARBON TETRACHLORIDE	5	5	25	20*	76*	5	25	100	**5***	llinois EPA Class I GW Standard	5
BARIUM	2,000	2,000	2,000	NA	NA	2,000	2,000	8,100	**2,000**	Illinois EPA Class I GW Standard	5
ARSENIC	10	50	200	NA	NA	10	200	13.4	**10**	Illinois EPA Class I GW Standard	9
LEAD	15	7.5	100	NA	NA	7.5	100	14.9	**7.5**	Illinois EPA Class I GW Standard	9
PENTACHLOROPHENOL	1	1	5	NA	NA	1	5	7.8	**1**	Illinois EPA Class I GW Standard	21

* - Alternatives with long durations may also need components to address Indoor Inhalation TACO values.
GW - Groundwater.
IEPA - Illinois Environmental Protection Agency.
MCL - Maximum Contaminant Level.
NA - Not applicable.
PRG - Preliminary Remediation Goal.
TACO - Tiered Approach to Corrective Action Objectives.

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE05_SS_EXCEED_PAH_R1.MXD 08/29/13 DC



Surface Soil

Metals (mg/kg)	*Preliminary Remediation Goal*	*Rationale*
Arsenic	13	TACO Ingestion
Iron	55000	HI=1 for Residential Exposure
Manganese	1600	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1800	Background
Benzo(a)pyrene	2100	Background
Benzo(b)fluoranthene	2100	Background
Benzo(k)fluoranthene	9000	TACO Ingestion
Dibenzo(a,h)anthracene	420	Background
Indeno(1,2,3-cd)pyrene	1600	Background

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J. NOVAK	05/22/12
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J. LOGAN	08/29/13
REVISED BY	DATE
D. COUCH	08/29/13
SCALE AS NOTED	

NAVFAC

EXCEEDANCES OF RESIDENTIAL PRGs IN SURFACE SOIL
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	F275
APPROVED BY	DATE 10/8/13
APPROVED BY	DATE
FIGURE NO. 2-1	REV 0

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE05_SS_EXCEED_TACO_R3.MXD 06/21/13 JEE

	TACO INDUSTRIAL INHALATION (ug/kg)	TACO INDUSTRIAL INGESTION (ug/kg)	TACO CONSTRUCTION WORKER INGESTION (ug/kg)	BACKGROUND (ug/kg)
BENZO(A)ANTHRACENE	NC	8000	170000	1800
BENZO(A)PYRENE	NC	800	17000	2100
BENZO(B)FLUORANTHENE	NC	8000	170000	2100
DIBENZO(A,H)ANTHRACENE	NC	800	17000	420
INDENO(1,2,3-CD)PYRENE	NC	8000	170000	1600

Aerial photograph provided by ESRI's ArcGIS Online World Imagery map service (© 2011 ESRI and its data suppliers).

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D. COUCH	05/16/13
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J. LOGAN	06/21/13
REVISED BY	DATE
SCALE AS NOTED	

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SURFACE SOIL SAMPLES
WITH CONCENTRATIONS GREATER THAN I/C
AND CONSTRUCTION WORKER TACO
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
2120	F275
APPROVED BY R. DAVIS	DATE 05/29/13
APPROVED BY	DATE
FIGURE NO. 2 - 2	REV 0

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE05_SB_RES_EXC_PRG_FS.MXD 08/29/13 DC

Subsurface Soil		
Metals (mg/kg)	*Preliminary Remediation Goal*	*Rationale*
Arsenic	13	TACO Ingestion
Manganese	1600	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1500	ILCR = IE-5 for Residential Exposure
Benzo(a)pyrene	150	ILCR = IE-5 for Residential Exposure
Benzo(b)fluoranthene	1500	ILCR = IE-5 for Residential Exposure
Benzo(k)fluoranthene	15000	ILCR = IE-5 for Residential Exposure
Dibenzo(a,h)anthracene	150	ILCR = IE-5 for Residential Exposure
Indeno(1,2,3-cd)pyrene	1500	ILCR = IE-5 for Residential Exposure

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S. PAXTON	10/18/12
CHECKED BY	DATE
J. LOGAN	08/29/13
REVISED BY	DATE
D. COUCH	08/29/13
SCALE AS NOTED	

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EXCEEDANCES OF RESIDENTIAL PRGs
IN SUBSURFACE SOIL
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
—	F275
APPROVED BY	DATE
[signature]	10/8/13
APPROVED BY	DATE
FIGURE NO. 2-3	REV 0

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE05_SSB_EXCEED_TACO_R2.MXD 06/21/13 JEE

	TACO INDUSTRIAL INHALATION (ug/kg)	TACO INDUSTRIAL INGESTION (ug/kg)	TACO CONSTRUCTION WORKER INGESTION (ug/kg)
BENZO(A)ANTHRACENE	NC	8000	170000
BENZO(A)PYRENE	NC	800	17000
BENZO(B)FLUORANTHENE	NC	8000	170000
DIBENZO(A,H)ANTHRACENE	NC	800	17000
INDENO(1,2,3-CD)PYRENE	NC	8000	170000

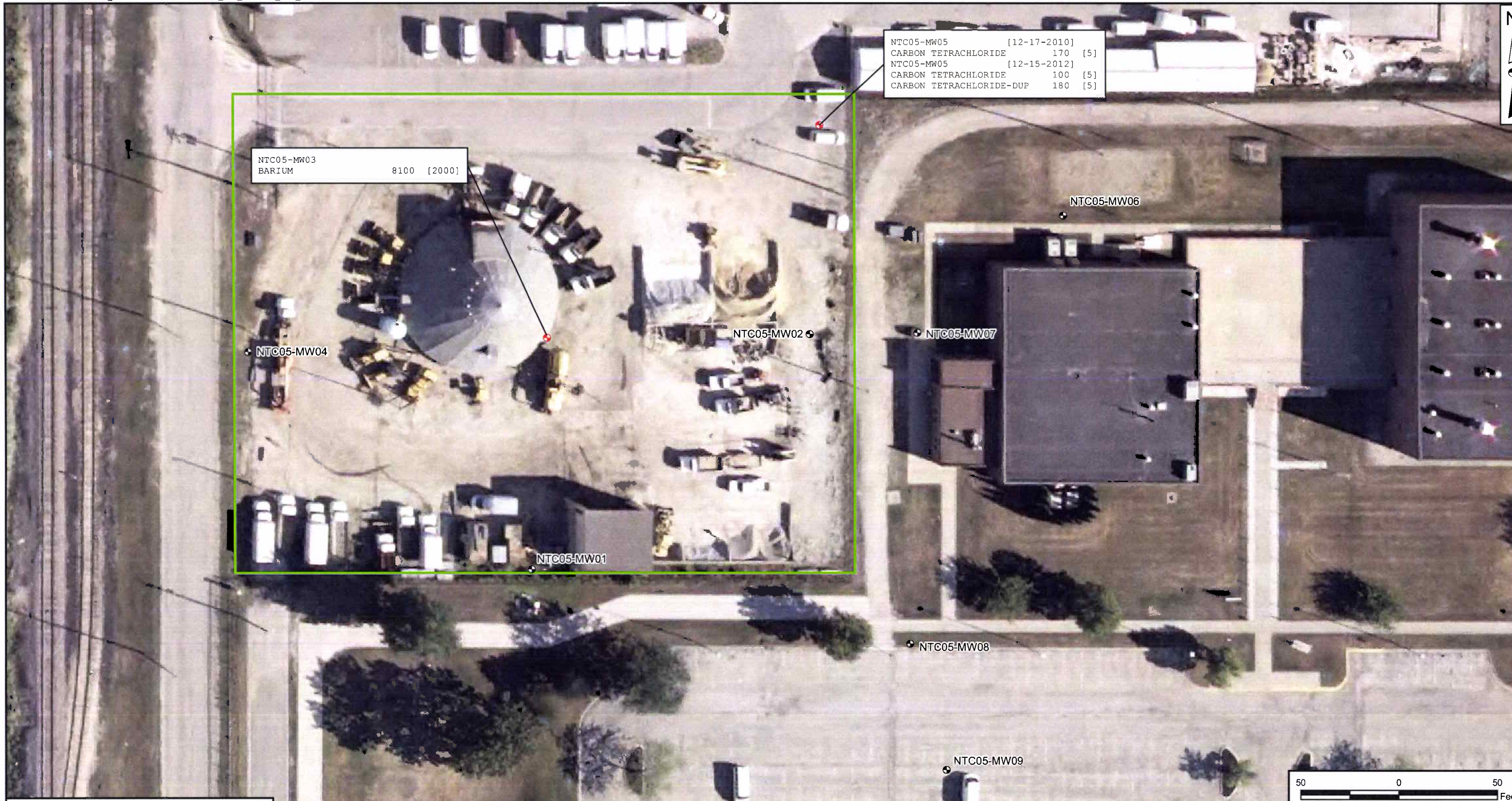
DRAWN BY	DATE
D. COUCH	05/16/13
CHECKED BY	DATE
J. LOGAN	06/21/13
REVISED BY	DATE
SCALE AS NOTED	

NAVFAC

SUBSURFACE SOIL SAMPLES
WITH CONCENTRATIONS GREATER THAN I/C
AND CONSTRUCTION WORKER TACO
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
2120	F275
APPROVED BY R. DAVIS	DATE 5/29/13
APPROVED BY	DATE
FIGURE NO. 2 - 4	REV 0

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE05_GW_EXCEED_MIN_FS.MXD 09/19/13 DC



Legend

- Groundwater Location with Exceedances
- Groundwater Location without Exceedances
- Site 5 -Transformer Storage Boneyard
- [5] PRG

Note:
1) All values are expressed in micrograms per liter (ug/L).

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S. PAXTON	10/18/12
CHECKED BY	DATE
J. LOGAN	09/19/13
REVISED BY	DATE
D. COUCH	09/19/13
SCALE	
AS NOTED	

NAVFAC

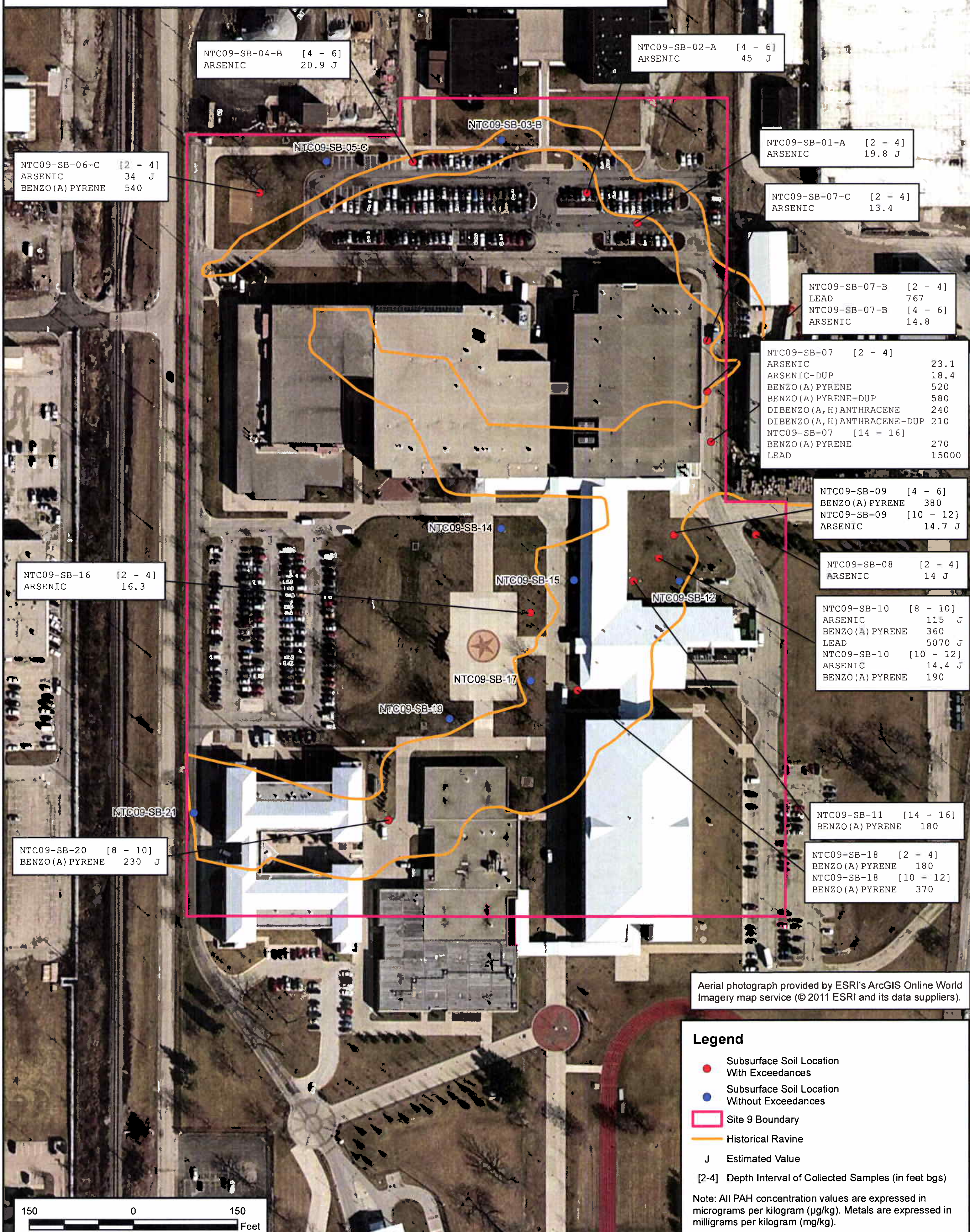
EXCEEDANCES OF GROUNDWATER PRGs
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
—	F275
APPROVED BY	DATE 10/8/13
APPROVED BY	DATE
FIGURE NO. 2 - 5	REV 0

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE09_PRG_EXCEEDANCE_TAGS_R2.MXD 09/23/13 DC

Subsurface Soil

Metals (mg/kg)	*Preliminary Remediation Goal*	*Rationale*
Arsenic	13	TACO Ingestion
Lead	400	TACO Ingestion
Manganese	1600	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1500	ILCR=1E-5 for Residential Exposure
Benzo(a)pyrene	150	ILCR=1E-5 for Residential Exposure
Benzo(b)fluoranthene	1500	ILCR=1E-5 for Residential Exposure
Dibenzo(a,h)anthracene	150	ILCR=1E-5 for Residential Exposure
Indeno(1,2,3-cd)pyrene	1500	ILCR=1E-5 for Residential Exposure



DRAWN BY	DATE
J. ENGLISH	05/23/12
CHECKED BY	DATE
J. LOGAN	09/23/13
REVISED BY	DATE
D. COUCH	09/23/13
SCALE AS NOTED	

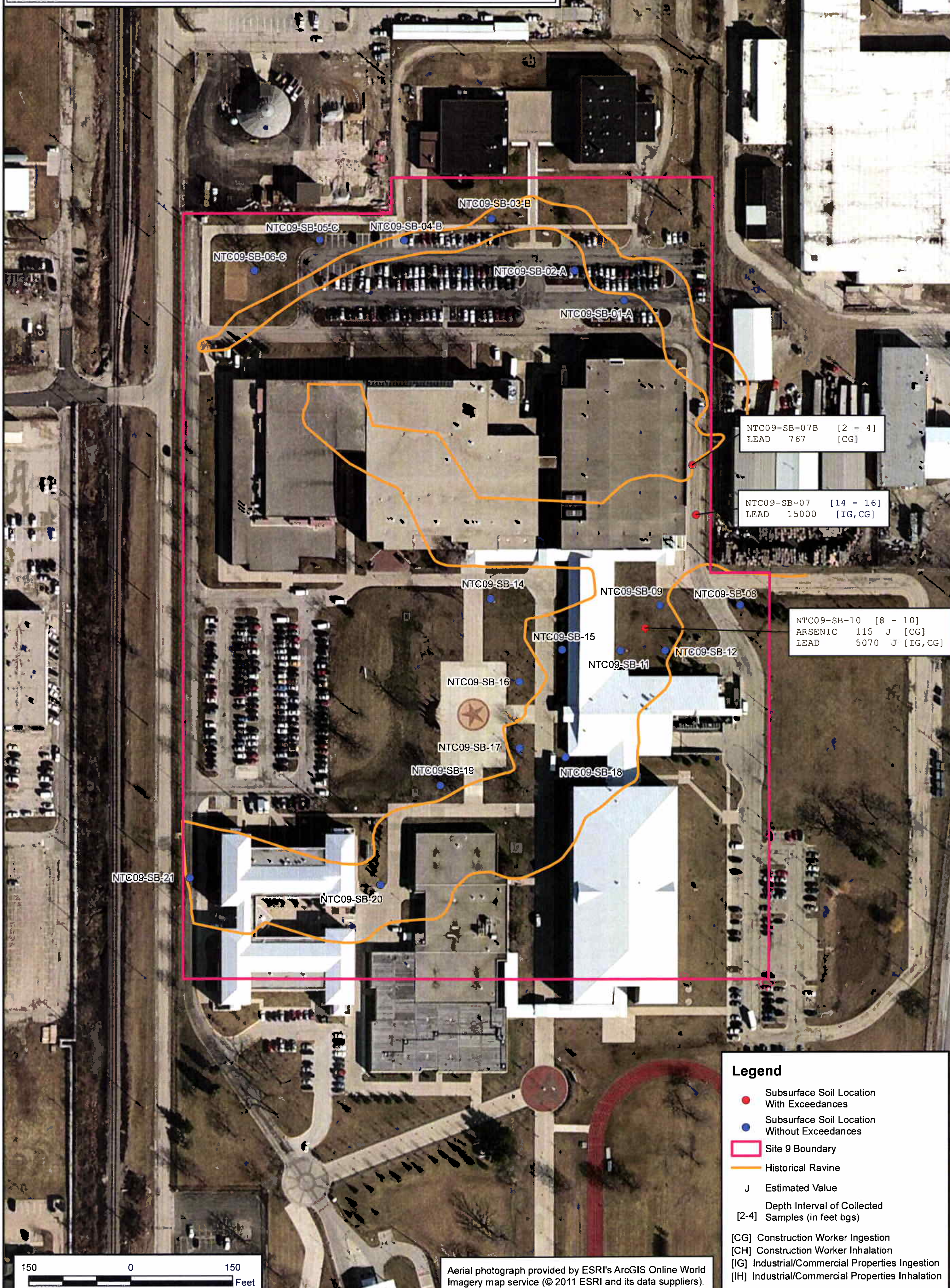
NAVFAC

EXCEEDANCES OF RESIDENTIAL PRGs IN SUBSURFACE SOIL
SITE 9 - CAMP MOFFETT RAVINE FILL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	510
APPROVED BY	DATE 10/8/13
APPROVED BY	DATE
FIGURE NO. 2 - 6	REV 0

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE09_SB_EXCEED_TACO.MXD 09/23/13 DC

	TACO INDUSTRIAL INHALATION	TACO INDUSTRIAL INGESTION	TACO CONSTRUCTION WORKER INGESTION
ARSENIC (mg/kg)	1200	NC	61
BENZO(A)PYRENE (ug/kg)	NC	800	17000
LEAD (mg/kg)	NC	800	700



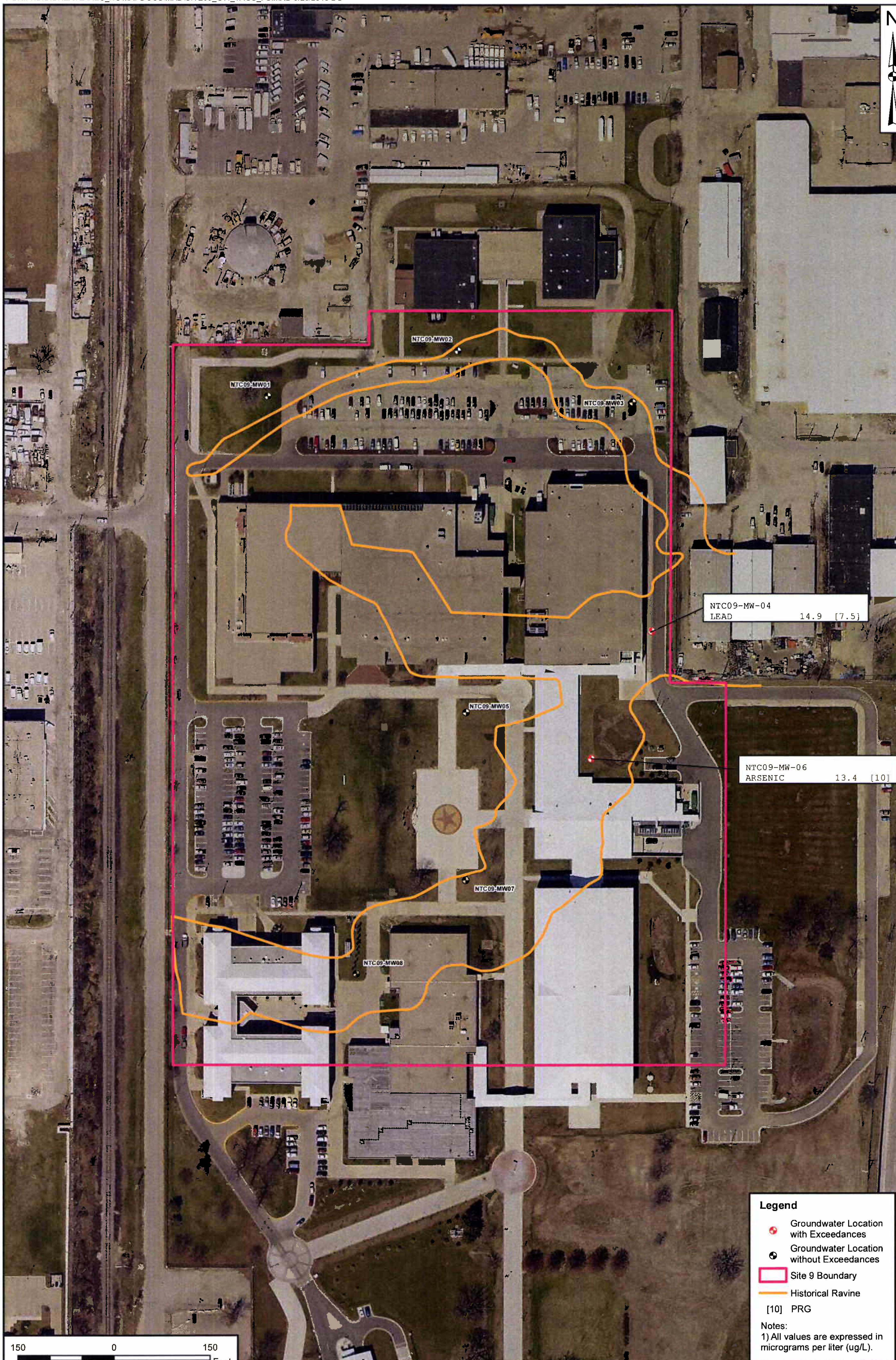
DRAWN BY	DATE
D. COUCH	05/16/13
CHECKED BY	DATE
J. LOGAN	09/23/13
REVISED BY	DATE
D. COUCH	09/23/13
SCALE AS NOTED	

NAVFAC

SUBSURFACE SOIL SAMPLES WITH CONCENTRATIONS GREATER THAN I/C AND CONSTRUCTION WORKER TACO
SITE 9 - CAMP MOFFETT RAVINE FILL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
1489	510
APPROVED BY	DATE
R. DAVIS	09/23/13
APPROVED BY	DATE
—	—
FIGURE NO. 2 - 7	REV 0

PGH:P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE09_GW_TAGS_FS.MXD 9/23/2013 DC



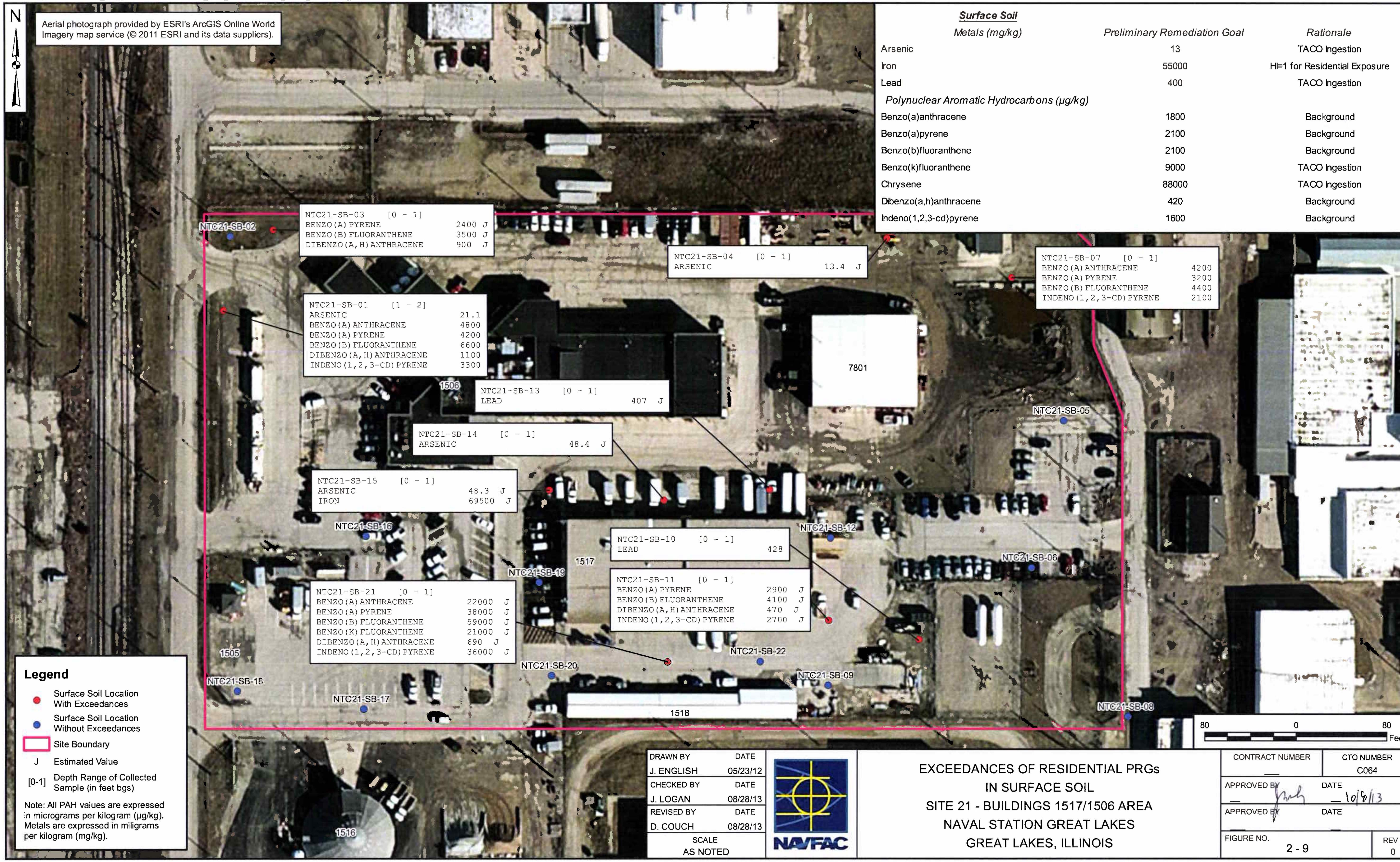
DRAWN BY	DATE
K. MOORE	02/09/10
CHECKED BY	DATE
J. LOGAN	09/23/13
REVISED BY	DATE
D. COUCH	09/23/13
SCALE	
AS NOTED	

NAVFAC

EXCEEDANCES OF GROUNDWATER PRGs
SITE 9 - CAMP MOFFETT RAVINE FILL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
—	F275
APPROVED BY	DATE
[signature]	10/8/13
APPROVED BY	DATE
—	—
FIGURE NO. 2 - 8	REV 0

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE21_PRG_EXCEEDANCE_TAGS_SURFACE_R1.MXD 08/28/13 DC



Surface Soil

Metals (mg/kg)	Preliminary Remediation Goal	Rationale
Arsenic	13	TACO Ingestion
Iron	55000	HI=1 for Residential Exposure
Lead	400	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1800	Background
Benzo(a)pyrene	2100	Background
Benzo(b)fluoranthene	2100	Background
Benzo(k)fluoranthene	9000	TACO Ingestion
Chrysene	88000	TACO Ingestion
Dibenzo(a,h)anthracene	420	Background
Indeno(1,2,3-cd)pyrene	1600	Background

Legend

- ● Surface Soil Location With Exceedances
- ● Surface Soil Location Without Exceedances
- ▭ Site Boundary
- J Estimated Value
- [0-1] Depth Range of Collected Sample (in feet bgs)

Note: All PAH values are expressed in micrograms per kilogram (µg/kg). Metals are expressed in miligrams per kilogram (mg/kg).

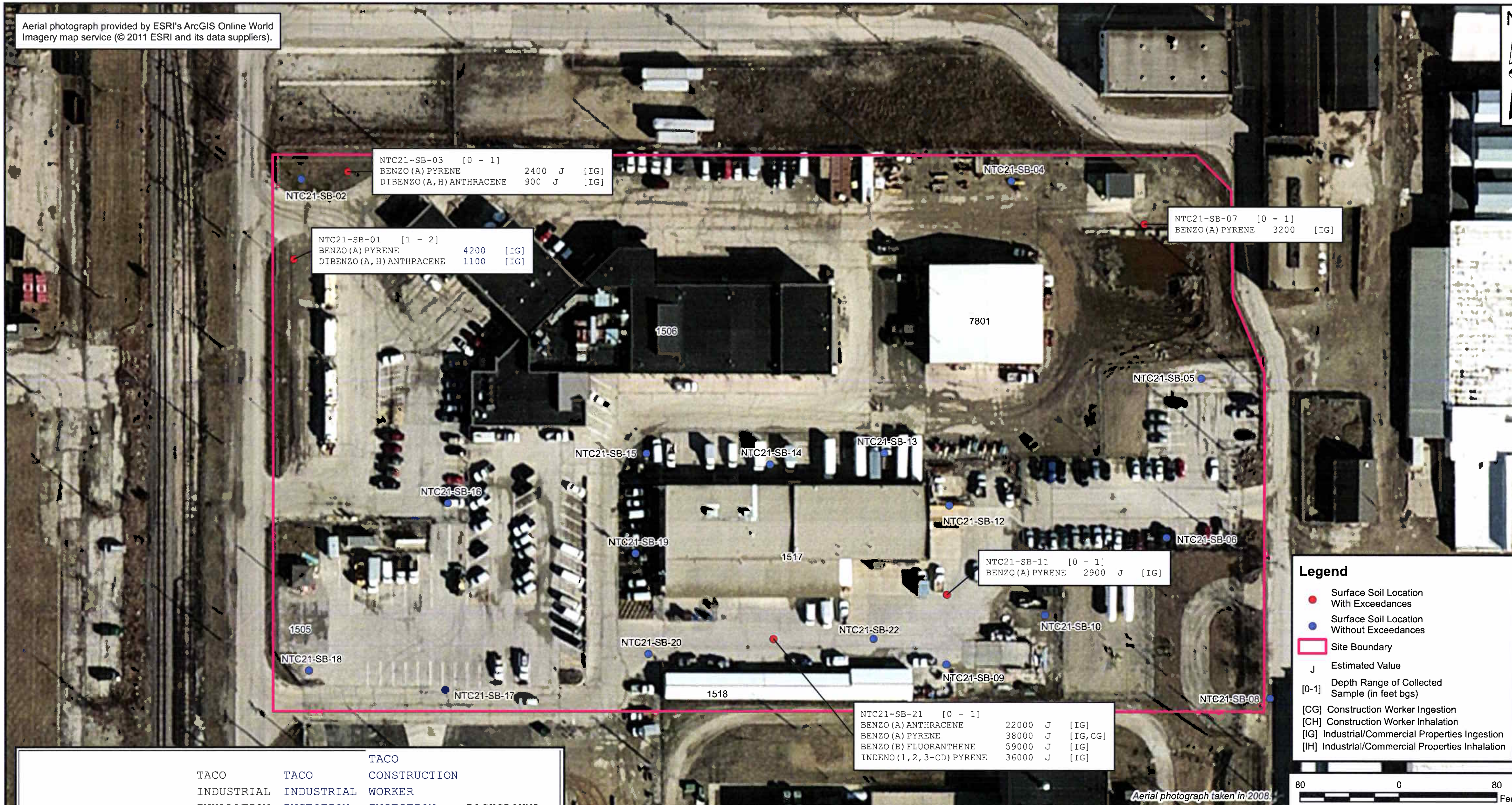
DRAWN BY	DATE
J. ENGLISH	05/23/12
CHECKED BY	DATE
J. LOGAN	08/28/13
REVISED BY	DATE
D. COUCH	08/28/13
SCALE AS NOTED	

NAVFAC

EXCEEDANCES OF RESIDENTIAL PRGs
IN SURFACE SOIL
SITE 21 - BUILDINGS 1517/1506 AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	C064
APPROVED BY [signature]	DATE 10/8/13
APPROVED BY	DATE
FIGURE NO. 2 - 9	REV 0

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE21_SS_EXCEED_TACO_R1.MXD 06/21/13 JEE



	TACO INDUSTRIAL INHALATION (ug/kg)	TACO INDUSTRIAL INGESTION (ug/kg)	TACO CONSTRUCTION WORKER INGESTION (ug/kg)	BACKGROUND (ug/kg)
BENZO(A)ANTHRACENE	NC	8000	170000	1800
BENZO(A)PYRENE	NC	800	17000	2100
BENZO(B)FLUORANTHENE	NC	8000	170000	2100
DIBENZO(A,H)ANTHRACENE	NC	800	17000	420
INDENO(1,2,3-CD)PYRENE	NC	8000	170000	1600

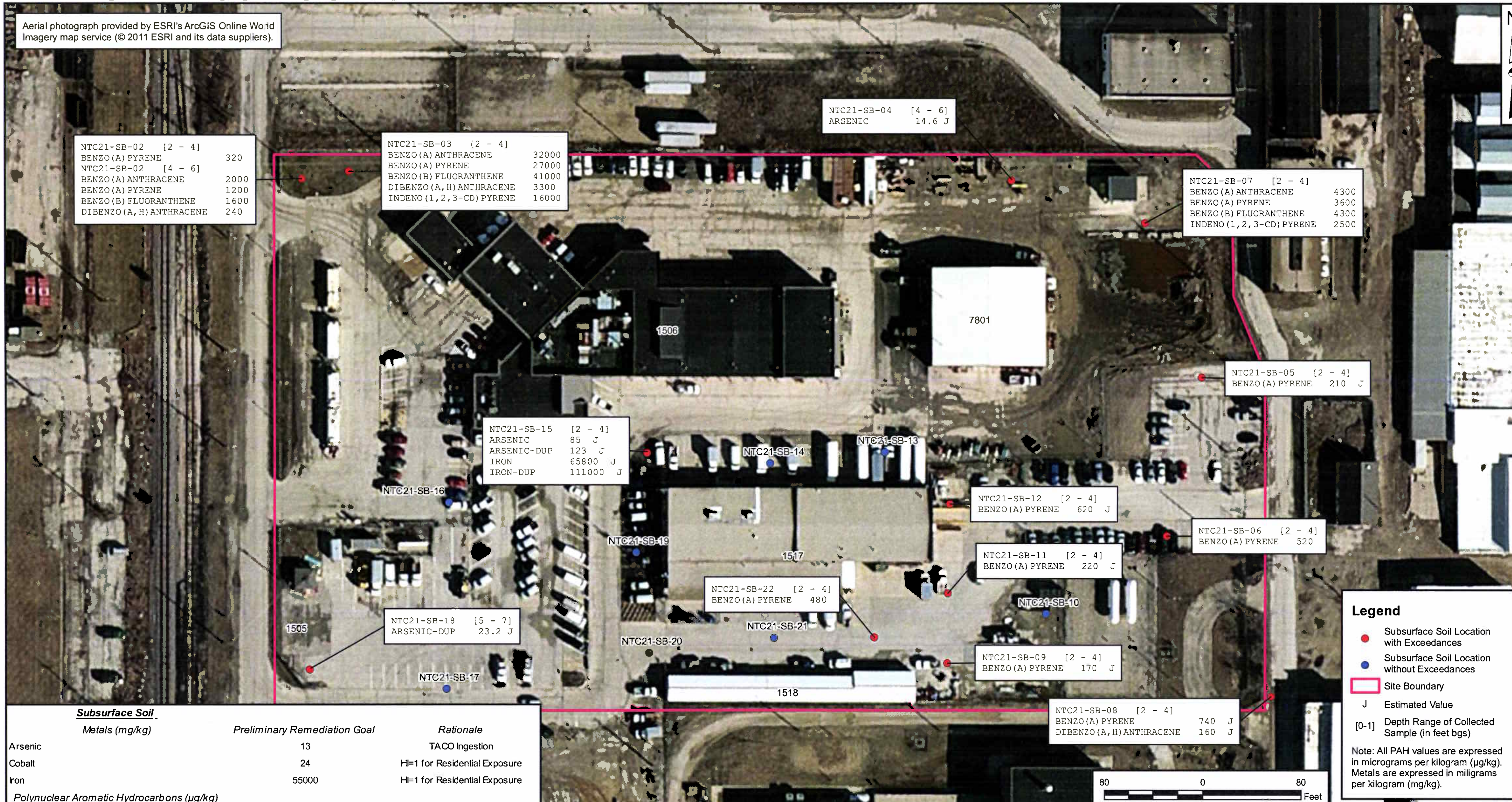
DRAWN BY: D. COUCH	DATE: 05/16/13
CHECKED BY: J. LOGAN	DATE: 06/21/13
REVISED BY:	DATE:
SCALE: AS NOTED	

NAVFAC

SURFACE SOIL SAMPLES WITH CONCENTRATIONS GREATER THAN I/C AND CONSTRUCTION WORKER TACO
SITE 21 - BUILDINGS 1517/1506 AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER: 1797	CTO NUMBER: C064
APPROVED BY: C. RICH	DATE: 06/21/13
APPROVED BY:	DATE:
FIGURE NO.: 2 - 10	REV: 0

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE21_PRG_EXCEEDANCE_TAGS_SUBSURFACE_R1.MXD 08/28/13 DC



Subsurface Soil

Metals (mg/kg)	*Preliminary Remediation Goal*	*Rationale*
Arsenic	13	TACO Ingestion
Cobalt	24	HI=1 for Residential Exposure
Iron	55000	HI=1 for Residential Exposure
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1500	ILCR=1E-5 for Residential Exposure
Benzo(a)pyrene	150	ILCR=1E-5 for Residential Exposure
Benzo(b)fluoranthene	1500	ILCR=1E-5 for Residential Exposure
Benzo(k)fluoranthene	15000	ILCR=1E-5 for Residential Exposure
Chrysene	150000	ILCR=1E-5 for Residential Exposure
Dibenzo(a,h)anthracene	150	ILCR=1E-5 for Residential Exposure
Indeno(1,2,3-cd)pyrene	1500	ILCR=1E-5 for Residential Exposure

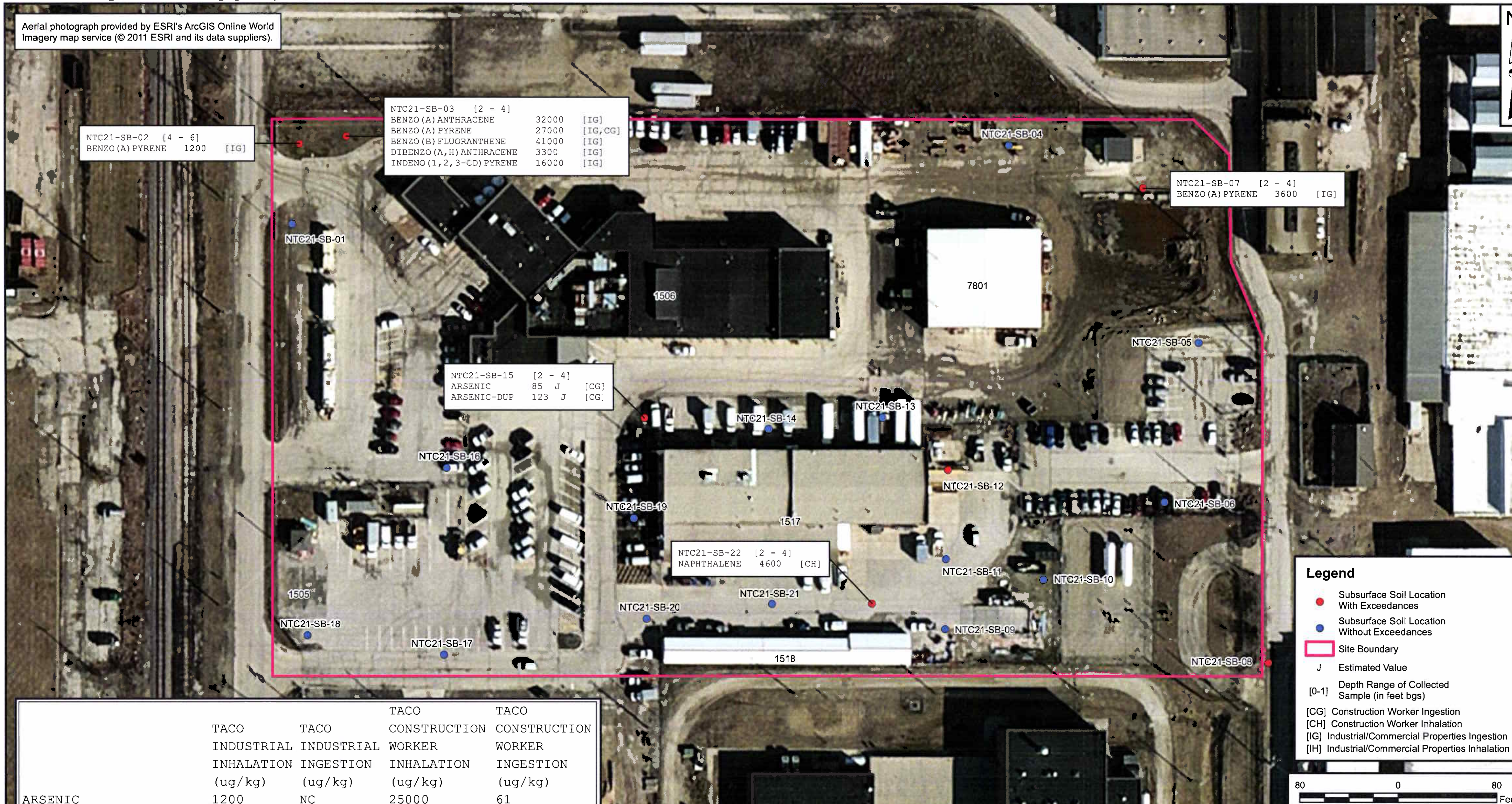
DRAWN BY	DATE
J. ENGLISH	05/23/12
CHECKED BY	DATE
J. LOGAN	08/28/13
REVISED BY	DATE
D. COUCH	08/28/13
SCALE AS NOTED	

NAVFAC

EXCEEDANCES OF RESIDENTIAL PRGs
IN SUBSURFACE SOIL
SITE 21 - BUILDINGS 1517/1506 AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	C064
APPROVED BY	DATE 10/8/13
APPROVED BY	DATE
FIGURE NO. 2 - 11	REV 0

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE21_SB_EXCEED_TACO.MXD 06/21/13 JEE



	TACO INDUSTRIAL INHALATION (ug/kg)	TACO INDUSTRIAL INGESTION (ug/kg)	TACO CONSTRUCTION WORKER INHALATION (ug/kg)	TACO CONSTRUCTION WORKER INGESTION (ug/kg)
ARSENIC	1200	NC	25000	61
BENZO(A)ANTHRACENE	NC	8000	NC	170000
BENZO(A)PYRENE	NC	800	NC	17000
BENZO(B)FLUORANTHENE	NC	8000	NC	170000
DIBENZO(A,H)ANTHRACENE	NC	800	NC	17000
INDENO(1,2,3-CD)PYRENE	NC	8000	NC	170000
NAPHTHALENE	270000	41000000	1800	4100000

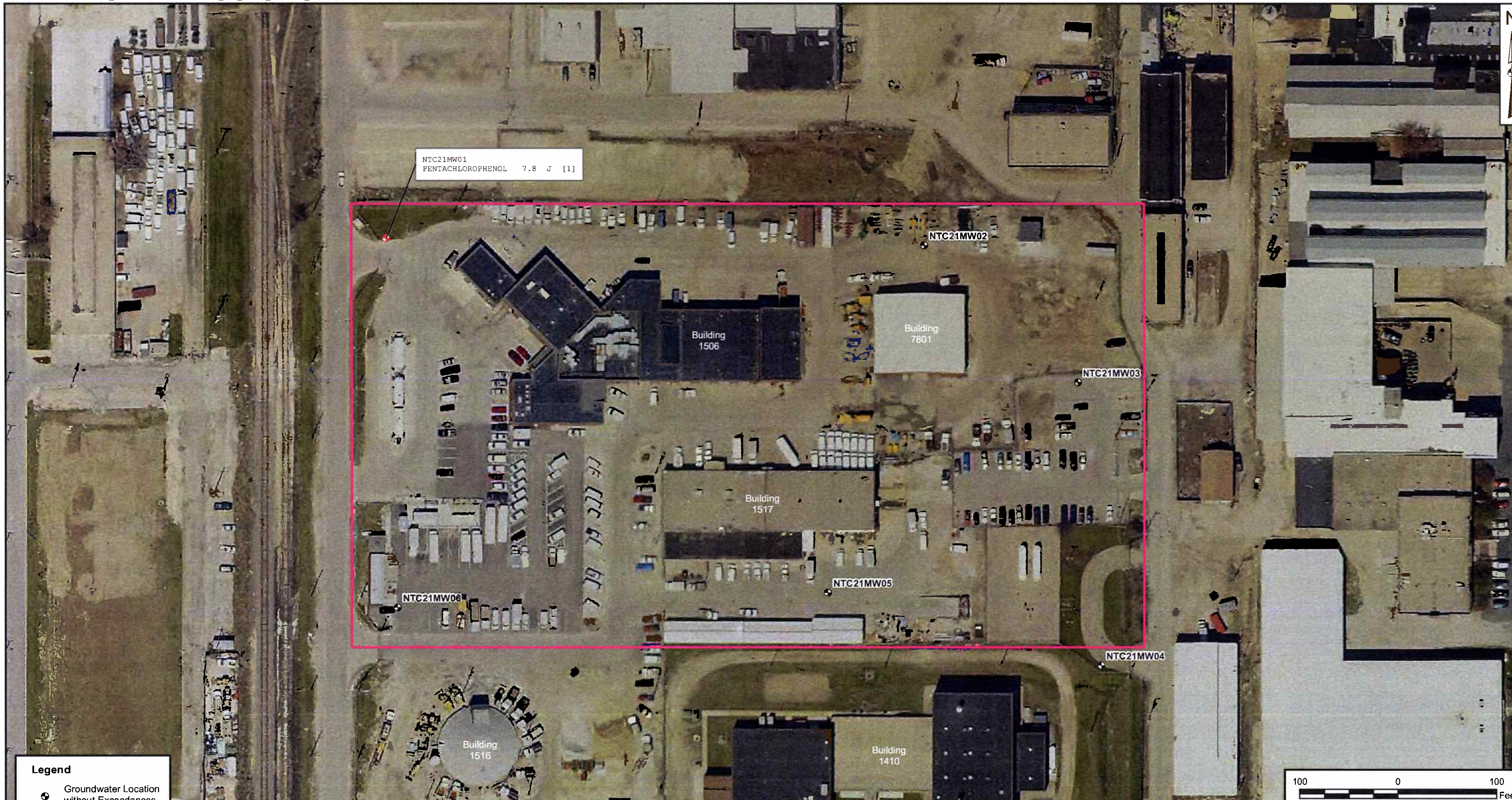
DRAWN BY: D. COUCH	DATE: 05/16/13
CHECKED BY: J. LOGAN	DATE: 06/21/13
REVISED BY	DATE
SCALE: AS NOTED	

NAVFAC

SUBSURFACE SOIL SAMPLES WITH CONCENTRATIONS GREATER THAN I/C AND CONSTRUCTION WORKER TACO
SITE 21 - BUILDINGS 1517/1506 AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER: 1797	CTO NUMBER: C064
APPROVED BY: C. RICH	DATE: 06/21/13
APPROVED BY	DATE
FIGURE NO.: 2 - 12	REV: 0

PGH:P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE21_GW_SVOC_EXCEED_FS.MXD 8/29/2013 DC



DRAWN BY	DATE
S. STROZ	08/08/11
CHECKED BY	DATE
J. LOGAN	08/29/13
REVISED BY	DATE
D. COUCH	08/29/13
SCALE AS NOTED	

NAVFAC

EXCEEDANCES OF GROUNDWATER PRGs
SITE 21 - BUILDINGS 1517/1506 AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	F275
APPROVED BY	DATE 10/8/13
APPROVED BY	DATE
FIGURE NO. 2 - 13	REV 0

3.0 SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS

This section identifies, screens, and evaluates the potential remediation technologies and process options that may be applicable to remedial alternatives for Sites 5, 9, and 21 at NSGL. The primary objective of this phase of the FFS is to develop an appropriate range of remedial technologies and process options that will be used for developing remedial alternatives.

3.1 PRELIMINARY SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL

The preliminary screening of remediation technologies and process options is based on overall applicability to the media of concern, COCs, and specific conditions present at the three sites. Table 3-1 summarizes the preliminary screening of remediation technologies and process options for the GRAs.

TABLE 3-1
REMEDIATION TECHNOLOGIES - SOIL

GRA	Remediation Technology	Process Option
No Action	None	Not applicable
Limited Action	Institutional Controls	LUCs
Containment	Barrier	Pavement or Soil
Removal	Excavation/Disposal	Off-base landfill disposal

3.2 DETAILED SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL

3.2.1 No Action

No Action would consist of “walking away” from the site without implementing any remedial action or performing any monitoring and/or maintenance. As required under CERCLA regulations, the No Action alternative is carried through the FFS to provide a baseline for comparison to other alternatives and their effectiveness in mitigating risks posed by site COCs. The following evaluation also accounts for groundwater.

3.2.1.1 Effectiveness

The No Action alternative would not be effective in reducing risks or meeting the RAOs and PRGs because no exposure control or treatment would be performed. Because no monitoring or maintenance would be performed, the No Action alternative would not be effective in evaluating the potential reduction of COC concentrations. The existing groundwater use restrictions under Base Instruction 11130.1 would remain in place; however, these restrictions could be lifted.

3.2.1.2 Implementability

There would be no implementability concerns because no actions would be implemented.

3.2.1.3 Cost

There would be no costs associated with the No Action alternative.

3.2.1.4 Conclusion

Although it would not be effective, the No Action alternative will be retained for comparison to other options.

3.2.2 Land Use Controls

The Illinois EPA and the Navy have signed a LUC Memorandum of Agreement (MOA) that provides a process for the long-term maintenance of LUCs, and allows the LUCs to be implemented if the property is transferred from the Navy. Based on other LUCs implemented at NSGL and site conditions, the LUCs would include property use restrictions. While the contaminants in soil at the sites are at concentrations that are acceptable for I/C use, the concentrations do not meet Illinois' more restrictive standards for residential properties. Therefore, the area in question may be restricted to I/C (nonsensitive) use.

LUCs to protect construction workers would include notification of the presence of contaminants in the soil, requirements to provide appropriate personal protective equipment (PPE) and methods to reduce and minimize exposure, and requirements for proposer management of excavated soil.

3.2.2.1 Effectiveness

LUCs alone would not effectively reduce concentrations of COCs. However, LUCs would be an effective tool to prevent future exposure to the COCs.

3.2.2.2 Implementability

LUCs have been implemented throughout NSGL and could be readily implemented at this site.

3.2.2.3 Cost

Costs to implement and maintain the LUCs would be low.

3.2.2.4 Conclusion

LUCs are retained for the development of remedial alternatives for soil.

3.2.3 Containment

The technology considered under this GRA is covers or barriers. Barriers would consist of installing pavement or maintaining the existing pavement, or placing approximately 2 feet of clean soil over contamination to prevent direct exposure.

3.2.3.1 Effectiveness

Barriers would not of itself remove the soil COCs or reduce their toxicity. Nonetheless, using barriers is a well-established and proven technology that would be effective in preventing direct exposure to contaminated soil. Long-term maintenance of the barrier through a LUC would ensure the continued effectiveness of the barrier. Because the effectiveness of a barrier depends on the strict maintenance of its integrity, this technology is typically incompatible with residential development that would make such maintenance very difficult. Barriers can sometimes be difficult to maintain in I/C scenarios, although barriers are typically under single ownership and easier to control.

3.2.3.2 Implementability

Installation of and maintenance of the existing pavement at Sites 5 and 21 and soil at Site 9 would be relatively easy to implement. Materials and services required to implement this technology are readily available. The maintenance of a barrier may also restrict future use of the site. Risk of worker exposure to contaminated soil during barrier repair and maintenance would be adequately mitigated by the wearing of appropriate PPE and by compliance with Occupational Safety and Health Act (OSHA) regulations and site-specific health and safety procedures. Adverse impact on the surrounding community and the environment as a result of the installation of a barrier could also be adequately mitigated by the implementation of engineering controls such as dust suppression and air quality monitoring.

3.2.3.3 Cost

The capital and O&M costs for barriers would be low to moderate.

3.2.3.4 Conclusion

Barriers are retained for the development of soil remedial alternatives for industrial use of the site. Barriers would be used to prevent exposure.

3.2.4 Removal

The only technology considered for removal is mechanical excavation. Mechanical excavation of the impacted soil would be performed using excavators. After excavation is completed, the location would be filled and graded with clean fill material. Excavated materials would be transported offsite for disposal in a non-hazardous waste landfill.

3.2.4.1 Effectiveness

Mechanical excavation would not reduce concentrations of COCs in the impacted soil, but would be an effective means for addressing soil with COC concentrations greater than PRGs at each site in order to open the property to unrestricted use.

3.2.4.2 Implementability

Mechanical excavation of soil would be implementable, and the necessary resources, equipment, and materials would be readily available. However, if buildings and utilities must remain intact, then implementability will be more difficult due to shoring of buildings and re-routing of utilities. It is anticipated that, based on results from the RI of each site, excavated material could be disposed in a non-hazardous waste landfill.

3.2.4.3 Cost

The cost of mechanical excavation would be moderate.

3.2.4.4 Conclusion

Mechanical excavation is retained for the development of remedial alternatives.

3.3 PRELIMINARY SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER

The preliminary screening of remediation technologies and process options is based on overall applicability to the media of concern, COCs, and specific conditions present at the three sites. Table 3-2 summarizes the preliminary screening of remediation technologies and process options for the GRAs.

TABLE 3-2
REMEDIATION TECHNOLOGIES - GROUNDWATER

GRA	Remediation Technology	Process Option
No Action	None	Not applicable
Limited Action	Institutional Controls	LUCs
	Monitoring	Sampling and Analysis
Removal	Extraction (and Treatment)	Extraction Wells
In-Situ Treatment	Biological	Anaerobic/Aerobic
	Chemical	Chemical Oxidation

3.4 DETAILED SCREENING OF REMEDIATION TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER

3.4.1 Limited Action

The technologies considered under this GRA are LUCs and monitoring.

3.4.1.1 LUCs

The Illinois EPA and the Navy have signed a LUC MOA that provides a process for the long-term maintenance of LUCs, and allows the LUCs to be implemented if the property is transferred from the Navy. Based on other LUCs implemented at NSGL and site conditions, the LUCs would include property use restrictions.

Because there are elevated concentrations of contaminants in groundwater at each site, the existing groundwater use restrictions (per Base Instruction 11130.1) would be incorporated into the LUCs for each site to address groundwater beneath Sites 5, 9, and 21.

Effectiveness

LUCs alone would not effectively reduce concentrations of COCs. However, LUCs would be an effective tool to prevent future exposure to the COCs. For groundwater, a LUC would be more effective than the existing restrictions because a LUC would be a permanent control through a LUC Implementation Plan (LUCIP), and would be included as part of a deed restriction if the property were to be transferred.

Implementability

LUCs have been implemented throughout NSGL and could be readily implemented at this site.

Cost

Costs to implement and maintain the LUCs would be low.

Conclusion

LUCs are retained for the development of remedial alternatives for groundwater.

3.4.1.2 Monitoring

Sampling and analysis of groundwater would be used to evaluate changes in concentrations.

Effectiveness

Monitoring would not of itself reduce the toxicity, mobility, or volume of COCs in groundwater, but it would allow the evaluation of the reductions in their concentrations through natural attenuation or active remediation.

Implementability

A groundwater monitoring program could be readily implemented and is routinely performed at other sites. Monitoring well installation and operation and maintenance would need to comply with applicable federal and State regulations.

Cost

Capital and O&M costs of monitoring would be low.

Conclusion

Monitoring is retained in combination with other process options.

3.4.2 Removal

The only technology and process option considered under this GRA is groundwater extraction with wells.

3.5.2.1 Extraction Wells

Wells would be drilled into the aquifer and screened below the water table to access the groundwater. Pumping would be used to extract the water as it collects in the wells and bring it to the surface. The process of extraction would create a hydraulic gradient that would induce further flow of groundwater into the well. Extraction wells placed within the contaminated plume could be used to clean the aquifer by removing the contaminated groundwater and flushing the saturated zone. The flushing action would occur when water from upgradient (clean) areas replaces the extracted contaminated groundwater and causes more contaminants to desorb from saturated zone soil. Thus, theoretically, the saturated zone soil would progressively lose contaminants until the concentrations in groundwater are at acceptable levels. The selection of the appropriate well system depends on the depth of contamination and the hydrologic and geologic characteristics of the aquifer.

Extraction pumps are typically submersible, electrically operated, centrifugal pumps or pneumatically operated ejector pumps. For shallow groundwater extraction (depths up to 10 feet), surface pumps may be used. Centrifugal pumps are not practical for use at low extraction rates less than 1 gpm, and, in such cases, pneumatic ejector pumps are preferred.

Effectiveness

Extraction wells are not likely to be effective at any of the sites. The results of the subsurface investigations show that the shallow aquifer in the vicinity of the contaminated groundwater consists of clay and sand clay mixtures. The groundwater yield is low, so extraction of groundwater is not likely to be very effective.

Implementability

Extraction wells are relatively easily installed, and pumps are widely available for a variety of flow rates and aquifer conditions. Implementation of this technology would require long-term operation and maintenance (O&M). Well screens would require regular inspection and well flushing to remove fine-grained material that may clog the wells. Pumps would also require regular preventive maintenance. Installation of extraction wells would need to comply with state and location regulations. Extracted groundwater would require treatment prior to disposal/discharge. Placement of wells and piping may interfere with current site operations.

Cost

The capital and O&M costs of extraction wells are low although the costs of the treatment plant are high.

Conclusion

Extraction wells are eliminated for the development of groundwater remedial alternatives.

3.4.3 In-Situ Treatment

The technologies considered under this GRA are enhanced bioremediation and chemical oxidation.

3.4.3.1 In-Situ Enhanced Bioremediation

In-situ enhanced bioremediation involves the use of microorganisms, primarily bacteria, actinomycetes, and fungi, to breakdown hazardous organic compounds into nontoxic or less toxic forms. In-situ enhanced bioremediation consists of using an electron-donor compound to cause reductive dehalogenation and/or an oxygen-releasing compound to enhance the growth of indigenous microorganisms and natural biodegradation processes. The bioremediation chemicals would be injected throughout the contaminated groundwater.

For Sites 5 and 21, in-situ bioremediation would consist of an electron-donor compound such as a sodium lactate or emulsified vegetable oil substrate, such as emulsified oil substrate to enhance the anaerobic dechlorination of the chlorinated contaminants. Carbon tetrachloride and PCP can be transformed to chloride, carbon dioxide, and water though anaerobic biological process. The electron donor compound would be injected into the contaminated zones using multiple direct push technology (DPT) injection points and/or permanent wells.

Bioremediation processes are not applicable to inorganics such as arsenic at Site 9.

Effectiveness

Bioremediation is a fairly well-proven technology for the complete dehalogenation of non-degraded chlorinated solvents from groundwater. However, although increasingly documented, the effectiveness of this technology still typically needs to be demonstrated through site-specific treatability testing.

Implementability

In-situ enhanced bioremediation could be implemented at Sites 5 and 21. Many qualified contractors would be available for the implementation of this technology. However, because of the high clay content and heterogeneity of the aquifer, distribution of the electron donor compound will be difficult. A combination of DPT injection and permanent wells would be used. Placement of injection points may interfere with current site operations.

Cost

Capital and O&M costs for in-situ enhanced bioremediation would be moderate to high.

Conclusion

In-situ enhanced bioremediation is eliminated for the development of groundwater remedial alternatives, primarily because it cannot be applied at Site 9.

3.4.3.2 In-Situ Chemical Oxidation

In-situ chemical oxidation (ISCO) involves the injection of chemical agents into the contaminant plume. These chemical agents promote the generation of highly reactive hydroxyl radicals that react with COCs such as chlorinated VOCs and result in the oxidative cleavage of the carbon-to-carbon bond, yielding water, carbon dioxide, oxygen, and dilute hydrochloric acid as by-products.

The chemical agents used for this purpose have included powerful oxidants such as iron-catalyzed hydrogen peroxide (known as Fenton's Reagent), sodium persulfate, or potassium permanganate. More recently, milder oxidants such as catalytically complexed sodium percarbonate (marketed as RegenOx™) have also been successfully used.

Similar to in-situ bioremediation additives, in-situ chemical oxidation reagents are generally injected into the contaminant plumes using multiple DPT injection points and/or injection wells.

Oxidation of inorganics such as iron, manganese, and arsenic to promote precipitation can be accomplished using chemical oxidizers described above and with less aggressive sources of oxygen, such as oxygen-releasing chemicals, compressed air, and compressed oxygen. Oxidation of iron and manganese will also promote the formation of compounds and complexes that bind arsenic. Oxygen Release Compound™ (ORC™) by Regenesis is a magnesium peroxide that is injected into the groundwater and then slowly releases oxygen. Oxygen can also be introduced to the groundwater with compressed air through sparging wells that allow the air to bubble through the groundwater. Compressed oxygen can be introduced to the groundwater through specialized sparging devices. The high pressure increases the solubility of the oxygen to promote faster oxidation.

Effectiveness

In-situ chemical oxidation with strong oxidants such as Fenton's Reagent and persulfate is a well-established technology that could be effective for the destruction of carbon tetrachloride at Site 5. Fenton's reagent, permanganate, and persulfate are effective for the treatment of PCP at Site 21. Low dosages of hydrogen peroxide at an elevated pH may be effective at reducing the concentrations of arsenic at Site 9. Treatability studies, either at bench-scale or pilot-scale may be required.

In-situ chemical oxidation with either strong or mild oxidants may not be cost effective for the removal of the COCs to the very low concentrations that are typically required to meet groundwater PRGs and to restore aquifer quality. This generally requires dosages of oxidants much in excess of stoichiometry and/or multiple applications.

The effectiveness of in-situ chemical oxidation can also be impacted by high clay content and heterogeneous subsurface conditions such as are known to be present at the sites. These conditions could result in uneven distribution of the injected chemical agents and incomplete contact of these agents with the groundwater COCs.

Implementability

In-situ chemical oxidation could be implemented at all three sites. However, the number of qualified contractors specializing in the application of this technology is relatively limited. However, because of the high clay content and heterogeneity of the aquifer, distribution of the oxidant will be difficult. A combination of DPT injection and permanent wells would be used, although placement of injection points may interfere with current site operations. The results of the treatability studies would need to be evaluated to refine the implementation of this technology.

Cost

Capital and O&M costs for in-situ chemical oxidation would be moderate to high.

Conclusion

In-situ chemical oxidation is retained in combination with other technologies and process options for the development of remedial alternatives. For the purposes of the FFS, oxidation of arsenic and other inorganic compounds using an oxidizer rather than an oxygen source will be retained.

4.0 ASSEMBLY OF REMEDIAL ALTERNATIVES

4.1 INTRODUCTION

In this section, the remedial technologies retained from the components selected in Section 3.0 are assembled into remediation alternatives for Sites 5, 9, and 21. Detailed and comparative evaluations of these remedial alternatives with respect to the criteria of the NCP of 40 Code of Federal Regulations (CFR) Part 300, as revised in 1990, are presented in Sections 5.0, 6.0, and 7.0 for Sites 5, 9, and 21, respectively. The criteria required by the NCP and the relative importance of these criteria are described in the following subsections.

4.1.1 Evaluation Criteria

In accordance with the NCP (40 CFR 300.430), the following nine criteria are used for the evaluation of remedial alternatives:

- 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.
- State Acceptance.
- Community Acceptance.

4.1.2 Relative Importance of Criteria

Among the nine criteria, the threshold criteria are considered to be:

- Overall Protection of Human Health and the Environment
- Compliance with ARARs (excluding those that may be waived)

The threshold criteria must be satisfied for an alternative to be eligible for selection.

Among the remaining criteria, the following five criteria are considered to be the primary balancing criteria:

- Long-Term Effectiveness and Permanence.
- Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment.
- Short-Term Effectiveness.
- Implementability.
- Cost.

The balancing criteria are used to weigh the relative merits of alternatives.

The remaining two (state and community acceptance) are considered to be modifying criteria that must be considered during remedy selection. Both state acceptance and community acceptance are addressed in the ROD once comments on the RI/FFS report and Proposed Plan have been received.

4.1.3 Selection of Remedy

The selection of a remedy is a two-step process. The first step consists of identification of a preferred alternative, and presentation of the alternative in a Proposed Plan to the community for review and comment.

The second step consists of the Navy's review of the public comments and a determination of whether or not the preferred alternative continues to be the most appropriate remedial action for the site, in consultation with Illinois EPA.

4.2 ASSEMBLY OF REMEDIAL ALTERNATIVES

This section develops the remedial alternatives for Sites 5, 9, and 21. Additional site-specific information and assumptions are provided in Sections 5.0 through 7.0 to further explain the alternative development process for each site.

Based on the technology screening presented in Section 3.0, the following remedial alternatives were developed for Sites 5, 9, and 21:

4.2.1 Site 5

- Alternative 5-1: No Action.
- Alternative 5-2: LUCs and Barrier.
- Alternative 5-2A: LUCs, Barrier, and ISCO.
- Alternative 5-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and Groundwater LUCs.
- Alternative 5-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, Groundwater LUCs, and ISCO.

Alternative 5-1 was developed and analyzed to serve as a baseline for other alternatives, as required by CERCLA and the NCP. Alternative 5-2 was developed and analyzed to evaluate a passive approach to the site, and Alternative 5-2A was developed and analyzed with a passive approach to soil, but with an active treatment approach to groundwater. Alternative 5-3 was formulated and analyzed to evaluate a complete soil removal remedy and passive approach to groundwater, and Alternative 5-3A was developed along the lines of Alternative 5-3, but with an active treatment approach to groundwater. Note that the LUCs component for Alternative 5-2 includes soil and groundwater, and the LUCs component for Alternative 5-3 includes groundwater only. A description and detailed analysis of these alternatives are presented in Section 5.0.

4.2.2 Site 9

- Alternative 9-1: No Action.
- Alternative 9-2: LUCs and Barrier.
- Alternative 9-2A: LUCs, Barrier, and ISCO.
- Alternative 9-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and Groundwater LUCs.
- Alternative 9-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, Groundwater LUCs, and ISCO.

Alternative 9-1 was developed and analyzed to serve as a baseline for other alternatives, as required by CERCLA and the NCP. Alternative 9-2 was developed and analyzed to evaluate a passive approach to the site, and Alternative 9-2A was developed and analyzed with a passive approach to soil, but with an active treatment approach to groundwater. Alternative 9-3 was formulated and analyzed to evaluate a complete soil removal remedy and passive approach to groundwater, and Alternative 9-3A was developed along the lines of Alternative 9-3, but with an active treatment approach to groundwater. Note that the LUCs component for Alternative 9-2 includes soil and groundwater, and the LUCs component for

Alternative 9-3 includes groundwater only. A description and detailed analysis of these alternatives are presented in Section 6.0.

4.2.3 Site 21

- Alternative 21-1: No Action.
- Alternative 21-2: LUCs and Barrier.
- Alternative 21-2A: LUCs, Barrier, and ISCO.
- Alternative 21-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and Groundwater LUCs.
- Alternative 21-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, Groundwater LUCs, and ISCO.

Alternative 21-1 was developed and analyzed to serve as a baseline for other alternatives, as required by CERCLA and the NCP. Alternative 21-2 was developed and analyzed to evaluate a passive approach to the site, and Alternative 21-2A was developed and analyzed with a passive approach to soil, but with an active treatment approach to groundwater. Alternative 21-3 was formulated and analyzed to evaluate a complete soil removal remedy and passive approach to groundwater, and Alternative 21-3A was developed along the lines of Alternative 21-3, but with an active treatment approach to groundwater. Note that the LUCs component for Alternative 21-2 includes soil and groundwater, and the LUCs component for Alternative 21-3 includes groundwater only. A description and detailed analysis of these alternatives are presented in Section 7.0.

5.0 DETAILED AND COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES FOR SITE 5

5.1 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

5.1.1 Alternative 5-1: No Action

5.1.1.1 Description

This alternative is a "walk-away" alternative required under CERCLA to establish a basis for comparison with other alternatives. Under this alternative, the property would be released for unrestricted use. Existing groundwater use restrictions would remain in place. In addition, there would be no Five-Year Review required to assess contamination at the site over time. This alternative could only be chosen if it is determined that taking no action would be protective of human health and the environment.

5.1.1.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 5-1 would not provide protection of human health and the environment. The potential for exposure of human receptors to contaminated soil via ingestion and dermal contact would remain unchanged. The existing groundwater use restrictions would be protective of human health; however, these restrictions could be lifted.

Compliance with ARARs and TBCs

Alternative 5-1 would not comply with chemical-specific ARARs and TBCs for soil because no action would be taken to reduce COC concentrations. The existing groundwater use restrictions comply with chemical-specific ARARs and TBCs for groundwater; however, these restrictions could be lifted. No location-specific or action-specific ARARs are associated with this alternative. Chemical-specific ARARs and TBCs for Alternative 5-1 are listed in Table 2-1.

Long-Term Effectiveness and Permanence

Alternative 5-1 would have no long-term effectiveness or permanence because nothing would be done to reduce concentrations of soil COCs or to reduce human exposure to site contaminants. The existing groundwater use restrictions would not provide long-term effectiveness or permanence because they are

not permanent and could be revoked. Unlike deed restrictions or similar covenants, the groundwater use restrictions do not run with the land.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 5-1 would not reduce the toxicity, mobility, or volume of COCs through treatment because no soil or groundwater treatment would occur.

Short-Term Effectiveness

Because no action would occur, implementation of Alternative 5-1 would not pose risks to on-site remediation workers or result in short-term adverse impact to the local community or the environment.

Alternative 5-1 would not achieve the RAOs or the PRGs, and would also have no life cycle sustainability impacts.

Implementability

Because no action would occur, Alternative 5-1 would be readily implementable. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable. The remedy would be implementable if ultimately selected in the Record of Decision.

Cost

There would be no costs associated with Alternative 5-1.

5.1.2 Alternative 5-2: LUCs and Barrier

5.1.2.1 Description

Alternative 5-2 would consist of two major components: (1) LUCs and (2) barrier.

The existing pavement would be used as a barrier to prevent exposure by I/C workers to soil contaminants exceeding I/C TACO criteria. Most of the site is covered by a combination of asphalt pavement (approximately 3 inches thick), concrete (approximately 6 inches thick), and building foundation (assumed to be at least 6 to 12 inches thick). The extent of coverage of the site is approximately 55 percent asphalt, 20 percent concrete, and 20 percent building foundation. Approximately 5 percent of the site, near the edges, is unpaved. The pavement would be inspected and repaired as needed to maintain protection. Figure 5-1 shows the extent of the barrier.

A LUC Remedial Design (RD) would be prepared in accordance with the Navy's LUC Principles (DoD, 2003) to establish methods to prevent exposure to COCs, and to restrict the disturbance of contaminated soil. LUCs would be implemented in accordance with the LUCMOA. Specifically, LUCs would be implemented to prevent residential land use, restrict unauthorized construction, require notification of the presence of contaminants to construction workers, require review of construction activities and intrusive work in the area to protect workers through PPE and alternative methods to reduce exposure, require proper management of excavated material, provide for long-term inspection of LUCs, and provide requirements for dealing with changes in land use or site features. LUCs would also require routine inspection of the pavement and repairs to the pavement to prevent exposure to contaminated soil. The areas to which the LUCs would apply would be identified and surveyed by an Illinois Licensed Professional Land Surveyor.

LUCs would also be implemented to restrict groundwater use. The LUCs would be specifically implemented through a LUC RD to continue the restrictions found in the existing NSGL Base Instruction 11130.1 that prohibit the use of groundwater. The LUCs would be permanent in the event of a change in land use or ownership. Figure 5-1 shows the extent of the area covered by LUCs.

Five-Year Reviews would be required since concentrations of contaminants would remain in soil and groundwater above levels acceptable for unrestricted use at the site.

5.1.2.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 5-2 would provide protection to human health by minimizing exposure to contaminated soil through LUCs and maintenance of the barrier and by preventing exposure to contaminated groundwater. No risks to the environment were identified.

Compliance with ARARs and TBCs

Chemical- and action-specific ARARs and TBCs for this alternative are listed in Tables 2-1 and 2-3, respectively. There are no location-specific ARARs associated with this alternative.

Risk-based chemical-specific TBCs [cancer slope factors (CSFs), reference doses (RfDs), USEPA Guidance documents, and Illinois TACO values] will be met through a combination of barriers and LUCs which prevent exposure and eliminate risk. Compliance with groundwater quality standard regulations will be attained by meeting the requirements for Alternative Groundwater Quality Restoration by implementing groundwater LUCs to prevent groundwater use and through natural attenuation. NSGL is in the Metropolitan Statistical Area, so the background soil concentrations in 35 IAC 742 for this area are used in the development of PRGs.

Action-specific ARARs and TBCs will be met. No wastes would be generated for this alternative, so hazardous waste characterization and generator management regulations and Illinois special waste regulations are not pertinent. Fugitive dust would be controlled as needed during maintenance of the barrier, such as replacement of paving. If the property is transferred to a non-federal owner, then LUCs will be recorded in the deed in accordance with the Uniform Environmental Covenants Act (UECA).

Long-Term Effectiveness and Permanence

Alternative 5-2 would be an effective means of minimizing exposure to contaminants in site soil and groundwater over the long term. The permanence of Alternative 5-2 would depend on the maintenance of the LUCs and barrier, verification that the land use is being properly controlled, and verification that groundwater is not being used. In addition, this alternative would require that Five-Year Reviews be conducted to assess the protectiveness and effectiveness of the LUCs.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 5-2 would not reduce the toxicity, mobility, or volume of COCs through treatment because no treatment would occur.

Short-Term Effectiveness

Implementation of Alternative 5-2 would not pose risks to on-site remediation workers or result in short-term adverse impact to the local community or the environment. Alternative 5-2 could be implemented within approximately 3 months and would achieve the RAOs 1 and 2 upon implementation by restricting exposure to soil at the site. RAO 3 is currently being met by existing controls, and implementation of the groundwater LUC would provide a permanent restriction.

Overall, the sustainability impact of Alternative 5-2 is low based on a sustainability analysis using Site Wise™ (see Appendix C). Emissions of CO_2, CH_4, and N_2O were normalized to carbon dioxide equivalents (CO_2e), which is a cumulative method of weighing greenhouse gas (GHG) emissions relative to global warming potential. Alternative 5-2 contained low GHG emissions (0.76 ton). Criteria pollutant emissions associated with Alternative 5-2 for nitrous oxides (NO_x), sulfur oxides (SO_x), and particulate matter with a diameter of 10 micrometers or less (PM_{10}) emissions were $2.8x10^{-4}$, $9.8x10^{-6}$, and $5.7x10^{-5}$ ton, respectively. Energy demand for Alternative 5-2 was low [8.6 million British Thermal Units (MMBTU)]. There is no direct water consumption associated with Alternative 5-2.

Implementability

Alternative 5-2 would be easily implemented since LUCs are already in place at other sites at NSGL. Inspection and maintenance of the barrier can be easily performed. Preparation of a LUC RD would be readily accomplished.

Cost

The estimated costs for Alternative 5-2 are shown below and a detailed cost estimate is provided in Appendix D.

- Capital Cost: $21,000
- Annual Cost: $9,000
- 5 Year Cost: $26,000
- 30-Year Net Present Worth (NPW): $366,000

This cost is for the remediation of this site independent of the other two sites. Remediation of all three sites is expected to be performed as part of a single project, so the actual cost for this site will be lower due to economies of scale.

5.1.3 Alternative 5-2A: LUCs, Barrier, and ISCO

5.1.3.1 Description

Alternative 5-2A would consist of three major components: (1) LUCs, (2) barrier, and (3) ISCO for groundwater treatment.

The existing pavement would be used as a barrier to prevent exposure by I/C workers to soil contaminants exceeding I/C TACO criteria. The pavement would be inspected and repaired as needed to maintain protection. Figure 5-2 shows the extent of the barrier.

A LUC RD would be prepared in accordance with the Navy's LUC Principles (DoD, 2003) to establish methods to prevent exposure to COCs, and to restrict the disturbance of contaminated soil. LUCs would be implemented in accordance with the LUCMOA. Specifically, LUCs would be implemented to prevent residential land use, restrict unauthorized construction, require notification of the presence of contaminants to construction workers, require review of construction activities and intrusive work in the area to protect workers through PPE and alternative methods to reduce exposure, require proper management of excavated material, provide for long-term inspection of LUCs, and provide requirements for dealing with changes in land use or site features. LUCs would also require routine inspection of the pavement and repairs to the pavement to prevent exposure to contaminated soil. The areas to which the LUCs would apply would be identified and surveyed by an Illinois Licensed Professional Land Surveyor.

LUCs would also be implemented to restrict groundwater use. These are required throughout the site, but are expected to be short-term where ISCO is applied and PRGs are met. The LUCs would be specifically implemented through a LUC RD to continue the restrictions found in the existing NSGL Base Instruction 11130.1 that prohibit the use of groundwater. The LUCs would be permanent in the event of a change in land use or ownership. Figure 5-2 shows the extent of the area covered by LUCs.

For the purposes of the development of this alternative, ISCO would consist of injection of Fenton's reagent to treat carbon tetrachloride. Other oxidants, such as persulfate, should be considered during remedial design. Oxidant injection would use injection wells so that multiple injections can be performed, if needed. The injection system would consist of a grid of injection wells over a 50-foot by 50-foot area centered on well MW05. Because of the low COC concentrations, high clay content, and heterogeneity, it is assumed that two injection events would be required to achieve chemical oxidation of the COCs. The area to be treated is shown on Figure 5-2. Thirty-two wells based on a 10-foot grid and 1,700 gallons of 7-percent (by weight) solution of Fenton's reagent are estimated to be required. A bench and/or pilot study would be performed to confirm well spacing and oxidant application rates.

Prior to the ISCO remedial design, groundwater samples would be collected from existing monitoring wells that have COC concentrations greater than the PRGs, and possibly wells downgradient of these wells, to determine the presence of contamination. Monitoring of groundwater would be required to assess the performance of chemical oxidation. Performance monitoring would include collecting groundwater samples from monitoring wells located within the contaminant plumes to assess trends in concentrations of COCs and on the periphery of the plumes to evaluate potential migration of COCs. Generally samples would be analyzed for field parameters [pH, dissolved oxygen (DO), oxidation-reduction potential (ORP), specific conductivity, turbidity, and groundwater elevation] and COCs.

Approximately 2 years would be required for treatment. The need for and locations of additional injection events will be determined based on the performance monitoring. Conceptual design calculations are provided in Appendix B.

Barium would not be treated because it appears to be associated with salt storage at the site and exceeded its MCL in only one well. Natural attenuation processes will reduce the barium concentrations over time.

Five-Year Reviews would be required since concentrations of contaminants would remain in soil above levels acceptable for unrestricted use at the site.

5.1.3.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 5-2A would provide protection to human health by minimizing exposure to contaminated soil through LUCs and maintenance of the barrier and by preventing exposure to contaminated groundwater through LUCs and treatment. No risks to the environment were identified.

Compliance with ARARs and TBCs

Chemical- and action-specific ARARs and TBCs for this alternative are listed in Tables 2-1 and 2-3, respectively. There are no location-specific ARARs associated with this alternative.

Risk-based chemical-specific TBCs (CSFs, RfDs, USEPA Guidance documents, and Illinois TACO values) will be met through a combination of barriers and LUCs which prevent exposure and eliminate risk. Compliance with groundwater quality standard regulations will be attained by meeting the requirements for Alternative Groundwater Quality Restoration by implementing groundwater LUCs to prevent groundwater use and through natural attenuation and by ISCO treatment of some of the groundwater. NSGL is in the Metropolitan Statistical Area, so the background soil concentrations in 35 IAC 742 for this area are used in the development of PRGs.

Action-specific ARARs and TBCs will be met. Solid wastes would be generated during the installation of ISCO injection wells and during the sampling of monitoring wells, so hazardous waste characterization and generator management regulations and Illinois special waste regulations would be followed. ISCO injection wells would be installed and abandoned according to Underground Injection Control (UIC) regulations for Class V wells. Fugitive dust would be controlled as needed during maintenance of the barrier, such as replacement of paving. If the property is transferred to a non-federal owner, then LUCs will be recorded in the deed in accordance with the UECA.

Long-Term Effectiveness and Permanence

Alternative 5-2A would be an effective means of minimizing exposure to contaminants in site soil and groundwater over the long term. The permanence of Alternative 5-2A for soil would depend on the maintenance of the LUCs and barrier and verification that the land use is being properly controlled. For groundwater, ISCO would permanently treat and remove some COCs. In addition, this alternative would require that Five-Year Reviews be conducted to assess the protectiveness and effectiveness of the LUCs.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 5-2A would reduce the volume of COCs in groundwater through ISCO.

Short-Term Effectiveness

Implementation of the soil components of Alternative 5-2A would not pose risks to on-site remediation workers or result in short-term adverse impact to the local community or the environment. Exposure of workers to contamination during installation of injection wells, construction and operation of the injection system, and groundwater sampling would be minimized by compliance with the requirements of the OSHA, including wearing of appropriate PPE and adherence to site-specific health and safety procedures. Alternative 5-2A could be implemented within approximately 3 months and would achieve RAOs 1 and 2 upon implementation by restricting exposure to soil at the site. RAO 3 is currently being met by existing controls, and implementation of the ISCO process would be completed within 2 years.

Overall, the sustainability impact of Alternative 5-2A is low based on a sustainability analysis using Site Wise™ (see Appendix C). Emissions of CO_2, CH_4, and N_2O were normalized to CO_2e, which is a cumulative method of weighing GHG emissions relative to global warming potential. Alternative 5-2A contained low GHG emissions (8.8 tons). Criteria pollutant emissions associated with Alternative 5-2A for NO_x, SO_x, and PM_{10} emissions were 0.019, 0.013, and 0.0022 ton, respectively. Energy demand for Alternative 5-2A was low (150 MMBTU) and was largely attributed to the laboratory analytical services. Water consumption associated with this Alternative is high, where a total of 5,200 gallons are used.

Implementability

Alternative 5-2A would be easily implemented since LUCs are already in place at other sites at NSGL. Inspection, maintenance of the barrier, and monitoring well sampling can be easily performed. The chemical oxidation approach of oxidant injection via injection wells could be readily installed and operated. The number of qualified contractors would be somewhat limited but not overly restrictive. Preparation of a LUC RD would be readily accomplished.

Cost

The estimated costs for Alternative 5-2A are shown below and a detailed cost estimate is provided in Appendix D.

- Capital Cost: $378,000
- Annual Cost: $9,000
- 5 Year Cost: $26,000
- NPW: $723,000

This cost is for the remediation of this site independent of the other two sites. Remediation of all three sites is expected to be performed as part of a single project, so the actual cost for this site will be lower due to economies of scale.

5.1.4 Alternative 5-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and LUCs

5.1.4.1 Description

Alternative 5-3 would consist of three major components: (1) soil excavation to meet unrestricted re-use, (2) off-site disposal, and (3) LUCs to restrict groundwater use.

Alternative 5-3 would consist of the excavation of approximately 4,000 cy of contaminated soil to meet PRGs for residential exposure, as shown on Figures 5-3 and 5-4 (see Appendix B). The total excavation area is approximately 37,000 square feet, and the depth of excavation ranges from 2 feet to 6 feet bgs. The excavation areas are adjacent to several buildings, but it is assumed that this alternative would only be implemented if the base was closed and there was a change in land use. In addition, this alternative assumes that the buildings would be demolished because of the change in land use, and so the buildings would not need to be protected during excavation. It is assumed that the contaminated soil is not under the buildings. Excavated material would be transported off-site to a non-hazardous landfill for disposal.

Prior to excavation, the limits of excavation would be confirmed by sampling. Excavated areas would be backfilled with clean soil and the surface would be seeded with grass.

LUCs would be implemented to restrict groundwater use. The LUCs would be specifically implemented through a LUC RD to continue with the restrictions found in the existing NSGL Base Instruction that does not allow the use of groundwater. The LUCs would be permanent in the event of a change in land use or ownership. Figure 5-1 shows the extent of the area covered by LUCs.

No Five-Year Reviews would be required for the soil because concentrations of contaminants in soil would be less than levels acceptable for unrestricted use at the site. However, the groundwater would be subject to Five-Year Reviews.

5.1.4.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 5-3 would be protective of human health (including I/C and construction worker exposure) because soil contaminants would be permanently removed from the site and exposure to contaminated groundwater would be prevented. No risks to the environment were identified.

Compliance with ARARs and TBCs

Chemical- and action-specific ARARs and TBCs for this alternative are listed in Tables 2-1 and 2-3, respectively. There are no location-specific ARARs associated with this alternative.

Risk-based chemical-specific TBCs (CSFs, RfDs, USEPA Guidance documents, and Illinois TACO values) will be met through excavation and off-site disposal of contaminated soil which eliminates risk. Compliance with groundwater quality standard regulations will be attained by meeting the requirements for Alternative Groundwater Quality Restoration by implementing groundwater LUCs to prevent groundwater use and through natural attenuation. NSGL is in the Metropolitan Statistical Area, so the background soil concentrations in 35 IAC 742 for this area are used in the development of PRGs.

Action-specific ARARs and TBCs will be met. Solid wastes would be generated during the excavation, so hazardous waste characterization and generator management regulations and Illinois special waste regulations would be followed during the management of the excavated soil. Fugitive dust would be controlled as needed during excavation. Soil erosion and sedimentation controls would be implemented during excavation and backfilling operations. If the property is transferred to a non-federal owner, then LUCs will be recorded in the deed in accordance with the UECA.

Long-Term Effectiveness and Permanence

Alternative 5-3 would address soil contamination in a way that provides long-term effectiveness and permanence. The contaminated soil would be removed from the site, thereby permanently limiting exposure to human receptors. The permanence of Alternative 5-3 for groundwater contamination would depend on the maintenance of the groundwater LUCs and verification that groundwater is not being used. In addition, this alternative would require that Five-Year Reviews be conducted for groundwater to assess the protectiveness and effectiveness of the LUCs.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 5-3 would not reduce the toxicity, mobility, or volume of COCs through treatment because no treatment would occur.

Short-Term Effectiveness

Implementation of Alternative 5-3 could result in short-term risk to remediation workers because of exposure to contaminated soil during excavation, staging, transportation, and off-site disposal. However, potential for exposure would be minimized by the implementation of engineering controls, such as dust suppression and appropriate site monitoring. The potential for worker exposure would be further reduced by compliance with site-specific health and safety procedures, including wearing appropriate PPE. Appropriate site monitoring would also be implemented for this alternative to monitor emissions during excavation activities.

Alternative 5-3 could also have a minimal adverse impact on the surrounding community and the environment as a result of the excavation and off-site transportation of contaminated soil. This impact would also be adequately mitigated by the implementation of engineering controls such as dust suppression and air quality monitoring, by adherence to spill prevention procedures, and by compliance with Department of Transportation (DOT) regulations.

Alternative 5-3 could be implemented within approximately 2 months and would achieve the RAOs 1 and 2 at completion. RAO 3 is currently being met by existing controls, and implementation of the groundwater LUC would provide a permanent restriction.

Overall, the sustainability impact of Alternative 5-3 is high based on a sustainability analysis using Site Wise™ (see Appendix C). Emissions of CO_2, CH_4, and N_2O were normalized to CO_2e, which is a cumulative method of weighing GHG emissions relative to global warming potential. Alternative 5-3 contained high CO_2e emissions (319 tons). Criteria pollutant emissions associated with Alternative 5-3 for NO_x, SO_x, and PM_{10} emissions were 0.60, 0.27, and 1.2 ton, respectively. Energy demand for Alternative 5-3 was high (14,000 MMBTU) and was largely attributed to production of borrow soil. Water consumption associated with this Alternative is low, where a total of 1,700 gallons are used.

Implementability

Alternative 5-3 would be easily implemented. However, it is assumed that existing buildings would be demolished, so shoring would not be required near the buildings. Buried utilities would be addressed as appropriate depending on whether the utility would be reused. Implementation of Alternative 5-3 would involve the completion of numerous administrative procedures such as obtaining a construction permit for excavation, and the off-site transportation and disposal of the excavated material, including determining the requirements for non-hazardous waste transport and disposal. These procedures could readily be accomplished. Preparation of a LUC RD for groundwater use restrictions would be readily accomplished. LUCs would be easily implemented at NSGL.

If this alternative is implemented while maintaining the buildings and utilities, then the alternative will be difficult to implement. Shoring would be required for excavations next to buildings. Buried utilities would need to be protected or possibly rerouted. Note that under current site use conditions, it is unlikely that meeting residential exposure criteria would be required.

Cost

The estimated costs for Alternative 5-3 are shown below and a detailed cost estimate is provided in Appendix D.

- Capital Cost: $1,301,000
- Annual Cost: $3,000
- 5 Year Cost: $26,000
- 30-Year NPW: $1,492,000

If buildings and utilities must be maintained, then costs will be higher to account for shoring of buildings and protection and/or rerouting of utilities. This cost is for the remediation of this site independent of the other two sites. Remediation of all three sites is expected to be performed as part of a single project, so the actual cost for this site will be lower due to economies of scale.

5.1.5 Alternative 5-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, LUCs, and ISCO

5.1.5.1 Description

Alternative 5-3A would consist of four major components: (1) ISCO for groundwater treatment, (2) soil excavation to meet unrestricted re-use, (3) off-site disposal, and (4) LUCs to restrict groundwater use.

The ISCO component of Alternative 5-3A would be the same as that described for Alternative 5-2A. The excavation and off-site disposal components would be the same as described for Alternative 5-3.

LUCs would be implemented to restrict groundwater use. These are required throughout the site, but are expected to be short-term where ISCO is applied and PRGs are met. The LUCs would be specifically implemented through a LUC RD to continue with the restrictions found in the existing NSGL Base Instruction that does not allow the use of groundwater. The LUCs would be permanent in the event of a change in land use or ownership. Figure 5-1 shows the extent of the area covered by LUCs.

No Five-Year Reviews would be required for the soil because concentrations of contaminants in soil would be less than levels acceptable for unrestricted use at the site. However, the groundwater would be subject to Five-Year Reviews until PRGs are met.

5.1.5.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 5-3A would be protective of human health (including I/C and construction worker exposure), because soil contaminants would be permanently removed from the site and by preventing exposure to contaminated groundwater through LUCs and treatment. No risks to the environment were identified.

Compliance with ARARs and TBCs

Chemical- and action-specific ARARs and TBCs for this alternative are listed in Tables 2-1 and 2-3, respectively. There are no location-specific ARARs associated with this alternative.

Risk-based chemical-specific TBCs (CSFs, RfDs, USEPA Guidance documents, and Illinois TACO values) will be met through excavation and off-site disposal of contaminated soil which eliminates risk. Compliance with groundwater quality standard regulations will be attained by meeting the requirements for Alternative Groundwater Quality Restoration by implementing groundwater LUCs to prevent groundwater use and through natural attenuation and by ISCO treatment of some of the groundwater. NSGL is in the Metropolitan Statistical Area, so the background soil concentrations in 35 IAC 742 for this area are used in the development of PRGs.

Action-specific ARARs and TBCs will be met. Solid wastes would be generated during the excavation, during the installation of ISCO injection wells, and during the sampling of monitoring wells, so hazardous waste characterization and generator management regulations and Illinois special waste regulations would be followed during the management of the excavated soil, well cuttings, and purge water. ISCO injection wells would be installed and abandoned according to UIC regulations for Class V wells. Fugitive dust would be controlled as needed during excavation. Soil erosion and sedimentation controls would be implemented during excavation and backfilling operations. If the property is transferred to a non-federal owner, then LUCs will be recorded in the deed in accordance with the UECA.

Long-Term Effectiveness and Permanence

Alternative 5-3A would address soil contamination in a way that provides long-term effectiveness and permanence. The contaminated soil would be removed from the site, thereby permanently limiting exposure to human receptors. For groundwater, ISCO would permanently treat and remove some COCs. In addition, this alternative would require that Five-Year Reviews be conducted for groundwater until PRGs are met through treatment.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 5-3A would reduce the volume of COCs in groundwater through ISCO.

Short-Term Effectiveness

Implementation of Alternative 5-3A could result in short-term risk to remediation workers because of exposure to contaminated soil during excavation, staging, transportation, and off-site disposal. However, potential for exposure would be minimized by the implementation of engineering controls, such as dust suppression and appropriate site monitoring. The potential for worker exposure would be further reduced by compliance with site-specific health and safety procedures, including wearing appropriate PPE. Appropriate site monitoring would also be implemented for this alternative to monitor emissions during excavation activities. Similarly, exposure of workers to contamination during installation of injection wells, construction and operation of the injection system, and groundwater sampling would be minimized by compliance with the requirements of the OSHA, including wearing of appropriate PPE and adherence to site-specific health and safety procedures.

Alternative 5-3A could also have a minimal adverse impact on the surrounding community and the environment as a result of the excavation and off-site transportation of contaminated soil and transportation of oxidant to the site. This impact would also be adequately mitigated by the implementation of engineering controls such as dust suppression and air quality monitoring, by adherence to spill prevention procedures, and by compliance with DOT regulations.

Alternative 5-3A could be implemented within approximately 2 months and would achieve the RAOs 1 and 2 at completion. RAO 3 is currently being met by existing controls, and implementation of the ISCO process would be completed within 2 years.

Overall, the sustainability impact of Alternative 5-3A is high based on a sustainability analysis using Site Wise™ (see Appendix C). Emissions of CO_2, CH_4, and N_2O were normalized to CO_2e, which is a cumulative method of weighing GHG emissions relative to global warming potential. Alternative 5-3A contained high CO_2e emissions (325 tons). Criteria pollutant emissions associated with Alternative 5-3A for NO_x, SO_x, and PM_{10} emissions were 0.62, 0.28, and 1.2 ton, respectively. Energy demand for Alternative 5-3A was high (14,000 MMBTU) and was largely attributed to production of borrow soil. Water consumption associated with this Alternative is high, where a total of 5,600 gallons are used.

Implementability

Alternative 5-3A would be easily implemented. However, it is assumed that existing buildings would be demolished, so shoring would not be required near the buildings. Buried utilities would be addressed as appropriate depending on whether the utility would be reused. Implementation of Alternative 5-3A would involve the completion of numerous administrative procedures such as obtaining a construction permit for excavation, and the off-site transportation and disposal of the excavated material, including determining the requirements for non-hazardous waste transport and disposal. These procedures could readily be accomplished. The chemical oxidation approach of oxidant injection via injection wells could be readily installed and operated. The number of qualified contractors would be somewhat limited but not overly restrictive. Preparation of a LUC RD for groundwater would be readily accomplished. LUCs would be easily implemented at NSGL.

If this alternative is implemented while maintaining the buildings and utilities, then the alternative will be difficult to implement. Shoring would be required for excavations next to buildings. Buried utilities would need to be protected or possibly rerouted. Note that under current site use conditions, it is unlikely that meeting residential exposure criteria would be required.

Cost

The estimated costs for Alternative 5-3A are shown below and a detailed cost estimate is provided in Appendix D.

- Capital Cost: $1,637,000
- Annual Cost: $3,000
- 5 Year Cost: $26,000
- 30-Year NPW: $1,829,000

If buildings and utilities must be maintained, then costs will be higher to account for shoring of buildings and protection and/or rerouting of utilities. This cost is for the remediation of this site independent of the other two sites. Remediation of all three sites is expected to be performed as part of a single project, so the actual cost for this site will be lower due to economies of scale.

5.2 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Table 5-1 provides a comparative analysis of the alternatives in relation to each specific evaluation criterion used in the detailed analysis. The Navy has the option of selecting any alternative or combination of alternatives.

TABLE 5-1

SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES – SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Evaluation Criterion	Alternative 5-1: No Action	Alternative 5-2: LUCs and Barrier	Alternative 5-2A: LUCs, Barrier, and ISCO	Alternative 5-3: Excavation (Unrestricted Re-use), Off-site Disposal, and LUCs	Alternative 5-3A: Excavation (Unrestricted Re-use), Off-site Disposal, LUCs, and ISCO
Overall Protection of Human Health and Environment	Not protective. The potential for exposure of human receptors to contaminated soil would remain unchanged. Groundwater use restrictions would remain, but could be lifted.	Protective of human health by minimizing exposure to contaminated soil and groundwater.	Protective of human health by minimizing exposure to contaminated soil and treating COCs in groundwater.	Protective of human health by removing contaminated soil from the site and by using LUCs to restrict the use of groundwater.	Protective of human health by removing contaminated soil from the site and by treating COCs in groundwater.
Compliance with ARARs and TBCs					
Chemical-Specific	Would not comply	Would comply.	Would comply.	Would comply.	Would comply.
Location-Specific	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Action-Specific	Not applicable	Would comply	Would comply	Would comply	Would comply

TABLE 5-1

SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES – SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Evaluation Criterion	Alternative 5-1: No Action	Alternative 5-2: LUCs and Barrier	Alternative 5-2A: LUCs, Barrier, and ISCO	Alternative 5-3: Excavation (Unrestricted Re-use), Off-site Disposal, and LUCs	Alternative 5-3A: Excavation (Unrestricted Re-use), Off-site Disposal, LUCs, and ISCO
Long-Term Effectiveness and Permanence	Neither effective nor permanent.	Provides long-term effectiveness and permanence. Least effective because LUCs must be continually enforced to prevent exposure.	Provides long-term effectiveness and permanence. More effective than Alternative 5-2 because groundwater COCs are treated, but LUCs must be continually enforced to prevent exposure to soil contaminants.	Provides long-term effectiveness and permanence. More effective than Alternatives 5-2 and 5-2A because soil contaminants are removed from the site.	Provides long-term effectiveness and permanence. Most effective because soil contaminants are removed from the site and groundwater COCs are treated.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	None. There would be no treatment.	None. There would be no treatment.	There would be treatment of groundwater COCs.	None. There would be no treatment.	There would be treatment of groundwater COCs.

TABLE 5-1

SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES – SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Evaluation Criterion	Alternative 5-1: No Action	Alternative 5-2: LUCs and Barrier	Alternative 5-2A: LUCs, Barrier, and ISCO	Alternative 5-3: Excavation (Unrestricted Re-use), Off-site Disposal, and LUCs	Alternative 5-3A: Excavation (Unrestricted Re-use), Off-site Disposal, LUCs, and ISCO
Short-Term Effectiveness	Would not result in risks to remediation workers or result in short-term adverse impacts to the local community and the environment. Would not achieve RAOs or PRGs.	Would not result in risks to remediation workers or result in short-term adverse impacts to the local community and the environment. LUC remedial design would be implemented in approximately 3 months, and would achieve RAOs or PRGs after implementation.	Slight increase of risk to remediation workers from ISCO would be controlled by PPE and safety procedures. Potential impact to the local community and the environment during oxidant transport. LUC remedial design would be implemented in approximately 3 months, and would achieve RAOs or PRGs after implementation. ISCO would be completed within 2 years.	Exposure of remediation workers would be controlled by PPE and safety procedures. Potential impact to community from truck traffic. Action would be completed in 2 months. RAOs 1 and 2 would be met after completion of excavation. Would achieve RAO 3 after implementation of LUCs.	Exposure of remediation workers during excavation and ISCO would be controlled by PPE and safety procedures. Potential impact to community from truck traffic and oxidant transport. Action would be completed in 2 months. RAOs 1 and 2 would be met after completion of excavation. Would achieve RAO 3 after implementation of ISCO. ISCO would be completed within 2 years.
Implementability	Nothing to implement.	Easy to implement. Would be easiest to implement.	Easy to implement. Would be easier to implement than Alternatives 5-3 and 5-3A.	Easy to implement, but less difficult to implement than Alternative 5-3A.	Easy to implement, but most difficult to implement.

TABLE 5-1

SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES – SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Evaluation Criterion	Alternative 5-1: No Action	Alternative 5-2: LUCs and Barrier	Alternative 5-2A: LUCs, Barrier, and ISCO	Alternative 5-3: Excavation (Unrestricted Re-use), Off-site Disposal, and LUCs	Alternative 5-3A: Excavation (Unrestricted Re-use), Off-site Disposal, LUCs, and ISCO
Costs: Capital NPW of Annual Costs NPW	 $0 $0 $0	 $21,000 $345,000 (30-Year) $366,000 (30-Year)	 $378,000 $345,000 (30-Year) $723,000 (30-Year)	 $1,301,000 $191,000 (30-Year) $1,492,000 (30-Year)	 $1,637,000 $192,000 (30-Year) $1,829,000 (30-Year)

ARARs - Applicable or Relevant and Appropriate Requirements.
ISCO - In-situ chemical oxidation.
LUCs - Land use controls.
NPW - Net present worth.
PPE - Personal protective equipment.
RAO - Remedial Action Objective.
TBC - To Be Considered.

Costs are stand alone cost for the site – economy of scale will be obtained when done in combination with other sites.

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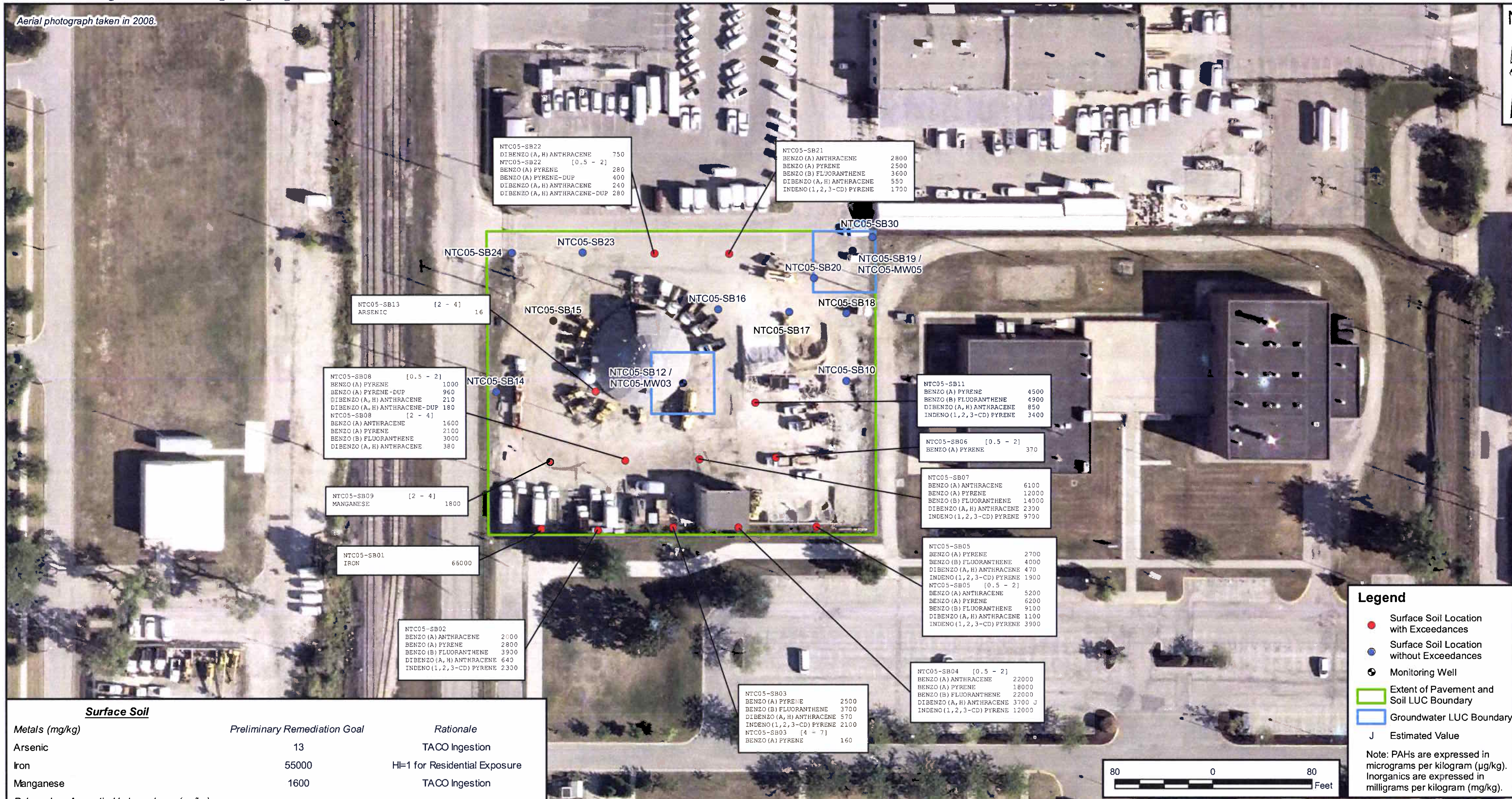

Surface Soil

Metals (mg/kg)	*Preliminary Remediation Goal*	*Rationale*
Arsenic	13	TACO Ingestion
Iron	55000	HI=1 for Residential Exposure
Manganese	1600	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1800	Background
Benzo(a)pyrene	2100	Background
Benzo(b)fluoranthene	2100	Background
Benzo(k)fluoranthene	9000	TACO Ingestion
Dibenzo(a,h)anthracene	420	Background
Indeno(1,2,3-cd)pyrene	1600	Background

DRAWN BY	DATE
D. COUCH	08/29/13
CHECKED BY	DATE
J. LOGAN	09/19/13
REVISED BY	DATE
D. COUCH	09/19/13
SCALE AS NOTED	

NAVFAC

ALTERNATIVE 5-2
BARRIER AND LAND USE CONTROL BOUNDARIES
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	F275
APPROVED BY	DATE 10/3/13
APPROVED BY	DATE
FIGURE NO. 5-1	REV 0

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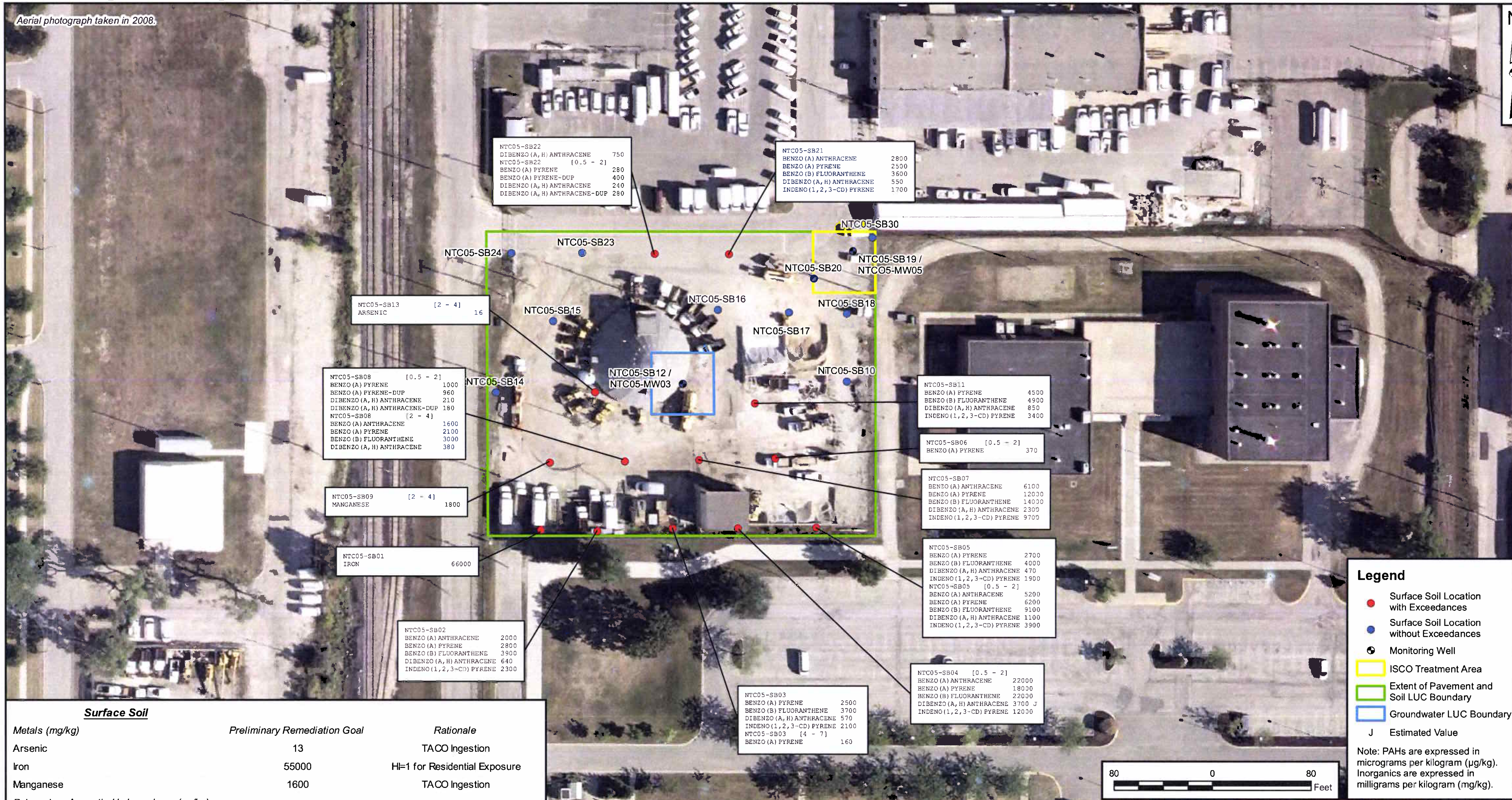


Surface Soil

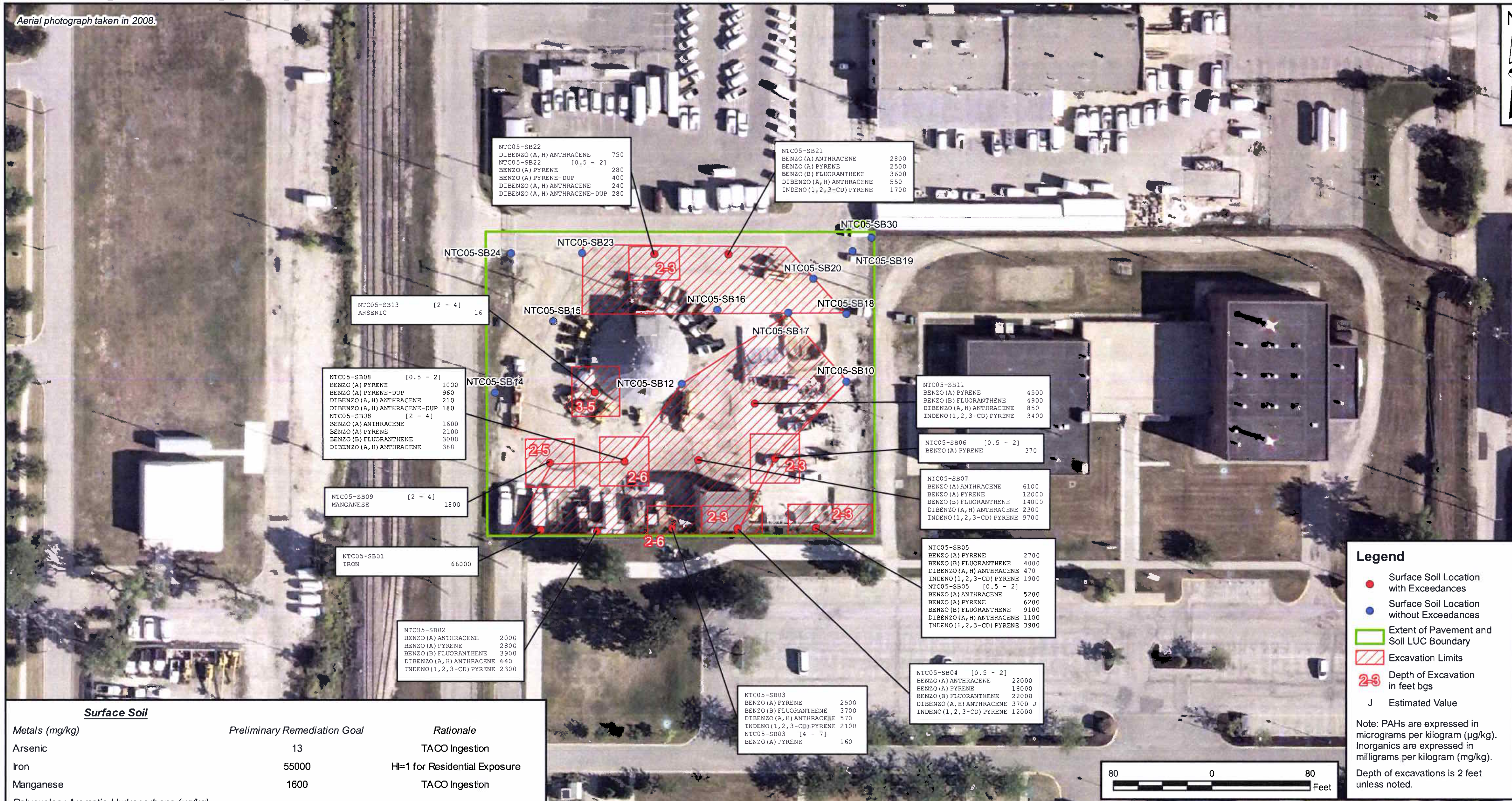
Metals (mg/kg)	*Preliminary Remediation Goal*	*Rationale*
Arsenic	13	TACO Ingestion
Iron	55000	HI=1 for Residential Exposure
Manganese	1600	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1800	Background
Benzo(a)pyrene	2100	Background
Benzo(b)fluoranthene	2100	Background
Benzo(k)fluoranthene	9000	TACO Ingestion
Dibenzo(a,h)anthracene	420	Background
Indeno(1,2,3-cd)pyrene	1600	Background

DRAWN BY	DATE
D. COUCH	08/29/13
CHECKED BY	DATE
J. LOGAN	09/19/13
REVISED BY	DATE
D. COUCH	09/19/13
SCALE AS NOTED	

NAVFAC

ALTERNATIVE 5-2A
BARRIER AND LAND USE CONTROL BOUNDARIES
AND ISCO TREATMENT AREA
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	F275
APPROVED BY	DATE 10/8/13
APPROVED BY	DATE
FIGURE NO. 5-2	REV 0



Surface Soil

Metals (mg/kg)	Preliminary Remediation Goal	Rationale
Arsenic	13	TACO Ingestion
Iron	55000	HI=1 for Residential Exposure
Manganese	1600	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1800	Background
Benzo(a)pyrene	2100	Background
Benzo(b)fluoranthene	2100	Background
Benzo(k)fluoranthene	9000	TACO Ingestion
Dibenzo(a,h)anthracene	420	Background
Indeno(1,2,3-cd)pyrene	1600	Background

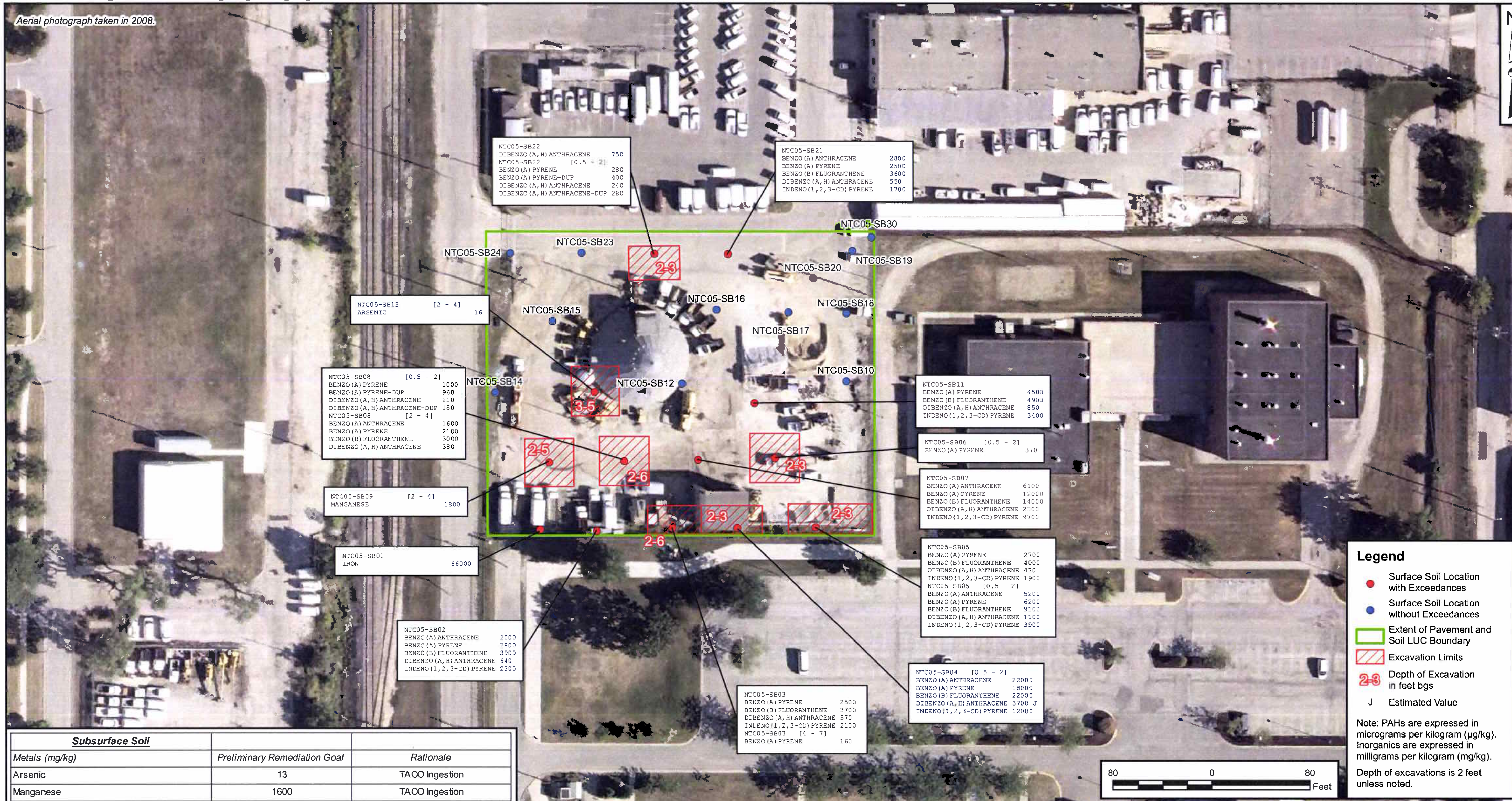
DRAWN BY D. COUCH	DATE 08/29/13
CHECKED BY J. LOGAN	DATE 09/19/13
REVISED BY D. COUCH	DATE 09/19/13
SCALE AS NOTED	

NAVFAC

ALTERNATIVE 5-3
EXCAVATION LIMITS - SURFACE AND SUBSURFACE
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER F275
APPROVED BY	DATE 10/8/13
APPROVED BY	DATE
FIGURE NO. 5-3	REV 0

PGH P:\GIS\GREATLAKES_NS\MAPDOCS\MXD\SITE05_SSSB_EXCEED_PAH_5-4.MXD 09/19/13 DC



Subsurface Soil		
Metals (mg/kg)	*Preliminary Remediation Goal*	*Rationale*
Arsenic	13	TACO Ingestion
Manganese	1600	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1500	ILCR = IE-5 for Residential Exposure
Benzo(a)pyrene	150	ILCR = IE-5 for Residential Exposure
Benzo(b)fluoranthene	1500	ILCR = IE-5 for Residential Exposure
Benzo(k)fluoranthene	15000	ILCR = IE-5 for Residential Exposure
Dibenzo(a,h)anthracene	150	ILCR = IE-5 for Residential Exposure
Indeno(1,2,3-cd)pyrene	1500	ILCR = IE-5 for Residential Exposure

DRAWN BY	DATE
D. COUCH	08/29/13
CHECKED BY	DATE
J. LOGAN	09/19/13
REVISED BY	DATE
D. COUCH	09/19/13
SCALE AS NOTED	

NAVFAC

ALTERNATIVE 5-3
EXCAVATION LIMITS - SUBSURFACE ONLY
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	F275
APPROVED BY	DATE 10/8/13
APPROVED BY	DATE
FIGURE NO. 5-4	REV 0

6.0 DETAILED AND COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES FOR SITE 9

6.1 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

6.1.1 Alternative 9-1: No Action

6.1.1.1 Description

This alternative is a "walk-away" alternative required under CERCLA to establish a basis for comparison with other alternatives. Under this alternative, the property would be released for unrestricted use. Existing groundwater use restrictions would remain in place. In addition, there would be no Five-Year Review required to assess contamination at the site over time. This alternative could only be chosen if it is determined that taking no action would be protective of human health and the environment.

6.1.1.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 9-1 would not provide protection of human health and the environment. The potential for exposure of human receptors to contaminated soil via ingestion and dermal contact would remain unchanged. The existing groundwater use restrictions would be protective of human health; however, these restrictions could be lifted.

Compliance with ARARs and TBCs

Alternative 9-1 would not comply with chemical-specific ARARs and TBCs for soil because no action would be taken to reduce COC concentrations. The existing groundwater use restrictions comply with chemical-specific ARARs and TBCs for groundwater; however, these restrictions could be lifted. No location-specific or action-specific ARARs are associated with this alternative. Chemical-specific ARARs and TBCs for Alternative 9-1 are listed in Table 2-1.

Long-Term Effectiveness and Permanence

Alternative 9-1 would have no long-term effectiveness or permanence because nothing would be done to reduce concentrations of soil COCs or to reduce human exposure to site contaminants. The existing groundwater use restrictions would not provide long-term effectiveness or permanence because they are

not permanent and could be revoked. Unlike deed restrictions or similar covenants, the groundwater use restrictions do not run with the land.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 9-1 would not reduce the toxicity, mobility, or volume of COCs through treatment because no soil or groundwater treatment would occur.

Short-Term Effectiveness

Because no action would occur, implementation of Alternative 9-1 would not pose risks to on-site remediation workers or result in short-term adverse impact to the local community or the environment.

Alternative 9-1 would not achieve the RAOs or the PRGs, and would also have no life cycle sustainability impacts.

Implementability

Because no action would occur, Alternative 9-1 would be readily implementable. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable. The remedy would be implementable if ultimately selected in the Record of Decision.

Cost

There would be no costs associated with Alternative 9-1.

6.1.2 Alternative 9-2: LUCs and Barrier

6.1.2.1 Description

Alternative 9-2 would consist of two major components: (1) LUCs and (2) barrier.

The existing soil, pavement, and buildings would be used as a barrier to prevent exposure by I/C workers to soil contaminants exceeding I/C TACO criteria. The northern ravine fill arm is covered by a combination of asphalt pavement (approximately 3 inches thick) and soil (average 2 feet thick). The extent of coverage is approximately 60 percent asphalt, and 40 percent soil. The middle ravine fill arm is covered by a combination of building foundations (assumed to be at least 6 to 12 inches thick), asphalt pavement (approximately 3 inches thick), and soil (assumed to be approximately 2 feet thick). The extent of coverage is approximately 90 percent building foundations, 5 percent asphalt, and 5 percent soil. The southern ravine fill arm is covered by a combination of building foundations (assumed to be at least 6 to 12 inches thick), asphalt pavement and concrete sidewalks (approximately 3 inches thick), and soil (average 2 feet thick). The extent of coverage is approximately 45 percent building foundations, 25 percent asphalt pavement and concrete sidewalks, and 30 percent soil. The barrier would be inspected and repaired as needed to maintain protection. Figure 6-1 shows the extent of the barrier.

A LUC RD would be prepared in accordance with the Navy's LUC Principles (DoD, 2003) to establish methods to prevent exposure to COCs, and to restrict the disturbance of contaminated soil. LUCs would be implemented in accordance with the LUCMOA. Specifically, LUCs would be implemented to prevent residential land use, restrict unauthorized construction, require notification of the presence of contaminants to construction workers, require review of construction activities and intrusive work in the area to protect workers through PPE and alternative methods to reduce exposure, require proper management of excavated material, provide for long-term inspection of LUCs, and provide requirements for dealing with changes in land use or site features. LUCs would also require routine inspection of the soil, pavement, and buildings and repairs to the barrier to prevent exposure to contaminated soil. The areas to which the LUCs would apply would be identified and surveyed by an Illinois Licensed Professional Land Surveyor.

LUCs would also be implemented to restrict groundwater use. The LUCs would be specifically implemented through a LUC RD to continue the restrictions found in the existing NSGL Base Instruction 11130.1 that prohibits the use of groundwater. The LUCs would be permanent in the event of a change in land use or ownership. Figure 6-1 shows the extent of the area covered by LUCs.

Five-Year Reviews would be required since concentrations of contaminants would remain in soil and groundwater above levels acceptable for unrestricted use at the site.

6.1.2.2 Detailed Analysis

<u>Overall Protection of Human Health and the Environment</u>

Alternative 9-2 would provide protection to human health by minimizing exposure to contaminated soil through LUCs and maintenance of the barrier and by preventing exposure to contaminated groundwater. No risks to the environment were identified.

Compliance with ARARs and TBCs

Chemical- and action-specific ARARs and TBCs for this alternative are listed in Tables 2-1 and 2-3, respectively. There are no location-specific ARARs associated with this alternative.

Risk-based chemical-specific TBCs (CSFs, RfDs, USEPA Guidance documents, and Illinois TACO values) will be met through a combination of barriers and LUCs which prevent exposure and eliminate risk. Compliance with groundwater quality standard regulations will be attained by meeting the requirements for Alternative Groundwater Quality Restoration by implementing groundwater LUCs to prevent groundwater use and through natural attenuation. NSGL is in the Metropolitan Statistical Area, so the background soil concentrations in 35 IAC 742 for this area are used in the development of PRGs.

Action-specific ARARs and TBCs will be met. No wastes would be generated for this alternative, so hazardous waste characterization and generator management regulations and Illinois special waste regulations are not pertinent. Fugitive dust would be controlled as needed during maintenance of the barrier, such as replacement of paving. The uncontaminated soil and building foundations over the ravine meets the final cover requirements of the Solid Waste Regulations. Inspection procedures developed in the LUC RD will meet the closure standards of the Solid Waste Regulations. If the property is transferred to a non-federal owner, then LUCs will be recorded in the deed in accordance with the UECA, and a notation of the presence of the ravine fill will be made in the deed in accordance with the Solid Waste Regulations.

Supplemental landfill cover improvements are not required. Concentrations of contaminants in surface soil samples are less than PRGs. The average thickness of the uncontaminated surface soil is approximately 2 feet. In many places, the surface soil is also paved over by parking lots, roads, and sidewalks. In addition, a large proportion of the ravine fill area is covered by building foundations. The soil and building foundation meet the Solid Waste Landfill final cover requirements and provide sufficient barrier to direct contact. An impermeable cover is not required based on minimal impacts to groundwater.

Long-Term Effectiveness and Permanence

Alternative 9-2 would be an effective means of minimizing exposure to contaminants in site soil and groundwater over the long term. The permanence of Alternative 9-2 would depend on the maintenance of the LUCs and barrier, verification that the land use is being properly controlled, and verification that groundwater is not being used. In addition, this alternative would require that Five-Year Reviews be conducted to assess the protectiveness and effectiveness of the LUCs.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 9-2 would not reduce the toxicity, mobility, or volume of COCs through treatment because no treatment would occur.

Short-Term Effectiveness

Implementation of Alternative 9-2 would not pose risks to on-site remediation workers or result in short-term adverse impact to the local community or the environment. Alternative 9-2 could be implemented within approximately 3 months and would achieve RAOs 1 and 2 upon implementation by restricting exposure to soil at the site. RAO 3 is currently being met by existing controls, and implementation of the groundwater LUC would provide a permanent restriction.

Overall, the sustainability impact of Alternative 9-2 is low based on a sustainability analysis using Site Wise™ (see Appendix C). Emissions of CO_2, CH_4, and N_2O were normalized to CO_2e, which is a cumulative method of weighing GHG emissions relative to global warming potential. Alternative 9-2 contained low GHG emissions (0.76 ton). Criteria pollutant emissions associated with Alternative 9-2 for NO_x, SO_x, and PM_{10} emissions were $2.8x10^{-4}$, $9.8x10^{-6}$, and $5.7x10^{-5}$ ton, respectively. Energy demand for Alternative 9-2 was low (8.6 MMBTU). There is no direct water consumption associated with Alternative 9-2.

Implementability

Alternative 9-2 would be easily implemented since LUCs are already in place at other sites at NSGL. Inspection and maintenance of the barrier can be easily performed. Preparation of a LUC RD would be readily accomplished.

Cost

The estimated costs for Alternative 9-2 are shown below and a detailed cost estimate is provided in Appendix D.

- Capital Cost: $21,000
- Annual Cost: $9,000
- 5 Year Cost: $26,000
- 30-Year NPW: $366,000

This cost is for the remediation of this site independent of the other two sites. Remediation of all three sites is expected to be performed as part of a single project, so the actual cost for this site will be lower due to economies of scale.

6.1.3 Alternative 9-2A: LUCs, Barrier, and ISCO

6.1.3.1 Description

Alternative 9-2A would consist of four major components: (1) LUCs, (2) barrier, and (3) ISCO for groundwater treatment.

The existing soil, pavement, and buildings would be used as a barrier to prevent exposure by I/C workers to soil contaminants exceeding I/C TACO criteria. The barrier would be inspected and repaired as needed to maintain protection. Figure 6-2 shows the extent of the barrier.

A LUC RD would be prepared in accordance with the Navy's LUC Principles (DoD, 2003) to establish methods to prevent exposure to COCs, and to restrict the disturbance of contaminated soil. LUCs would be implemented in accordance with the LUCMOA. Specifically, LUCs would be implemented to prevent residential land use, restrict unauthorized construction, require notification of the presence of contaminants to construction workers, require review of construction activities and intrusive work in the area to protect workers through PPE and alternative methods to reduce exposure, require proper management of excavated material, provide for long-term inspection of LUCs, and provide requirements for dealing with changes in land use or site features. LUCs would also require routine inspection of the soil, pavement, and buildings and repairs to the barrier to prevent exposure to contaminated soil. The areas to which the LUCs would apply would be identified and surveyed by an Illinois Licensed Professional Land Surveyor.

LUCs would also be implemented to restrict groundwater use. These are required throughout the site, but are expected to be short-term where ISCO is applied and PRGs are met. The LUCs would be specifically implemented through a LUC RD to continue the restrictions found in the existing NSGL Base Instruction 11130.1 that prohibits the use of groundwater. The LUCs would be permanent in the event of a change in land use or ownership. Figure 6-2 shows the extent of the area covered by LUCs.

For the purposes of the development of this alternative, ISCO would consist of injection of Fenton's reagent to treat arsenic. Other oxidants, such as persulfate, or other oxygen sources, such as ORC, should be considered during remedial design. A relatively low dosage rate would be used to promote oxidizing conditions to precipitate iron and arsenic compounds. The pH would also be increased to promote precipitation. Oxidant injection would use injection wells so that multiple injections can be performed, if needed. The injection system would consist of a grid of injection wells over a 50-foot by 50-foot area centered on well MW06. Because of the low COC concentrations, high clay content, and heterogeneity, it is assumed that two injection events would be required to achieve chemical oxidation of the COCs. The area to be treated is shown on Figure 6-2. Thirty-two wells based on a 10-foot grid and 4,500 gallons of 4-percent (by weight) solution of Fenton's reagent are estimated to be required. A bench and/or pilot study would be performed to confirm well spacing and oxidant application rates.

Prior to the ISCO remedial design, groundwater samples would be collected from existing monitoring wells that have COC concentrations greater than the PRGs, and possibly wells downgradient of these wells, to determine the presence of contamination. Monitoring of groundwater would be required to assess the performance of chemical oxidation. Performance monitoring would include collecting groundwater samples from monitoring wells located within the contaminant plumes to assess trends in concentrations of COCs and on the periphery of the plumes to evaluate potential migration of COCs. Generally samples would be analyzed for field parameters (pH, DO, ORP, specific conductivity, turbidity, and groundwater elevation) and COCs.

Approximately 2 years would be required for treatment. The need for and locations of additional injection events will be determined based on the performance monitoring. Conceptual design calculations are provided in Appendix B.

Lead would not be treated because it exceeded its MCL in only one well. Natural attenuation processes will reduce the lead concentrations over time.

Five-Year Reviews would be required since concentrations of contaminants would remain in soil above levels acceptable for unrestricted use at the site.

6.1.3.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 9-2A would provide protection to human health by minimizing exposure to contaminated soil through LUCs and maintenance of the barrier and by preventing exposure to contaminated groundwater through LUCs and treatment. No risks to the environment were identified.

Compliance with ARARs and TBCs

Chemical- and action-specific ARARs and TBCs for this alternative are listed in Tables 2-1 and 2-3, respectively. There are no location-specific ARARs associated with this alternative.

Risk-based chemical-specific TBCs (CSFs, RfDs, USEPA Guidance documents, and Illinois TACO values) will be met through a combination of barriers and LUCs which prevent exposure and eliminate risk. Compliance with groundwater quality standard regulations will be attained by meeting the requirements for Alternative Groundwater Quality Restoration by implementing groundwater LUCs to prevent groundwater use and through natural attenuation and by ISCO treatment of some of the groundwater. NSGL is in the Metropolitan Statistical Area, so the background soil concentrations in 35 IAC 742 for this area are used in the development of PRGs.

Action-specific ARARs and TBCs will be met. Solid wastes would be generated during the installation of ISCO injection wells and during the sampling of monitoring wells, so hazardous waste characterization and generator management regulations and Illinois special waste regulations would be followed. ISCO injection wells would be installed and abandoned according to UIC regulations for Class V wells. Fugitive dust would be controlled as needed during maintenance of the barrier, such as replacement of paving. The uncontaminated soil and building foundations over the ravine meets the final cover requirements of the Solid Waste Regulations. Inspection procedures developed in the LUC RD will meet the closure standards of the Solid Waste Regulations. If the property is transferred to a non-federal owner, then LUCs will be recorded in the deed in accordance with the UECA, and a notation of the presence of the ravine fill will be made in the deed in accordance with the Solid Waste Regulations.

Supplemental landfill cover improvements are not required. Concentrations of contaminants in surface soil samples are less than PRGs. The average thickness of the uncontaminated surface soil is approximately 2 feet. In many places, the surface soil is also paved over by parking lots, roads, and sidewalks. In addition, a large proportion of the ravine fill area is covered by building foundations. The soil and building foundation meet the Solid Waste Landfill final cover requirements and provide sufficient barrier to direct contact. An impermeable cover is not required based on minimal impacts to groundwater.

Long-Term Effectiveness and Permanence

Alternative 9-2A would be an effective means of minimizing exposure to contaminants in site soil and groundwater over the long term. The permanence of Alternative 9-2A for soil would depend on the maintenance of the LUCs and barrier and verification that the land use is being properly controlled. For groundwater, ISCO would permanently treat and remove some COCs. In addition, this alternative would require that Five-Year Reviews be conducted to assess the protectiveness and effectiveness of the LUCs.

<u>Reduction of Toxicity, Mobility, or Volume through Treatment</u>

Alternative 9-2A would reduce the volume of COCs in groundwater through ISCO.

<u>Short-Term Effectiveness</u>

Implementation of the soil components of Alternative 9-2A would not pose risks to on-site remediation workers or result in short-term adverse impact to the local community or the environment. Exposure of workers to contamination during installation of injection wells, construction and operation of the injection system, and groundwater sampling would be minimized by compliance with the requirements of the OSHA, including wearing of appropriate PPE and adherence to site-specific health and safety procedures. Alternative 9-2A could be implemented within approximately 3 months and would achieve RAOs 1 and 2 upon implementation by restricting exposure to soil at the site. RAO 3 is currently being met by existing controls, and implementation of the ISCO process would be completed within 2 years.

Overall, the sustainability impact of Alternative 9-2A is low based on a sustainability analysis using Site Wise™ (see Appendix C). Emissions of CO_2, CH_4, and N_2O were normalized to CO_2e, which is a cumulative method of weighing GHG emissions relative to global warming potential. Alternative 9-2A contained low GHG emissions (10.2 tons). Criteria pollutant emissions associated with Alternative 9-2A for NO_x, SO_x, and PM_{10} emissions were 0.019, 0.015, and 0.0027 ton, respectively. Energy demand for Alternative 9-2A was low (210 MMBTU) and was largely attributed to the manufacture of PVC used in the installation wells. Water consumption associated with this Alternative is high, where a total of 12,000 gallons are used.

<u>Implementability</u>

Alternative 9-2A would be easily implemented since LUCs are already in place at other sites at NSGL. Inspection, maintenance of the barrier, and monitoring well sampling can be easily performed. The chemical oxidation approach of oxidant injection via injection wells could be readily installed and operated. The number of qualified contractors would be somewhat limited but not overly restrictive. Preparation of a LUC RD would be readily accomplished.

Cost

The estimated costs for Alternative 9-2A are shown below and a detailed cost estimate is provided in Appendix D.

- Capital Cost: $488,000
- Annual Cost: $9,000
- 5 Year Cost: $26,000
- 30-Year NPW: $834,000

This cost is for the remediation of this site independent of the other two sites. Remediation of all three sites is expected to be performed as part of a single project, so the actual cost for this site will be lower due to economies of scale.

6.1.4 Alternative 9-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and LUCs

6.1.4.1 Description

Alternative 9-3 would consist of three major components: (1) soil excavation to meet unrestricted re-use, (2) off-site disposal, and (3) LUCs to restrict groundwater use.

Alternative 9-3 would consist of the excavation of approximately 10,000 cy of contaminated soil to meet PRGs for residential exposure, as shown on Figure 6-3 (see Appendix B). The total excavation area is approximately 24,000 square feet, and the depth of excavation ranges from 4 feet to 16 feet bgs. There is uncertainty about this volume because the extent of contamination has not been fully delineated. A sampling and analysis program would be implemented prior excavation, which could lead to an increase in the volume of soil for excavation and disposal. The excavation areas are adjacent to several buildings, but it is assumed that this alternative would only be implemented if the base was closed and there was a change in land use. In addition, this alternative assumes that the buildings would be demolished because of the change in land use, so the buildings would not need to be protected during excavation. Excavated material would be transported off-site to a non-hazardous landfill for disposal. Prior to excavation, the limits of excavation would be confirmed by sampling. Excavated areas would be backfilled with clean soil and the surface would be seeded with grass.

LUCs would be implemented to restrict groundwater use. The LUCs would be specifically implemented through a LUC RD to continue with the restrictions found in the existing NSGL Base Instruction that does not allow the use of groundwater. The LUCs would be permanent in the event of a change in land use or ownership. Figure 6-1 shows the extent of the area covered by LUCs.

No Five-Year Reviews would be required for the soil because concentrations of contaminants in soil would be less than levels acceptable for unrestricted use at the site. However, the groundwater would be subject to Five-Year Reviews.

6.1.4.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 9-3 would be protective of human health (including I/C and construction worker exposure), because soil contaminants would be permanently removed from the site and exposure to contaminated groundwater would be prevented. No risks to the environment were identified.

Compliance with ARARs and TBCs

Chemical- and action-specific ARARs and TBCs for this alternative are listed in Tables 2-1 and 2-3, respectively. There are no location-specific ARARs associated with this alternative.

Risk-based chemical-specific TBCs (CSFs, RfDs, USEPA Guidance documents, and Illinois TACO values) will be met through excavation and off-site disposal of contaminated soil which eliminates risk. Compliance with groundwater quality standard regulations will be attained by meeting the requirements for Alternative Groundwater Quality Restoration by implementing groundwater LUCs to prevent groundwater use and through natural attenuation. NSGL is in the Metropolitan Statistical Area, so the background soil concentrations in 35 IAC 742 for this area are used in the development of PRGs.

Action-specific ARARs and TBCs will be met. Solid wastes would be generated during the excavation, so hazardous waste characterization and generator management regulations and Illinois special waste regulations would be followed during the management of the excavated soil. Fugitive dust would be controlled as needed during excavation. Soil erosion and sedimentation controls would be implemented during excavation and backfilling operations. If the property is transferred to a non-federal owner, then LUCs will be recorded in the deed in accordance with the UECA, and a notation of the presence of the ravine fill will be made in the deed in accordance with the Solid Waste Regulations.

Long-Term Effectiveness and Permanence

Alternative 9-3 would address soil contamination in a way that provides long-term effectiveness and permanence. The contaminated soil would be removed from the site, thereby permanently limiting exposure to human receptors. The permanence of Alternative 9-3 for groundwater contamination would depend on the maintenance of the groundwater LUCs and verification that groundwater is not being used. In addition, this alternative would require that Five-Year Reviews be conducted for groundwater to assess the protectiveness and effectiveness of the LUCs.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 9-3 would not reduce the toxicity, mobility, or volume of COCs through treatment because no treatment would occur.

Short-Term Effectiveness

Implementation of Alternative 9-3 could result in short-term risk to remediation workers because of exposure to contaminated soil during excavation, staging, transportation, and off-site disposal. However, potential for exposure would be minimized by the implementation of engineering controls, such as dust suppression and appropriate site monitoring. The potential for worker exposure would be further reduced by compliance with site-specific health and safety procedures, including wearing appropriate PPE. Appropriate site monitoring would also be implemented for this alternative to monitor emissions during excavation activities.

Alternative 9-3 could also have a minimal adverse impact on the surrounding community and the environment as a result of the excavation and off-site transportation of contaminated soil. This impact would also be adequately mitigated by the implementation of engineering controls such as dust suppression and air quality monitoring, by adherence to spill prevention procedures, and by compliance with DOT regulations.

Alternative 9-3 could be implemented within approximately 4 months and would achieve RAOs 1 and 2 at completion. RAO 3 is currently being met by existing controls, and implementation of the groundwater LUC would provide a permanent restriction.

Overall, the sustainability impact of Alternative 9-3 is high based on a sustainability analysis using Site Wise^{TM} (see Appendix C). Emissions of CO_2, CH_4, and N_2O were normalized to CO_2e, which is a cumulative method of weighing GHG emissions relative to global warming potential. Alternative 9-3 contained high CO_2e emissions (850 tons). Criteria pollutant emissions associated with Alternative 9-3 for NO_x, SO_x, and PM_{10} emissions were 1.7, 0.73, and 3.2 tons, respectively. Energy demand for Alternative 9-3 was high (37,000 MMBTU) and was largely attributed to production of borrow soil. Water consumption associated with this Alternative is low, where a total of 2,600 gallons are used.

Implementability

Alternative 9-3 would be easily implemented. However, it is assumed that existing buildings would be demolished, so shoring would not be required near the buildings. Buried utilities would be addressed as appropriate depending on whether the utility would be reused. Implementation of Alternative 9-3 would involve the completion of numerous administrative procedures such as obtaining a construction permit for excavation, and the off-site transportation and disposal of the excavated material, including determining the requirements for non-hazardous waste transport and disposal. These procedures could readily be accomplished. Preparation of a LUC RD for groundwater use restrictions would be readily accomplished. LUCs would be easily implemented at NSGL.

If this alternative is implemented while maintaining the buildings and utilities, then the alternative will be difficult to implement. Shoring would be required for excavations next to buildings. Buried utilities would need to be protected or possibly rerouted. Note that under current site use conditions, it is unlikely that meeting residential exposure criteria would be required.

Cost

The estimated costs for Alternative 9-3 are shown below and a detailed cost estimate is provided in Appendix D.

- Capital Cost: $3,220,000
- Annual Cost: $3,000
- 5 Year Cost: $26,000
- 30-Year NPW: $3,411,000

If buildings and utilities must be maintained, then costs will be higher to account for shoring of buildings and protection and/or rerouting of utilities. This cost is for the remediation of this site independent of the other two sites. Remediation of all three sites is expected to be performed as part of a single project, so the actual cost for this site will be lower due to economies of scale.

6.1.5 Alternative 9-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, LUCs, and ISCO

6.1.5.1 Description

Alternative 9-3A would consist of four major components: (1) ISCO for groundwater treatment, (2) soil excavation to meet unrestricted re-use, (3) off-site disposal, and (4) LUCs to restrict groundwater use.

The ISCO component of Alternative 9-3A would be the same as that described for Alternative 9-2A. The excavation and off-site disposal components would be the same as described for Alternative 9-3.

LUCs would be implemented to restrict groundwater use. These are required throughout the site, but are expected to be short-term where ISCO is applied and PRGs are met. The LUCs would be specifically implemented through a LUC RD to continue with the restrictions found in the existing NSGL Base Instruction that does not allow the use of groundwater. The LUCs would be permanent in the event of a change in land use or ownership. Figure 6-1 shows the extent of the area covered by LUCs.

No Five-Year Reviews would be required for the soil because concentrations of contaminants in soil would be less than levels acceptable for unrestricted use at the site. However, the groundwater would be subject to Five-Year Reviews until PRGs are met.

6.1.5.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 9-3A would be protective of human health (including I/C and construction worker exposure), because soil contaminants would be permanently removed from the site and by preventing exposure to contaminated groundwater through LUCs and treatment. No risks to the environment were identified.

Compliance with ARARs and TBCs

Chemical- and action-specific ARARs and TBCs for this alternative are listed in Tables 2-1 and 2-3, respectively. There are no location-specific ARARs associated with this alternative.

Risk-based chemical-specific TBCs (CSFs, RfDs, USEPA Guidance documents, and Illinois TACO values) will be met through excavation and off-site disposal of contaminated soil which eliminates risk. Compliance with groundwater quality standard regulations will be attained by meeting the requirements for Alternative Groundwater Quality Restoration by implementing groundwater LUCs to prevent groundwater use and through natural attenuation and by ISCO treatment of some of the groundwater. NSGL is in the Metropolitan Statistical Area, so the background soil concentrations in 35 IAC 742 for this area are used in the development of PRGs.

Action-specific ARARs and TBCs will be met. Solid wastes would be generated during the excavation, during the installation of ISCO injection wells, and during the sampling of monitoring wells, so hazardous waste characterization and generator management regulations and Illinois special waste regulations would be followed during the management of the excavated soil, well cuttings, and purge water. ISCO injection wells would be installed and abandoned according to UIC regulations for Class V wells. Fugitive dust would be controlled as needed during excavation. Soil erosion and sedimentation controls would be implemented during excavation and backfilling operations. If the property is transferred to a non-federal owner, then LUCs will be recorded in the deed in accordance with the UECA, and a notation of the presence of the ravine fill will be made in the deed in accordance with the Solid Waste Regulations.

Long-Term Effectiveness and Permanence

Alternative 9-3A would address soil contamination in a way that provides long-term effectiveness and permanence. The contaminated soil would be removed from the site, thereby permanently limiting exposure to human receptors. For groundwater, ISCO would permanently treat and remove some COCs. In addition, this alternative would require that Five-Year Reviews be conducted for groundwater until PRGs are met through treatment.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 9-3A would reduce the volume of COCs in groundwater through ISCO.

Short-Term Effectiveness

Implementation of Alternative 9-3A could result in short-term risk to remediation workers because of exposure to contaminated soil during excavation, staging, transportation, and off-site disposal. However, potential for exposure would be minimized by the implementation of engineering controls, such as dust suppression and appropriate site monitoring. The potential for worker exposure would be further reduced by compliance with site-specific health and safety procedures, including wearing appropriate PPE. Appropriate site monitoring would also be implemented for this alternative to monitor emissions during excavation activities. Similarly, exposure of workers to contamination during installation of injection wells, construction and operation of the injection system, and groundwater sampling would be minimized by compliance with the requirements of the OSHA, including wearing of appropriate PPE and adherence to site-specific health and safety procedures.

Alternative 9-3A could also have a minimal adverse impact on the surrounding community and the environment as a result of the excavation and off-site transportation of contaminated soil and transportation of oxidant to the site. This impact would also be adequately mitigated by the implementation of engineering controls such as dust suppression and air quality monitoring, by adherence to spill prevention procedures, and by compliance with DOT regulations.

Alternative 9-3A could be implemented within approximately 4 months and would achieve RAOs 1 and 2 at completion. RAO 3 is currently being met by existing controls, and implementation of the ISCO process would be completed within 2 years.

Overall, the sustainability impact of Alternative 9-3A is high based on a sustainability analysis using Site Wise™ (see Appendix C). Emissions of CO_2, CH_4, and N_2O were normalized to CO_2e, which is a cumulative method of weighing GHG emissions relative to global warming potential. Alternative 9-3A contained high CO_2e emissions (860 tons). Criteria pollutant emissions associated with Alternative 9-3A for NO_x, SO_x, and PM_{10} emissions were 1.7, 0.73, and 3.2 tons, respectively. Energy demand for Alternative 9-3A was high (37,000 MMBTU) and was largely attributed to production of borrow soil. Water consumption associated with this Alternative is high, where a total of 13,000 gallons are used.

Implementability

Alternative 9-3A would be easily implemented. However, it is assumed that existing buildings would be demolished, so shoring would not be required near the buildings. Buried utilities would be addressed as appropriate depending on whether the utility would be reused. Implementation of Alternative 9-3A would involve the completion of numerous administrative procedures such as obtaining a construction permit for excavation, and the off-site transportation and disposal of the excavated material, including determining the requirements for non-hazardous waste transport and disposal. These procedures could readily be accomplished. The chemical oxidation approach of oxidant injection via injection wells could be readily installed and operated. The number of qualified contractors would be somewhat limited but not overly restrictive. Preparation of a LUC RD for groundwater would be readily accomplished. LUCs would be easily implemented at NSGL.

If this alternative is implemented while maintaining the buildings and utilities, then the alternative will be difficult to implement. Shoring would be required for excavations next to buildings. Buried utilities would need to be protected or possibly rerouted. Note that under current site use conditions, it is unlikely that meeting residential exposure criteria would be required.

Cost

The estimated costs for Alternative 9-3A are shown below and a detailed cost estimate is provided in Appendix D.

- Capital Cost: $3,668,000
- Annual Cost: $3,000
- 5 Year Cost: $26,000
- 30-Year NPW: $3,860,000

If buildings and utilities must be maintained, then costs will be higher to account for shoring of buildings and protection and/or rerouting of utilities. This cost is for the remediation of this site independent of the other two sites. Remediation of all three sites is expected to be performed as part of a single project, so the actual cost for this site will be lower due to economies of scale.

6.2 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Table 6-1 provides a comparative analysis of the alternatives in relation to each specific evaluation criterion used in the detailed analysis. The Navy has the option of selecting any alternative or combination of alternatives.

TABLE 6-1

SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES – SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Evaluation Criterion	Alternative 9-1: No Action	Alternative 9-2: LUCs and Barrier	Alternative 9-2A: LUCs, Barrier, and ISCO	Alternative 9-3: Excavation (Unrestricted Re-use), Off-site Disposal, and LUCs	Alternative 9-3A: Excavation (Unrestricted Re-use), Off-site Disposal, LUCs, and ISCO
Overall Protection of Human Health and Environment	Not protective. The potential for exposure of human receptors to contaminated soil would remain unchanged. Groundwater use restrictions would remain, but could be lifted.	Protective of human health by minimizing exposure to contaminated soil and groundwater.	Protective of human health by minimizing exposure to contaminated soil and treating COCs in groundwater.	Protective of human health by removing contaminated soil from the site and by using LUCs to restrict the use of groundwater.	Protective of human health by removing contaminated soil from the site and by treating COCs in groundwater.
Compliance with ARARs and TBCs					
Chemical-Specific	Would not comply	Would comply.	Would comply.	Would comply.	Would comply.
Location-Specific	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Action-Specific	Not applicable	Would comply	Would comply	Would comply	Would comply

TABLE 6-1

SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES – SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Evaluation Criterion	Alternative 9-1: No Action	Alternative 9-2: LUCs and Barrier	Alternative 9-2A: LUCs, Barrier, and ISCO	Alternative 9-3: Excavation (Unrestricted Re-use), Off-site Disposal, and LUCs	Alternative 9-3A: Excavation (Unrestricted Re-use), Off-site Disposal, LUCs, and ISCO
Long-Term Effectiveness and Permanence	Neither effective nor permanent.	Provides long-term effectiveness and permanence. Least effective because LUCs must be continually enforced to prevent exposure.	Provides long-term effectiveness and permanence. More effective than Alternative 9-2 because groundwater COCs are treated, but LUCs must be continually enforced to prevent exposure to soil contaminants.	Provides long-term effectiveness and permanence. More effective than Alternatives 9-2 and 9-2A because soil contaminants are removed from the site.	Provides long-term effectiveness and permanence. Most effective because soil contaminants are removed from the site and groundwater COCs are treated.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	None. There would be no treatment.	None. There would be no treatment.	There would be treatment of groundwater COCs.	None. There would be no treatment.	There would be treatment of groundwater COCs.

TABLE 6-1

SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES – SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Evaluation Criterion	Alternative 9-1: No Action	Alternative 9-2: LUCs and Barrier	Alternative 9-2A: LUCs, Barrier, and ISCO	Alternative 9-3: Excavation (Unrestricted Re-use), Off-site Disposal, and LUCs	Alternative 9-3A: Excavation (Unrestricted Re-use), Off-site Disposal, LUCs, and ISCO
Short-Term Effectiveness	Would not result in risks to remediation workers or result in short-term adverse impacts to the local community and the environment. Would not achieve RAOs or PRGs.	Would not result in risks to remediation workers or result in short-term adverse impacts to the local community and the environment. LUC remedial design would be implemented in approximately 3 months, and would achieve RAOs or PRGs after implementation.	Slight increase of risk to remediation workers from ISCO would be controlled by PPE and safety procedures. Potential impact to the local community and the environment during oxidant transport. LUC remedial design would be implemented in approximately 3 months, and would achieve RAOs or PRGs after implementation. ISCO would be completed within 2 years.	Exposure of remediation workers would be controlled by PPE and safety procedures. Potential impact to community from truck traffic. Action would be completed in 4 months. RAOs 1 and 2 would be met after completion of excavation. Would achieve RAO 3 after implementation of LUCs.	Exposure of remediation workers during excavation and ISCO would be controlled by PPE and safety procedures. Potential impact to community from truck traffic and oxidant transport. Action would be completed in 4 months. RAOs 1 and 2 would be met after completion of excavation. Would achieve RAO 3 after implementation of ISCO. ISCO would be completed within 2 years.
Implementability	Nothing to implement.	Easy to implement. Would be easiest to implement.	Easy to implement. Would be easier to implement than Alternatives 9-3 and 9-3A.	Easy to implement, but less difficult to implement than Alternative 9-3A.	Easy to implement, but most difficult to implement.

TABLE 6-1

SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES – SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Evaluation Criterion	Alternative 9-1: No Action	Alternative 9-2: LUCs and Barrier	Alternative 9-2A: LUCs, Barrier, and ISCO	Alternative 9-3: Excavation (Unrestricted Re-use), Off-site Disposal, and LUCs	Alternative 9-3A: Excavation (Unrestricted Re-use), Off-site Disposal, LUCs, and ISCO
Costs:					
Capital	$0	$21,000	$488,000	$3,220,000	$3,668,000
NPW of Annual Costs	$0	$345,000 (30-Year)	$346,000 (30-Year)	$191,000 (30-Year)	$192,000 (30-Year)
NPW	$0	$366,000 (30-Year)	$834,000 (30-Year)	$3,411,000 (30-Year)	$3,860,000 (30-Year)

ARARs - Applicable or Relevant and Appropriate Requirements.
ISCO - In-situ chemical oxidation.
LUCs - Land use controls.
NPW - Net present worth.
PPE - Personal protective equipment.
RAO - Remedial Action Objective.
TBC - To Be Considered.

Costs are stand alone cost for the site – economy of scale will be obtained when done in combination with other sites.

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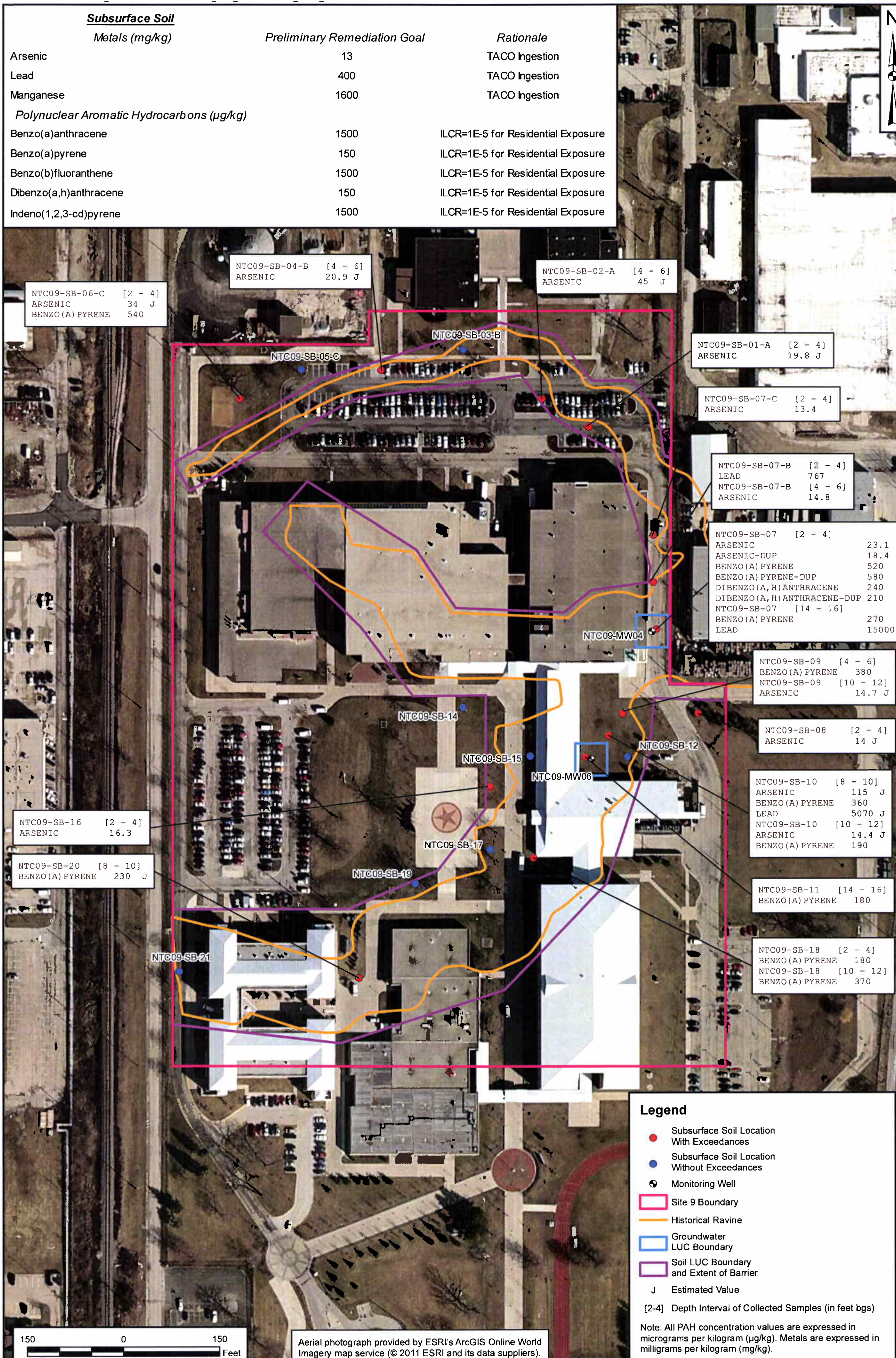
Subsurface Soil

Metals (mg/kg)	*Preliminary Remediation Goal*	*Rationale*
Arsenic	13	TACO Ingestion
Lead	400	TACO Ingestion
Manganese	1600	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1500	ILCR=1E-5 for Residential Exposure
Benzo(a)pyrene	150	ILCR=1E-5 for Residential Exposure
Benzo(b)fluoranthene	1500	ILCR=1E-5 for Residential Exposure
Dibenzo(a,h)anthracene	150	ILCR=1E-5 for Residential Exposure
Indeno(1,2,3-cd)pyrene	1500	ILCR=1E-5 for Residential Exposure



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J. LOGAN	09/23/13
REVISED BY	DATE
D. COUCH	09/23/13
SCALE AS NOTED	

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ALTERNATIVE 9-2
BARRIER AND LAND USE CONTROL BOUNDARIES
SITE 9 - CAMP MOFFETT RAVINE FILL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER 510
APPROVED BY	DATE 10/8/13
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FIGURE NO. 6-1	REV 0

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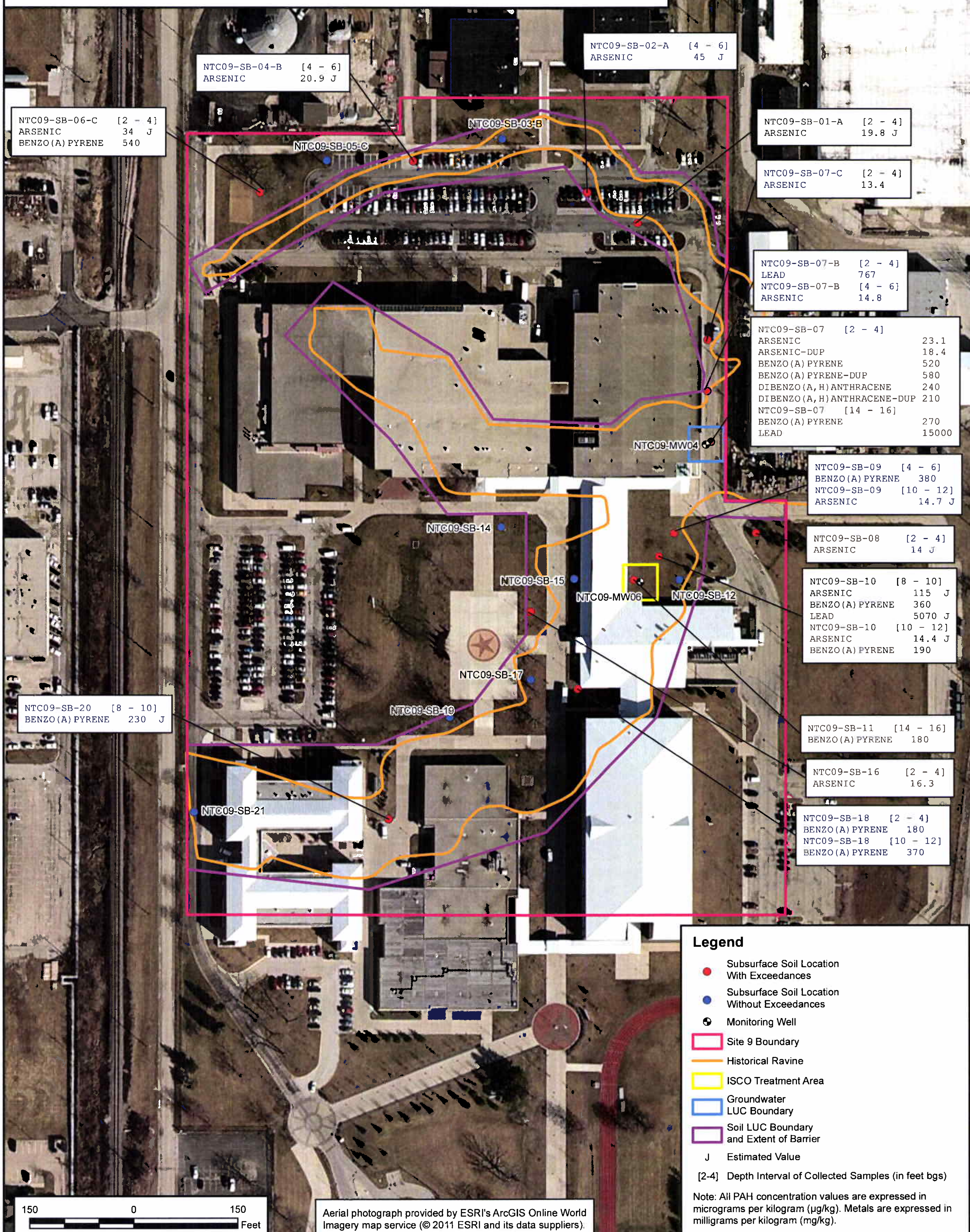
Subsurface Soil

Metals (mg/kg)	*Preliminary Remediation Goal*	*Rationale*
Arsenic	13	TACO Ingestion
Lead	400	TACO Ingestion
Manganese	1600	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1500	ILCR=1E-5 for Residential Exposure
Benzo(a)pyrene	150	ILCR=1E-5 for Residential Exposure
Benzo(b)fluoranthene	1500	ILCR=1E-5 for Residential Exposure
Dibenzo(a,h)anthracene	150	ILCR=1E-5 for Residential Exposure
Indeno(1,2,3-cd)pyrene	1500	ILCR=1E-5 for Residential Exposure



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ALTERNATIVE 9-2A
BARRIER AND LAND USE CONTROL BOUNDARIES
AND ISCO TREATMENT AREA
SITE 9 - CAMP MOFFETT RAVINE FILL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	510
APPROVED BY	DATE 10/8/13
APPROVED BY	DATE
FIGURE NO. 6-2	REV 0

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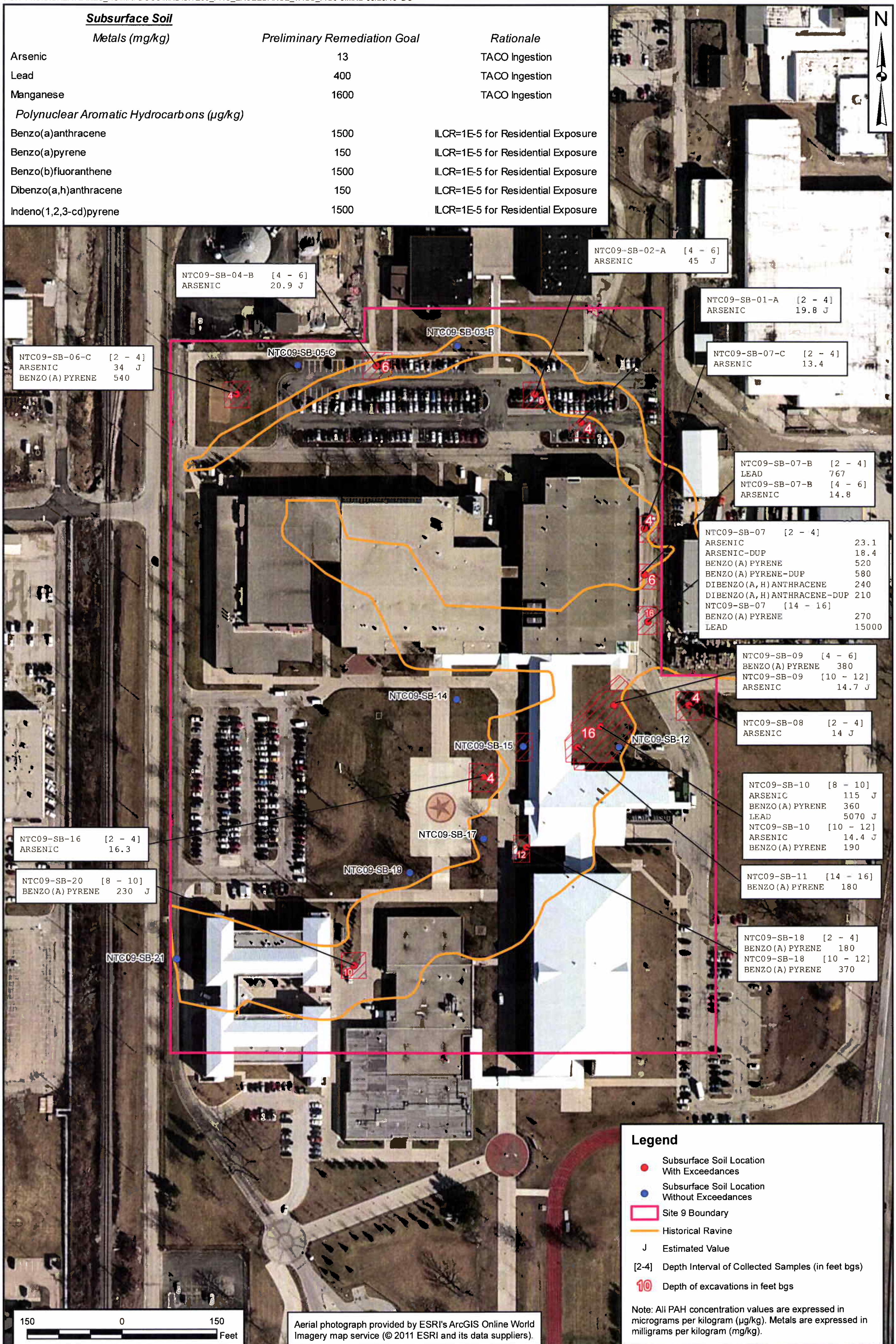
Subsurface Soil

Metals (mg/kg)	*Preliminary Remediation Goal*	*Rationale*
Arsenic	13	TACO Ingestion
Lead	400	TACO Ingestion
Manganese	1600	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (μg/kg)		
Benzo(a)anthracene	1500	ILCR=1E-5 for Residential Exposure
Benzo(a)pyrene	150	ILCR=1E-5 for Residential Exposure
Benzo(b)fluoranthene	1500	ILCR=1E-5 for Residential Exposure
Dibenzo(a,h)anthracene	150	ILCR=1E-5 for Residential Exposure
Indeno(1,2,3-cd)pyrene	1500	ILCR=1E-5 for Residential Exposure



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ALTERNATIVE 9-3 - LIMITS OF EXCAVATION
SITE 9 - CAMP MOFFETT RAVINE FILL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
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APPROVED BY	DATE 10/8/13
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FIGURE NO. 6-3	REV 0

7.0 DETAILED AND COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES FOR SITE 21

7.1 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

7.1.1 Alternative 21-1: No Action

7.1.1.1 Description

This alternative is a "walk-away" alternative required under CERCLA to establish a basis for comparison with other alternatives. Under this alternative, the property would be released for unrestricted use. Existing groundwater use restrictions would remain in place. In addition, there would be no Five-Year Review required to assess contamination at the site over time. This alternative could only be chosen if it is determined that taking no action would be protective of human health and the environment.

7.1.1.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 21-1 would not provide protection of human health and the environment. The potential for exposure of human receptors to contaminated soil via ingestion and dermal contact would remain unchanged. The existing groundwater use restrictions would be protective of human health; however, these restrictions could be lifted.

Compliance with ARARs and TBCs

Alternative 21-1 would not comply with chemical-specific ARARs and TBCs for soil because no action would be taken to reduce COC concentrations. The existing groundwater use restrictions comply with chemical-specific ARARs and TBCs for groundwater; however, these restrictions could be lifted. No location-specific or action-specific ARARs are associated with this alternative. Chemical-specific ARARs and TBCs for Alternative 21-1 are listed in Table 2-1.

Long-Term Effectiveness and Permanence

Alternative 21-1 would have no long-term effectiveness or permanence because nothing would be done to reduce concentrations of soil COCs or to reduce human exposure to site contaminants. The existing groundwater use restrictions would not provide long-term effectiveness or permanence because they are

not permanent and could be revoked. Unlike deed restrictions or similar covenants, the groundwater use restrictions do not run with the land.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 21-1 would not reduce the toxicity, mobility, or volume of COCs through treatment because no soil or groundwater treatment would occur.

Short-Term Effectiveness

Because no action would occur, implementation of Alternative 21-1 would not pose risks to on-site remediation workers or result in short-term adverse impact to the local community or the environment.

Alternative 21-1 would not achieve the RAOs or the PRGs, and would also have no life cycle sustainability impacts.

Implementability

Because no action would occur, Alternative 21-1 would be readily implementable. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable. The remedy would be implementable if ultimately selected in the Record of Decision.

Cost

There would be no costs associated with Alternative 21-1.

7.1.2 Alternative 21-2: LUCs and Barrier

7.1.2.1 Description

Alternative 21-2 would consist of two major components: (1) LUCs and (2) barrier.

The existing pavement would be used as a barrier to prevent exposure by I/C workers to soil contaminants exceeding I/C TACO criteria. Nearly all of the site is covered by a combination of asphalt pavement (approximately 3 inches thick), and building foundations (assumed to be at least 6 to 12 inches thick). The extent of coverage of the site is approximately 80 percent asphalt and 15 percent building foundation. Approximately 5 percent of the site, near the corners of the site, is unpaved. In addition, approximately 2,000 ft^2 in the northwest corner of the site would need to be further evaluated to determine if any action is needed. The barrier would be inspected and repaired as needed to maintain protection. Figure 7-1 shows the extent of the barrier.

A LUC RD would be prepared in accordance with the Navy's LUC Principles (DoD, 2003) to establish methods to prevent exposure to COCs, and to restrict the disturbance of contaminated soil. LUCs would be implemented in accordance with the LUCMOA. Specifically, LUCs would be implemented to prevent residential land use, restrict unauthorized construction, require notification of the presence of contaminants to construction workers, require review of construction activities and intrusive work in the area to protect workers through PPE and alternative methods to reduce exposure, require proper management of excavated material, provide for long-term inspection of LUCs, and provide requirements for dealing with changes in land use or site features. LUCs would also require routine inspection of the pavement and repairs to the pavement to prevent exposure to contaminated soil. The areas to which the LUCs would apply would be identified and surveyed by an Illinois Licensed Professional Land Surveyor.

LUCs would also be implemented to restrict groundwater use. The LUCs would be specifically implemented through a LUC RD to continue the restrictions found in the existing NSGL Base Instruction 11130.1 that prohibits the use of groundwater. The LUCs would be permanent in the event of a change in land use or ownership. Figure 7-1 shows the extent of the area covered by LUCs.

Five-Year Reviews would be required since concentrations of contaminants would remain in soil and groundwater above levels acceptable for unrestricted use at the site.

7.1.2.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 21-2 would provide protection to human health by minimizing exposure to contaminated soil through LUCs and maintenance of the barrier and by preventing exposure to contaminated groundwater. No risks to the environment were identified.

Compliance with ARARs and TBCs

Chemical- and action-specific ARARs and TBCs for this alternative are listed in Tables 2-1 and 2-3, respectively. There are no location-specific ARARs associated with this alternative.

Risk-based chemical-specific TBCs (CSFs, RfDs, USEPA Guidance documents, and Illinois TACO values) will be met through a combination of barriers and LUCs which prevent exposure and eliminate risk. Compliance with groundwater quality standard regulations will be attained by meeting the requirements for Alternative Groundwater Quality Restoration by implementing groundwater LUCs to prevent groundwater use and through natural attenuation. NSGL is in the Metropolitan Statistical Area, so the background soil concentrations in 35 IAC 742 for this area are used in the development of PRGs.

Action-specific ARARs and TBCs will be met. No wastes would be generated for this alternative, so hazardous waste characterization and generator management regulations and Illinois special waste regulations are not pertinent. Fugitive dust would be controlled as needed during maintenance of the barrier, such as replacement of paving. If the property is transferred to a non-federal owner, then LUCs will be recorded in the deed in accordance with the UECA.

Long-Term Effectiveness and Permanence

Alternative 21-2 would be an effective means of minimizing exposure to contaminants in site soil and groundwater over the long term. The permanence of Alternative 21-2 would depend on the maintenance of the LUCs and barrier, verification that the land use is being properly controlled, and verification that groundwater is not being used. In addition, this alternative would require that Five-Year Reviews be conducted to assess the protectiveness and effectiveness of the LUCs.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 21-2 would not reduce the toxicity, mobility, or volume of COCs through treatment because no treatment would occur.

Short-Term Effectiveness

Implementation of Alternative 21-2 would not pose risks to on-site remediation workers or result in short-term adverse impact to the local community or the environment. Alternative 21-2 could be implemented within approximately 3 months and would achieve RAOs 1 and 2 upon implementation by restricting exposure to soil at the site. RAO 3 is currently being met by existing controls, and implementation of the groundwater LUC would provide a permanent restriction.

Overall, the sustainability impact of Alternative 21-2 is low based on a sustainability analysis using Site Wise™ (see Appendix C). Emissions of CO_2, CH_4, and N_2O were normalized to CO_2e, which is a cumulative method of weighing GHG emissions relative to global warming potential. Alternative 21-2 contained low GHG emissions (0.76 ton). Criteria pollutant emissions associated with Alternative 21-2 for NO_x, SO_x, and PM_{10} emissions were 2.8×10^{-4}, 9.8×10^{-6}, and 5.7×10^{-5} ton, respectively. Energy demand for Alternative 21-2 was low (8.6 MMBTU). There is no direct water consumption associated with Alternative 21-2.

Implementability

Alternative 21-2 would be easily implemented since LUCs are already in place at other sites at NSGL. Inspection and maintenance of the barrier can be easily performed. Preparation of a LUC RD would be readily accomplished.

Cost

The estimated costs for Alternative 21-2 are shown below and a detailed cost estimate is provided in Appendix D.

- Capital Cost: $21,000
- Annual Cost: $9,000
- 5 Year Cost: $26,000
- 30-Year NPW: $366,000

This cost is for the remediation of this site independent of the other two sites. Remediation of all three sites is expected to be performed as part of a single project, so the actual cost for this site will be lower due to economies of scale.

7.1.3 Alternative 21-2A: LUCs, Barrier, and ISCO

7.1.3.1 Description

Alternative 21-2A would consist of four major components: (1) LUCs, (2) barrier, and (3) ISCO for groundwater treatment.

The existing pavement would be used as a barrier to prevent exposure by I/C workers to soil contaminants exceeding I/C TACO criteria. In addition, approximately 2,000 ft^2 in the northwest corner of the site would need to be further evaluated to determine if any action is needed. All pavement would be inspected and repaired as needed to maintain protection. Figure 7-2 shows the extent of the barrier.

A LUC RD would be prepared in accordance with the Navy's LUC Principles (DoD, 2003) to establish methods to prevent exposure to COCs, and to restrict the disturbance of contaminated soil. LUCs would be implemented in accordance with the LUCMOA. Specifically, LUCs would be implemented to prevent residential land use, restrict unauthorized construction, require notification of the presence of contaminants to construction workers, require review of construction activities and intrusive work in the area to protect workers through PPE and alternative methods to reduce exposure, require proper management of excavated material, provide for long-term inspection of LUCs, and provide requirements for dealing with changes in land use or site features. LUCs would also require routine inspection of the pavement and repairs to the pavement to prevent exposure to contaminated soil. The areas to which the LUCs would apply would be identified and surveyed by an Illinois Licensed Professional Land Surveyor.

LUCs would also be implemented to restrict groundwater use. These are required throughout the site, but are expected to be short-term where ISCO is applied and PRGs are met. The LUCs would be specifically implemented through a LUC RD to continue the restrictions found in the existing NSGL Base Instruction 11130.1 that prohibits the use of groundwater. The LUCs would be permanent in the event of a change in land use or ownership. Figure 7-2 shows the extent of the area covered by LUCs.

For the purposes of the development of this alternative, ISCO would consist of injection of Fenton's reagent to treat pentachlorophenol. Other oxidants, such as persulfate, should be considered during remedial design. Oxidant injection would use injection wells so that multiple injections can be performed, if needed. The injection system would consist of a grid of injection wells over a 50-foot by 50-foot area centered on well MW01. Because of the low COC concentrations, high clay content, and heterogeneity, it is assumed that two injection events would be required to achieve chemical oxidation of the COCs. The area to be treated is shown on Figure 7-2. Thirty-two wells based on a 10-foot grid and 5,600 gallons of 7-percent (by weight) solution of Fenton's reagent are estimated to be required. A bench and/or pilot study would be performed to confirm well spacing and oxidant application rates.

Prior to the ISCO remedial design, groundwater samples would be collected from existing monitoring wells that have COC concentrations greater than the PRGs, and possibly wells downgradient of these wells, to determine the presence of contamination. Monitoring of groundwater would be required to assess the performance of chemical oxidation. Performance monitoring would include collecting groundwater samples from monitoring wells located within the contaminant plumes to assess trends in concentrations of COCs and on the periphery of the plumes to evaluate potential migration of COCs. Generally samples would be analyzed for field parameters (pH, DO, ORP, specific conductivity, turbidity, and groundwater elevation) and COCs.

Approximately 2 years would be required for treatment. The need for and locations of additional injection events will be determined based on the performance monitoring. Conceptual design calculations are provided in Appendix B.

Five-Year Reviews would be required since concentrations of contaminants would remain in soil above levels acceptable for unrestricted use at the site.

7.1.3.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 21-2A would provide protection to human health by minimizing exposure to contaminated soil through LUCs and maintenance of the barrier and by preventing exposure to contaminated groundwater through LUCs and treatment. No risks to the environment were identified.

Compliance with ARARs and TBCs

Chemical- and action-specific ARARs and TBCs for this alternative are listed in Tables 2-1 and 2-3, respectively. There are no location-specific ARARs associated with this alternative.

Risk-based chemical-specific TBCs (CSFs, RfDs, USEPA Guidance documents, and Illinois TACO values) will be met through a combination of barriers and LUCs which prevent exposure and eliminate risk. Compliance with groundwater quality standard regulations will be attained by meeting the requirements for Alternative Groundwater Quality Restoration by implementing groundwater LUCs to prevent groundwater use and through natural attenuation and by ISCO treatment of some of the groundwater. NSGL is in the Metropolitan Statistical Area, so the background soil concentrations in 35 IAC 742 for this area are used in the development of PRGs.

Action-specific ARARs and TBCs will be met. Solid wastes would be generated during the installation of ISCO injection wells and during the sampling of monitoring wells, so hazardous waste characterization and generator management regulations and Illinois special waste regulations would be followed. ISCO injection wells would be installed and abandoned according to UIC regulations for Class V wells. Fugitive dust would be controlled as needed during maintenance of the barrier, such as replacement of paving. If the property is transferred to a non-federal owner, then LUCs will be recorded in the deed in accordance with the UECA.

Long-Term Effectiveness and Permanence

Alternative 21-2A would be an effective means of minimizing exposure to contaminants in site soil and groundwater over the long term. The permanence of Alternative 21-2A would depend on the maintenance of the LUCs and barrier and verification that the land use is being properly controlled. For groundwater, ISCO would permanently treat and remove some COCs. In addition, this alternative would require that Five-Year Reviews be conducted to assess the protectiveness and effectiveness of the LUCs.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 21-2A would reduce the volume of COCs in groundwater through ISCO.

Short-Term Effectiveness

Implementation of the soil components of Alternative 21-2A would not pose risks to on-site remediation workers or result in short-term adverse impact to the local community or the environment. Exposure of workers to contamination during installation of injection wells, construction and operation of the injection system, and groundwater sampling would be minimized by compliance with the requirements of the OSHA, including wearing of appropriate PPE and adherence to site-specific health and safety procedures. Alternative 21-2A could be implemented within approximately 3 months and would achieve RAOs 1 and 2 upon implementation by restricting exposure to soil at the site. RAO 3 is currently being met by existing controls, and implementation of the ISCO process would be completed within 2 years.

Overall, the sustainability impact of Alternative 21-2A is low based on a sustainability analysis using Site Wise^{TM} (see Appendix C). Emissions of CO_2, CH_4, and N_2O were normalized to CO_2e, which is a cumulative method of weighing GHG emissions relative to global warming potential. Alternative 21-2A contained low GHG emissions (12 tons). Criteria pollutant emissions associated with Alternative 21-2A for NO_x, SO_x, and PM_{10} emissions were 0.019, 0.016, and 0.0032 ton, respectively. Energy demand for Alternative 21-2A was low (220 MMBTU) and was largely attributed to laboratory analytical services. Water consumption associated with this Alternative is high, where a total of 14,000 gallons are used.

Implementability

Alternative 21-2A would be easily implemented since LUCs are already in place at other sites at NSGL. Inspection, maintenance of the barrier, and monitoring well sampling can be easily performed. The chemical oxidation approach of oxidant injection via injection wells could be readily installed and operated. The number of qualified contractors would be somewhat limited but not overly restrictive. Preparation of a LUC RD would be readily accomplished.

Cost

The estimated costs for Alternative 21-2A are shown below and a detailed cost estimate is provided in Appendix D.

- Capital Cost: $554,000
- Annual Cost: $9,000
- 5 Year Cost: $26,000
- 30-Year NPW: $900,000

This cost is for the remediation of this site independent of the other two sites. Remediation of all three sites is expected to be performed as part of a single project, so the actual cost for this site will be lower due to economies of scale.

7.1.4 Alternative 21-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and LUCs

7.1.4.1 Description

Alternative 21-3 would consist of three major components: (1) soil excavation to meet unrestricted re-use, (2) off-site disposal, and (3) LUCs to restrict groundwater use.

Alternative 21-3 would consist of the excavation of approximately 3,000 cy of contaminated soil to meet PRGs for residential exposure, as shown on Figures 7-3 and 7-4 (see Appendix B). The total excavation area is approximately 34,000 square feet, and the depth of excavation ranges from 1 foot to 6 feet bgs. Figure 7-3 shows the entire extent of the excavations. Figure 7-4 shows the extent of the subsurface soil excavations only, for clarity. The excavation areas are adjacent to several buildings, but it is assumed that this alternative would only be implemented if the base was closed and there was a change in land use. In addition, this alternative assumes that the buildings would be demolished because of the change in land use, so the buildings would not need to be protected during excavation. It is assumed that the contaminated soil is not under the buildings. Excavated material would be transported off-site to a non-hazardous landfill for disposal. Prior to excavation, the limits of excavation would be confirmed by sampling. Excavated areas would be backfilled with clean soil and the surface would be seeded with grass.

LUCs would be implemented to restrict groundwater use. The LUCs would be specifically implemented through a LUC RD to continue with the restrictions found in the existing NSGL Base Instruction that does not allow the use of groundwater. The LUCs would be permanent in the event of a change in land use or ownership. Figure 7-1 shows the extent of the area covered by LUCs.

No Five-Year Reviews would be required for the soil because concentrations of contaminants in soil would be less than levels acceptable for unrestricted use at the site. However, the groundwater would be subject to Five-Year Reviews.

7.1.4.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 21-3 would be protective of human health (including I/C and construction worker exposure), because soil contaminants would be permanently removed from the site and exposure to contaminated groundwater would be prevented. No risks to the environment were identified.

Compliance with ARARs and TBCs

Chemical- and action-specific ARARs and TBCs for this alternative are listed in Tables 2-1 and 2-3, respectively. There are no location-specific ARARs associated with this alternative.

Risk-based chemical-specific TBCs (CSFs, RfDs, USEPA Guidance documents, and Illinois TACO values) will be met through excavation and off-site disposal of contaminated soil which eliminates risk. Compliance with groundwater quality standard regulations will be attained by meeting the requirements for Alternative Groundwater Quality Restoration by implementing groundwater LUCs to prevent groundwater use and through natural attenuation. NSGL is in the Metropolitan Statistical Area, so the background soil concentrations in 35 IAC 742 for this area are used in the development of PRGs.

Action-specific ARARs and TBCs will be met. Solid wastes would be generated during the excavation, so hazardous waste characterization and generator management regulations and Illinois special waste regulations would be followed during the management of the excavated soil. Fugitive dust would be controlled as needed during excavation. Soil erosion and sedimentation controls would be implemented during excavation and backfilling operations. If the property is transferred to a non-federal owner, then LUCs will be recorded in the deed in accordance with the UECA.

Long-Term Effectiveness and Permanence

Alternative 21-3 would address soil contamination in a way that provides long-term effectiveness and permanence. The contaminated soil would be removed from the site, thereby permanently limiting exposure to human receptors. The permanence of Alternative 21-3 for groundwater contamination would depend on the maintenance of the groundwater LUCs and verification that groundwater is not being used. In addition, this alternative would require that Five-Year Reviews be conducted for groundwater to assess the protectiveness and effectiveness of the LUCs.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 21-3 would not reduce the toxicity, mobility, or volume of COCs through treatment because no treatment would occur.

Short-Term Effectiveness

Implementation of Alternative 21-3 could result in short-term risk to remediation workers because of exposure to contaminated soil during excavation, staging, transportation, and off-site disposal. However, potential for exposure would be minimized by the implementation of engineering controls, such as dust suppression and appropriate site monitoring. The potential for worker exposure would be further reduced by compliance with site-specific health and safety procedures, including wearing appropriate PPE. Appropriate site monitoring would also be implemented for this alternative to monitor emissions during excavation activities.

Alternative 21-3 could also have a minimal adverse impact on the surrounding community and the environment as a result of the excavation and off-site transportation of contaminated soil. This impact would also be adequately mitigated by the implementation of engineering controls such as dust suppression and air quality monitoring, by adherence to spill prevention procedures, and by compliance with DOT regulations.

Alternative 21-3 could be implemented within approximately 2 months and would achieve RAOs 1 and 2 at completion. RAO 3 is currently being met by existing controls, and implementation of the groundwater LUC would provide a permanent restriction.

Overall, the sustainability impact of Alternative 21-3 is high based on a sustainability analysis using Site Wise™ (see Appendix C). Emissions of CO_2, CH_4, and N_2O were normalized to CO_2e, which is a cumulative method of weighing GHG emissions relative to global warming potential. Alternative 21-3 contained high CO_2e emissions (260 tons). Criteria pollutant emissions associated with Alternative 21-3 for NO_x, SO_x, and PM_{10} emissions were 0.56, 0.24, and 0.90 ton, respectively. Energy demand for Alternative 21-3 was high (11,000 MMBTU) and was largely attributed to production of borrow soil. Water usage associated with decontamination activities is low, where a total of 1,700 gallons are used.

Implementability

Alternative 21-3 would be easily implemented. However, it is assumed that existing buildings would be demolished, so shoring would not be required near the buildings. Buried utilities would be addressed as appropriate depending on whether the utility would be reused. Implementation of Alternative 21-3 would involve the completion of numerous administrative procedures such as obtaining a construction permit for excavation, and the off-site transportation and disposal of the excavated material, including determining the requirements for non-hazardous waste transport and disposal. These procedures could readily be accomplished. Preparation of a LUC RD for groundwater use restrictions would be readily accomplished. LUCs would be easily implemented at NSGL.

If this alternative is implemented while maintaining the buildings and utilities, then the alternative will be difficult to implement. Shoring would be required for excavations next to buildings. Buried utilities would need to be protected or possibly rerouted. Note that under current site use conditions, it is unlikely that meeting residential exposure criteria would be required.

Cost

The estimated costs for Alternative 21-3 are shown below and a detailed cost estimate is provided in Appendix D.

- Capital Cost: $1,244,000
- Annual Cost: $3,000
- 5 Year Cost: $26,000
- 30-Year NPW: $1,436,000

If buildings and utilities must be maintained, then costs will be higher to account for shoring of buildings and protection and/or rerouting of utilities. This cost is for the remediation of this site independent of the other two sites. Remediation of all three sites is expected to be performed as part of a single project, so the actual cost for this site will be lower due to economies of scale.

7.1.5 Alternative 21-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, LUCs, and ISCO

7.1.5.1 Description

Alternative 21-3A would consist of four major components: (1) ISCO for groundwater treatment, (2) soil excavation to meet unrestricted re-use, (3) off-site disposal, and (4) LUCs to restrict groundwater use.

The ISCO component of Alternative 21-3A would be the same as that described for Alternative 21-2A. The excavation and off-site disposal components would be the same as described for Alternative 21-3.

LUCs would be implemented to restrict groundwater use. These are required throughout the site, but are expected to be short-term where ISCO is applied and PRGs are met. The LUCs would be specifically implemented through a LUC RD to continue with the restrictions found in the existing NSGL Base Instruction that does not allow the use of groundwater. The LUCs would be permanent in the event of a change in land use or ownership. Figure 7-1 shows the extent of the area covered by LUCs.

No Five-Year Reviews would be required for the soil because concentrations of contaminants in soil would be less than levels acceptable for unrestricted use at the site. However, the groundwater would be subject to Five-Year Reviews until PRGs are met.

7.1.5.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative 21-3A would be protective of human health (including I/C and construction worker exposure), because soil contaminants would be permanently removed from the site and by preventing exposure to contaminated groundwater through LUCs and treatment. No risks to the environment were identified.

Compliance with ARARs and TBCs

Chemical- and action-specific ARARs and TBCs for this alternative are listed in Tables 2-1 and 2-3, respectively. There are no location-specific ARARs associated with this alternative.

Risk-based chemical-specific TBCs (CSFs, RfDs, USEPA Guidance documents, and Illinois TACO values) will be met through excavation and off-site disposal of contaminated soil which eliminates risk. Compliance with groundwater quality standard regulations will be attained by meeting the requirements for Alternative Groundwater Quality Restoration by implementing groundwater LUCs to prevent groundwater use and through natural attenuation and by ISCO treatment of some of the groundwater. NSGL is in the Metropolitan Statistical Area, so the background soil concentrations in 35 IAC 742 for this area are used in the development of PRGs.

Action-specific ARARs and TBCs will be met. Solid wastes would be generated during the excavation, during the installation of ISCO injection wells, and during the sampling of monitoring wells, so hazardous waste characterization and generator management regulations and Illinois special waste regulations would be followed during the management of the excavated soil, well cuttings, and purge water. ISCO injection wells would be installed and abandoned according to UIC regulations for Class V wells. Fugitive dust would be controlled as needed during excavation. Soil erosion and sedimentation controls would be implemented during excavation and backfilling operations. If the property is transferred to a non-federal owner, then LUCs will be recorded in the deed in accordance with the UECA.

Long-Term Effectiveness and Permanence

Alternative 21-3A would address soil contamination in a way that provides long-term effectiveness and permanence. The contaminated soil would be removed from the site, thereby permanently limiting exposure to human receptors. For groundwater, ISCO would permanently treat and remove some COCs. In addition, this alternative would require that Five-Year Reviews be conducted for groundwater until PRGs are met through treatment.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative 21-3A would reduce the volume of COCs in groundwater through ISCO.

Short-Term Effectiveness

Implementation of Alternative 21-3A could result in short-term risk to remediation workers because of exposure to contaminated soil during excavation, staging, transportation, and off-site disposal. However, potential for exposure would be minimized by the implementation of engineering controls, such as dust suppression and appropriate site monitoring. The potential for worker exposure would be further reduced by compliance with site-specific health and safety procedures, including wearing appropriate PPE. Appropriate site monitoring would also be implemented for this alternative to monitor emissions during excavation activities. Similarly, exposure of workers to contamination during installation of injection wells, construction and operation of the injection system, and groundwater sampling would be minimized by compliance with the requirements of the OSHA, including wearing of appropriate PPE and adherence to site-specific health and safety procedures.

Alternative 21-3A could also have a minimal adverse impact on the surrounding community and the environment as a result of the excavation and off-site transportation of contaminated soil and transportation of oxidant to the site. This impact would also be adequately mitigated by the implementation of engineering controls such as dust suppression and air quality monitoring, by adherence to spill prevention procedures, and by compliance with DOT regulations.

Alternative 21-3A could be implemented within approximately 2 months and would achieve RAOs 1 and 2 at completion. RAO 3 is currently being met by existing controls, and implementation of the ISCO process would be completed within 2 years.

Overall, the sustainability impact of Alternative 21-3A is high based on a sustainability analysis using Site Wise™ (see Appendix C). Emissions of CO_2, CH_4, and N_2O were normalized to CO_2e, which is a cumulative method of weighing GHG emissions relative to global warming potential. Alternative 21-3A contained high CO_2e emissions (270 tons). Criteria pollutant emissions associated with Alternative 21-3A for NO_x, SO_x, and PM_{10} emissions were 0.56, 0.25, and 0.90 ton, respectively. Energy demand for Alternative 21-3A was high (11,000 MMBTU) and was largely attributed to production of borrow soil. Water usage associated with decontamination activities is high, where a total of 14,000 gallons are used.

Implementability

Alternative 21-3A would be easily implemented. However, it is assumed that existing buildings would be demolished, so shoring would not be required near the buildings. Buried utilities would be addressed as appropriate depending on whether the utility would be reused. Implementation of Alternative 21-3A would involve the completion of numerous administrative procedures such as obtaining a construction permit for excavation, and the off-site transportation and disposal of the excavated material, including determining the requirements for non-hazardous waste transport and disposal. These procedures could readily be accomplished. The chemical oxidation approach of oxidant injection via injection wells could be readily installed and operated. The number of qualified contractors would be somewhat limited but not overly restrictive. Preparation of a LUC RD for groundwater would be readily accomplished. LUCs would be easily implemented at NSGL.

If this alternative is implemented while maintaining the buildings and utilities, then the alternative will be difficult to implement. Shoring would be required for excavations next to buildings. Buried utilities would need to be protected or possibly rerouted. Note that under current site use conditions, it is unlikely that meeting residential exposure criteria would be required.

Cost

The estimated costs for Alternative 21-3A are shown below and a detailed cost estimate is provided in Appendix D.

- Capital Cost: $1,686,000
- Annual Cost: $3,000
- 5 Year Cost: $26,000
- 30-Year NPW: $1,878,000

If buildings and utilities must be maintained, then costs will be higher to account for shoring of buildings and protection and/or rerouting of utilities. This cost is for the remediation of this site independent of the other two sites. Remediation of all three sites is expected to be performed as part of a single project, so the actual cost for this site will be lower due to economies of scale.

7.2 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Table 7-1 provides a comparative analysis of the alternatives in relation to each specific evaluation criterion used in the detailed analysis. The Navy has the option of selecting any alternative or combination of alternatives.

TABLE 7-1

SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES – SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Evaluation Criterion	Alternative 21-1: No Action	Alternative 21-2: LUCs and Barrier	Alternative 21-2A: LUCs, Barrier, and ISCO	Alternative 21-3: Excavation (Unrestricted Re-use), Off-site Disposal, and LUCs	Alternative 21-3A: Excavation (Unrestricted Re-use), Off-site Disposal, LUCs, and ISCO
Overall Protection of Human Health and Environment	Not protective. The potential for exposure of human receptors to contaminated soil would remain unchanged. Groundwater use restrictions would remain, but could be lifted.	Protective of human health by minimizing exposure to contaminated soil and groundwater.	Protective of human health by minimizing exposure to contaminated soil and treating COCs in groundwater.	Protective of human health by removing contaminated soil from the site and by using LUCs to restrict the use of groundwater.	Protective of human health by removing contaminated soil from the site and by treating COCs in groundwater.
Compliance with ARARs and TBCs					
Chemical-Specific	Would not comply	Would comply.	Would comply.	Would comply.	Would comply.
Location-Specific	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Action-Specific	Not applicable	Would comply	Would comply	Would comply	Would comply

TABLE 7-1

SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES – SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Evaluation Criterion	Alternative 21-1: No Action	Alternative 21-2: LUCs and Barrier	Alternative 21-2A: LUCs, Barrier, and ISCO	Alternative 21-3: Excavation (Unrestricted Re-use), Off-site Disposal, and LUCs	Alternative 21-3A: Excavation (Unrestricted Re-use), Off-site Disposal, LUCs, and ISCO
Long-Term Effectiveness and Permanence	Neither effective nor permanent.	Provides long-term effectiveness and permanence. Least effective because LUCs must be continually enforced to prevent exposure.	Provides long-term effectiveness and permanence. More effective than Alternative 21-2 because groundwater COCs are treated, but LUCs must be continually enforced to prevent exposure to soil contaminants.	Provides long-term effectiveness and permanence. More effective than Alternatives 21-2 and 21-2A because soil contaminants are removed from the site.	Provides long-term effectiveness and permanence. Most effective because soil contaminants are removed from the site and groundwater COCs are treated.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	None. There would be no treatment.	None. There would be no treatment.	There would be treatment of groundwater COCs.	None. There would be no treatment.	There would be treatment of groundwater COCs.

TABLE 7-1

SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES – SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Evaluation Criterion	Alternative 21-1: No Action	Alternative 21-2: LUCs and Barrier	Alternative 21-2A: LUCs, Barrier, and ISCO	Alternative 21-3: Excavation (Unrestricted Re-use), Off-site Disposal, and LUCs	Alternative 21-3A: Excavation (Unrestricted Re-use), Off-site Disposal, LUCs, and ISCO
Short-Term Effectiveness	Would not result in risks to remediation workers or result in short-term adverse impacts to the local community and the environment. Would not achieve RAOs or PRGs.	Would not result in risks to remediation workers or result in short-term adverse impacts to the local community and the environment. LUC remedial design would be implemented in approximately 3 months, and would achieve RAOs or PRGs after implementation.	Slight increase of risk to remediation workers from ISCO would be controlled by PPE and safety procedures. Potential impact to the local community and the environment during oxidant transport. LUC remedial design would be implemented in approximately 3 months, and would achieve RAOs or PRGs after implementation. ISCO would be completed within 2 years.	Exposure of remediation workers would be controlled by PPE and safety procedures. Potential impact to community from truck traffic. Action would be completed in 2 months. RAOs 1 and 2 would be met after completion of excavation. Would achieve RAO 3 after implementation of LUCs.	Exposure of remediation workers during excavation and ISCO would be controlled by PPE and safety procedures. Potential impact to community from truck traffic and oxidant transport. Action would be completed in 2 months. RAOs 1 and 2 would be met after completion of excavation. Would achieve RAO 3 after implementation of ISCO. ISCO would be completed within 2 years.
Implementability	Nothing to implement.	Easy to implement. Would be easiest to implement.	Easy to implement. Would be easier to implement than Alternatives 21-3 and 21-3A.	Easy to implement, but less difficult to implement than Alternative 21-3A.	Easy to implement, but most difficult to implement.

TABLE 7-1

SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES – SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

Evaluation Criterion	Alternative 21-1: No Action	Alternative 21-2: LUCs and Barrier	Alternative 21-2A: LUCs, Barrier, and ISCO	Alternative 21-3: Excavation (Unrestricted Re-use), Off-site Disposal, and LUCs	Alternative 21-3A: Excavation (Unrestricted Re-use), Off-site Disposal, LUCs, and ISCO
Costs:					
Capital	$0	$21,000	$554,000	$1,244,000	$1,686,000
NPW of Annual Costs	$0	$345,000 (30-Year)	$346,000 (30-Year)	$192,000 (30-Year)	$192,000 (30-Year)
NPW	$0	$366,000 (30-Year)	$900,000 (30-Year)	$1,436,000 (30-Year)	$1,878,000 (30-Year)

ARARs - Applicable or Relevant and Appropriate Requirements.
ISCO - In-situ chemical oxidation.
LUCs - Land use controls.
NPW - Net present worth.
PPE - Personal protective equipment.
RAO - Remedial Action Objective.
TBC - To Be Considered.

Costs are stand alone cost for the site – economy of scale will be obtained when done in combination with other sites.

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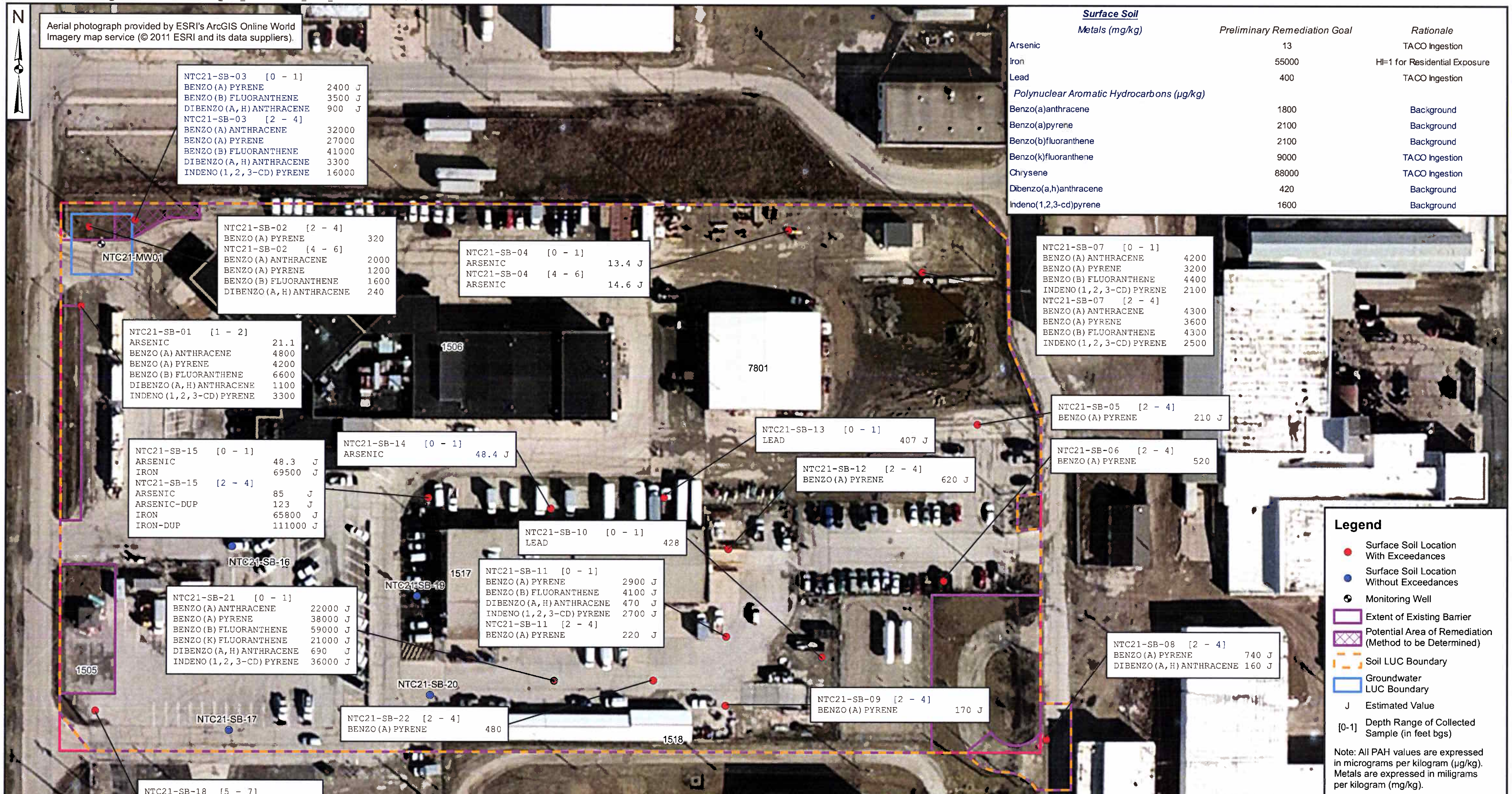

Surface Soil

Metals (mg/kg)	Preliminary Remediation Goal	Rationale
Arsenic	13	TACO Ingestion
Iron	55000	HI=1 for Residential Exposure
Lead	400	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1800	Background
Benzo(a)pyrene	2100	Background
Benzo(b)fluoranthene	2100	Background
Benzo(k)fluoranthene	9000	TACO Ingestion
Chrysene	88000	TACO Ingestion
Dibenzo(a,h)anthracene	420	Background
Indeno(1,2,3-cd)pyrene	1600	Background

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D. COUCH	08/29/13
CHECKED BY	DATE
J. LOGAN	09/19/13
REVISED BY	DATE
D. COUCH	09/19/13
SCALE AS NOTED	

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ALTERNATIVE 21-2
BARRIER AND LAND USE CONTROL BOUNDARIES
SITE 21 - BUILDINGS 1517/1506 AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	C064
APPROVED BY	DATE 10/8/13
APPROVED BY	DATE
FIGURE NO. 7-1	REV 0

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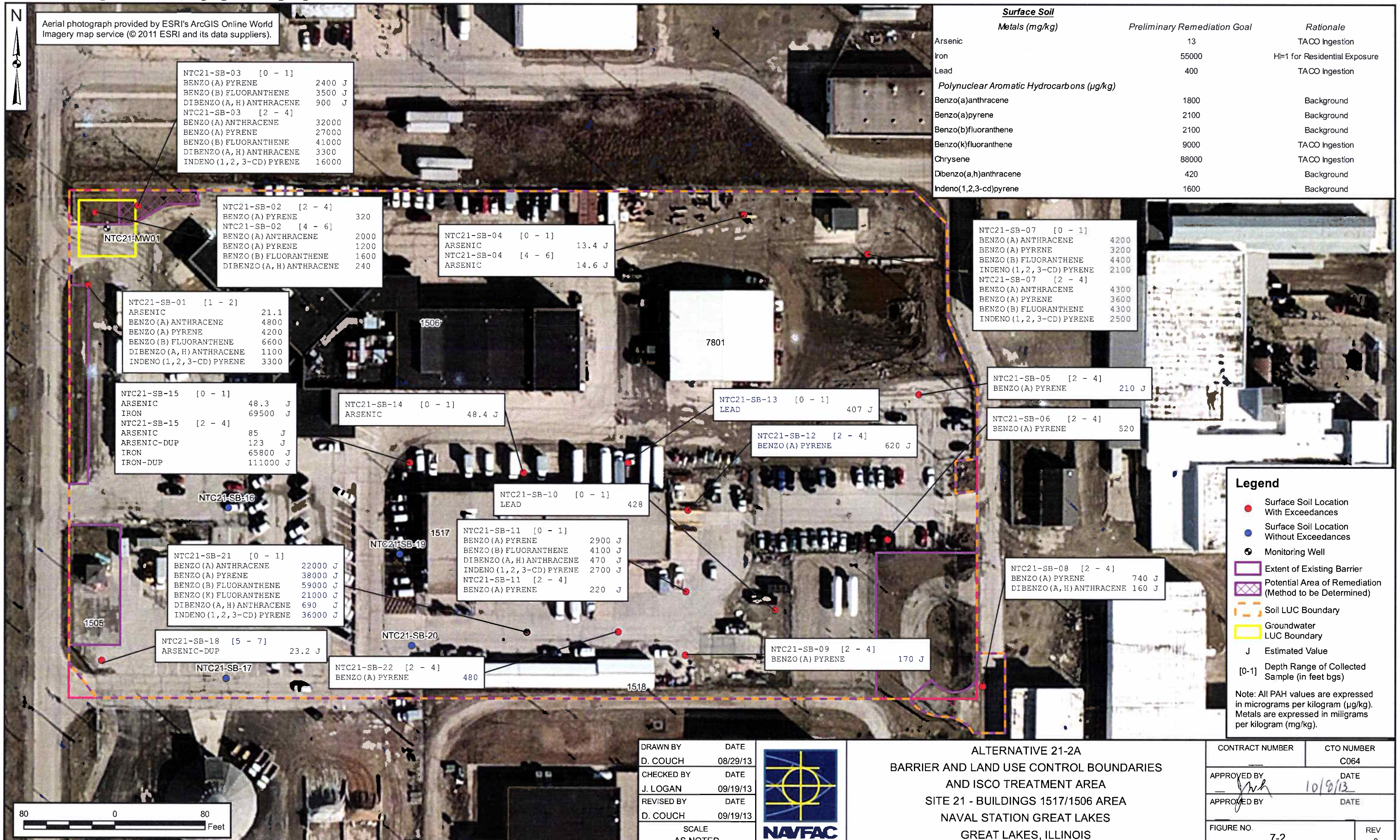

Surface Soil

Metals (mg/kg)	*Preliminary Remediation Goal*	*Rationale*
Arsenic	13	TACO Ingestion
Iron	55000	HI=1 for Residential Exposure
Lead	400	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1800	Background
Benzo(a)pyrene	2100	Background
Benzo(b)fluoranthene	2100	Background
Benzo(k)fluoranthene	9000	TACO Ingestion
Chrysene	88000	TACO Ingestion
Dibenzo(a,h)anthracene	420	Background
Indeno(1,2,3-cd)pyrene	1600	Background

Legend

- Surface Soil Location With Exceedances
- Surface Soil Location Without Exceedances
- Monitoring Well
- Extent of Existing Barrier
- Potential Area of Remediation (Method to be Determined)
- Soil LUC Boundary
- Groundwater LUC Boundary
- J Estimated Value
- [0-1] Depth Range of Collected Sample (in feet bgs)

Note: All PAH values are expressed in micrograms per kilogram (µg/kg). Metals are expressed in miligrams per kilogram (mg/kg).

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D. COUCH	09/19/13
SCALE	
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ALTERNATIVE 21-2A
BARRIER AND LAND USE CONTROL BOUNDARIES
AND ISCO TREATMENT AREA
SITE 21 - BUILDINGS 1517/1506 AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	C064
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FIGURE NO. 7-2	REV 0

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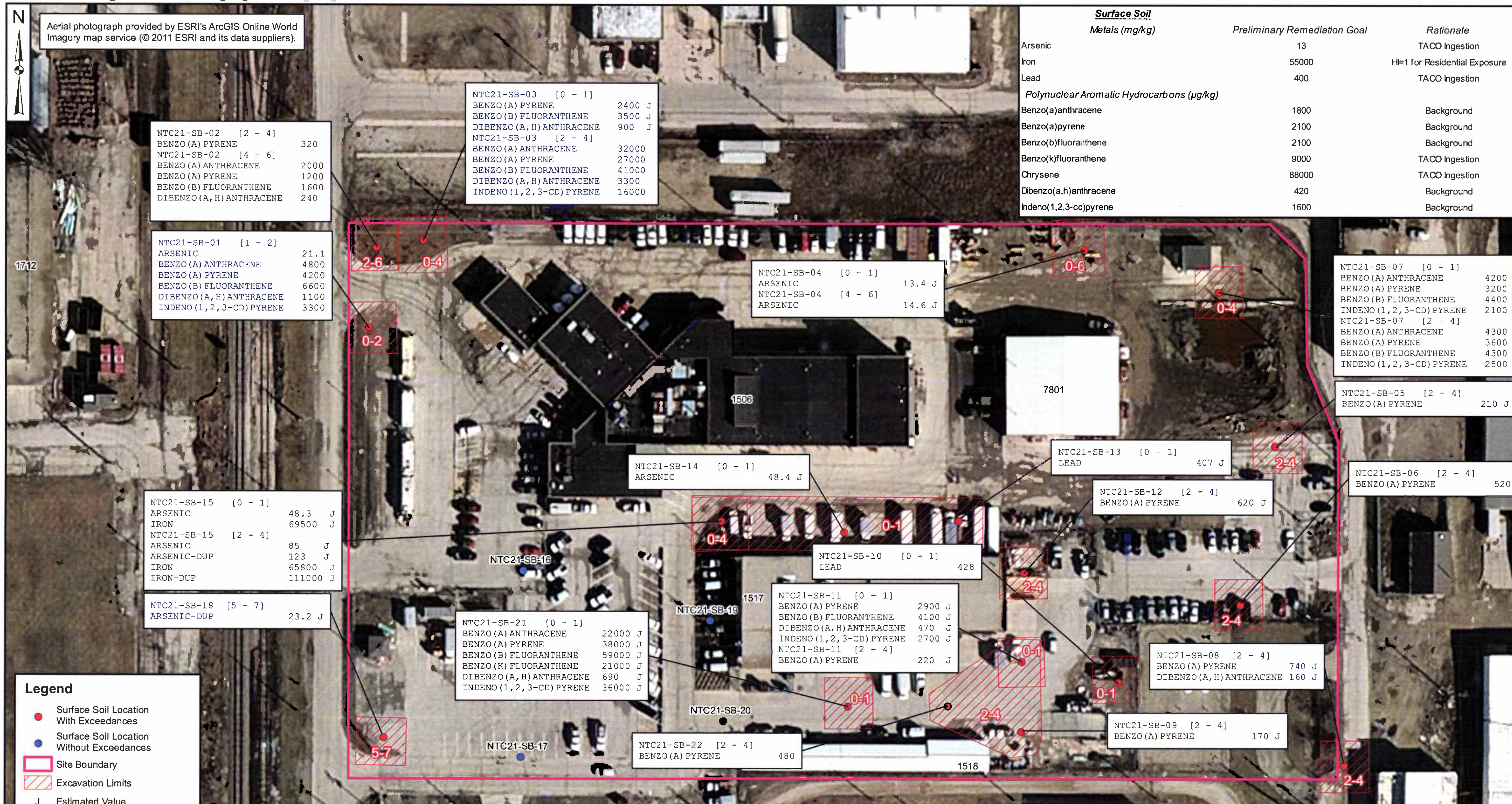
Surface Soil

Metals (mg/kg)	Preliminary Remediation Goal	Rationale
Arsenic	13	TACO Ingestion
Iron	55000	HI=1 for Residential Exposure
Lead	400	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1800	Background
Benzo(a)pyrene	2100	Background
Benzo(b)fluoranthene	2100	Background
Benzo(k)fluoranthene	9000	TACO Ingestion
Chrysene	88000	TACO Ingestion
Dibenzo(a,h)anthracene	420	Background
Indeno(1,2,3-cd)pyrene	1600	Background



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D. COUCH	09/19/13
SCALE AS NOTED	

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ALTERNATIVE 21-3 - LIMITS OF EXCAVATION
SURFACE AND SUBSURFACE
SITE 21 - BUILDINGS 1517/1506 AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	C064
APPROVED BY	DATE 10/8/13
APPROVED BY	DATE
FIGURE NO. 7-3	REV 0

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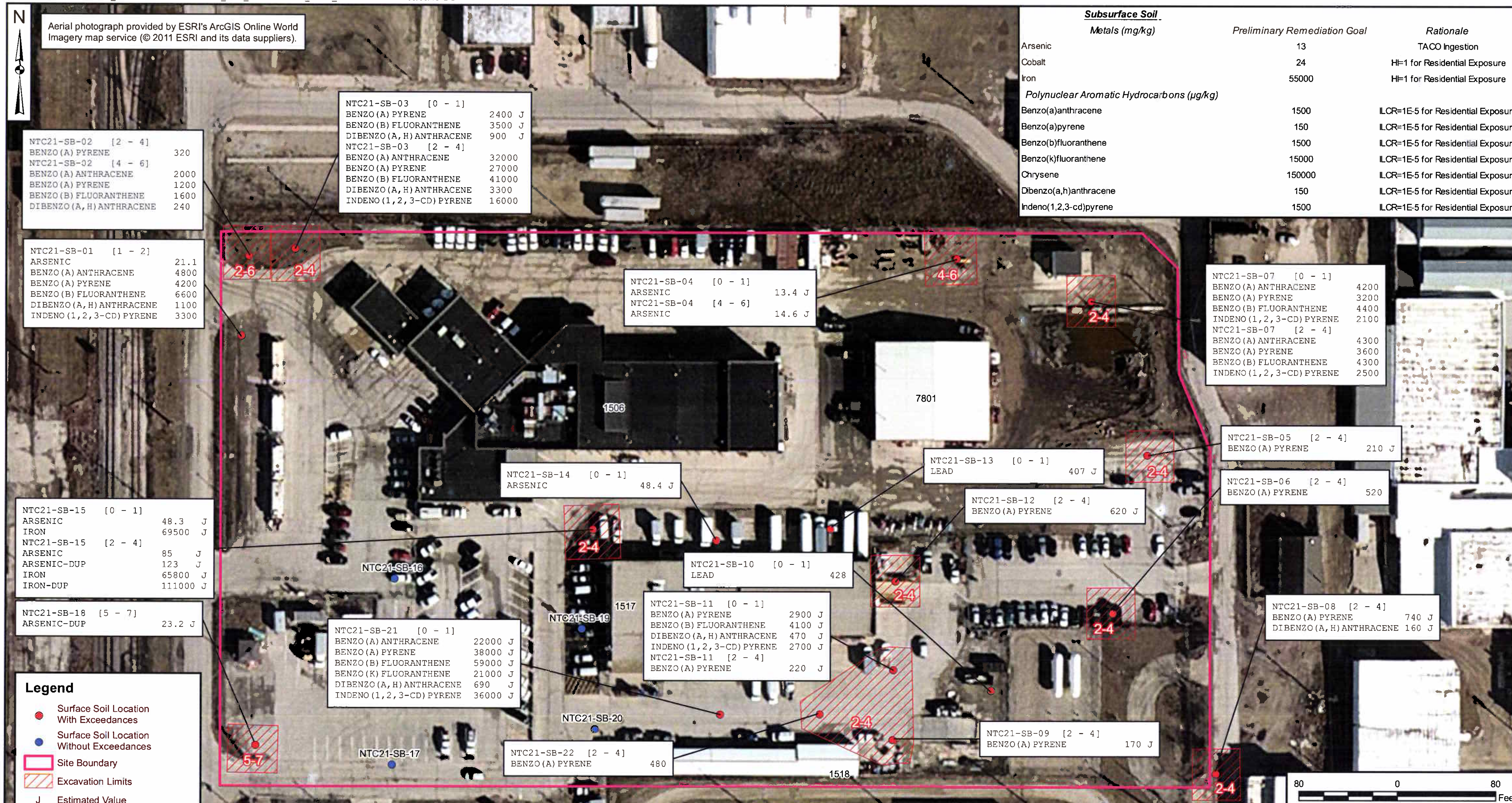

Subsurface Soil

Metals (mg/kg)	*Preliminary Remediation Goal*	*Rationale*
Arsenic	13	TACO Ingestion
Cobalt	24	HI=1 for Residential Exposure
Iron	55000	HI=1 for Residential Exposure
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1500	ILCR=1E-5 for Residential Exposure
Benzo(a)pyrene	150	ILCR=1E-5 for Residential Exposure
Benzo(b)fluoranthene	1500	ILCR=1E-5 for Residential Exposure
Benzo(k)fluoranthene	15000	ILCR=1E-5 for Residential Exposure
Chrysene	150000	ILCR=1E-5 for Residential Exposure
Dibenzo(a,h)anthracene	150	ILCR=1E-5 for Residential Exposure
Indeno(1,2,3-cd)pyrene	1500	ILCR=1E-5 for Residential Exposure

DRAWN BY: D. COUCH	DATE: 08/29/13
CHECKED BY: J. LOGAN	DATE: 09/05/13
REVISED BY: D. COUCH	DATE: 09/05/13
SCALE: AS NOTED	

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ALTERNATIVE 21-3 - LIMITS OF EXCAVATION
SUBSURFACE SOIL ONLY
SITE 21 - BUILDINGS 1517/1506 AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER: C064
APPROVED BY: [signature]	DATE: 10/8/13
APPROVED BY	DATE
FIGURE NO. 7-4	REV 0

REFERENCES

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Tetra Tech, 2013b. Remedial Investigation/Risk Assessment Report for Site 5 – Transformer Storage Boneyard, Naval Station Great Lakes, Great Lakes, Illinois. May.

Tetra Tech, 2012. Remedial Investigation Report for Site 21 – Buildings 1517/1506 Area, Naval Station Great Lakes, Great Lakes, Illinois. July.

USEPA (United States Environmental Protection Agency), 2010. Oak Ridge National Laboratory Regional Screening Levels for Chemical Contaminants at Superfund Sites.

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APPENDIX A

RISK CALCULATIONS

SITE 5 – INHALATION HI CALCULATIONS (RME) FOR CONSTRUCTION WORKER USING ILLINOIS EPA TACO PARTICULATE EMISSIONS FACTOR - SURFACE AND SUBSURFACE SOIL

TABLE 4.2

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical concentration in soil	mg/kg	95% UCL or Max	USEPA, May 1993	95% UCL or Max	USEPA, May 1993	Intake (mg/kg/day) = $\frac{CS \times \left[\frac{1}{VF} + \frac{1}{PEF}\right] \times ET \times EF \times ED}{AT \times 24}$
	VF	Volatilization factor - Chemical Specific	m^3/kg	(1)	USEPA, December 2002	(1)	USEPA, December 2002	
	PEF	Particulate emission factor	m^3/kg	1.24E+08	IEPA, 2007. TACO	1.24E+08	IEPA, 2007. TACO	
	ET	Exposure Time	hours/day	8	USEPA, December 2002	4	USEPA, December 2002	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	AT-C	Averaging Time (Cancer)	days	25550	USEPA, December 1989	25550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Notes:

(1) - Calculated according to USEPA Soil Screening Guidance, December 2002.

Daily Intake Calculations

Inhalation Intake = (ET x EF x ED x (1/PEF)+(1/VF)) / (AT x 24)

Cancer Inhalation Intake(RME) = 3.91E-04
Noncancer Inhalation Intake(RME) = 2.38E-01

Cancer Inhalation Intake(CTE) = 1.96E-04
Noncancer Inhalation Intake(CTE) = 1.19E-01

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Cancer Inhalation Unit Risk (IUR)
Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Reference Concentration (RfCi)

CALCULATION OF AMBIENT AIR CONCENTRATION
SOURCE: U.S. EPA SOIL SCREENING GUIDANCE

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Purpose: To calculate ambient air concentrations resulting from fugitive dust and volatilization from soil.

Relevant Equations:

$$Cair = Cs \times (1/PEF + 1/VF)$$

$$VF = \frac{Q/C \times (3.14 \times DA \times T)^{1/2} \times 10^{-4}\ m^2/cm^2}{2 \times pb \times DA}$$

$$DA = \frac{[(\theta a^{10/3} \times Di \times H + \theta w^{10/3} \times Dw)/n^2)]}{pb \times Kd + \theta w + \theta a \times H}$$

$$Csat = S/pb \times (Kd \times pb + \theta w + H \times \theta a)$$

INPUT PARAMTERS

Parameter	Value	Definition	
Q/C = :	14.31	Inverse of mean conc. at center of source (g/m^2-s per kg/m^3).	
T = :	7.6E+08	Exposure interval (seconds).	
pb = :	1.5	Dry soil bulk density (g/cm^3).	
ps = :	2.65	soil particle density (g/cm^3).	
n = :	0.434	Total soil porosity (L_{pore}/L_{soil}).	
θw = :	0.15	Water-filled soil porosity (L_{pore}/L_{soil}).	
θa = :	0.284	Air-filled soil porosity (L_{air}/L_{soil}).	
Di = :	Chemical specific	Diffusivity in air (cm^2/sec).	
H' = :	Chemical specific	Dimensionless Henry's Law Constant.	
Dw = :	Chemical specific	Diffusivity in water (cm^2/sec).	
DA = :	Chemical specific	Apparent diffusivity (cm^2/sec).	
Kd = :	Chemical specific	Soil-water partition coefficient (cm^3/g).	
Koc = :	Chemical specific	Soil organic carbon partition coefficient (cm^3/g).	
foc = :	0.006	Fraction organic carbon in soil (g/g).	
F_D = :	0.185	dispersion correction factor	
V =:	0.5	Fraction of vegatative cover (unitless)	
Um =:	3.44	Mean annual wind speed (m/s)	
Ut =:	11.32	equivalent threshold value of windspeed at 7 m (m/s)	2.92
F(x) =:	0.0086	Function dependent on Um/Ut	0.0085
PEF = :	1.36E+09	Particulate emission factor (m^3/kg)	1.19E+10

Error in Calcs? No = 0, Yes > 0 0

Chemical	Cs (mg/kg)	Volatile	Chemical Properties: Koc (cm^3/g)	Di (cm^2/sec)	Dw (cm^2/sec)	S (mg/L)	H'	Intermediate Calculations: Kd (cm^3/g)	Da (cm^2/sec)	VF (m^3/kg)	Csat (mg/kg)	Results: CaV (mg/m^3)	CaP (mg/m^3)	CaTot (mg/m^3)	
All Soil															
naphthalene		Y	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	1.20E+01	5.15E-06	5.54E+04	3.75E+02	0.00E+00	0.00E+00	0.00E+00	0
tetrachloroethylene		Y	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.54E-01	9.30E-01	2.47E-03	2.53E+03	2.35E+02	0.00E+00	0.00E+00	0.00E+00	
xylenes	0.76	Y	3.74E+02	7.14E-02	9.34E-06	161	2.15E-01	2.24E+00	3.43E-04	6.78E+03	3.84E+02	1.12E-04	5.59E-10	1.12E-04	

MW g/mole	Koc L/Kg	Dair (cm^2/sec)	Dwater (cm^2/sec)	S mg/L	H'	H (atm-m^3/mol)	Volatile
1.06E+02	3.74E+02	7.14E-02	9.34E-06	161	2.15E-01	5.25E-03	

TABLE 7.2. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Max.	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation [1]	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration (Subchronic [2] if available)	Reference Concentration Units	Hazard Quotient
Inhalation	XYLENES (PARTICULATE)	7.60E-01	mg/kg	6.1E-09	mg/m^3	R	1.5E-09	mg/m^3	1.0E-01	mg/m^3	1.5E-08
	ALUMINUM	1.40E+04	mg/kg	1.1E-04	mg/m^3	R	2.7E-05	mg/m^3	5.0E-03	mg/m^3	5.4E-03
	ARSENIC	1.20E+01	mg/kg	9.7E-08	mg/m^3	R	2.3E-08	mg/m^3	1.5E-05	mg/m^3	1.5E-03
	COBALT	1.10E+01	mg/kg	8.9E-08	mg/m^3	R	2.1E-08	mg/m^3	*2.0E-05*	mg/m^3	1.1E-03
	MANGANESE	9.40E+02	mg/kg	7.6E-06	mg/m^3	R	1.8E-06	mg/m^3	5.0E-05	mg/m^3	3.6E-02
	MERCURY	5.30E-01	mg/kg	4.3E-09	mg/m^3	R	1.0E-09	mg/m^3	3.0E-05	mg/m^3	3.4E-05
	XYLENES (VOL)	7.60E-01	mg/kg	1.1E-04	mg/m^3	R	2.7E-05	mg/m^3	1.0E-01	mg/m^3	2.7E-04
	(total)										0.04
										Total Hazard Index Across All Exposure Routes/Pathways	**0.04**

[1] Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

[2] Subchronic values in *italics.*

8.2. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Max.	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
Inhalation	XYLENES (PARTICULATE)	7.60E-01	mg/kg	6.1E-09	mg/m^3	R	2.4E-12	mg/m^3		$(mg/m^3)^{-1}$	
	ALUMINUM	1.40E+04	mg/kg	1.1E-04	mg/m^3	R	4.4E-08	mg/m^3		$(mg/m^3)^{-1}$	
	ARSENIC	1.20E+01	mg/kg	9.7E-08	mg/m^3	R	3.8E-11	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	1.6E-10
	COBALT	1.10E+01	mg/kg	8.9E-08	mg/m^3	R	3.5E-11	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	3.1E-10
	MANGANESE	9.40E+02	mg/kg	7.6E-06	mg/m^3	R	3.0E-09	mg/m^3		$(mg/m^3)^{-1}$	
	MERCURY	5.30E-01	mg/kg	4.3E-09	mg/m^3	R	1.7E-12	mg/m^3		$(mg/m^3)^{-1}$	
	XYLENES (VOL)	7.60E-01	mg/kg	6.1E-09	mg/m^3	R	2.4E-12	mg/m^3		$(mg/m^3)^{-1}$	
	(total)										4.8E-10
										Total Risk Across All Exposure Routes/Pathways	**4.8E-10**

TABLE 4.4

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical concentration in soil	mg/kg	95% UCL or Max	USEPA, May 1993	95% UCL or Max	USEPA, May 1993	Intake (mg/kg/day) = $\frac{CS \times \left[\frac{1}{VF} + \frac{1}{PEF}\right] \times ET \times EF \times ED}{AT \times 24}$
	VF	Volatilization factor - Chemical Specific	m^3/kg	(1)	USEPA, December 2002	(1)	USEPA, December 2002	
	PEF	Particulate emission factor	m^3/kg	1.24E+08	IEPA, 2007. TACO.	1.24E+08	IEPA, 2007. TACO.	
	ET	Exposure Time	hours/day	8	USEPA, December 2002	4	USEPA, December 2002	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	AT-C	Averaging Time (Cancer)	days	25550	USEPA, December 1989	25550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Notes:

(1) - Calculated according to USEPA Soil Screening Guidance, December 2002.

Daily Intake Calculations

Inhalation Intake = (ET x EF x ED x (1/PEF)+(1/VF)) / (AT x 24)

Cancer Inhalation Intake(RME) = 3.91E-04
Noncancer Inhalation Intake(RME) = 2.38E-01

Cancer Inhalation Intake(CTE) = 1.96E-04
Noncancer Inhalation Intake(CTE) = 1.19E-01

Cancer risk from inhalation = Air concentration x Cancer Inhalation Intake x Cancer Inhalation Unit Risk (IUR)
Hazard Index from inhalation = Air concentration x Noncancer Inhalation Intake / Reference Concentration (RfCi)

TABLE 7.4. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Max.	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation [1]	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration	Reference Concentration Units	Hazard Quotient
	ALUMINUM	1.90E+04	mg/kg	1.5E-04	mg/m^3	R	3.6E-05	mg/m^3	5.0E-03	mg/m^3	7.3E-03
	ARSENIC	1.60E+01	mg/kg	1.3E-07	mg/m^3	R	3.1E-08	mg/m^3	1.5E-05	mg/m^3	2.0E-03
	COBALT	1.40E+01	mg/kg	1.1E-07	mg/m^3	R	2.7E-08	mg/m^3	*2.0E-05*	mg/m^3	1.3E-03
	MANGANESE	1.80E+03	mg/kg	1.5E-05	mg/m^3	R	3.5E-06	mg/m^3	5.0E-05	mg/m^3	6.9E-02
	MERCURY	1.20E-01	mg/kg	9.7E-10	mg/m^3	R	2.3E-10	mg/m^3	3.0E-05	mg/m^3	7.7E-06
	(total)										8.0E-02
										Total Hazard Index Across All Exposure Routes/Pathways	**0.08**

1 Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

2 Subchronic values in *italics.*

8.4. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Max.	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
	ALUMINUM	1.90E+04	mg/kg	1.5E-04	mg/m^3	R	6.0E-08	mg/m^3			
	ARSENIC	1.60E+01	mg/kg	1.3E-07	mg/m^3	R	5.1E-11	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	2.2E-10
	COBALT	1.40E+01	mg/kg	1.1E-07	mg/m^3	R	4.4E-11	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	4.0E-10
	MANGANESE	1.80E+03	mg/kg	1.5E-05	mg/m^3	R	5.7E-09	mg/m^3			
	MERCURY	1.20E-01	mg/kg	0.0E+00	mg/m^3	R	0.0E+00	mg/m^3			
	(total)										6.1E-10
										Total Risk Across All Exposure Routes/Pathways	**6.1E-10**

SITE 9 – INHALATION HI CALCULATIONS (RME) FOR CONSTRUCTION WORKER USING ILLINOIS EPA TACO PARTICULATE EMISSIONS FACTOR - SUBSURFACE SOIL

TABLE 4.2

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 9 - CAMP MOFFETT
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical concentration in soil	mg/kg	95% UCL or Max	USEPA, May 1993	95% UCL or Max	USEPA, May 1993	$$\frac{CS \times \left[\frac{1}{VF} + \frac{1}{PEF}\right] \times ET \times EF \times ED}{AT \times 24}$$
	VF	Volatilization factor - Chemical Specific	m^3/kg	(1)	USEPA, December 2002	(1)	USEPA, December 2002	
	PEF	Particulate emission factor	m^3/kg	1.24E+08	IEPA, 2007. TACO.	1.24E+08	IEPA, 2007. TACO.	
	ET	Exposure Time	hours/day	8	USEPA, December 2002	4	USEPA, December 2002	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	AT-C	Averaging Time (Cancer)	days	25550	USEPA, December 1989	25550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Notes:
(1) - Calculated according to USEPA Soil Screening Guidance, December 2002.

Daily Intake Calculations
Inhalation Intake = (ET x EF x ED x (1/PEF)+(1/VF)) / (AT x 24)

Cancer Inhalation Intake(RME) = 3.91E-04 Cancer Inhalation Intake(CTE) = 1.96E-04
Noncancer Inhalation Intake(RME) = 2.38E-01 Noncancer Inhalation Intake(CTE) = 1.19E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Cancer Inhalation Unit Risk (IUR)
Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Reference Air Concentration (RfCi)

CALCULATION OF AMBIENT AIR CONCENTRATION
SOURCE: U.S. EPA SOIL SCREENING GUIDANCE

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Purpose: To calculate ambient air concentrations resulting from fugitive dust and volatilization from soil.

Relevant Equations:

$$\text{Cair} = \text{Cs} \times (1/\text{PEF} + 1/\text{VF})$$

$$\text{VF} = \frac{\text{Q/C} \times (3.14 \times \text{DA} \times \text{T})^{1/2} \times 10^{-4}\ \text{m}^2/\text{cm}^2}{2 \times \text{pb} \times \text{DA}}$$

$$\text{DA} = \frac{[(\theta a^{10/3} \times \text{Di} \times \text{H} + \theta w^{10/3} \times \text{Dw})/n^2)]}{\text{pb} \times \text{Kd} + \theta w + \theta a \times \text{H}}$$

$$\text{Csat} = \text{S/pb} \times (\text{Kd} \times \text{pb} + \theta w + \text{H} \times \theta a)$$

INPUT PARAMTERS			
Parameter	**Value**	**Definition**	
Q/C = :	97.78	Inverse of mean conc. at center of source (g/m^2-s per kg/m^3).	
T = :	7.6E+08	Exposure interval (seconds).	
pb = :	1.5	Dry soil bulk density (g/cm^3).	
ps = :	2.65	soil particle density (g/cm^3).	
n = :	0.434	Total soil porosity (L_{pore}/L_{soil}).	
θw = :	0.15	Water-filled soil porosity (L_{pore}/L_{soil}).	
θa = :	0.284	Air-filled soil porosity (L_{air}/L_{soil}).	
Di = :	Chemical specific	Diffusivity in air (cm^2/sec).	
H' = :	Chemical specific	Dimensionless Henry's Law Constant.	
Dw = :	Chemical specific	Diffusivity in water (cm^2/sec).	
DA = :	Chemical specific	Apparent diffusivity (cm^2/sec).	
Kd = :	Chemical specific	Soil-water partition coefficient (cm^3/g).	
Koc = :	Chemical specific	Soil organic carbon partition coefficient (cm^3/g).	
foc = :	0.006	Fraction organic carbon in soil (g/g).	
F_D = :	1	dispersion correction factor	
V =:	0.5	Fraction of vegatative cover (unitless)	
Um =:	3.44	Mean annual wind speed (m/s)	
Ut =:	11.32	equivalent threshold value of windspeed at 7 m (m/s)	2.92
F(x) =:	0.0086	Function dependent on Um/Ut	0.0085
PEF = :	1.36E+09	Particulate emission factor (m^3/kg)	8.1E+10

Error in Calcs? No = 0, Yes > 0 0

Chemical	Cs (mg/kg)	Volatile	Chemical Properties					Intermediate Calculations				Results			
			Koc (cm^3/g)	Di (cm^2/sec)	Dw (cm^2/sec)	S (mg/L)	H'	Kd (cm^3/g)	Da (cm^2/sec)	VF (m^3/kg)	Csat (mg/kg)	CaV (mg/m^3)	CaP (mg/m^3)	CaTot (mg/m^3)	
All Soil															
naphthalene	0.1837	Y	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	1.20E+01	5.15E-06	7.00E+04	3.75E+02	2.62E-06	1.35E-10	2.62E-06	0
tetrachloroethylene	0.93	Y	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.54E-01	9.30E-01	2.47E-03	3.20E+03	2.35E+02	2.91E-04	6.84E-10	2.91E-04	

TABLE 7.2. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 9 - CAMP MOFFETT
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation [1]	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration (Subchronic [2] if available)	Reference Concentration Units	Hazard Quotient
Inhalation	BAP EQUIVALENT (FULL DLs)	9.51E-01	mg/kg	7.7E-09	mg/m^3	R	1.8E-09	mg/m^3		mg/m^3	
	NAPHTHALENE (partic.)	3.80E-01	mg/kg	3.1E-09	mg/m^3	R	7.3E-10	mg/m^3	3.0E-03	mg/m^3	2.4E-07
	TCDD TEQs (FULL DLs)	8.92E-06	mg/kg	7.2E-14	mg/m^3	R	1.7E-14	mg/m^3	4.00E-08	mg/m^3	4.3E-07
	ALUMINUM	1.97E+04	mg/kg	1.6E-04	mg/m^3	R	3.8E-05	mg/m^3	5.0E-03	mg/m^3	7.6E-03
	ANTIMONY	1.18E+01	mg/kg	9.5E-08	mg/m^3	R	2.3E-08	mg/m^3	2.0E-04	mg/m^3	1.1E-04
	ARSENIC	1.15E+02	mg/kg	9.3E-07	mg/m^3	R	2.2E-07	mg/m^3	1.5E-05	mg/m^3	1.5E-02
	BARIUM	1.22E+03	mg/kg	9.8E-06	mg/m^3	R	2.3E-06	mg/m^3	*5.0E-03*	mg/m^3	4.7E-04
	CADMIUM	8.04E+00	mg/kg	6.5E-08	mg/m^3	R	1.5E-08	mg/m^3	1.0E-05	mg/m^3	1.5E-03
	CHROMIUM	3.15E+01	mg/kg	2.5E-07	mg/m^3	R	6.0E-08	mg/m^3	1.0E-04	mg/m^3	6.0E-04
	COBALT	2.21E+01	mg/kg	1.8E-07	mg/m^3	R	4.2E-08	mg/m^3	6.0E-06	mg/m^3	7.1E-03
	MANGANESE	1.09E+03	mg/kg	8.8E-06	mg/m^3	R	2.1E-06	mg/m^3	5.0E-05	mg/m^3	4.2E-02
	MERCURY	3.15E+01	mg/kg	2.5E-07	mg/m^3	R	6.0E-08	mg/m^3	3.0E-05	mg/m^3	2.0E-03
	VANADIUM	1.13E+01	mg/kg	9.1E-08	mg/m^3	R	2.2E-08	mg/m^3	7.0E-06	mg/m^3	3.1E-03
	NAPHTHALENE (vol.)	1.84E-01	mg/kg	2.6E-06	mg/m^3	R	6.2E-07	mg/m^3	3.0E-03	mg/m^3	2.1E-04
	TETRACHLOROETHYLENE	9.30E-01	mg/kg	2.9E-04	mg/m^3	R	6.9E-05	mg/m^3	2.7E-01	mg/m^3	2.6E-04
	(total)										8.0E-02
										Total Hazard Index Across All Exposure Routes/Pathways	**0.08**

[1] Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

[2] Subchronic values in *italics.*

8.2. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 9 - CAMP MOFFETT
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
Inhalation	BAP EQUIVALENT (FULL DLs)	9.51E-01	mg/kg	7.7E-09	mg/m^3	R	3.0E-12	mg/m^3	1.1E+00	$(mg/m^3)^{-1}$	3.3E-12
	TCDD TEQs (FULL DLs)	8.92E-06	mg/kg	7.2E-14	mg/m^3	R	2.8E-17	mg/m^3	3.8E+04	$(mg/m^3)^{-1}$	1.1E-12
	ARSENIC	1.15E+02	mg/kg	9.3E-07	mg/m^3	R	3.6E-10	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	1.6E-09
	CADMIUM	8.04E+00	mg/kg	6.5E-08	mg/m^3	R	2.5E-11	mg/m^3	1.8E+00	$(mg/m^3)^{-1}$	4.6E-11
	CHROMIUM	3.15E+01	mg/kg	2.5E-07	mg/m^3	R	9.9E-11	mg/m^3	1.2E+01	$(mg/m^3)^{-1}$	1.2E-09
	COBALT	2.21E+01	mg/kg	1.8E-07	mg/m^3	R	7.0E-11	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	6.3E-10
	VANADIUM	1.13E+01	mg/kg	9.1E-08	mg/m^3	R	3.6E-11	mg/m^3	8.3E+00	$(mg/m^3)^{-1}$	3.0E-10
	TETRACHLOROETHYLENE	9.30E-01	mg/kg	2.9E-04	mg/m^3	R	1.1E-07	mg/m^3	5.9E-03	$(mg/m^3)^{-1}$	6.7E-10
	(total)										4.4E-09
										Total Risk Across All Exposure Routes/Pathways	**4.4E-09**

[1] Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

[2] Subchronic values in *italics.*

SITE 21 – INHALATION HI CALCULATIONS (RME) FOR CONSTRUCTION WORKER USING ILLINOIS EPA TACO PARTICULATE EMISSIONS FACTOR - SURFACE AND SUBSURFACE SOIL

TABLE 4.2

VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 21 - BUILDING 1517
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical concentration in soil	mg/kg	95% UCL or Max	USEPA, May 1993	95% UCL or Max	USEPA, May 1993	Intake (mg/kg/day) =
	VF	Volatilization factor - Chemical Specific	m^3/kg	(1)	USEPA, December 2002	(1)	USEPA, December 2002	$\frac{CS \times \left[\frac{1}{VF} + \frac{1}{PEF}\right] \times ET \times EF \times ED}{AT \times 24}$
	PEF	Particulate emission factor	m^3/kg	1.24E+08	IEPA, 2007. TACO.	1.24E+08	IEPA, 2007. TACO.	
	ET	Exposure Time	hours/day	8	USEPA, December 2002	4	USEPA, December 2002	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	AT-C	Averaging Time (Cancer)	days	25550	USEPA, December 1989	25550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Notes:

(1) - Calculated according to USEPA Soil Screening Guidance, December 2002.

Daily Intake Calculations
Inhalation Intake = (ET x EF x ED x (1/PEF)+(1/VF)) / (AT x 24)

Cancer Inhalation Intake(RME) = 3.91E-04   Cancer Inhalation Intake(CTE) = 1.96E-04
Noncancer Inhalation Intake(RME) = 2.38E-01   Noncancer Inhalation Intake(CTE) = 1.19E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Cancer Inhalation Unit Risk (IUR)
Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Reference Air Concentration (RfCi)

CALCULATION OF AMBIENT AIR CONCENTRATION
SOURCE: U.S. EPA SOIL SCREENING GUIDANCE

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Purpose: To calculate ambient air concentrations resulting from fugitive dust and volatilization from soil.

Relevant Equations:

$$Cair = Cs \times (1/PEF + 1/VF)$$

$$VF = \frac{Q/C \times (3.14 \times DA \times T)^{1/2} \times 10^{-4}\ m^2/cm^2}{2 \times pb \times DA}$$

$$DA = \frac{[(\theta a^{10/3} \times Di \times H + \theta w^{10/3} \times Dw)/n^2)]}{pb \times Kd + \theta w + \theta a \times H}$$

$$Csat = S/pb \times (Kd \times pb + \theta w + H \times \theta a)$$

INPUT PARAMTERS			
Parameter	**Value**	**Definition**	
Q/C = :	97.78	Inverse of mean conc. at center of source (g/m^2-s per kg/m^3).	
T = :	7.6E+08	Exposure interval (seconds).	
pb = :	1.5	Dry soil bulk density (g/cm^3).	
ps = :	2.65	soil particle density (g/cm^3).	
n = :	0.434	Total soil porosity (L_{pore}/L_{soil}).	
θw = :	0.15	Water-filled soil porosity (L_{pore}/L_{soil}).	
θa = :	0.284	Air-filled soil porosity (L_{air}/L_{soil}).	
Di = :	Chemical specific	Diffusivity in air (cm^2/sec).	
H' = :	Chemical specific	Dimensionless Henry's Law Constant.	
Dw = :	Chemical specific	Diffusivity in water (cm^2/sec).	
DA = :	Chemical specific	Apparent diffusivity (cm^2/sec).	
Kd = :	Chemical specific	Soil-water partition coefficient (cm^3/g).	
Koc = :	Chemical specific	Soil organic carbon partition coefficient (cm^3/g).	
foc = :	0.006	Fraction organic carbon in soil (g/g).	
F_D = :	1	dispersion correction factor	
V =:	0.5	Fraction of vegatative cover (unitless)	
Um =:	3.44	Mean annual wind speed (m/s)	
Ut =:	11.32	equivalent threshold value of windspeed at 7 m (m/s)	2.92
F(x) =:	0.0086	Function dependent on Um/Ut	0.0085
PEF = :	1.36E+09	Particulate emission factor (m^3/kg)	8.1E+10

Error in Calcs? No = 0, Yes > 0 0

			Chemical Properties					Intermediate Calculations				Results		
Chemical	**Cs (mg/kg)**	**Volatile**	**Koc (cm^3/g)**	**Di (cm^2/sec)**	**Dw (cm^2/sec)**	**S (mg/L)**	**H'**	**Kd (cm^3/g)**	**Da (cm^2/sec)**	**VF (m^3/kg)**	**Csat (mg/kg)**	**CaV (mg/m^3)**	**CaP (mg/m^3)**	**CaTot (mg/m^3)**
All Soil														
naphthalene	0.52	Y	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	1.20E+01	5.15E-06	7.00E+04	3.75E+02	7.42E-06	3.82E-10	7.42E-06
tetrachloroethylene		Y	1.55E+02	7.20E-02	8.20E-06	2.00E+02	7.54E-01	9.30E-01	2.47E-03	3.20E+03	2.35E+02	0.00E+00	0.00E+00	0.00E+00

TABLE 7.2. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 21 - BUILDING 1517
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation [1]	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration (Subchronic [2] if available)	Reference Concentration Units	Hazard Quotient
Inhalation	NAPHTHALENE (partic.)	5.20E-01	mg/kg	4.2E-09	mg/m^3	R	1.0E-09	mg/m^3	3.0E-03	mg/m^3	3.E-07
	ALUMINUM	2.95E+04	mg/kg	2.4E-04	mg/m^3	R	5.7E-05	mg/m^3	5.0E-03	mg/m^3	1.E-02
	ARSENIC	4.84E+01	mg/kg	3.9E-07	mg/m^3	R	9.3E-08	mg/m^3	1.5E-05	mg/m^3	6.E-03
	BARIUM	2.34E+02	mg/kg	1.9E-06	mg/m^3	R	4.5E-07	mg/m^3	*5.0E-03*	mg/m^3	9.E-05
	CADMIUM	1.30E+01	mg/kg	1.0E-07	mg/m^3	R	2.5E-08	mg/m^3	1.0E-05	mg/m^3	2.E-03
	CHROMIUM	1.63E+02	mg/kg	1.3E-06	mg/m^3	R	3.1E-07	mg/m^3	1.0E-04	mg/m^3	3.E-03
	COBALT	1.77E+01	mg/kg	1.4E-07	mg/m^3	R	3.4E-08	mg/m^3	6.0E-06	mg/m^3	6.E-03
	MANGANESE	2.42E+03	mg/kg	2.0E-05	mg/m^3	R	4.6E-06	mg/m^3	5.0E-05	mg/m^3	9.E-02
	MERCURY	8.98E+00	mg/kg	7.2E-08	mg/m^3	R	1.7E-08	mg/m^3	3.0E-05	mg/m^3	6.E-04
	NAPHTHALENE (vol.)	5.20E-01	mg/kg	7.4E-06	mg/m^3	R	1.8E-06	mg/m^3	3.0E-03	mg/m^3	6.E-04
	(total)										0.12
							Total Hazard Index Across All Exposure Routes/Pathways				**0.12**

1 Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

2 Subchronic values in *italics.*

8.2. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SURFACE SOIL
SITE 21 - BUILDING 1517
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Surface Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
Inhalation	ARSENIC	4.84E+01	mg/kg	3.9E-07	mg/m^3	R	1.5E-10	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	6.6E-10
	CADMIUM	1.30E+01	mg/kg	1.0E-07	mg/m^3	R	4.1E-11	mg/m^3	1.8E+00	$(mg/m^3)^{-1}$	7.4E-11
	CHROMIUM	1.63E+02	mg/kg	1.3E-06	mg/m^3	R	5.1E-10	mg/m^3	1.2E+01	$(mg/m^3)^{-1}$	6.2E-09
	COBALT	1.77E+01	mg/kg	1.4E-07	mg/m^3	R	5.6E-11	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	5.0E-10
	(total)										7.4E-09
										Total Risk Across All Exposure Routes/Pathways	**7.E-09**

TABLE 4.4
VALUES USED FOR DAILY INTAKE CALCULATIONS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 21 - BUILDING 1517
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Parameter Code	Parameter Definition	Units	RME Value	RME Rationale/ Reference	CT Value	CT Rationale/ Reference	Intake Equation/ Model Name
Inhalation	CS	Chemical concentration in soil	mg/kg	95% UCL or Max	USEPA, May 1993	Mean	USEPA, May 1993	Intake (mg/kg/day) =
	VF	Volatilization factor - Chemical Specific	m^3/kg	(1)	USEPA, December 2002	(1)	USEPA, December 2002	$\frac{CS \times \left[\frac{1}{VF} + \frac{1}{PEF}\right] \times ET \times EF \times ED}{AT \times 24}$
	PEF	Particulate emission factor	m^3/kg	1.24E+08	IEPA, 2007. TACO.	1.24E+08	IEPA, 2007. TACO.	
	ET	Exposure Time	hours/day	8	USEPA, December 2002	4	USEPA, December 2002	
	EF	Exposure Frequency	days/year	30	IEPA, April 2004	30	IEPA, April 2004	
	ED	Exposure Duration	years	1	Professional Judgement	1	Professional Judgement	
	AT-C	Averaging Time (Cancer)	days	25550	USEPA, December 1989	25550	USEPA, December 1989	
	AT-N	Averaging Time (Non-Cancer)	days	42	IEPA, Janaury 2003	42	IEPA, Janaury 2003	

Notes:
(1) - Calculated according to USEPA Soil Screening Guidance, December 2002.

Daily Intake Calculations
Inhalation Intake = (ET x EF x ED x (1/PEF)+(1/VF)) / (AT x 24)

Cancer Inhalation Intake(RME) = 3.91E-04 Cancer Inhalation Intake(CTE) = 1.96E-04
Noncancer Inhalation Intake(RME) = 2.38E-01 Noncancer Inhalation Intake(CTE) = 1.19E-01

Cancer risk from ingestion = Air concentration x Cancer Inhalation Intake x Cancer Inhalation Unit Risk (IUR)
Hazard Index from ingestion = Air concentration x Noncancer Inhalation Intake / Reference Air Concentration (RfCi)

CALCULATION OF AMBIENT AIR CONCENTRATION
SOURCE: U.S. EPA SOIL SCREENING GUIDANCE

Scenario Timeframe: Future
Medium: Subsurfce Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Purpose: To calculate ambient air concentrations resulting from fugitive dust and volatilization from soil.

Relevant Equations:

$$Cair = Cs \times (1/PEF + 1/VF)$$

$$VF = \frac{Q/C \times (3.14 \times DA \times T)^{1/2} \times 10^{-4}\ m^2/cm^2}{2 \times pb \times DA}$$

$$DA = \frac{[(\theta a^{10/3} \times Di \times H + \theta w^{10/3} \times Dw)/n^2)]}{pb \times Kd + \theta w + \theta a \times H}$$

$$Csat = S/pb \times (Kd \times pb + \theta w + H \times \theta a)$$

INPUT PARAMTERS			
Parameter	**Value**	**Definition**	
Q/C = :	97.78	Inverse of mean conc. at center of source (g/m^2-s per kg/m^3).	
T = :	7.6E+08	Exposure interval (seconds).	
pb = :	1.5	Dry soil bulk density (g/cm^3).	
ps = :	2.65	soil particle density (g/cm^3).	
n = :	0.434	Total soil porosity (L_{pore}/L_{soil}).	
θw = :	0.15	Water-filled soil porosity (L_{pore}/L_{soil}).	
θa = :	0.284	Air-filled soil porosity (L_{air}/L_{soil}).	
Di = :	Chemical specific	Diffusivity in air (cm^2/sec).	
H' = :	Chemical specific	Dimensionless Henry's Law Constant.	
Dw = :	Chemical specific	Diffusivity in water (cm^2/sec).	
DA = :	Chemical specific	Apparent diffusivity (cm^2/sec).	
Kd = :	Chemical specific	Soil-water partition coefficient (cm^3/g).	
Koc = :	Chemical specific	Soil organic carbon partition coefficient (cm^3/g).	
foc = :	0.006	Fraction organic carbon in soil (g/g).	
F_D = :	1	dispersion correction factor	
V =:	0.5	Fraction of vegatative cover (unitless)	
Um =:	3.44	Mean annual wind speed (m/s)	
Ut =:	11.32	equivalent threshold value of windspeed at 7 m (m/s)	2.92
F(x) =:	0.0086	Function dependent on Um/Ut	0.0085
PEF = :	1.36E+09	Particulate emission factor (m^3/kg)	8.1E+10

Error in Calcs? No = 0, Yes > 0 0

Chemical	Cs (mg/kg)	Volatile	Chemical Properties					Intermediate Calculations				Results		
			Koc (cm^3/g)	Di (cm^2/sec)	Dw (cm^2/sec)	S (mg/L)	H'	Kd (cm^3/g)	Da (cm^2/sec)	VF (m^3/kg)	Csat (mg/kg)	CaV (mg/m^3)	CaP (mg/m^3)	CaTot (mg/m^3)
All Soil														
naphthalene	4.60E+00	Y	2.00E+03	5.90E-02	7.50E-06	3.10E+01	1.98E-02	1.20E+01	5.15E-06	7.00E+04	3.75E+02	6.57E-05	3.38E-09	6.57E-05

TABLE 7.4. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF NON-CANCER HAZARDS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 21 - BUILDING 1517
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Hazard Calculation [1]	Intake (Non-Cancer)	Intake (Non-Cancer) Units	Reference Concentration (Subchronic [2] if available)	Reference Concentration Units	Hazard Quotient
	NAPHTHALENE (partic.)	4.60E+00	mg/kg	3.7E-08	mg/m^3	R	8.8E-09	mg/m^3	3.0E-03	mg/m^3	2.9E-06
	ALUMINUM	2.43E+04	mg/kg	2.0E-04	mg/m^3	R	4.7E-05	mg/m^3	5.0E-03	mg/m^3	9.3E-03
	ARSENIC	8.50E+01	mg/kg	6.9E-07	mg/m^3	R	1.6E-07	mg/m^3	1.5E-05	mg/m^3	1.1E-02
	CADMIUM	9.62E+00	mg/kg	7.8E-08	mg/m^3	R	1.8E-08	mg/m^3	1.0E-05	mg/m^3	1.8E-03
	CHROMIUM	3.43E+01	mg/kg	2.8E-07	mg/m^3	R	6.6E-08	mg/m^3	1.0E-04	mg/m^3	6.6E-04
	COBALT	2.38E+01	mg/kg	1.9E-07	mg/m^3	R	4.6E-08	mg/m^3	6.0E-06	mg/m^3	7.6E-03
	MANGANESE	1.69E+03	mg/kg	1.4E-05	mg/m^3	R	3.2E-06	mg/m^3	5.0E-05	mg/m^3	6.5E-02
	MERCURY	4.84E-01	mg/kg	3.9E-09	mg/m^3	R	9.3E-10	mg/m^3	3.0E-05	mg/m^3	3.1E-05
	NAPHTHALENE (vol.)	4.60E+00	mg/kg	6.6E-05	mg/m^3	R	1.6E-05	mg/m^3	3.0E-03	mg/m^3	5.2E-03
	(total)										1.0E-01

Total Hazard Index Across All Exposure Routes/Pathways **0.1**

[1] Specify Medium-Specific (M) or Route-Specific (R) EPC selected for hazard calculation.

[2] Subchronic values in *italics.*

8.4. REASONABLE MAXIMUM EXPOSURE (RME)
CALCULATION OF CANCER RISKS
EXPOSURE OF CONSTRUCTION WORKERS BY INHALATION FROM SUBSURFACE SOIL
SITE 21 - BUILDING 1517
NAVAL STATION GREAT LAKES, ILLINOIS

Scenario Timeframe: Future
Medium: Subsurface Soil
Exposure Medium: Air
Exposure Point: Entire Site
Receptor Population: Construction Worker
Receptor Age: Adult

Exposure Route	Chemical of Potential Concern	Medium EPC Value	Medium EPC Units	Route EPC Value	Route EPC Units	EPC Selected for Risk Calculation (1)	Intake (Cancer)	Intake (Cancer) Units	Cancer Unit Risk	Cancer Unit Risk Units	Cancer Risk
	ARSENIC	8.50E+01	mg/kg	6.9E-07	mg/m^3	R	2.7E-10	mg/m^3	4.3E+00	$(mg/m^3)^{-1}$	1.2E-09
	CADMIUM	9.62E+00	mg/kg	7.8E-08	mg/m^3	R	3.0E-11	mg/m^3	1.8E+00	$(mg/m^3)^{-1}$	5.5E-11
	CHROMIUM	3.43E+01	mg/kg	2.8E-07	mg/m^3	R	1.1E-10	mg/m^3	1.2E+01	$(mg/m^3)^{-1}$	1.3E-09
	COBALT	2.38E+01	mg/kg	1.9E-07	mg/m^3	R	7.5E-11	mg/m^3	9.0E+00	$(mg/m^3)^{-1}$	6.8E-10
	(total)										3.2E-09
										Total Risk Across All Exposure Routes/Pathways	**3.2E-09**

APPENDIX B

ALTERNATIVES CALCULATIONS

CLIENT: NS Great Lakes - Site 5/9/21 FS		JOB NUMBER:
SUBJECT: Excavation Volumes		
BASED ON:		DRAWING NUMBER:
BY: JWL Date: 09/03/13	CHECKED BY: Date: MEB 9/10/13	APPROVED BY: DATE:

Purpose:
Estimate excavation volumes for each site based on sketches attached (5-1, 5-2, 9-1, 21-1, and 21-2).

Site 5

Surface soil excavation is assumed to be 2 feet throughout.
Several subsurface samples (0.5 to 2 feet bgs) and two deeper intervals must be excavated.
For 0.5 to 2 feet locations, assume 1 additional foot is excavated (2 - 3 feet bgs).
For the two deeper locations, assume excavation 6 feet bgs.

Surface Soil Excavations:

Depth of excavation, feet	2

From sketch 5-1, surface soil excavation area can be divided up into subsections.
Scale is 1 inch = 80 feet

Area	L (midpoint) (in)	W (in)	Area (in2)	Area (ft2)
A	2.4	0.7	1.68	10,752
B (triangle)	1.7	0.8	0.68	4,352
C	1.6	0.8	1.28	8,192
D	2.3	0.7	1.61	10,304
SE corner	1	0.5	0.5	3,200
Total				36,800

Volume, ft3	73,600
Total Surface Volume, cubic yards	2,726

Because of shallow depth, assume that sloped sides are not needed.

CLIENT: NS Great Lakes - Site 5/9/21 FS			JOB NUMBER:
SUBJECT: Excavation Volumes			
BASED ON:			DRAWING NUMBER:
BY: JWL		CHECKED BY:	APPROVED BY: DATE:
Date: 09/03/13		Date: MEB 9/10/13	

Subsurface excavations (sketch 5-2)

Location	Sample (feet bgs)	extra excavation (feet bgs)	Thickness (feet)	Notes
SB03	4-7	2 - 6	4	
SB04	0.5 - 2	2 - 3	1	
SB05	0.5 - 2	2 - 3	1	
SB06	0.5 - 2	2 - 3	1	
SB08	2 - 4	2 - 6	4	
SB09	2 - 4	2 - 4	2	
SB13	2 - 4	0 - 4	4	
SB22	0.5 - 2	2 - 3	1	

Areas

Location	L (feet)	W (feet)		Area (ft2)	
SB03	45	20		900	Close, so footprints were combined
SB04	45	20		900	
SB05	-	-		3,200	Same as surface SE corner
SB06	40	40		1,600	small portion outside surface excavation
SB08	40	40		1,600	small portion outside surface excavation
SB09	40	40		1,600	small portion outside surface excavation
SB13	40	40		1,600	outside of surface excavation
SB22	40	40		1,600	

Volume

Location	Area (ft2)	Thickness (feet)	Volume (cy)	
SB03	900	4	133	
SB04	900	1	33	
SB05	3,200	1	119	
SB06	1,600	1	59	
SB06 (0-2)	800	2	59	portion outside of main surface excavation
SB08	1,600	4	237	
SB09	1,600	4	237	
SB13	1,600	1	59	small shallow quantity, assume not segregated.
SB22	1,600	1	59	

Total		996

To account for sloped sides of deeper excavation, increase volume by 15%.

Total subsurface		1,146

Summary

Total excavation, cy	3,872
Backfill, cy	3,872

CLIENT: NS Great Lakes - Site 5/9/21 FS		JOB NUMBER:
SUBJECT: Excavation Volumes		
BASED ON:		DRAWING NUMBER:
BY: JWL Date: 09/03/13	CHECKED BY: Date: MEB 9/10/13	APPROVED BY: DATE:

Site 9

Because of the limited number of samples, the excavation limits will be based on building foundations, roads/walkways, or the ravine outline.
For otherwise unbounded areas, with no samples for delineation, a 40' x 40' excavation is assumed.

The contaminated soil is at 2 to 4 feet bgs interval.
The 0-2 foot interval is clean and will be set aside for reuse.

From sketch 9-1, excavation area can be divided up into subsections
Scale is 1 inch = 100 feet

Area	L (feet)	W (feet)		Area (ft2)
SB-01A	40	40		1,600
SB-02A	40	40		1,600
SB-04B	40	40		1,600
SB-06C	40	40		1,600
SB-07B	40	20		800
SB-07C	40	20		800
SB-07	40	20		800
SB-08	40	40		1,600
SB-10	80	120		9,600
SB-16	40	40		1,600
SB-18	40	20		800
SB-20	40	40		1,600
Total				24,000

Each area has a different interval with contaminated soil.
No samples were collected between the shallow and deep samples, so assume that the soil between the samples is contaminated, too.

CLIENT: NS Great Lakes - Site 5/9/21 FS		JOB NUMBER:
SUBJECT: Excavation Volumes		
BASED ON:		DRAWING NUMBER:
BY: JWL Date: 09/03/13	CHECKED BY: Date: MEB 9/10/13	APPROVED BY: DATE:

Area	Area (ft2)	Total Depth (Feet)	Contamin-ated Interval(s) (ft bgs)	Contamin-ated Interval(s) (ft)	Total Volume (cy)
SB-01A	1,600	4	2-4	2	237
SB-02A	1,600	6	4-6	2	356
SB-04B	1,600	6	4-6	2	356
SB-06C	1,600	4	2-4	2	237
SB-07B	800	6	4-6	2	178
SB-07C	800	4	2-4	2	119
SB-07	800	16	2-4, 14-16	4	474
SB-08	1,600	4	2-4	2	237
SB-10	9,600	16	4-12, 14-16	10	5,689
SB-16	1,600	4	2-4	2	237
SB-18	800	12	2-4, 10-12	4	356
SB-20	1,600	10	8-10	2	593

Area	Area (ft2)	Soil in contamin-ated interval (cy)	Soil between intervals (cy)	Total Volume (cy)
SB-01A	1,600	119	119	237
SB-02A	1,600	119	237	356
SB-04B	1,600	119	237	356
SB-06C	1,600	119	119	237
SB-07B	800	59	119	178
SB-07C	800	59	59	119
SB-07	800	119	356	474
SB-08	1,600	119	119	237
SB-10	9,600	3,556	2,133	5,689
SB-16	1,600	119	119	237
SB-18	800	119	237	356
SB-20	1,600	119	474	593
Total		4,741	4,326	9,067
			check	9,067

To account for sloped sides, increase volumes by 15%.

Summary		w/15%
Total excavation, cy	9,067	10,427
Backfill, cy	9,067	10,427

CLIENT: NS Great Lakes - Site 5/9/21 FS		JOB NUMBER:
SUBJECT: Excavation Volumes		
BASED ON:		DRAWING NUMBER:
BY: JWL Date: 09/03/13	CHECKED BY: Date: MEB 9/10/13	APPROVED BY: DATE:

Site 21

See sketches 21-1 and 21-2.
1. Because of the limited number of samples, most excavation limits are based on 40' x 40' squares.
2. Surface and subsurface soil is contaminated, although often not coincidental.
3. Note that, in general, contaminated surface soil is 0-1' and subsurface soil is 2'-4', so there is a 1-foot layer to reuse in some locations.

Area	Surface?	Subsurface?
SB-03/02	Y	Y
SB-01	Y	N
SB-04	Y	Y
SB-07	Y	Y
SB-10	Y	N
SB-13	Y	N
SB-14	Y	N
SB-15	Y	Y
SB-11	Y*	Y*
SB-21	Y	N
SB-05	N	Y
SB-06	N	Y
SB-12	N	Y
SB-11/22/09	Y*	Y*
SB-18	N	Y
SB-08	N	Y

* - for surface, SB-11 is calculated separately. For subsurface, SB-11 is included with other points.

Contaminated Intervals (feet bgs)			Thickness, feet	
			Surface	Sub
SB-03/02	0-1	2-6	1	4
SB-01	1-2	na	1	0
SB-04	0-1	4-6	1	2
SB-07	0-1	2-4	1	2
SB-10	0-1	na	1	0
SB-13	0-1	na	1	0
SB-14	0-1	na	1	0
SB-15	0-1	2-4	1	2
SB-11	0-1	2-4	1	2
SB-21	0-1	na	1	0
SB-05	NA	2-4	0	2
SB-06	NA	2-4	0	2
SB-12	NA	2-4	0	2
SB-11/22/09	NA	2-4	0	2
SB-18	NA	5-7	0	2
SB-08	NA	2-4	0	2

CLIENT: NS Great Lakes - Site 5/9/21 FS		JOB NUMBER:
SUBJECT: Excavation Volumes		
BASED ON:		DRAWING NUMBER:
BY: JWL Date: 09/03/13	CHECKED BY: Date: MEB 9/10/13	APPROVED BY: DATE:

Surface Soil excavations

	L (feet)	W (feet)		Area (ft2)
SB-03/02	40	40		1,600
SB-01	40	40		1,600
SB-04	40	40		1,600
SB-07	40	40		1,600
SB-10	40	40		1,600
SB-13, -14, -15	240	40		9,600
SB-11	40	40		1,600
SB-21	40	40		1,600
				20,800

SB-13, 14, and 15 are combined. The dimensions reflect the combined area.

	Area (ft2)	Contamin-ated soil (cy)	Clean Soil (reused) (cy)	Total (cy)
SB-03/02	1,600	59		59
SB-01	1,600	59	59	119
SB-04	1,600	59		59
SB-07	1,600	59		59
SB-10	1,600	59		59
SB-13, -14, -15	9,600	356		356
SB-11	1,600	59		59
SB-21	1,600	59		59

Total		770	59	830
Backfill		770		

CLIENT: NS Great Lakes - Site 5/9/21 FS		JOB NUMBER:	
SUBJECT: Excavation Volumes			
BASED ON:		DRAWING NUMBER:	
BY: JWL Date: 09/03/13	CHECKED BY: Date: MEB 9/10/13	APPROVED BY:	DATE:

Subsurface soil excavations

	L (feet)	W (feet)		Area (ft2)	
SB-03/02	80	40		3,200	
SB-01	na	na	na	na	
SB-04	40	40		1,600	
SB-07	40	40		1,600	
SB-14	na	na	na	na	
SB-15	40	40		1,600	
SB-11 (see below)	na	na	na	na	
SB-21	na	na	na	na	
SB-05	40	40		1,600	
SB-06	40	40		1,600	
SB-12	40	40		1,600	
SB-11/22/09	100	100		5,000	triangular
SB-18	40	40		1,600	
SB-08	40	40		1,600	
Total				21,000	

	Area (ft2)	Contamin-ated soil (cy)	Clean Soil (reused) (cy)	Total (cy)	
SB-03/02	3,200	474	237	711	40x40 0-1' on west is clean
SB-01	na	na	na	na	
SB-04	1,600	119	178	296	See note 3, above
SB-07	1,600	119	59	178	See note 3, above
SB-14	na	na	na	na	
SB-15	1,600	119	59	178	See note 3, above
SB-11 see below)	na	na	na	na	
SB-21	na	na	na	na	
SB-05	1,600	119	119	237	
SB-06	1,600	119	119	237	
SB-12	1,600	119	119	237	
SB-11/22/09	5,000	370	311	681	clean soil (reused) accounted for SB-11
SB-18	1,600	119	296	415	See note 3, above
SB-08	1,600	119	119	237	
Total		1,793	1,615	3,407	
Backfill		1,793		3,407	check

To account for sloped sides, increase volumes by 15%.

Summary		w/15%
Total excavation, cy	4,237	4,873
Total contaminated soil, cy	2,563	2,947
Reused soil, cy	1,674	1,925
Backfill from offsite, cy	2,563	2,947

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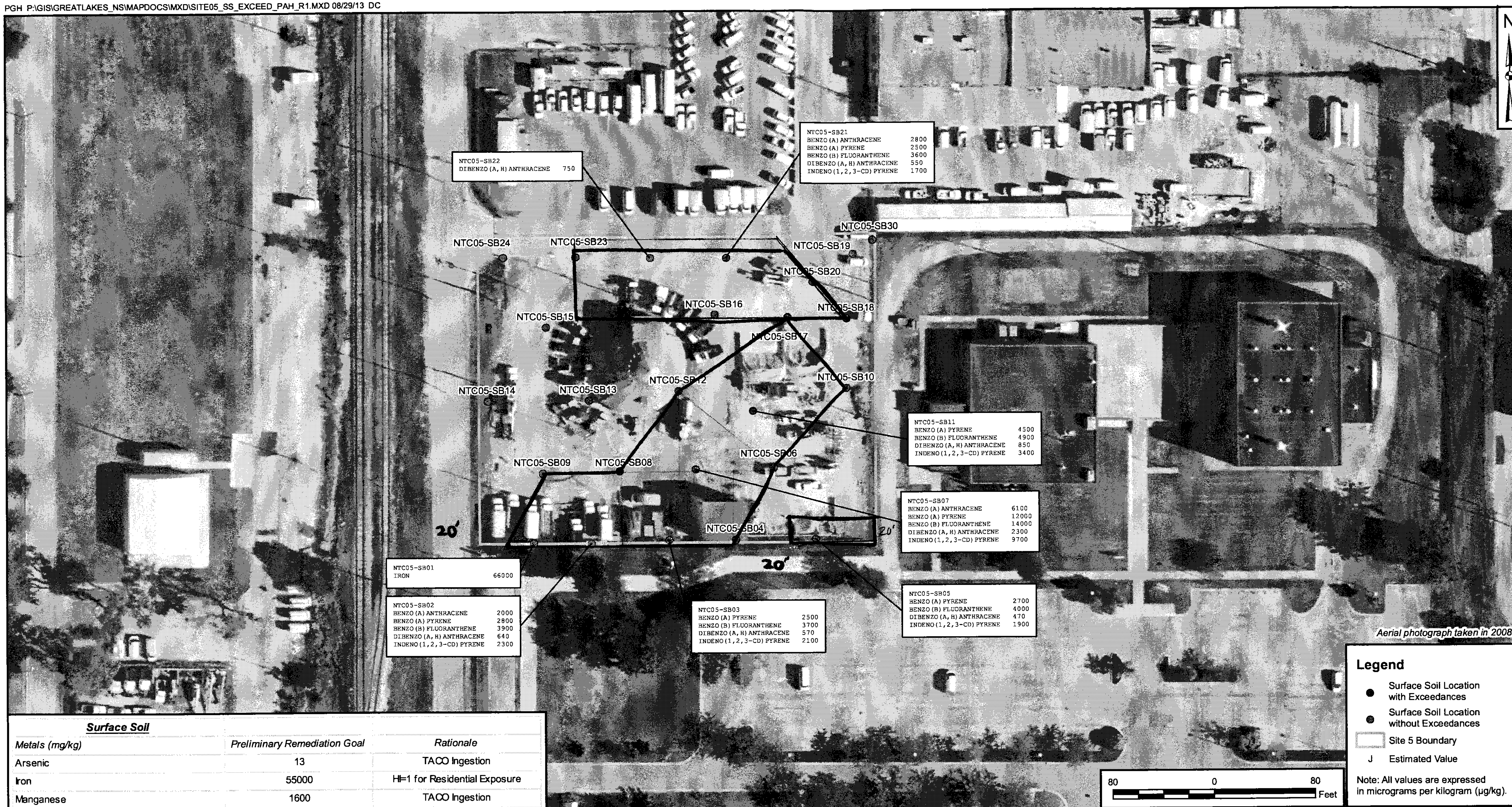

Surface Soil

Metals (mg/kg)	Preliminary Remediation Goal	Rationale
Arsenic	13	TACO Ingestion
Iron	55000	HI=1 for Residential Exposure
Manganese	1600	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1800	Background
Benzo(a)pyrene	2100	Background
Benzo(b)fluoranthene	2100	Background
Benzo(k)fluoranthene	9000	TACO Ingestion
Dibenzo(a,h)anthracene	420	Background
Indeno(1,2,3-cd)pyrene	1600	Background

DRAWN BY	DATE
J. NOVAK	05/22/12
CHECKED BY	DATE
J. LOGAN	08/29/13
REVISED BY	DATE
D. COUCH	08/29/13
SCALE AS NOTED	

NAVFAC

EXCEEDANCES OF RESIDENTIAL PRGs IN SURFACE SOIL
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	F275
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO.	REV 0

SURFACE EXCAVATIONS
SKETCH 5-1

8/30/13

Subsurface Soil		
Metals (mg/kg)	*Preliminary Remediation Goal*	*Rationale*
Arsenic	13	TACO Ingestion
Manganese	1600	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1500	ILCR = IE-5 for Residential Exposure
Benzo(a)pyrene	150	ILCR = IE-5 for Residential Exposure
Benzo(b)fluoranthene	1500	ILCR = IE-5 for Residential Exposure
Benzo(k)fluoranthene	15000	ILCR = IE-5 for Residential Exposure
Dibenzo(a,h)anthracene	150	ILCR = IE-5 for Residential Exposure
Indeno(1,2,3-cd)pyrene	1500	ILCR = IE-5 for Residential Exposure

DRAWN BY	DATE
S. PAXTON	10/18/12
CHECKED BY	DATE
J. LOGAN	08/29/13
REVISED BY	DATE
D. COUCH	08/29/13
SCALE AS NOTED	

NAVFAC

EXCEEDANCES OF RESIDENTIAL PRGs
IN SUBSURFACE SOIL
SITE 5 - TRANSFORMER STORAGE BONEYARD
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
—	F275
APPROVED BY	DATE
—	—
APPROVED BY	DATE
FIGURE NO.	REV 0

SUBSURFACE EXCAVATIONS
SKETCH 5-2

8/30/13

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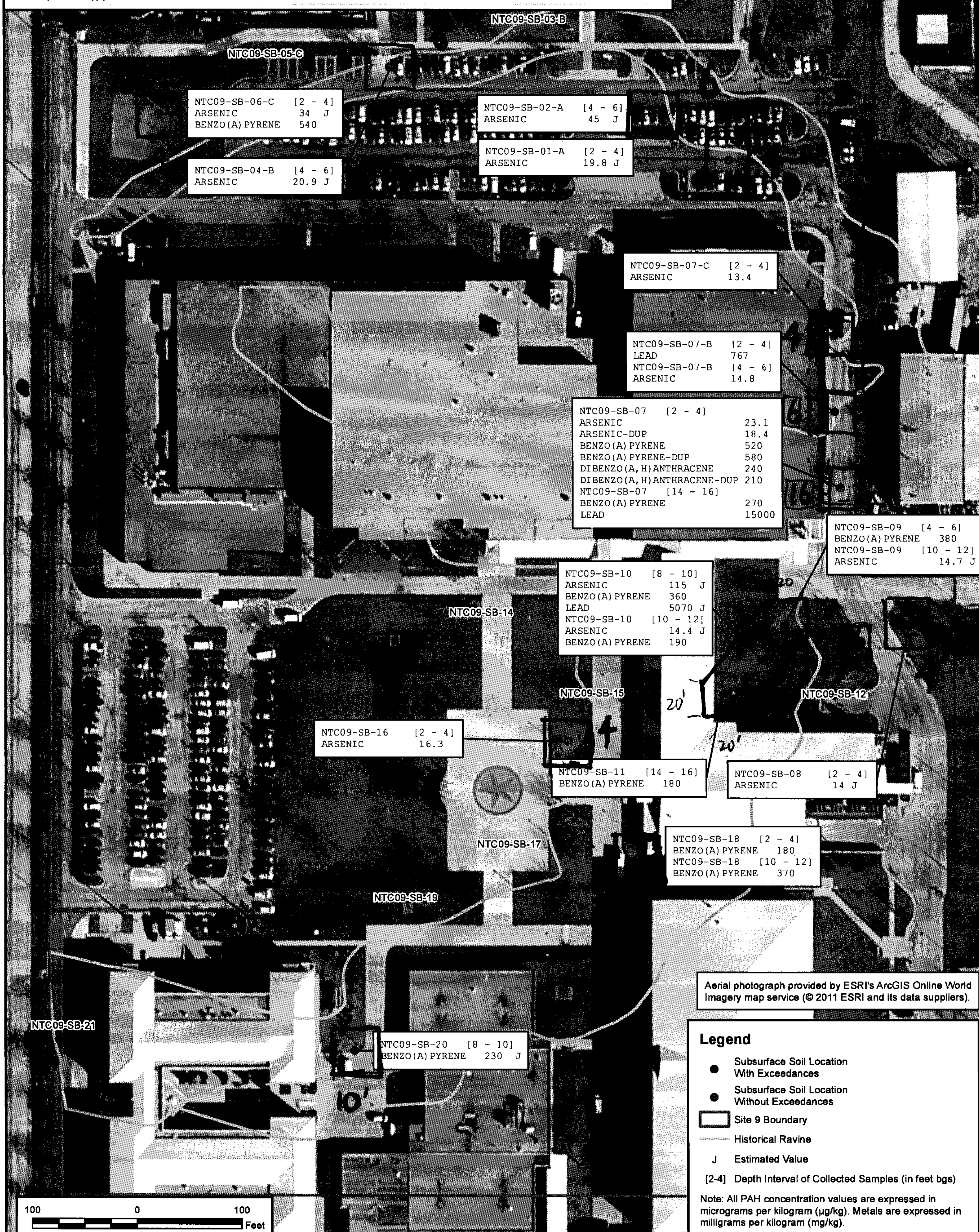
Subsurface Soil

Metals (mg/kg)	*Preliminary Remediation Goal*	*Rationale*
Arsenic	13	TACO Ingestion
Lead	400	TACO Ingestion
Manganese	1600	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1500	ILCR=1E-5 for Residential Exposure
Benzo(a)pyrene	150	ILCR=1E-5 for Residential Exposure
Benzo(b)fluoranthene	1500	ILCR=1E-5 for Residential Exposure
Dibenzo(a,h)anthracene	150	ILCR=1E-5 for Residential Exposure
Indeno(1,2,3-cd)pyrene	1500	ILCR=1E-5 for Residential Exposure



DRAWN BY	DATE
J. ENGLISH	05/23/12
CHECKED BY	DATE
J. LOGAN	08/30/13
REVISED BY	DATE
D. COUCH	08/30/13
SCALE	AS NOTED

NAVFAC

EXCEEDANCES OF PRGs IN SOIL
SITE 9 - CAMP MOFFETT RAVINE FILL AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	510
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO.	REV
	0

SKETCH #9-1 SUBSURFACE EXCAVATION 40 X 40
8/30/13
6-3

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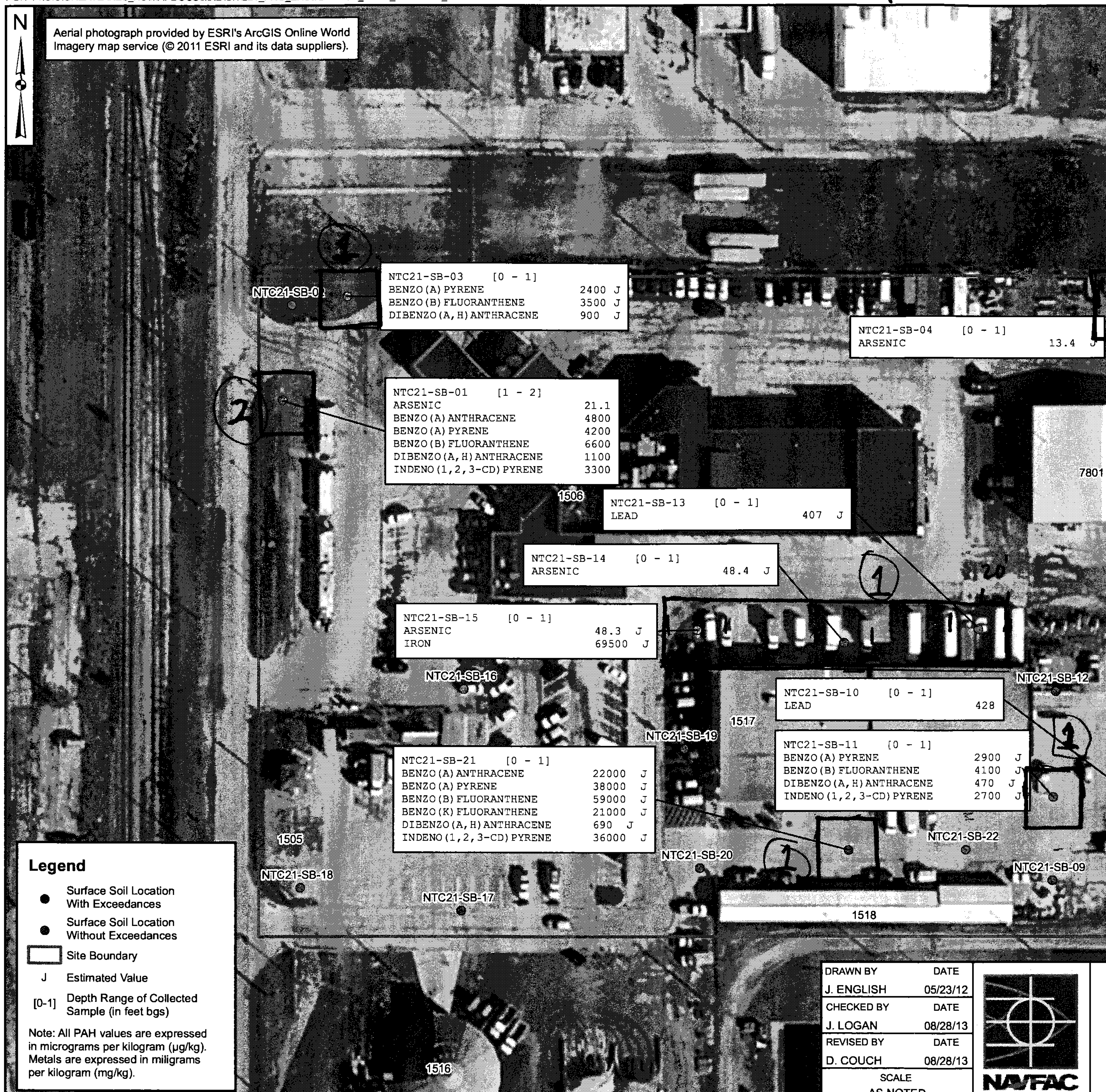
Depth □



Surface Soil Metals (mg/kg)	Preliminary Remediation Goal	Rationale
Arsenic	13	TACO Ingestion
Iron	55000	HI=1 for Residential Exposure
Lead	400	TACO Ingestion
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1800	Background
Benzo(a)pyrene	2100	Background
Benzo(b)fluoranthene	2100	Background
Benzo(k)fluoranthene	9000	TACO Ingestion
Chrysene	88000	TACO Ingestion
Dibenzo(a,h)anthracene	420	Background
Indeno(1,2,3-cd)pyrene	1600	Background

Legend

- ● Surface Soil Location With Exceedances
- ● Surface Soil Location Without Exceedances
- Site Boundary
- J Estimated Value
- [0-1] Depth Range of Collected Sample (in feet bgs)

Note: All PAH values are expressed in micrograms per kilogram (µg/kg). Metals are expressed in milligrams per kilogram (mg/kg).

DRAWN BY	DATE
J. ENGLISH	05/23/12
CHECKED BY	DATE
J. LOGAN	08/28/13
REVISED BY	DATE
D. COUCH	08/28/13
SCALE AS NOTED	

NAVFAC

EXCEEDANCES OF RESIDENTIAL PRGs IN SURFACE SOIL
SITE 21 - BUILDINGS 1517/1506 AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	C064
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO.	REV 0

SKETCH 21-1   40' × 40', except as noted   SURFACE EXCAVATIONS 8/13/12

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#-#-depth

Subsurface Soil		
Metals (mg/kg)	Preliminary Remediation Goal	Rationale
Arsenic	13	TACO Ingestion
Cobalt	24	HI=1 for Residential Exposure
Iron	55000	HI=1 for Residential Exposure
Polynuclear Aromatic Hydrocarbons (µg/kg)		
Benzo(a)anthracene	1500	ILCR=1E-5 for Residential Exposure
Benzo(a)pyrene	150	ILCR=1E-5 for Residential Exposure
Benzo(b)fluoranthene	1500	ILCR=1E-5 for Residential Exposure
Benzo(k)fluoranthene	15000	ILCR=1E-5 for Residential Exposure
Chrysene	150000	ILCR=1E-5 for Residential Exposure
Dibenzo(a,h)anthracene	150	ILCR=1E-5 for Residential Exposure
Indeno(1,2,3-cd)pyrene	1500	ILCR=1E-5 for Residential Exposure

DRAWN BY	DATE
J. ENGLISH	05/23/12
CHECKED BY	DATE
J. LOGAN	08/28/13
REVISED BY	DATE
D. COUCH	08/28/13
SCALE AS NOTED	

NAVFAC

EXCEEDANCES OF RESIDENTIAL PRGs
IN SUBSURFACE SOIL
SITE 21 - BUILDINGS 1517/1506 AREA
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

CONTRACT NUMBER	CTO NUMBER
	C064
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. 2-11	REV 0

SKETCH 21-2

40' x 40' except as noted

SUBSURFACE EXCAVATIONS 8/30/13

Tetra Tech NUS			*STANDARD CALCULATION SHEET*
CLIENT: NS Great Lakes, Sites 5/9/21 FS	FILE No:	BY: JWL	PAGE: 1 of 2
SUBJECT: Site 5. Alternative 5-3 – Cost item and quantity estimates for various cost components		CHECKED BY: MEB 9/10/13	DATE: 09/05/13

Purpose: Estimate quantities for various cost items to be used in the cost estimate for Alternative 5-3.

Additional delineation: Assume that the areas require additional delineation. Assume that the large surface soil area, which is fairly well delineated, needs 4 samples. Assume that the surface soil area on the southeast requires 4 samples, one on each side. Analyze only for PAHs.

Surface soil samples: 4 + 4 = 8

For subsurface soil, there are 7 sample locations. Assume that each location need 4 samples plus one bottom sample.

Subsurface soil samples: 7 x (4 + 1) = 35

Total samples = 43

Labor (sampling for delineation sampling)

3 day with 2 people, 10 hours/day

3 day x 10 hrs/day x 2 people = 60 hours

ODCs (equipment, supplies)

Assume $1,500 for the event.

Subcontractors (DPT)
Because of sample depth, assume that a DPT rig would be used.

Assume $1,000 per day plus $1,000 mobilization

3 Days

3 x $1,000 + $1,000 = $4,000

Survey site (for sample locations)

8 field hours at 150 $/hour and 4 office hours at 75 $/hr

8 hrs x 150 $/hr + 4 hrs x 75$/hr = $1,500

Pavement removal

See Volumes calculation: 37,000 ft2

Tetra Tech NUS		*STANDARD CALCULATION SHEET*	
CLIENT: NS Great Lakes, Sites 5/9/21 FS	FILE No:	BY: JWL	PAGE: 2 of 2
SUBJECT: Site 5. Alternative 5-3 – Cost item and quantity estimates for various cost components		CHECKED BY: MEB 9/10/13	DATE: 09/05/13

Top soil (6 “) for final backfill (no pavement is being replaced):

(From Volumes Spreadsheet)

Backfill area = 37,000 ft2

37,000 ft2 x 0.5 ft = 18,500 ft3 = 685, round to 690 cy top soil

Total backfill volume (from Volumes Spreadsheet):
3,872 cy

Net fill needed:
3,872 – 690 = 3,182 cy

Re-Seed Area

Use excavation area plus 20% for damage.

37,000 ft2 x 1.2 = ~44,000 ft2

LUCs

Plan and LUCRD – use 250 hours

Annual inspections and reports – use $2,150

Five Year Review

Use typical value - $23,000

Tetra Tech NUS			*STANDARD CALCULATION SHEET*
CLIENT: NS Great Lakes, Sites 5/9/21 FS	FILE No:	BY: JWL	PAGE: 1 of 2
SUBJECT: Site 9. Alternative 9-3 – Cost item and quantity estimates for various cost components		CHECKED BY: MEB 9/10/13	DATE: 09/05/13

Purpose: Estimate quantities for various cost items to be used in the cost estimate for Alternative 9-3.

Additional delineation: Assume that the areas require additional delineation. Assume that each of the 11 small areas require 4 samples, one on each side. Assume that the larger area requires 8 samples. Analyze only for PAHs.

Delineation samples: 11x 4 + 1 x 8 = 52

In addition, because of the absence of samples between the surface and subsurface samples, additional samples will be collected over that interval at the excavation locations at SB-07, SB-10, SB-18, and SB-20. (If contaminant levels are less than PRGs, then some of the soil may be re-used as backfill.) Assume 6 samples per area.

Deep interval samples: 4 x 6 = 24

Total samples: 52 + 24 = 76

Labor (sampling for delineation sampling)

4 days with 2 people, 10 hours/day

4 day x 10 hrs/day x 2 people = 80 hours

ODCs (equipment, supplies)

Assume $1,000 for the event.

Subcontractors (DPT)
Because of sample depth, assume that a DPT rig would be used.

Assume $1,000 per day plus $1,000 mobilization

4 Days

4 x $1,000 + $1,000 = $5,000

Survey site (for sample locations)

8 field hours at 150 $/hour and 4 office hours at 75 $/hr

8 hrs x 150 $/hr + 4 hrs x 75$/hr = $1,500

Tetra Tech NUS			*STANDARD CALCULATION SHEET*
CLIENT: NS Great Lakes, Sites 5/9/21 FS	FILE No:	BY: JWL	PAGE: 2 of 2
SUBJECT: Site 9. Alternative 9-3 – Cost item and quantity estimates for various cost components		CHECKED BY: MEB 9/10/13	DATE: 09/05/13

<u>Pavement removal</u>

Paved Areas: 06C, 02A, 01A, 07B, 07C, and 07.

The Total area (from the Volumes Spreadsheet) =

1,600 ft2 +1,600 ft2 +1,600 ft2 +800 ft2 +800 ft2 + 800 ft2

= 7,200 ft2

<u>Top soil (6 “) for final backfill (no pavement is being replaced):</u>

(From Volumes Spreadsheet)

Backfill area = 24,000 ft2

24,000 ft2 x 0.5 ft = 12,000 ft3 = 444, round to 450 cy top soil

Total backfill volume (from Volumes Spreadsheet):
10,427 cy

Net fill needed:
10,427 – 450 = 9,977 cy

<u>Re-Seed Area</u>

Use excavation area plus 20% for damage.

24,000 ft2 x 1.2 = ~29,000 ft2

<u>LUCs</u>

Plan and LUCRD – use 250 hours

Annual inspections and reports – use $2,350

<u>Five Year Review</u>

Use typical value - $23,000

Tetra Tech NUS			*STANDARD CALCULATION SHEET*
CLIENT: NS Great Lakes, Sites 5/9/21 FS	FILE No:	BY: JWL	PAGE: 1 of 2
SUBJECT: Site 21. Alternative 21-3 – Cost item and quantity estimates for various cost components		CHECKED BY: MEB 9/10/13	DATE: 09/05/13

Purpose: Estimate quantities for various cost items to be used in the cost estimate for Alternative 21-3.

Additional delineation: Assume that the areas require additional delineation. Assume that each area requires 4 samples, one on each side. Assume separate sampling for surface and subsurface excavations. Assume SB-13/15/15 and SB-9/11/22 each require 4 additional samples due to size. Analyze only for PAHs.

8 surface areas
11 subsurface areas

19 total areas

Total samples: 19 x 4 +(4 + 4) = 84

Labor (sampling for delineation sampling)

4 days with 2 people, 10 hours/day

4 day x 10 hrs/day x 2 people = 80 hours

ODCs (equipment, supplies)

Assume $1,500 for the event.

Subcontractors (DPT)
Because of sample depth, assume that a DPT rig would be used.

Assume $1,000 per day plus $1,000 mobilization

4 Days

4 x $1,000 + $1,000 = $5,000

Survey site (for sample locations)

8 field hours at 150 $/hour and 8 office hours at 75 $/hr

8 hrs x 150 $/hr + 8 hrs x 75$/hr = $1,800

Tetra Tech NUS			*STANDARD CALCULATION SHEET*
CLIENT: NS Great Lakes, Sites 5/9/21 FS	FILE No:	BY: JWL	PAGE: 2 of 2
SUBJECT: Site 21. Alternative 21-3 – Cost item and quantity estimates for various cost components		CHECKED BY: MEB 9/10/13	DATE: 09/05/13

Pavement removal

Site is mostly paved. Subsurface only areas are SB-06, -06, -12, -9/11/22, -18, and -08.

20,800 (surface) + 13,000 (subsurface only) = 33,800 ft2

Top soil (6 ") for final backfill (no pavement is being replaced):

(From Volumes Spreadsheet)

Backfill area = 33,800 ft2

33,800 ft2 x 0.5 ft = 16,900 ft3 = 626, round to 630 cy top soil

Total backfill volume from off-site source (from Volumes Spreadsheet):
2,947 cy

Net fill needed:
2,947 – 630 = 2,317 cy

Re-Seed Area

Use excavation area plus 20% for damage.

33,800 ft2 x 1.2 = ~41,000 ft2

LUCs

Plan and LUCRD – use 250 hours

Annual inspections and reports – use $2,350

Five Year Review

Use typical value - $23,000

CLIENT: NS GREAT LAKES, IL		JOB NO.:
SUBJECT: Sites 5/9/21 FFS - ISCO Estimates		
BASED ON:		DRAWING NUMBER:
BY: JWL Date: 6/6/13	CHECKED BY: MEB Date: 6/19/13	APPROVED BY: DATE:

Purpose: Estimate quantities and costs for ISCO for each site (Sites 5, 9, and 21). Estimate approach is based on typical values for ISCO on Table 9.12 of In Situ Chemical Oxidation for Groundwater Remediation by Siegrist et al.

Introduction: The groundwater in the vicinity of the well where a COC exceeds the PRG at each site will be treated. There is very little delineation and contamination does not appear to be widespread. A 50' x 50' area is assumed. For Sites 9 and 21, the screened interval of the monitoring well is assumed to be the thickness of the treatment zone. For Site 5, the thickness of the treatment zone is assumed to be between the water table and the top of the clay.

Values in blue font are entered into the spreadsheet.

Physical characteristics of treatment zones at each site.

	Site 5	Site 9	Site 21
Width, feet	50	50	50
Length, feet	50	50	50
Area, Feet2	2,500	2,500	2,500
Treatment interval, feet	3	8	10
Bottom depth, feet bgs	6	22	15
Volume media, Ft3	7,500	20,000	25,000
Volume media, cy	278	741	926

Estimate injection wells.
Because of the high clay content and heterogeneity, a small ROI is assumed.

Injection well ROI, feet	5	5	5
Injection well area, ft2	78.5	78.5	78.5
Number of Injection wells	32	32	32
Total well feet	192	704	480

CLIENT:	NS GREAT LAKES, IL		JOB NO.:	
SUBJECT:	Sites 5/9/21 FFS - ISCO Estimates			
BASED ON:			DRAWING NUMBER:	
BY: JWL	CHECKED BY: MEB		APPROVED BY:	DATE:
Date: 6/6/13	Date: 6/19/13			

Estimate oxidant quantity. Assume H2O2.
Per ISCO reference Table 9.12, use median CHP 1.2 lb/1,000 lb median for Sites 5 and 21.
Because of lower level of contamination at Site 9 and the goal is to oxidize iron, use 1/2 of above, 0.6 lb/1,000 lb

Media density, lb/ft3	120	120	120
Mass of media, lb	900,000	2,400,000	3,000,000
CHP loading, lb/1,000 lb	1.2	0.6	1.2
CHP (as H2O2), lb	1,080	1,440	3,600

Estimate water volume.
Per ISCO Book, Table 9.12, 0.086 pore volumes, use 0.1

Porosity	0.3	0.3	0.3
Total Pore volume, gal	16,832	44,886	56,108
No. of PVs to inject	0.1	0.1	0.1
Vol to inject, gal	1,683	4,489	5,611
%H2O2	7	4	7
Delivery rate, gal/day	800	800	800
Number of days	2.1	5.6	7.0
as Full days	3	6	8
No. days plus mob/demob	5	8	10

CLIENT: NS GREAT LAKES, IL			JOB NO.:
SUBJECT: Sites 5/9/21 FFS - ISCO Estimates			
BASED ON:			DRAWING NUMBER:
BY: JWL Date: 6/6/13	CHECKED BY: MEB Date: 6/19/13		APPROVED BY: DATE:

Costs

Costs and unit costs were scaled from a Geocleanse estimate for a comparably sized site.

Unit Cost

Well install, $/foot	$75	$75	$75
Injection, $/day	$4,600	$4,600	$4,600
Reagents, $/lb H2O2	$1.55	$1.55	$1.55

Project Design	$4,000	$4,000	$4,000
Well installation	$14,400	$52,800	$36,000
Injection	$23,000	$36,800	$46,000
Reagents	$1,674	$2,232	$5,580
Mob/Demob	$18,000	$18,000	$18,000
Documentation	$4,000	$4,000	$4,000
Subtotal	$65,074	$117,832	$113,580

Second injection, 75% of first, 6 Months later

Injection	$17,250	$27,600	$34,500
Reagents	$1,256	$1,674	$4,185
Mob/Demob	$18,000	$18,000	$18,000
Subtotal	$36,506	$47,274	$56,685
Grand Total	$101,580	$165,106	$170,265

Table 9.12. Median Values Reportedly Used for ISCO Design Parameters for Common Oxidants Based on a Review of Case Studies (from Chapter 8)

	Permanganate	CHP	Persulfate	Ozone
Median design ROI (ft)	15 (n = 33)	15 (n = 35)	12.5 (n = 6)	25 (n = 6)
Median observed ROI (ft)	25 (n = 13)	15 (n = 8)	20 (n = 3)	40 (n = 3)
Median oxidant dose (g oxidant/kg media)	0.41 (n = 37)	1.2 (n = 21)	3.4 (n = 7)	0.041 (n = 5)
Median number of PVs delivered	0.16 (n = 34)	0.086 (n = 27)	0.82 (n = 7)	No data
Median number of delivery events	2 (n = 70)	2 (n = 63)	1 (n = 11)	1 (n = 16)
Median duration of delivery events (days)	4 (n = 49)	6.5 (n = 48)	4.5 (n = 8)	280 (n = 16)

n = number of sites fitting category.

reaction zones expanding radially from the point of oxidant delivery and it is implemented through a spreadsheet tool. The model is a mathematically simplified version of subsurface transport of reactive solutions, but has the advantage over the mass balance approach of explicitly including key parameters as mentioned above. The output of this particular modeling approach is a design ROI for either a well or probe injection delivery of oxidant solution (the two most common delivery approaches). Estimation of the ROI allows for an initial cost-comparison of the different design approaches and site-characteristics that govern the ROI. It also allows evaluation of the site-specific characteristics to which the ROI is most sensitive (e.g., oxidant type, oxidant demand/kinetics, percent mobile zone, etc.). As explained later in Section 9.3.6, this insight can be used to focus expenditures on collecting key site data to reduce design and cost uncertainty.

As part of Tier 1 Conceptual Design Process 3a or 3b shown in Figure 9.3, costs are considered on a preliminary basis to help optimize the design approach and compare options. For example, CDISCO has a cost estimating procedure which generates a preliminary cost estimate based on the user specified TTZ dimensions, injection ROI overlap (%), number of injection events planned, fixed cost, and unit costs for injection point installation, chemical reagents, and labor for injection. Two injection approaches are possible: injection through temporary direct push probes or injection through permanent wells. Cost factors are included for mobilization, labor, materials, equipment rental, travel, and subcontractor costs. Costs are considered in more detail later after a full analysis of design and design certainty (shown as Process 8 in Figure 9.3).

9.3.4 Feasibility of Conceptual Design Options

The next step of ISCO Conceptual Design is shown as Decision A in Figure 9.3. This decision is based on a judgment of the technical and economic feasibility of viable ISCO options that emerge from Tier 1 Conceptual Design. The decision is based on:

- Ability to implement the design; with considerations including
  - Practicality of delivery point spacing
  - Practicality of the volume and mass of oxidant required
  - Potential interference due to above or below ground infrastructure
  - Safe handling of design oxidant concentrations
- Project budget constraints

CLIENT: NS GREAT LAKES, IL			JOB NO.:
SUBJECT: Sites 5/9/21 FFS - Miscellaneous Cost Estimates			
BASED ON:			DRAWING NUMBER:
BY: JWL	CHECKED BY: MEB		APPROVED BY: DATE:
Date: 09/05/13	Date: 9/10/13		

Purpose: Quantify and provide cost estimate for miscellaneous components. These apply to all sites, except as noted.

Barrier (Cover) Maintenance

Assumptions:

Repave 40' x 40' section annually.

Length, feet	40
Width, feet	40
Area, Ft2	1,600
Unit cost, $/ft2	$3.10
Pavement Cost, $	$4,960.00
Mob/Demob	$500.00
Total	$5,460.00
Use	**$5,500.00**

CLIENT: NS GREAT LAKES, IL			JOB NO.:
SUBJECT: Sites 5/9/21 FFS - Miscellaneous Cost Estimates			
BASED ON:			DRAWING NUMBER:
BY: JWL	CHECKED BY: MEB		APPROVED BY: DATE:
Date: 09/05/13	Date: 9/10/13		

ISCO DELINEATION

Assume each groundwater area needs to be delineated.
Use DPT to collect groundwater samples (rather than additional wells)
Assume one extra well is installed.

Delineation sampling
Unit costs

DPT rig, $/day	$1,500.00	
Sampling labor, $/hr	$80.00	
Analysis, $/sample	$100.00	simplified, would vary slightly per site.
Equipment/supplies/IDW, $/event	$1,500.00	
Well, $/foot	$40.00	
Well casing, $/each	$100.00	

Cost	Quantity	
DPT rig, days	2	$3,000.00
Preparation, hours	24	$1,920.00
Sampling labor, hours	20	$1,600.00
Analysis, each	20	$2,000.00
Equip, etc, event	1	$1,500.00
Well, foot	20	$800.00
Casing, each	1	$40.00
Sampling Plan, hours	150	$12,000.00
Total		$22,860.00
Use		**$23,000.00**

ISCO - Bench/Pilot

For small site, assume that only bench tests are needed.
Assume sample collection would be during delineation.

Bench tests	$2,500.00
Report	$5,000.00
Total	**$7,500.00**

CLIENT: NS GREAT LAKES, IL		JOB NO.:	
SUBJECT: Sites 5/9/21 FFS - Miscellaneous Cost Estimates			
BASED ON:		DRAWING NUMBER:	
BY: JWL	CHECKED BY: MEB	APPROVED BY:	DATE:
Date: 09/05/13	Date: 9/10/13		

ISCO - Performance sampling

Assume 5 sampling events. 5

Assume four samples per event.

Assume crew of two.

1 10-hour crew day for sampling

8 hours for mob/demob/planning

Total man-hours	28
Labor rate (loaded) $/hr	80
Labor cost, $	$2,240.00

Supplies, per diem, equipment	$1,500.00

Total sampling cost per event, $	**$3,740.00**

Analyses

4 wells plus 1 duplicate	5

Analysis unit costs

Analysis, $/sample	$100.00	Simplify, will vary slightly per site.

Cost, per site	**$500.00**

Total per event	$4,240.00

Total per treatment activity	**$21,200.00**

Report (at end of project)

Total man-hours	100
Labor rate (loaded) $/hr	40
Labor cost, $	**$4,000.00**

Grand Total	**$25,200.00**

APPENDIX C

SUSTAINABILITY EVALUATION

APPENDIX C-1 ENVIRONMENTAL FOOTPRINT REPORT

APPENDIX C

Environmental Footprint Evaluation

Feasibility Study

Great Lakes Sites 5, 9 and 21

Naval Training Center Great Lakes

Great Lakes, Illinois

September 2013

OBJECTIVE

This Environmental Footprint Evaluation of remedial alternatives is provided as an Appendix to the Feasibility Study (FS) for Sites 5, 9 and 21 located at the Naval Air Training Center located in Great Lakes, IL. The purpose of the footprint evaluation is to assess the environmental impacts of the four remedial alternatives using the metrics of greenhouse gas (GHG) and criteria pollutant emissions, energy use, water consumption, and worker safety. The results of this footprint evaluation are intended to provide additional information for consideration during remedy selection, design, and to enhance the understanding of the environmental impacts throughout the remedy life-cycle for each of the proposed alternatives.

POLICY BACKGROUND

Department of Defense (DOD) and Navy policies require continual optimization of remedies in every phase from remedy selection through site closeout (NAVFAC, 2010a).

In January 2007, Executive Order 13423 set targets for sustainable practices for (i) energy efficiency, greenhouse gas emissions avoidance or reduction, and petroleum products use reduction, (ii) renewable energy, including bioenergy, (iii) water conservation, (iv) acquisition, (v) pollution and waste prevention and recycling, etc. In October 2009, Executive Order 13514 was issued, which reinforced these sustainability requirements and established specific goals for federal agencies to meet by 2020.

In August 2009 DOD issued a policy for “Consideration of Green and Sustainable Remediation Practices in the Defense Environmental Restoration Program.” The DOD policy and related Navy guidance state that opportunities to increase sustainability should be considered throughout all phases of remediation (i.e., site investigation, remedy selection, remedy design and construction, operation, monitoring, and site closeout). In response to this policy, the Department of the Navy (DON) issued an updated Navy Guidance for “Optimizing Remedy Evaluation, Selection, and Design” (NAVFAC, 2010), which includes environmental footprint evaluations as part of the traditional DON optimization review process for remedy selection, design, and remedial action operation. In August 2010, the Naval Facilities Engineering Command (NAVFAC) issued policy requiring use of the SiteWise™ tool to perform environmental impact reviews as part of all Feasibility Studies. As such, this environmental footprint evaluation of remedial alternatives is being performed to estimate the environmental footprint associated with each alternative in the interest of reducing the environmental impact of remedial actions Naval Training Center Great Lakes.

Applying the DON optimization concepts with an environmental footprint evaluation within the remedy selection and design phases allows for the following benefits:

- Determining factors in each remedial alternative with the greatest environmental impacts and gathering insight into how to reduce these impacts;
- Evaluating remedial alternatives with optimized or reduced environmental footprints in conjunction with other selection criteria;
- Designing and implementing a more robust remedy while balancing the impact to the environment; and
- Ensuring efficient, cost-effective and sustainable site closeout.

EVALUATION TOOLS

This evaluation was performed using a hybrid model of the Navy's SiteWise™ tool supplemented with Tetra Tech developed model as appropriate for some site-specific items.

SiteWise™ is a life-cycle footprint assessment tool developed jointly by the U.S. Navy, U.S. Army Corps of Engineers (USACE), and Battelle. SiteWise™ assesses the environmental footprint of a remedial alternative/technology using a consistent set of metrics. The assessment is conducted using a building block approach, where each remedial alternative is first broken down into modules that follow the phases for most remedial actions, including remedial investigation (RI), remedial action construction (RA-C), remedial action operation (RA-O), and long-term monitoring (LTM). Once broken down by remedial phase, the footprint of each phase is calculated. The phase-specific footprints are then combined to estimate the overall footprint of the remedial alternative. This building block approach reduces redundancy in the footprint assessment and facilitates the identification of specific impact drivers that contribute to the environmental footprint. The inputs that need to be considered include (1) production of material required by the activity; (2) transportation of the required materials to the site, transportation of personnel; (3) all site activities to be performed; and (4) management of the waste produced by the activity.

GSRx builds off of SiteWise™ and allows for a flexible, detailed analysis, particularly for materials and equipment use. GSRx was used to account for materials and activities not readily input into SiteWise™

and where equipment usage assumptions built into SiteWise™ were not consistent with site-specific requirements.

ENVIRONMENTAL FOOTPRINT EVALUATION FRAMEWORK AND LIMITATIONS

The environmental footprint evaluation performed for the FS of Sites 5, 9 and 21 at Naval Training Center Great Lakes considered life-cycle quantitative metrics for global warming potential (through greenhouse gas emissions), criteria air pollutant emissions (through NO_X, SO_X and PM_{10} emissions), energy consumption, water usage, and worker safety.

Life cycle impacts were calculated for energy consumption, emissions of GHG (carbon dioxide [CO_2], methane [CH_4], and nitrous oxide [N_2O]) and criteria pollutants (nitrogen oxides [NO_x], sulfur oxides [SO_x] and particulate matter [PM_{10}]), water usage, and energy consumption, and worker safety.

Life cycle inventory inputs in SiteWise™ were divided into four categories – 1) materials production; 2) transportation of personnel, materials and equipment; 3) equipment use and miscellaneous; and 4) residual handling and disposal. Cost estimates from the RI/FS and design calculations were used as a basis for inventory quantities and related assumptions. Emission factors, energy consumption, and water usage data were correlated to material quantities, equipment, transportation distances, and installation time frames in order to calculate life-cycle emissions, energy consumption, water usage, and worker safety. Default SiteWise™ emission, energy usage, water consumption, and worker fatality and accident risk factors were utilized.

Although GSRx was used to minimize limitations resulting within SiteWise™, elimination of all limitations was not possible while using a hybrid model of SiteWise™ and GSRx. For example, several materials and construction equipment inventoried were input into GSRx and these impacts were incorporated into SiteWise™ within the “Equipment Use and Miscellaneous” sector. This sector in SiteWise™ does not differentiate into the specific equipment usage or material consumption items that are input in GSRx, but rather are considered miscellaneous items. However, impact drivers for items input in GSRx can be identified and evaluated directly within the respective GSRx evaluation and output summary sheets. In addition, worker safety results in general do not include worker safety related to equipment usage that was input within GSRx because GSRx was not developed to evaluate worker safety.

EVALUATION RESULTS: SITE 5

The following are the alternatives that were analyzed with SiteWise™ and GSRx for Site 5 at Naval Training Center Great Lakes:

- Alternative 5-2: Land use Controls and Cover
- Alternative 5-2A: LUCs, Cover and ISCO
- Alternative 5-3: Excavation (Unrestricted Re-Use), Off-Site Disposal and Groundwater LUCs
- Alternative 5-3A: Excavation (Unrestricted Re-Use), Off-Site Disposal, Groundwater LUCs, and ISCO

The following sections summarize the relative environmental impacts and primary impact drivers for the four alternatives and their respective metrics. In addition, the attachment includes the inventory and output sheets that were used for the SiteWise™/GSRx hybrid model. An evaluation of SiteWise™ and GSRx output summary sheets and related figures included in the footprint evaluation attachments (Appendix C-2-1 and C-3-1), provides detailed information on the contribution to each metric from each phase of the remedial process (RI, RAC, RAO, and LTM) and for each respective input category (materials production, transportation, equipment usage, etc). Further inspection of related inventory sheets provide information on the specific contribution to a metric from each item of material, transportation, equipment, etc. This level of detail also helps clarify results that could be misinterpreted based on SiteWise™ data entry limitations mentioned previously. The environmental impacts of the alternatives analyzed are summarized quantitatively in Table 1. Environmental impact drivers for each of the alternatives analyzed are summarized in Table 2.

Greenhouse Gas Emissions

Emissions of CO_2, CH_4, and N_2O were normalized to CO_2 equivalents (CO_2e), which is a cumulative method of weighing GHG emissions relative to global warming potential. Figure 1 shows the overall GHG emissions of each of the alternatives analyzed; the x-axis represents the four alternatives evaluated and the y-axis represents the GHG emissions in metric ton of CO_2e.

The total amount of GHG emissions resulting from Alternative 5-2 is 0.69 metric ton of CO_2e. The activity that contributes to GHG emissions in this alternative is transportation of personnel.

The total amount of GHG emissions resulting from Alternative 5-2A is 8.00 metric ton of CO_2e. The activities that contribute to GHG emissions are:

- Laboratory analytical services contributes 2.36 metric ton of CO_2e (29 percent of the total GHG emissions resulting from Alternative 5-2A). Laboratory analytical services take place before and after each injection event (20 samples total).
- Transportation of personnel emits 2.02 metric ton of CO_2e (25 percent of the total GHG emissions resulting from Alternative 5-2A).

- Manufacture of HDPE emits 1.56 metric ton of CO_2e (20 percent of the total GHG emissions resulting from Alternative 5-2A). HDPE is used for the production of HDPE liner used in decontamination activities

The total amount of GHG emissions resulting from Alternative 5-3 is 289.99 metric ton of CO_2e. The activities that contribute the most to GHG emissions are:

- Production of borrow soil emits 121.16 metric ton of CO_2e (42 percent of the total GHG emissions resulting from Alternative 5-3). Soil is used for backfilling the excavated areas.
- Transportation of disposal of non-hazardous waste contributes 109.21 metric ton of CO_2e (38 percent of the total GHG emissions resulting from Alternative 5-3). Excavated soils are being transported to a local facility.
- Transportation of materials emits 22.87 metric ton of CO_2e (approximately eight percent of the total GHG emissions resulting from Alternative 5-3).

The total amount of GHG emissions resulting from Alternative 5-3A is 295.53 metric ton of CO_2e. The activities that contribute the most to GHG emissions are:

- Production of borrow soil emits 121.16 metric ton of CO_2e (41 percent of the total GHG emissions resulting from Alternative 5-3A). Soil is used for backfilling the excavated areas.
- Transportation of disposal of non-hazardous waste contributes 109.21 metric ton of CO_2e (37 percent of the total GHG emissions resulting from Alternative 5-3A). Excavated soils are being transported to a local facility.
- Transportation of materials emits 22.88 metric ton of CO_2e (approximately eight percent of the total GHG emissions resulting from Alternative 5-3A).

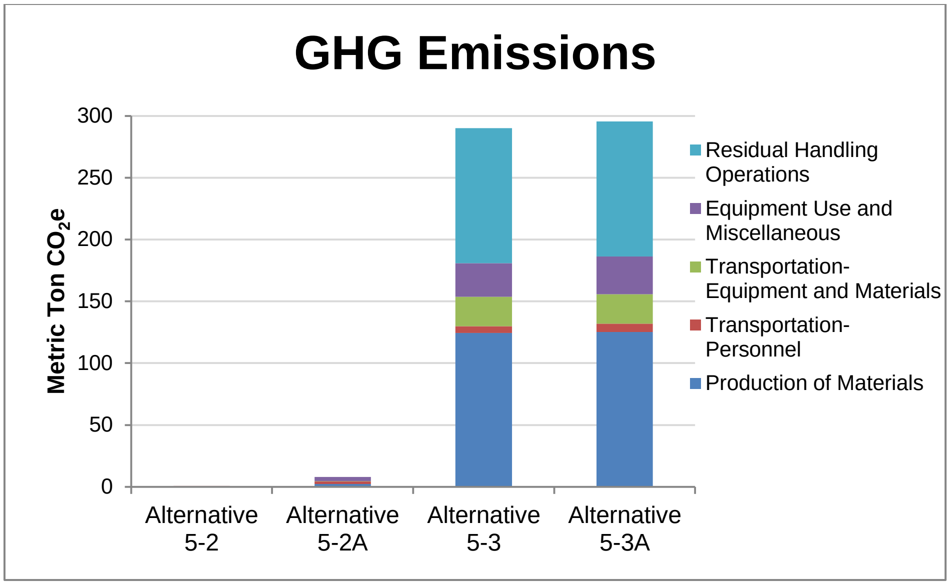


Figure 1: GHG Emissions for Alternatives at Site 5, Naval Training Center Great Lakes

Figure 2 shows the breakdown of the percent that each of main activities of each alternative (x-axis) contributes to the GHG emissions (y-axis).

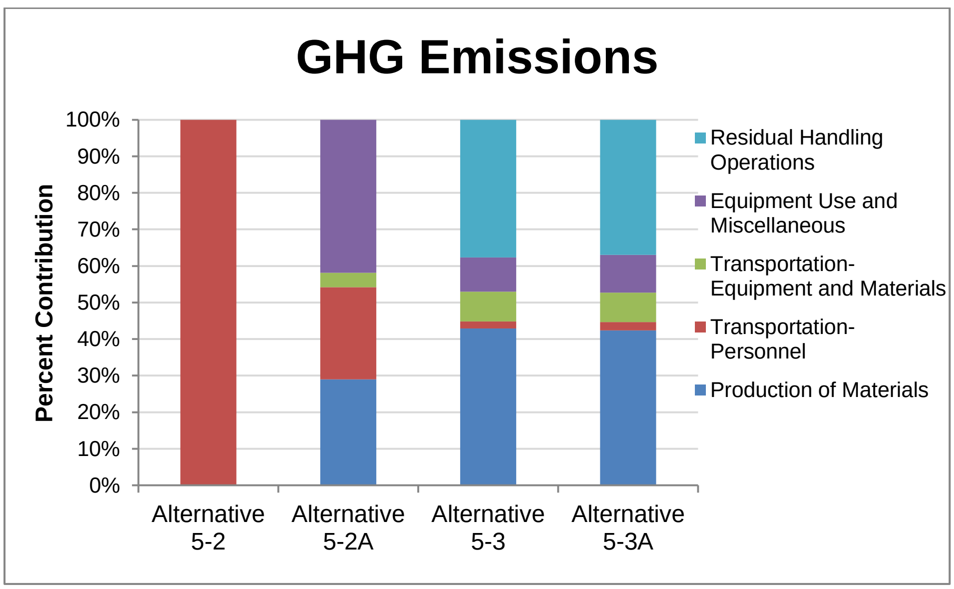


Figure 2: GHG Emissions percentage breakdown for Alternatives at Site 5, Naval Training Center Great Lakes

Criteria Pollutant Emissions

NO_X

Figure 3 shows the breakdown of the NO_X emissions for the four alternatives evaluated. The x–axis of this figure represents Alternative 5-2, Alternative 5-2A, Alternative 5-3 and Alternative 5-3A, the y-axis represents the NO_X emissions in metric ton.

The total amount of NO_X emissions resulting from Alternative 5-2 is 2.54×10^{-4} metric ton. The activity that contributes to the NO_X emissions is transportation of personnel.

The total amount of NO_X emissions resulting from Alternative 5-2A is 1.70×10^{-2} metric ton. The activities that contribute to the NO_X emissions are:

- Laboratory analytical services emits 8.16×10^{-3} metric ton of NO_X (48 percent of the total NO_X emissions resulting from Alternative 5-2A). Laboratory analytical services take place before and after each injection event (20 samples total).
- Use of DPT releases 7.54×10^{-3} metric ton of NO_X (44 percent of the total NO_X emissions resulting from Alternative 5-2A). The DPT is in use for 45 hours during the installation of the injection system.
- Transportation of personnel emits 7.47×10^{-4} metric ton of NO_X (approximately four percent of the total NO_X emissions resulting from Alternative 5-2A).

The total amount of NO_X emissions resulting from Alternative 5-3 is 5.47×10^{-1} metric ton. The activities that contribute to the most NO_X emissions are:

- Transportation of disposal of non-hazardous waste contributes 3.74×10^{-1} metric ton of NO_X (68 percent of the total NO_X emissions resulting from Alternative 5-3). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases 8.97×10^{-2} metric ton of NO_X (16 percent of the total NO_X emissions from Alternative 5-3). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 148 hours.
- Use of the 140 hp dozer releases 2.54×10^{-2} metric ton of NO_X (approximately five percent of the total NO_X emissions from Alternative 5-3). The dozer is used to help placing the clean fill. The dozer is in operation for 64 hours.

The total amount of NO_X emissions resulting from Alternative 5-3A is 5.63×10^{-1} metric ton. The activities that contribute to the most NO_X emissions are:

- Transportation of disposal of non-hazardous waste contributes 3.74×10^{-1} metric ton of NO_X (66 percent of the total NO_X emissions resulting from Alternative 5-3A). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases 8.97×10^{-2} metric ton of NO_X (16 percent of the total NO_X emissions from Alternative 5-3A). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 148 hours.
- Laboratory analytical services releases 2.78×10^{-2} metric ton of NO_X (approximately five percent of the total NO_X emissions from Alternative 5-A3). A total of 68 samples are analyzed through the lifetime of this Alternative.

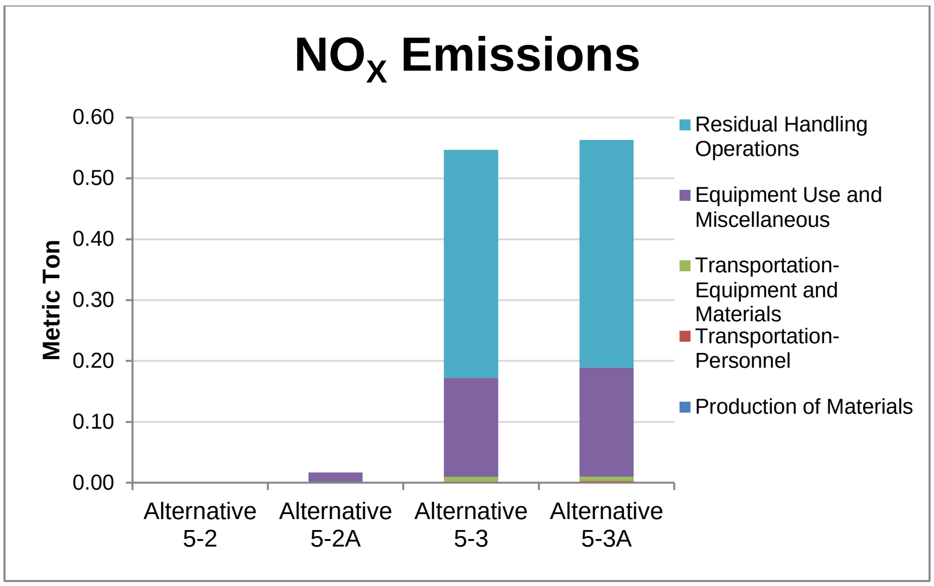


Figure 3 NO_X Emissions for Alternatives at Site 5, Naval Training Center Great Lakes

Figure 4 shows the percentage contribution from each of the main activity sectors.

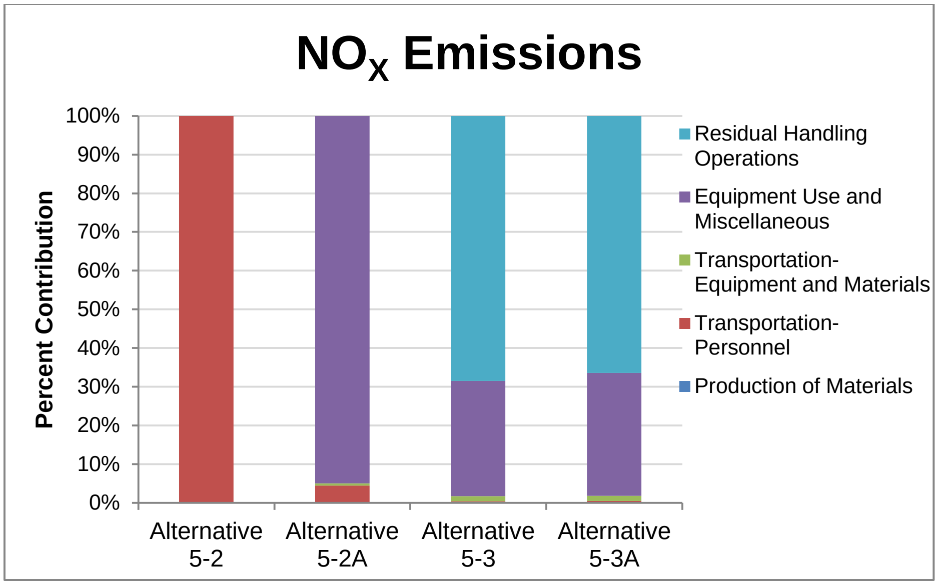


Figure 4: NO_X Emissions percentage breakdown for Alternatives at Site 5, Naval Training Center Great Lakes

SO_X

Figure 5 contains the distribution of the SO_X emissions resulting from the activities related to Alternatives 5-2, 5-2A, 5-3, and 5-3A. The x-axis of this graph represents the alternatives evaluated; the y-axis represents the SO_X emissions in metric ton.

The total amount of SO_X emissions resulting from Alternative 5-2 is 8.94×10^{-6} metric ton. The activity that contributes to the SO_X emissions is transportation of personnel.

The total amount of SO_X emissions resulting from Alternative 5-2A is 1.20×10^{-2} metric ton. The activities that contribute to the SO_X emissions are:

- Laboratory analytical services emits 5.44×10^{-3} metric ton of SO_X (45 percent of the total SO_X emissions resulting from Alternative 5-2A). Laboratory analytical services take place before and after each injection event (20 samples total).
- Manufacture of HDPE emits 3.49×10^{-3} metric ton of SO_X (29 percent of the total SO_X emissions resulting from Alternative 5-2A). HDPE is used for the production of HDPE liner used in decontamination activities.
- Use of electricity for injection pumps emits 1.59×10^{-3} metric ton of SO_X (13 percent of the total SO_X emissions resulting from Alternative 5-2A). Injection pumps are used for a total of 48 hours for both injection events.

The total amount of SO_X emissions resulting from Alternative 5-3 is $2.46x10^{-1}$ metric ton. The activities that contribute to the most SO_X emissions are:

- Transportation of disposal of non-hazardous waste contributes $1.93x10^{-1}$ metric ton of SO_X (78 percent of the total SO_X emissions resulting from Alternative 5-3). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases $2.65x10^{-2}$ metric ton of SO_X (11 percent of the total SO_X emissions from Alternative 5-3). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 148 hours.
- Laboratory analytical services releases $1.31x10^{-2}$ metric ton of SO_X (11 percent of the total SO_X emissions from Alternative 5-3). A total of 48 samples are analyzed for this Alternative.

The total amount of SO_X emissions resulting from Alternative 5-3A is $2.55x10^{-1}$ metric ton. The activities that contribute to the most SO_X emissions are:

- Transportation of disposal of non-hazardous waste contributes $1.93x10^{-1}$ metric ton of SO_X (76 percent of the total SO_X emissions resulting from Alternative 5-3A). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases $2.65x10^{-2}$ metric ton of SO_X (approximately ten percent of the total SO_X emissions from Alternative 5-3A). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 148 hours.
- Laboratory analytical services releases $1.85x10^{-2}$ metric ton of SO_X (approximately seven percent of the total SO_X emissions from Alternative 5-3A). A total of 68 samples are analyzed through the lifetime of this Alternative.

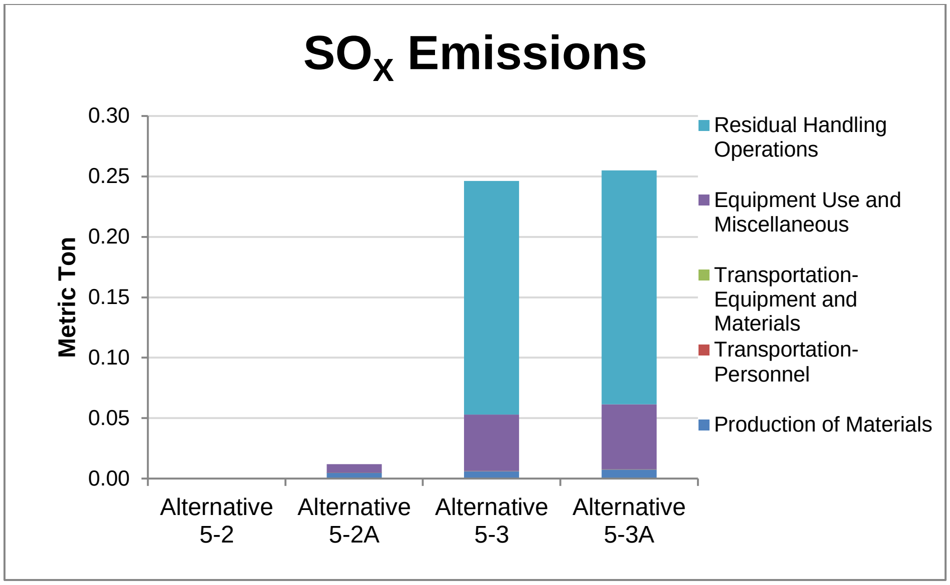


Figure 5: SO_X Emissions for Alternatives at Site 5, Naval Training Center Great Lakes

Figure 6 shows the percentage breakdown of the activities contributing to SO_X emissions.

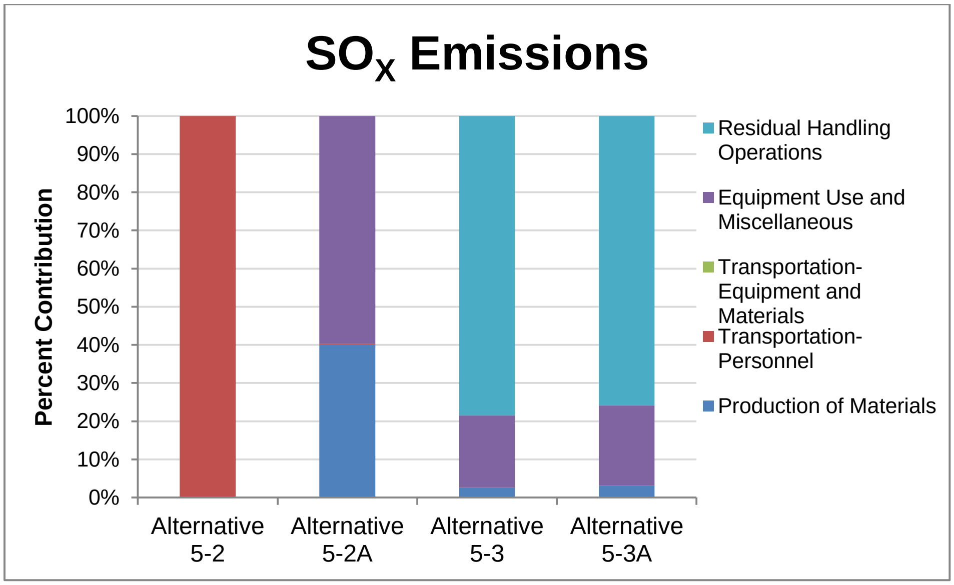


Figure 6: SO_X Emissions percentage breakdown for Alternatives at Site 5, Naval Training Center Great Lakes

PM_{10}

The breakdown of the distribution of the PM_{10} emissions resulting from the activities involved in Alternatives 5-2, 5-2A, 5-3 and 5-3A are shown in Figure 7. The x-axis of this figure represents the four alternatives evaluated, while the y-axis represents the PM_{10} emissions in metric ton.

The total amount of PM_{10} emissions resulting from Alternative 5-2 is 5.15×10^{-5} metric ton. The activity that contributes to the PM_{10} emissions is transportation of personnel.

The total amount of PM_{10} emissions resulting from Alternative 5-2A is 2.12×10^{-3} metric ton. The activities that contribute to the PM_{10} emissions are:

- Use of the DPT releases 7.51×10^{-4} metric ton of PM_{10} (37 percent of the total PM_{10} emissions resulting from Alternative 5-2A). DPT is in operation for 45 hours.
- Manufacture of HDPE emits 5.08×10^{-4} metric ton of PM_{10} (25 percent of the total PM_{10} emissions resulting from Alternative 5-2A). HDPE is used for the production of HDPE liner used in decontamination activities.
- Manufacture of hydrogen peroxide, use as a surrogate of Fenton Reagent, releases 2.70×10^{-4} metric ton of PM_{10} (13 percent of the total PM_{10} emissions resulting from Alternative 5-2A). Fenton Reagent is used during two injection events.

The total amount of PM_{10} emissions resulting from Alternative 5-3 is 1.05 metric ton. The activities that contribute to the most PM_{10} emissions are:

- Transportation of disposal of non-hazardous waste contributes 1.03 metric ton of PM_{10} (98 percent of the total PM_{10} emissions resulting from Alternative 5-3). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases 8.53×10^{-3} metric ton of PM_{10} (approximately one percent of the total PM_{10} emissions from Alternative 5-3). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 148 hours.
- Use of the 140 hp dozer releases 2.65×10^{-3} metric ton of PM_{10} (less than one percent of the total PM_{10} emissions from Alternative 5-3). The dozer is used for aiding in placing the clean fill. The dozer is in operation for 64 hours.

The total amount of PM_{10} emissions resulting from Alternative 5-3A is 1.05 metric ton. The activities that contribute to the most PM_{10} emissions are:

- Transportation of disposal of non-hazardous waste contributes 1.03 metric ton of PM_{10} (98 percent of the total PM_{10} emissions resulting from Alternative 5-3A). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases 8.53×10^{-3} metric ton of PM_{10} (approximately one percent of the total PM_{10} emissions from Alternative 5-3A). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 148 hours.
- Use of the 140 hp dozer releases 2.65×10^{-3} metric ton of PM_{10} (less than one percent of the total PM_{10} emissions from Alternative 5-3A). The dozer is used for helping in placing the clean fill. The dozer is in operation for 64 hours.

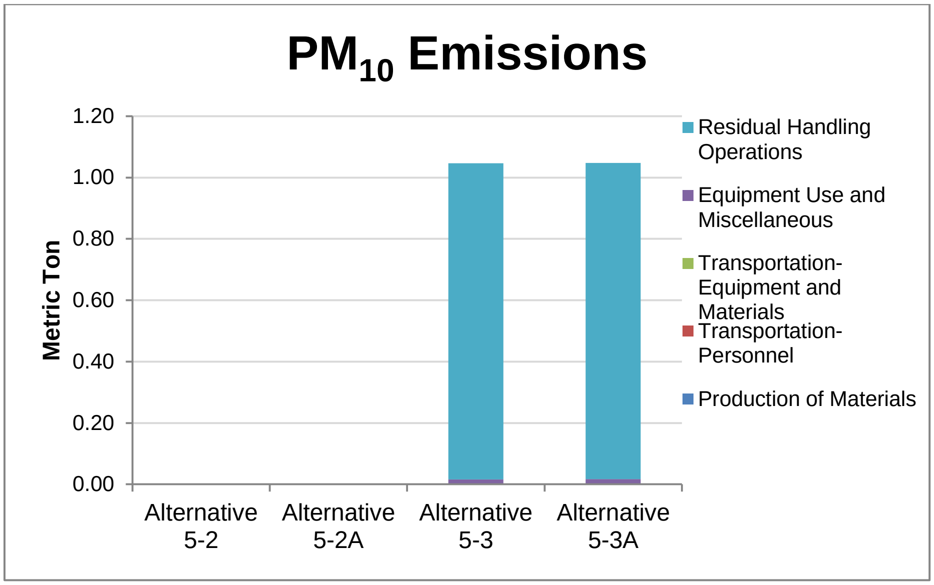


Figure 7: PM_{10} Emissions for Alternatives at Site 5, Naval Training Center Great Lakes

Figure 8 shows the percentage of PM_{10} emissions contributed by each of the activity sectors per alternative.

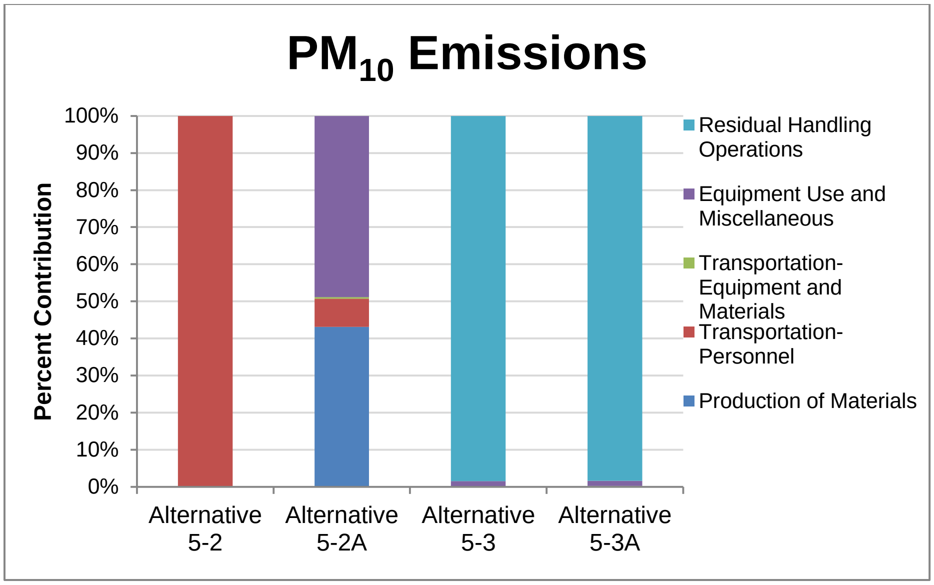


Figure 8: PM_{10} Emissions percentage breakdown for Alternatives Site 5, Naval Training Center Great Lakes

Energy Consumption

The energy consumption for each of the alternatives evaluated is shown in Figure 9. The x-axis shows the four alternatives evaluated, and the y-axis shows the amount of energy consumed in units of million British Thermal Units (MMBTU).

The total amount of energy consumed resulting from the activities from Alternative 5-2 is 8.63 MMBTU. The activity that contributes to the energy consumption is transportation of personnel.

The total amount of energy consumed resulting from the activities from Alternative 5-2A is 149.58 MMBTU. The activities that contribute to the energy consumption are:

- Laboratory analytical services consume 35.20 MMBTU (24 percent of the total energy consumed by Alternative 5-2A). Laboratory analytical services take place before and after each injection event (20 samples total).
- Manufacture of HDPE consumes 31.28 MMBTU (21 percent of the total energy consumed by Alternative 5-2A). HDPE is used as a liner during the decontamination activities.
- Transportation of personnel consumes 25.41 MMBTU (17 percent of the total energy consumed by Alternative 5-2A).

The total amount of energy consumed resulting from the activities from Alternative 5-3 is 13,803.86 MMBTU. The activities that contribute to the energy consumption are:

- Production of borrow soil consumes 10,924.94 MMBTU (79 percent of the total energy consumed resulting from Alternative 5-3). Soil is used for backfilling the excavated areas.
- Transportation of disposal of non-hazardous waste consumes 1,945.14 (14 percent of the total energy consumption resulting from Alternative 5-3). Excavated soils are being transported to a local facility.
- Transportation of materials consumes 298.50 MMBTU (approximately two percent of the total energy consumption resulting from Alternative 5-3).

The total amount of energy consumed resulting from the activities from Alternative 5-3A is 13,910.84 MMBTU. The activities that contribute to the energy consumption are:

- Production of borrow soil consumes 10,924.94 MMBTU (79 percent of the total energy consumed resulting from Alternative 5-3A). Soil is used for backfilling the excavated areas.
- Transportation of disposal of non-hazardous waste consumes 1,945.14 (14 percent of the total energy consumption resulting from Alternative 5-3A). Excavated soils are being transported to a local facility.
- Transportation of materials consumes 298.60 MMBTU (approximately two percent of the total energy consumption resulting from Alternative 5-3A).

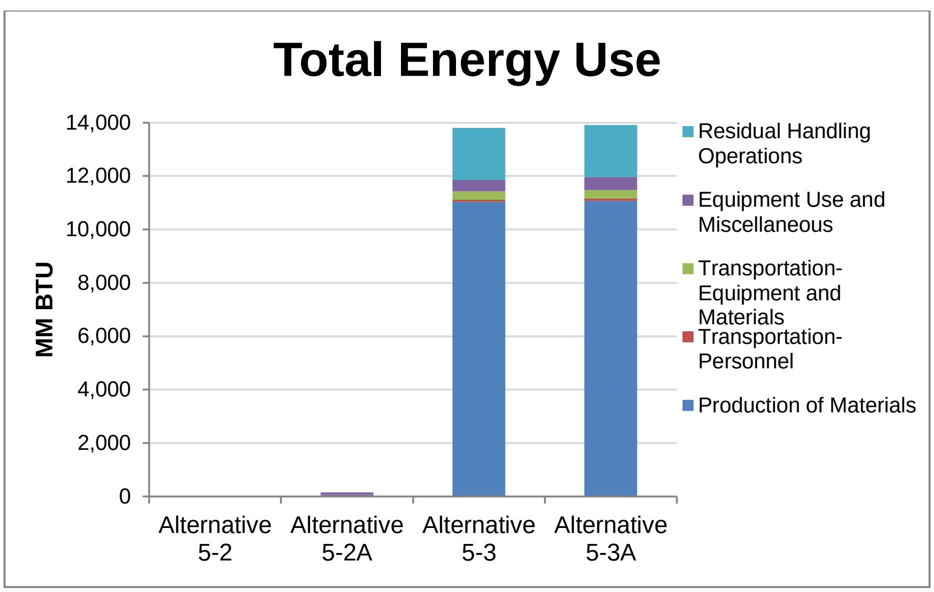


Figure 9: Energy Consumption for Alternatives at Site 5, Naval Training Center Great Lakes

Figure 10 shows the percentage breakdown contribution of energy consumption from the different activity groups.

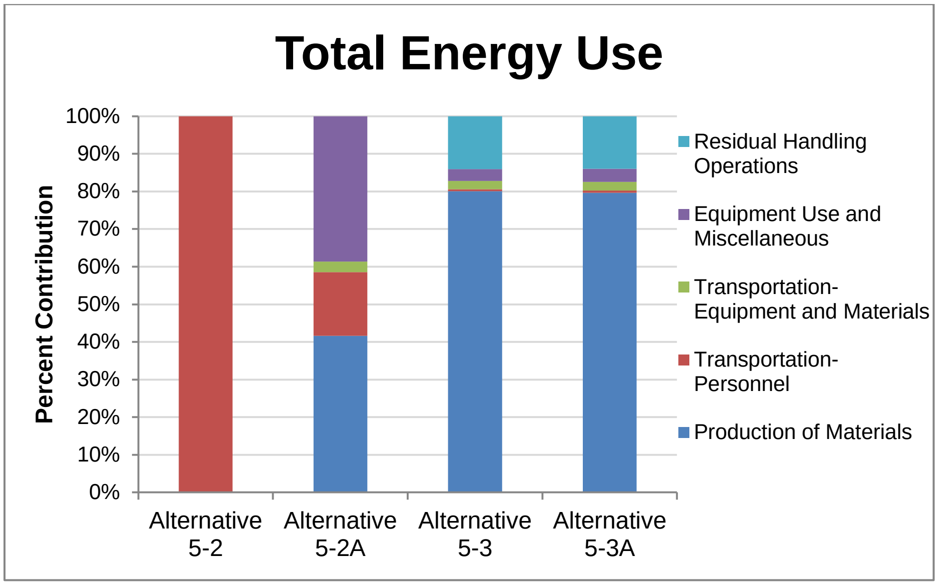


Figure 10: Energy Consumption percentage breakdown for Alternatives at Site 5, Naval Training Center Great Lakes

Water Usage

The water consumption of the evaluated alternatives is shown in Figure 11. The x-axis shows the four evaluated alternatives, and the y-axis show the amount of water consumed in thousands of gallons.

There is no direct water consumption for Alternative 5-2.

The total amount of water consumed resulting from the activities from Alternative 5-2A is 5,200 gallons of water.

- Treatment water consumes 3,400 gallons of water (66 percent of the total water consumption from Alternative 5-2A). Treatment water is used in two injection events.
- Decontamination water consumes 1,000 gallons of water (19 percent of the total water consumption from Alternative 5-2A). Decontamination water is used for cleaning the equipment in between and after operations.

- Manufacture of PVC consumes 330 gallons of water (approximately six percent of the total water consumption from Alternative 5-2A). PVC is used to produce the pipes for the injection system.

The total amount of water consumed resulting from the activities from Alternative 5-3 is 1,660 gallons of water.

- Decontamination water consumes 1,000 gallons of water (61 percent of the total water consumption from Alternative 5-3). Decontamination water is used for cleaning the equipment in between and after operations.
- Production of fertilizer consumes 398 gallons of water (24 percent of the total water consumption from Alternative 5-3). Fertilizer is used for revegetation purposes.
- Production of HDPE consumes 252 gallons of water (15 percent of the total water consumption from Alternative 5-3). HDPE is used as a liner for the decontamination equipment pad.

The total amount of water consumed resulting from the activities from Alternative 5-3A is 5,600 gallons of water.

- Treatment water consumes 3,400 gallons of water (61 percent of the total water consumption from Alternative 5-3A). Treatment water is used in two injection events.
- Decontamination water consumes 1,000 gallons of water (18 percent of the total water consumption from Alternative 5-3A). Decontamination water is used for cleaning the equipment in between and after operations.
- Production of fertilizer consumes 398 gallons of water (approximately seven percent of the total water consumption from Alternative 5-3A). Fertilizer is used for revegetation purposes.

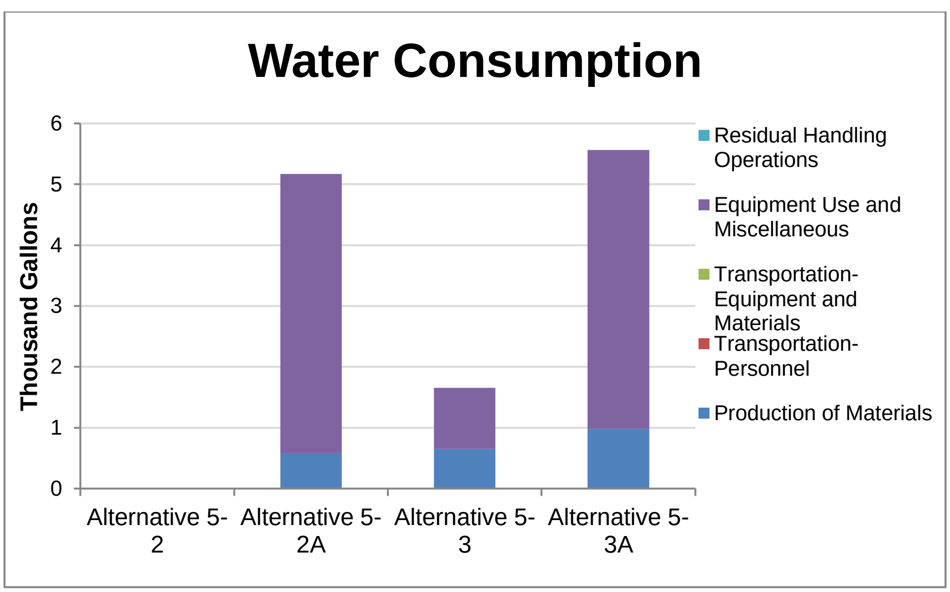


Figure 11: Water Consumption for Alternatives at Site 5, Naval Training Center Great Lakes

Figure 12 has a representation of the percentage breakdown of the contribution of the different sectors of the water use through the lifetime of the alternatives.

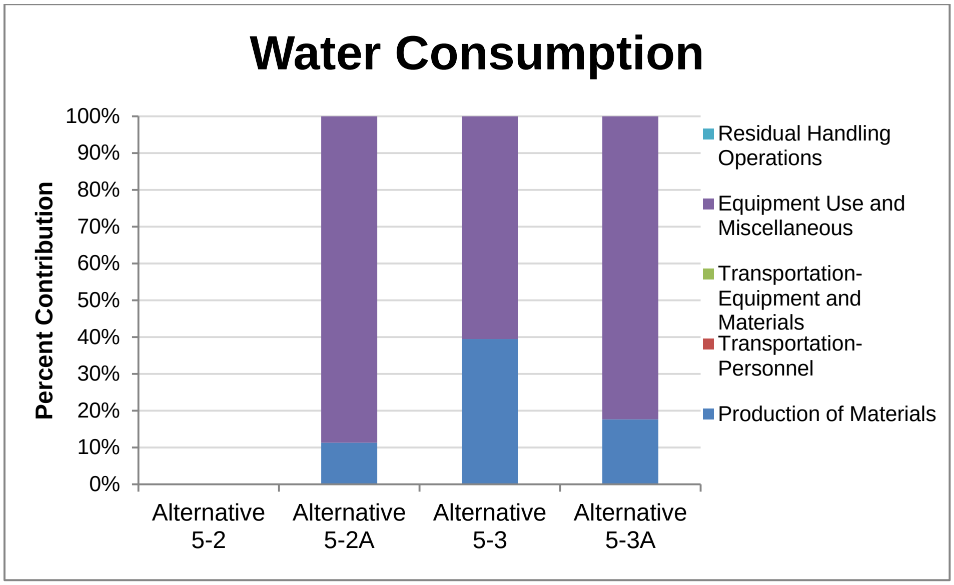


Figure 12: Water Consumption percentage breakdown for Alternatives at Site 5, Naval Training Center Great Lakes

Accident Risk

Accident Risk Fatality

Figure 13 shows the risk of fatality between the evaluated alternatives. The x-axis represents the four alternatives evaluated, and the y-axis represents the risk of fatality.

For Alternative 5-2, the activity with the highest risk of resulting in fatality is the transportation of personnel.

For Alternative 5-2A, the activity with the highest risk of resulting in fatality is the transportation of personnel, followed by equipment use.

For Alternative 5-3 , the activity with the highest risk of resulting in fatality is residual handling operations, followed by transportation of personnel.

For Alternative 5-3A, the activity with the highest risk of resulting in fatality is the transportation of personnel, followed by the residual handling operations.

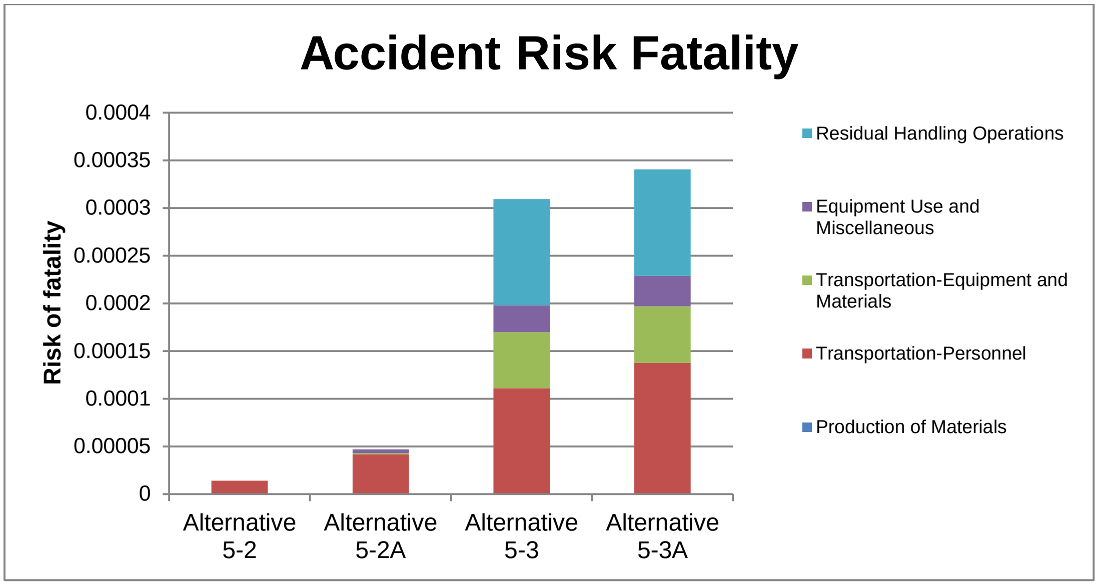


Figure 13 Risk of Fatality for Alternatives at Site 5, Naval Training Center Great Lakes

Accident Risk Injury

Figure 14 shows the risk of injury between the evaluated alternatives. The x-axis represents the four alternatives evaluated, and the y-axis represents the risk of injury.

For Alternative 5-2, the activity with the highest risk of resulting in injury is the transportation of personnel.

For Alternative 5-2A, the activity with the highest risk of resulting in injury is the transportation of personnel, followed by the equipment use.

For Alternative 5-3, the activity with the highest risk of resulting in injury is residual handling operations, followed by transportation of personnel.

For Alternative 5-3A, the activity with the highest risk of resulting in injury is the transportation of personnel, followed by the residual handling operations.

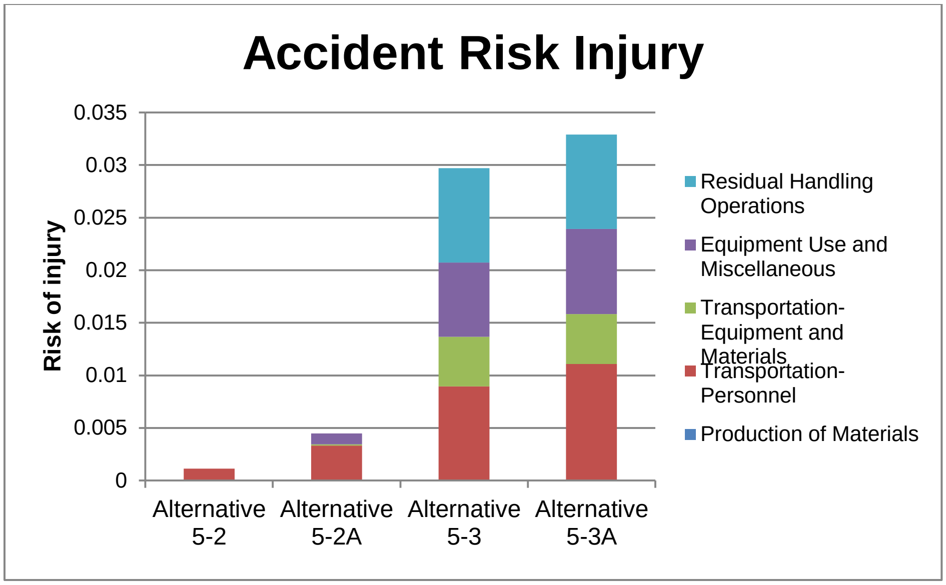


Figure 14 Risk of Injury for Alternatives at Site 5, Naval Training Center Great Lakes

EVALUATION RESULTS: SITE 9

The following are the alternatives that were analyzed with SiteWise™ and GSRx for Site 9 at Naval Training Center Great Lakes:

- Alternative 9-2: LUCs, and Cover
- Alternative 9-2A: LUCs, Cover, and ISCO
- Alternative 9-3: Excavation (Unrestricted Re-Use), Off-Site Disposal, and Groundwater LUCs
- Alternative 9-3A: Excavation (Unrestricted Re-Use), Off-Site Disposal, Groundwater LUCs, and ISCO

The following sections summarize the relative environmental impacts and primary impact drivers for the four alternatives and their respective metrics. In addition, the attachment includes the inventory and output sheets that were used for the SiteWise™/GSRx hybrid model. An evaluation of SiteWise™ and GSRx output summary sheets and related figures included in the footprint evaluation attachments (Appendix C-2-2 and C-3-2), provides detailed information on the contribution to each metric from each phase of the remedial process (RI, RAC, RAO, and LTM) and for each respective input category (materials production, transportation, equipment usage, etc). Further inspection of related inventory sheets provide information on the specific contribution to a metric from each item of material, transportation, equipment, etc. This level of detail also helps clarify results that could be misinterpreted based on SiteWise™ data entry limitations mentioned previously. The environmental impacts of the alternatives analyzed are summarized quantitatively in Table 3. Environmental impact drivers for each of the alternatives analyzed are summarized in Table 4.

Greenhouse Gas Emissions

Emissions of CO_2, CH_4, and N_2O were normalized to CO_2 equivalents (CO_2e), which is a cumulative method of weighing GHG emissions relative to global warming potential. Figure 15 shows the overall GHG emissions of each of the alternatives analyzed; the x-axis represents the four alternatives evaluated and the y-axis represents the GHG emissions in metric ton of CO_2e.

The total amount of GHG emissions resulting from Alternative 9-2 is 0.69 metric ton of CO_2e. The activity that contributes to GHG emissions is transportation of personnel.

The total amount of GHG emissions resulting from Alternative 9-2A is 9.30 metric ton of CO_2e. The activities that contribute to GHG emissions are:

- Laboratory analytical services contributes 2.36 metric ton of CO_2e (approximately 25 percent of the total GHG emissions resulting from Alternative 9-2A). Laboratory analytical services take place before and after each injection event (20 samples total).
- Transportation of personnel emits 2.19 metric ton of CO_2e (approximately 24 percent of the total GHG emissions resulting from Alternative 9-2A).
- Manufacture of HDPE emits 1.56 metric ton of CO_2e (approximately 17 percent of the total GHG emissions resulting from Alternative 9-2A). HDPE is used for the production of HDPE liner used in decontamination activities

The total amount of GHG emissions resulting from Alternative 9-3 is 776.56 metric ton of CO_2e. The activities that contribute the most to GHG emissions are:

- Production of borrow soil emits 326.29 metric ton of CO_2e (42 percent of the total GHG emissions resulting from Alternative 9-3). Soil is used for backfilling the excavated areas.
- Transportation of disposal of non-hazardous waste contributes 301 metric ton of CO_2e (39 percent of the total GHG emissions resulting from Alternative 9-3). Excavated soils are being transported to a local facility.
- Transportation of materials emits 61.59 metric ton of CO_2e (approximately eight percent of the total GHG emissions resulting from Alternative 9-3).

The total amount of GHG emissions resulting from Alternative 9-3A is 783.27 metric ton of CO_2e. The activities that contribute the most to GHG emissions are:

- Production of borrow soil emits 326.29 metric ton of CO_2e (42 percent of the total GHG emissions resulting from Alternative 9-3A). Soil is used for backfilling the excavated areas.
- Transportation of disposal of non-hazardous waste contributes 300.69 metric ton of CO_2e (38 percent of the total GHG emissions resulting from Alternative 9-3A). Excavated soils are being transported to a local facility.
- Transportation of materials emits 61.59 metric ton of CO_2e (approximately eight percent of the total GHG emissions resulting from Alternative 9-3A).

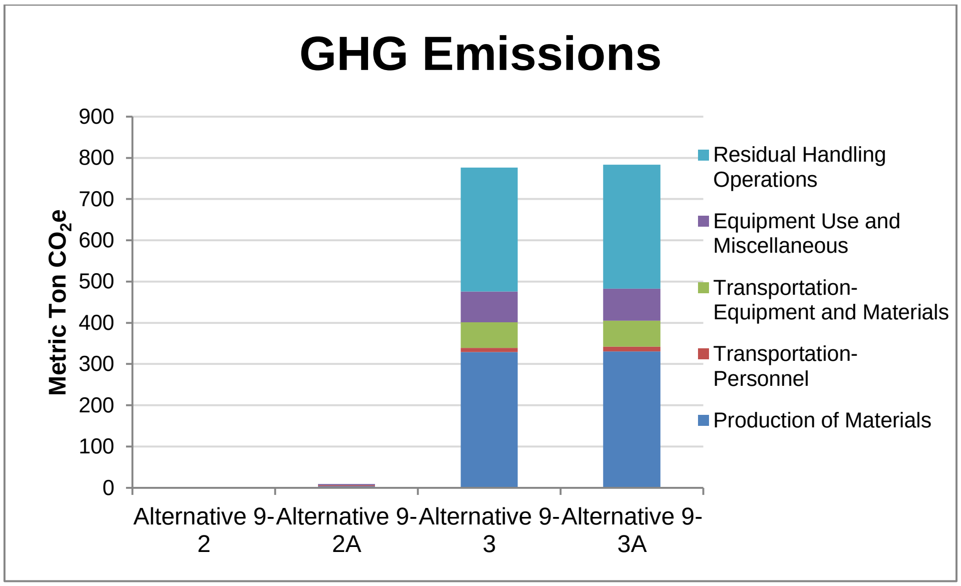


Figure 15: GHG Emissions for Alternatives at Site 9, Naval Training Center Great Lakes

Figure 16 shows the breakdown of the percent that each of main activities of each alternative (x-axis) contributes to the GHG emissions (y-axis).

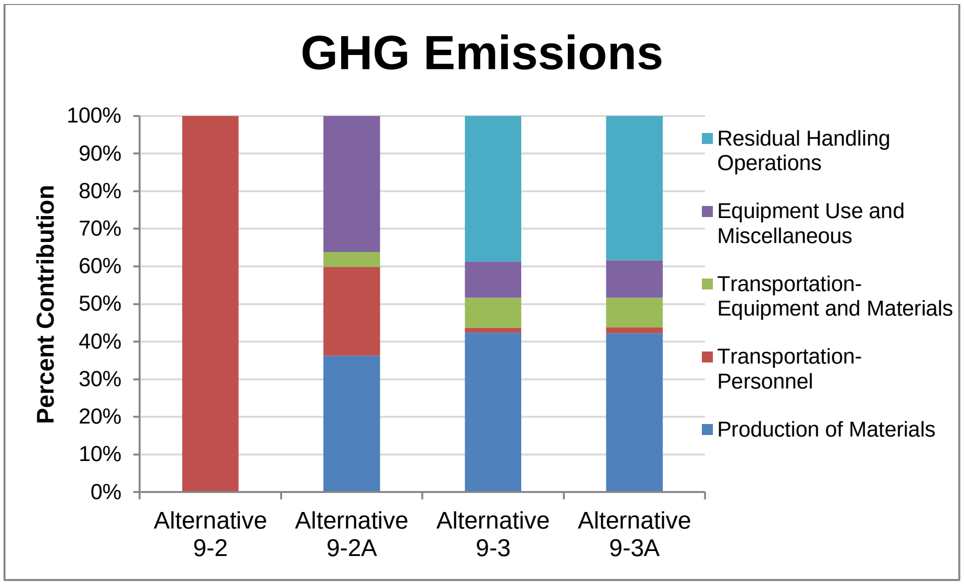


Figure C16: GHG Emissions percentage breakdown for Alternatives at Site 9, Naval Training Center Great Lakes

Criteria Pollutant Emissions

NO_X

Figure 17 shows the breakdown of the NO_X emissions for the two alternatives evaluated. The x–axis of this figure represents Alternative 9-2, 9-2A, 9-3 and 9-3A, the y-axis represents the NO_X emissions in metric ton.

The total amount of NO_X emissions resulting from Alternative 9-2 is $2.54x10^{-4}$ metric ton. The activity that contributes to the NO_X emissions is transportation of personnel.

The total amount of NO_X emissions resulting from Alternative 9-2A is $1.71x10^{-2}$ metric ton. The activities that contribute to the NO_X emissions are:

- Laboratory analytical services emits $8.16x10^{-3}$ metric ton of NO_X (48 percent of the total NO_X emissions resulting from Alternative 9-2A). Laboratory analytical services take place before and after each injection event (20 samples total).
- Use of DPT releases $7.54x10^{-3}$ metric ton of NO_X (44 percent of the total NO_X emissions resulting from Alternative 9-2A). The DPT is in use for 45 hours during the installation of the injection system.

- Transportation of personnel emits 8.11×10^{-4} metric ton of NO_X (approximately five percent of the total NO_X emissions resulting from Alternative 9-2A).

The total amount of NO_X emissions resulting from Alternative 9-3 is 1.51 metric ton. The activities that contribute to the most NO_X emissions are:

- Transportation of disposal of non-hazardous waste contributes 1.03 metric ton of NO_X (68 percent of the total NO_X emissions resulting from Alternative 9-3). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases 2.73×10^{-1} metric ton of NO_X (18 percent of the total NO_X emissions from Alternative 9-3). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 448 hours.
- Use of the 140 hp dozer releases 7.63×10^{-2} metric ton of NO_X (approximately five percent of the total NO_X emissions from Alternative 9-3). The dozer is used for placing the clean fill. The dozer is in operation for 192 hours.

The total amount of NO_X emissions resulting from Alternative 9-3A is 1.53 metric ton. The activities that contribute to the most NO_X emissions are:

- Transportation of disposal of non-hazardous waste contributes 1.03 metric ton of NO_X (67 percent of the total NO_X emissions resulting from Alternative 9-3A). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases 2.73×10^{-1} metric ton of NO_X (18 percent of the total NO_X emissions from Alternative 9-3A). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 448 hours.
- Use of the 140 hp dozer releases 7.63×10^{-2} metric ton of NO_X (approximately five percent of the total NO_X emissions from Alternative 9-3A). The dozer is used for placing the clean fill. The dozer is in operation for 192 hours.

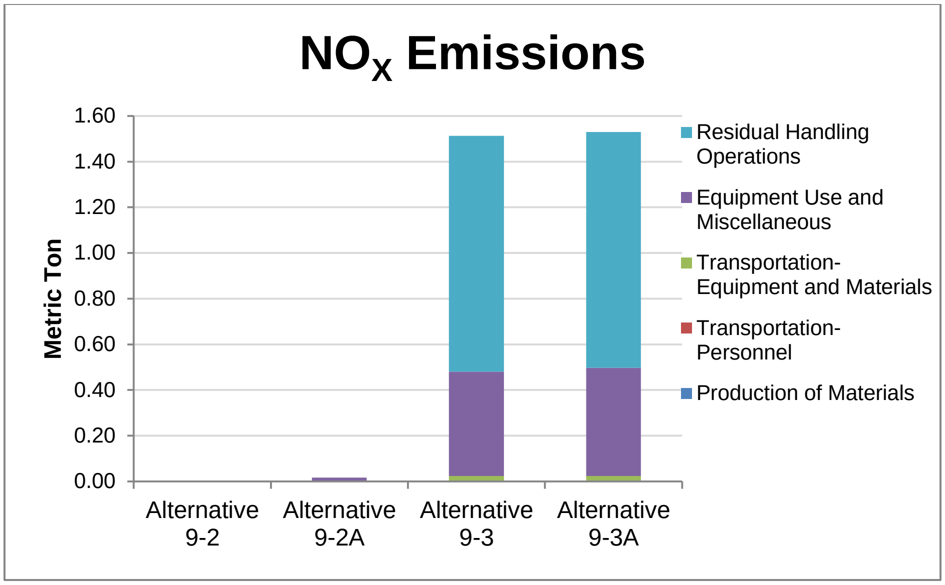


Figure 17 NO_X Emissions for Alternatives at Site 9, Naval Training Center Great Lakes

Figure 18 shows the percentage contribution from each of the main activity sectors.

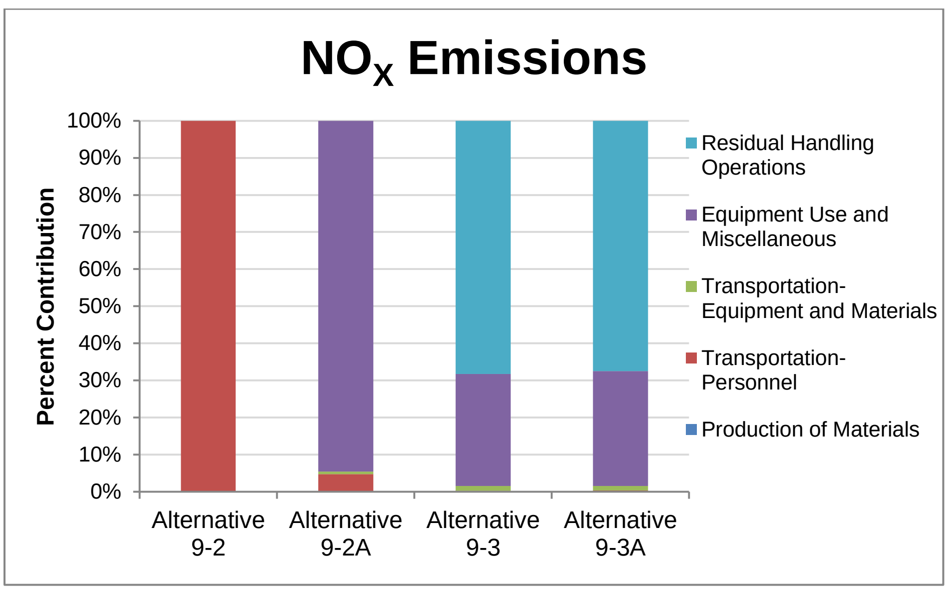


Figure 18: NO_X Emissions percentage breakdown for Alternatives at Site 9, Naval Training Center Great Lakes

SO_X

Figure 19 contains the distribution of the SO_X emissions resulting from the activities related to Alternatives 9-2, 9-2A, 9-3 and 9-3A. The x-axis of this graph represents the alternatives evaluated; the y-axis represents the SO_X emissions in metric ton.

The total amount of SO_X emissions resulting from Alternative 9-2 is 8.94×10^{-6} metric ton. The activity that contributes to the SO_X emissions is transportation of personnel.

The total amount of SO_X emissions resulting from Alternative 9-2A is 1.40×10^{-2} metric ton. The activities that contribute to the SO_X emissions are:

- Laboratory analytical services emits 5.44×10^{-3} metric ton of SO_X (39 percent of the total SO_X emissions resulting from Alternative 9-2A). Laboratory analytical services take place before and after each injection event (20 samples total).
- Manufacture of HDPE emits 3.49x10-3 metric ton of SO_X (25 percent of the total SO_X emissions resulting from Alternative 9-2A). HDPE is used for the production of HDPE liner used in decontamination activities.
- Manufacture of PVC emits 2.23×10^{-3} metric ton of SO_X (16 percent of the total SO_X emissions resulting from Alternative 9-2A). PVC is used in the production of the piping that is used for the injection events.

The total amount of SO_X emissions resulting from Alternative 9-3 is 6.65×10^{-1} metric ton. The activities that contribute to the most SO_X emissions are:

- Transportation of disposal of non-hazardous waste contributes 5.33×10^{-1} metric ton of SO_X (80 percent of the total SO_X emissions resulting from Alternative 9-3). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases 8.05×10^{-2} metric ton of SO_X (12 percent of the total SO_X emissions from Alternative 9-3). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 448 hours.
- Laboratory analytical services release 2.45×10^{-2} metric ton of SO_X (approximately four percent of the total SO_X emissions from Alternative 9-3). The total number of samples analyzed through the lifetime of the project is 91.

The total amount of SO_X emissions resulting from Alternative 9-3A is 6.76×10^{-1} metric ton. The activities that contribute to the most SO_X emissions are:

- Transportation of disposal of non-hazardous waste contributes 5.33x10^{-1} metric ton of SO_X (79 percent of the total SO_X emissions resulting from Alternative 9-3A). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases 8.05x10^{-2} metric ton of SO_X (12 percent of the total SO_X emissions from Alternative 9-3A). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 448 hours.
- Laboratory analytical services release 3.02x10^{-2} metric ton of SO_X (approximately four percent of the total SO_X emissions from Alternative 9-3A). The total number of samples analyzed through the lifetime of the project is 96.

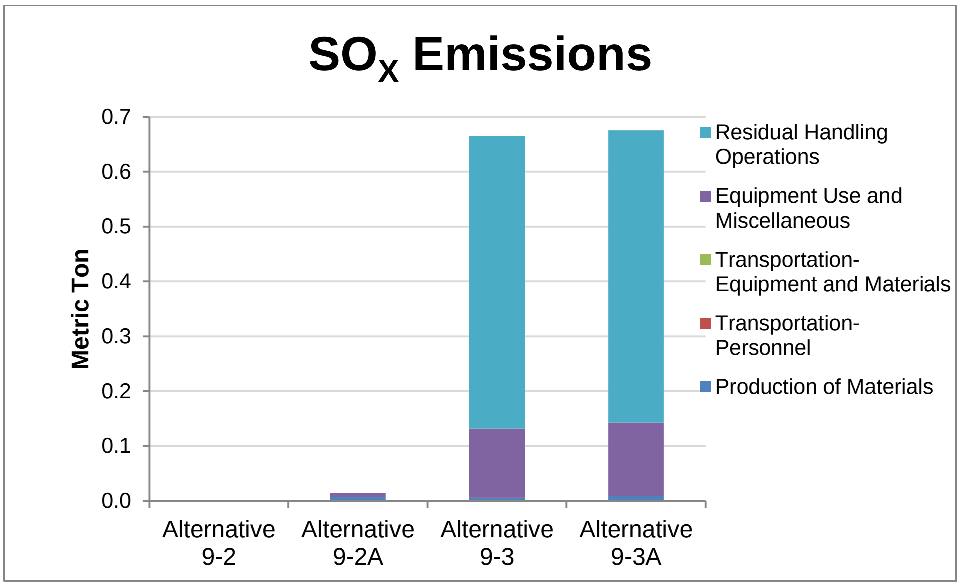


Figure 19: SO_X Emissions for Alternatives at Site 9, Naval Training Center Great Lakes

Figure 20 shows the percentage breakdown of the activities contributing to SO_X emissions.

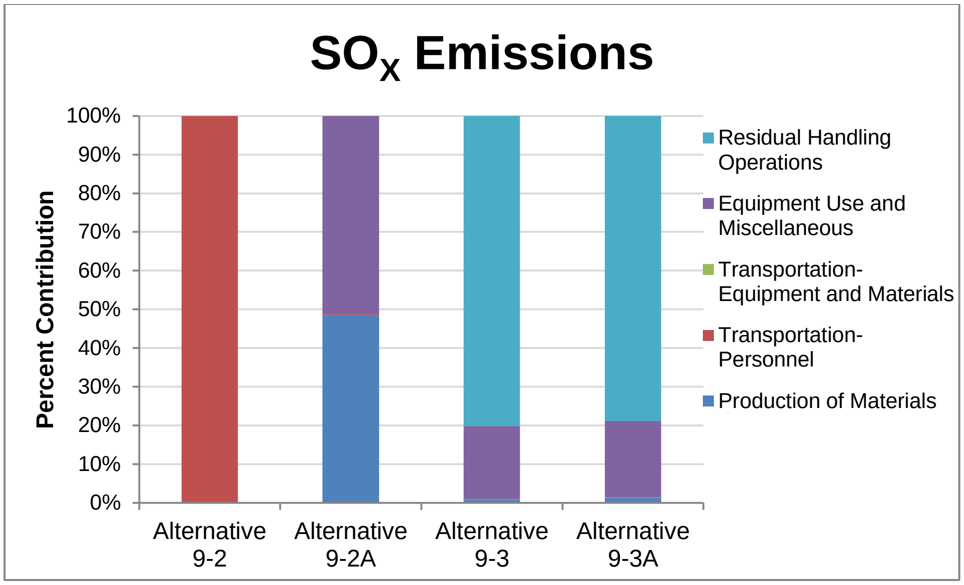


Figure 20: SO_X Emissions percentage breakdown for Alternatives at Site 9, Naval Training Center Great Lakes

PM_{10}

The breakdown of the distribution of the PM_{10} emissions resulting from the activities involved in Alternatives 9-2, 9-2A, 9-3 and 9-3A are shown in Figure 21. The x-axis of this figure represents the four alternatives evaluated, while the y-axis represents the PM_{10} emissions in metric ton.

The total amount of PM_{10} emissions resulting from Alternative 9-2 is 5.15×10^{-5} metric ton. The activity that contributes to the PM_{10} emissions is transportation of personnel.

The total amount of PM_{10} emissions resulting from Alternative 9-2A is 2.43×10^{-3} metric ton. The activities that contribute to the PM_{10} emissions are:

- Use of the DPT releases 7.51×10^{-4} metric ton of PM_{10} (31 percent of the total PM_{10} emissions resulting from Alternative 9-2A). DPT is in operation for 45 hours.
- Manufacture of HDPE emits 5.08×10^{-4} metric ton of PM_{10} (21 percent of the total PM_{10} emissions resulting from Alternative 9-2A). HDPE is used for the production of HDPE liner used in decontamination activities.
- Manufacture of hydrogen peroxide releases 4.08×10^{-4} metric ton of PM_{10} (17 percent of the total PM_{10} emissions resulting from Alternative 9-2A). Hydrogen peroxide is used as a surrogate for Fenton's Reagent used during the ISCO injection events (two events).

The total amount of PM_{10} emissions resulting from Alternative 9-3 is 2.89 metric ton. The activities that contribute to the most PM_{10} emissions are:

- Transportation of disposal of non-hazardous waste contributes 2.84 metric ton of PM_{10} (98 percent of the total PM_{10} emissions resulting from Alternative 9-3). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases $2.60x10^{-2}$ metric ton of PM_{10} (approximately one percent of the total PM_{10} emissions from Alternative 9-3). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 448 hours
- Use of the 140 hp dozer releases $7.96x10^{-3}$ metric ton of PM_{10} (less than one percent of the total PM_{10} emissions from Alternative 9-3). The dozer is used for placing the clean fill. The dozer is in operation for 192 hours.

The total amount of PM_{10} emissions resulting from Alternative 9-3A is 2.89 metric ton. The activities that contribute to the most PM_{10} emissions are:

- Transportation of disposal of non-hazardous waste contributes 2.84 metric ton of PM_{10} (98 percent of the total PM_{10} emissions resulting from Alternative 9-3A). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases $2.60x10^{-2}$ metric ton of PM_{10} (approximately one percent of the total PM_{10} emissions from Alternative 9-3A). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 448 hours
- Use of the 140 hp dozer releases $7.96x10^{-3}$ metric ton of PM_{10} (less than one percent of the total PM_{10} emissions from Alternative 9-3A). The dozer is used for placing the clean fill. The dozer is in operation for 192 hours.

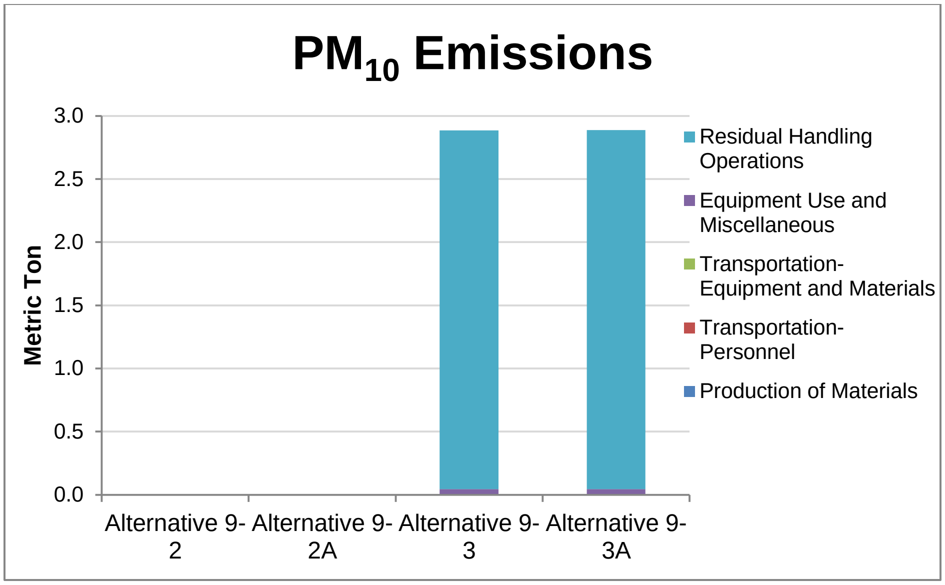


Figure 21: PM_{10} Emissions for Alternatives at Site 9, Naval Training Center Great Lakes

Figure 22 shows the percentage of PM_{10} emissions contributed by each of the activity sectors per alternative.

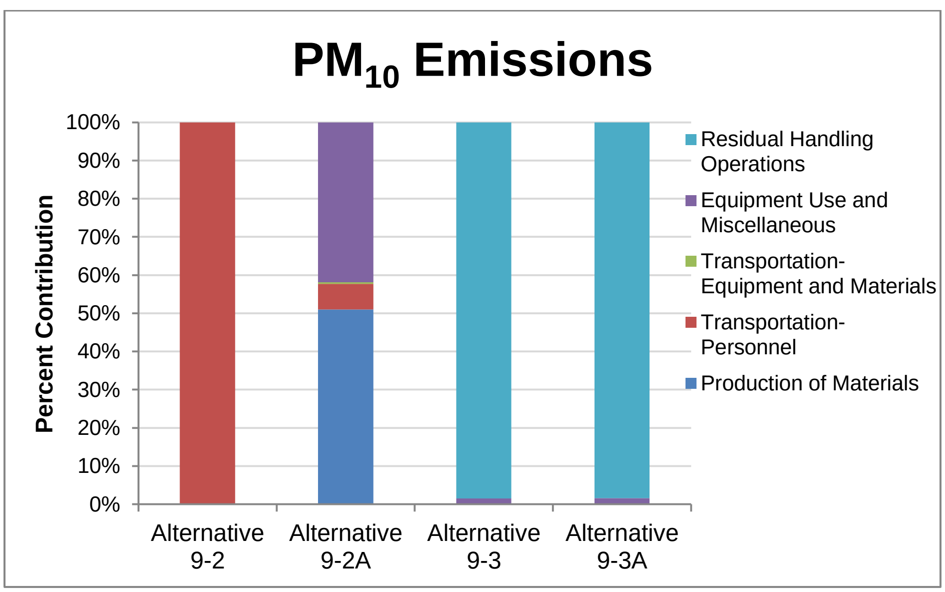


Figure 22: PM_{10} Emissions percentage breakdown for Alternatives Site 9, Naval Training Center Great Lakes

Energy Consumption

The energy consumption for each of the alternatives evaluated is shown in Figure 23. The x-axis shows the four alternatives evaluated, and the y-axis shows the amount of energy consumed MMBTU.

The total amount of energy consumed resulting from the activities from Alternative 9-2 is 8.63 MMBTU. The activity that contributes to the energy consumption is transportation of personnel.

The total amount of energy consumed resulting from the activities from Alternative 9-2A is 210.74 MMBTU. The activities that contribute to the energy consumption are:

- Manufacture of PVC consumes 71.51 MMBTU (34 percent of the total energy consumed by Alternative 9-2A). PVC is used in the production of the piping that is used for the injection events.
- Laboratory analytical services consume 35.20 MMBTU (17 percent of the total energy consumed by Alternative 9-2A). Laboratory analytical services take place before and after each injection event (20 samples total).
- Manufacture of HDPE consumes 31.28 MMBTU (15 percent of the total energy consumed by Alternative 9-2A). HDPE is used as a liner during the decontamination activities.

The total amount of energy consumed resulting from the activities from Alternative 9-3 is 36,994.91 MMBTU. The activities that contribute to the energy consumption are:

- Production of borrow soil consumes 29,420.02 MMBTU (80 percent of the total energy consumed resulting from Alternative 9-3). Soil is used for backfilling the excavated areas.
- Transportation of disposal of non-hazardous waste consumes 5,361.42 (14 percent of the total energy consumption resulting from Alternative 9-3). Excavated soils are being transported to a local facility.
- Transportation of materials consumes 803.81 MMBTU (approximately two percent of the total energy consumption resulting from Alternative 9-3).

The total amount of energy consumed resulting from the activities from Alternative 9-3A is 37,161.55 MMBTU. The activities that contribute to the energy consumption are:

- Production of borrow soil consumes 29,420.02 MMBTU (79 percent of the total energy consumed resulting from Alternative 9-3A). Soil is used for backfilling the excavated areas.

- Transportation of disposal of non-hazardous waste consumes 5,357.31 (14 percent of the total energy consumption resulting from Alternative 9-3A). Excavated soils are being transported to a local facility.
- Transportation of materials consumes 803.81 MMBTU (approximately two percent of the total energy consumption resulting from Alternative 9-3A).

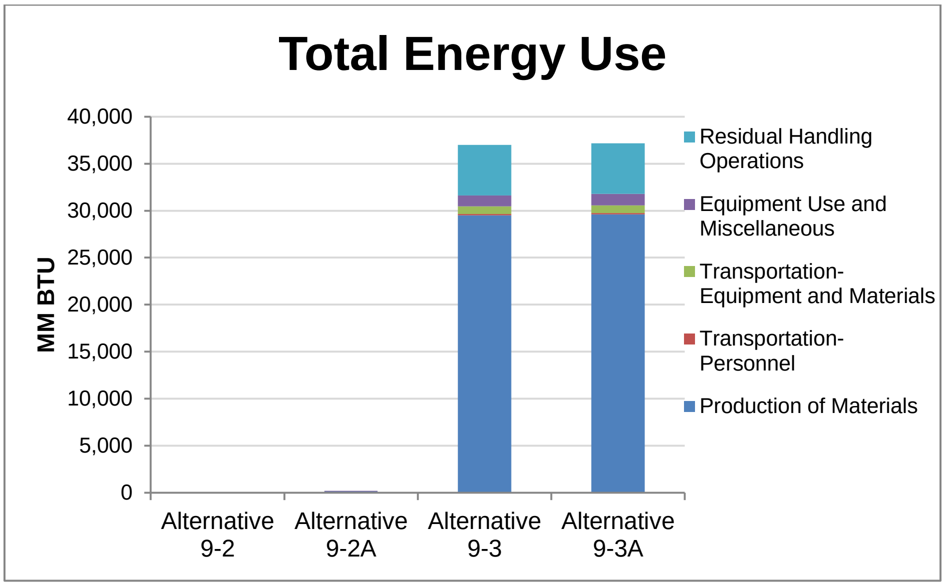


Figure 23: Energy Consumption for Alternatives at Site 9, Naval Training Center Great Lakes

Figure 24 shows the percentage breakdown contribution of energy consumption from the different activity groups.

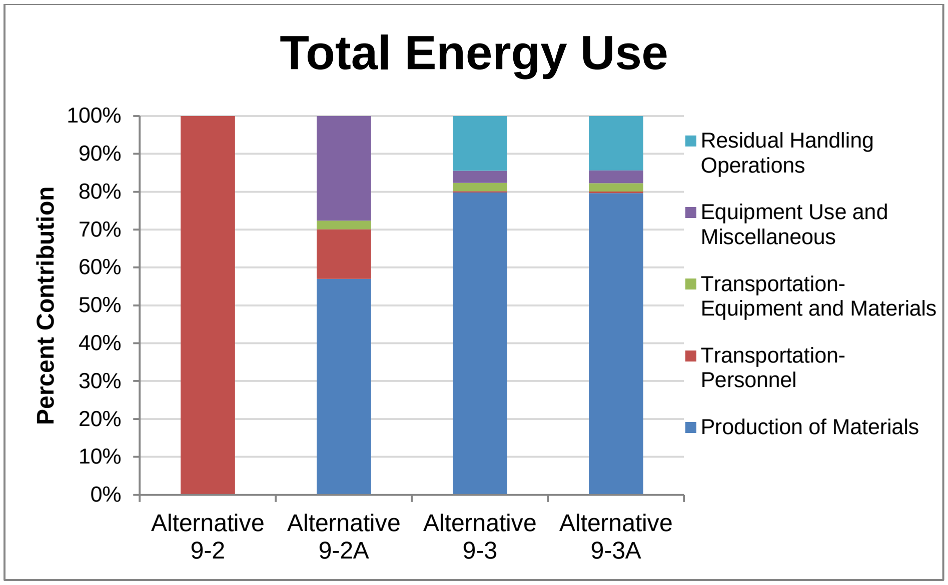


Figure 24: Energy Consumption percentage breakdown for Alternatives at Site 9, Naval Training Center Great Lakes

Water Usage

The water consumption of the evaluated alternatives is shown in Figure 25. The x-axis shows the four evaluated alternatives, and the y-axis show the amount of water consumed in thousands of gallons.

There is no direct water consumption for Alternative 9-2.

The total amount of water consumed resulting from the activities from Alternative 9-2A is 11,700 gallons of water.

- Treatment water consumes 9,000 gallons of water (77 percent of the total water consumption from Alternative 9-2A). Treatment water is used in two injection events.
- Manufacture of PVC consumes 1,250 gallons of water (approximately ten percent of the total water consumption from Alternative 9-2A). PVC is used to produce the pipes for the injection system.
- Decontamination water consumes 1,000 gallons of water (approximately nine percent of the total water consumption from Alternative 9-2A). Decontamination water is used for cleaning the equipment in between and after operations.

The total amount of water consumed resulting from the activities from Alternative 9-3 is 2,518 gallons of water.

- Decontamination water consumes 2,000 gallons of water (79 percent of the total water consumption from Alternative 9-3). Decontamination water is used for cleaning the equipment in between and after operations.
- Production of fertilizer consumes 262 gallons of water (10 percent of the total water consumption from Alternative 9-3). Fertilizer is used for revegetation purposes.
- Production of HDPE consumes 251 gallons of water (10 percent of the total water consumption from Alternative 9-3). HDPE is used as a liner for the decontamination equipment pad.

The total amount of water consumed resulting from the activities from Alternative 9-3A is 12,911 gallons of water.

- Treatment water consumes 9,000 gallons of water (70 percent of the total water consumption from Alternative 9-2A). Treatment water is used in two injection events.
- Decontamination water consumes 2,000 gallons of water (15 percent of the total water consumption from Alternative 9-3A). Decontamination water is used for cleaning the equipment in between and after operations.
- Manufacture of PVC consumes 1,250 gallons of water (approximately nine percent of the total water consumption from Alternative 9-2A). PVC is used to produce the pipes for the injection system.

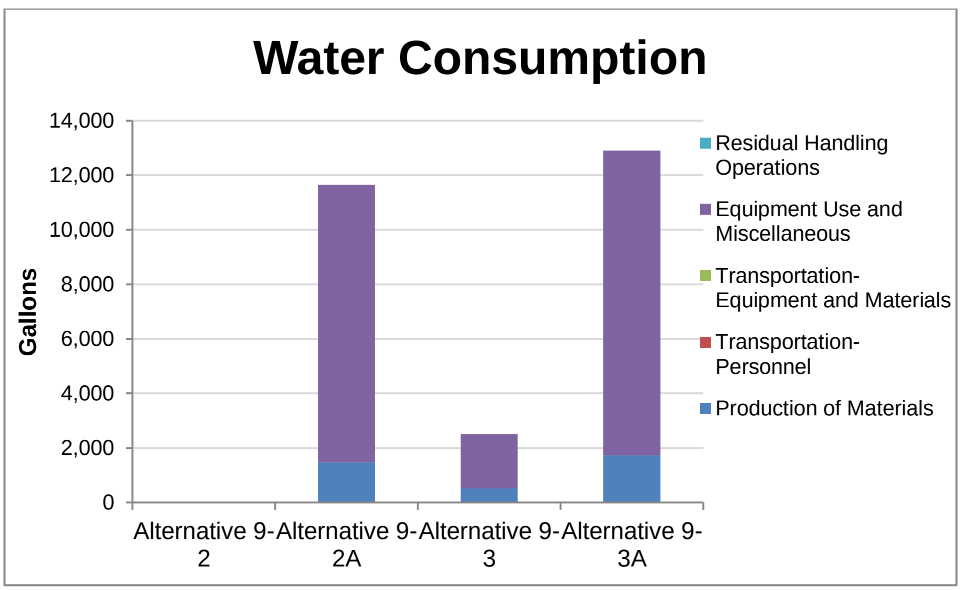


Figure 25: Water Consumption for Alternatives at Site 9, Naval Training Center Great Lakes

Figure 26 has a representation of the percentage breakdown of the contribution of the different sectors of the water use through the lifetime of the alternatives.

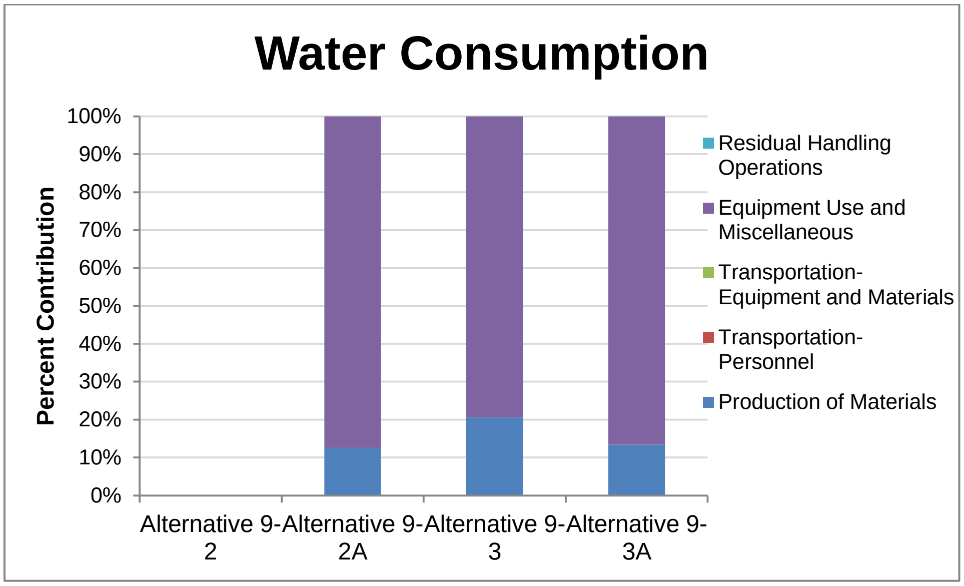


Figure 26: Water Consumption percentage breakdown for Alternatives at Site 9, Naval Training Center Great Lakes

Accident Risk

Accident Risk Fatality

Figure 27 shows the risk of fatality between the evaluated alternatives. The x-axis represents the four alternatives evaluated, and the y-axis represents the risk of fatality.

For Alternative 9-2, the activity with the highest risk of resulting in fatality is the transportation of personnel.

For Alternative 9-2A, the activity with the highest risk of resulting in fatality is the transportation of personnel, followed by the equipment use.

For Alternative 9-3 and Alternative 9-3A, the activity with the highest risk of resulting in fatality is the residual handling operations, followed by the transportation of personnel.

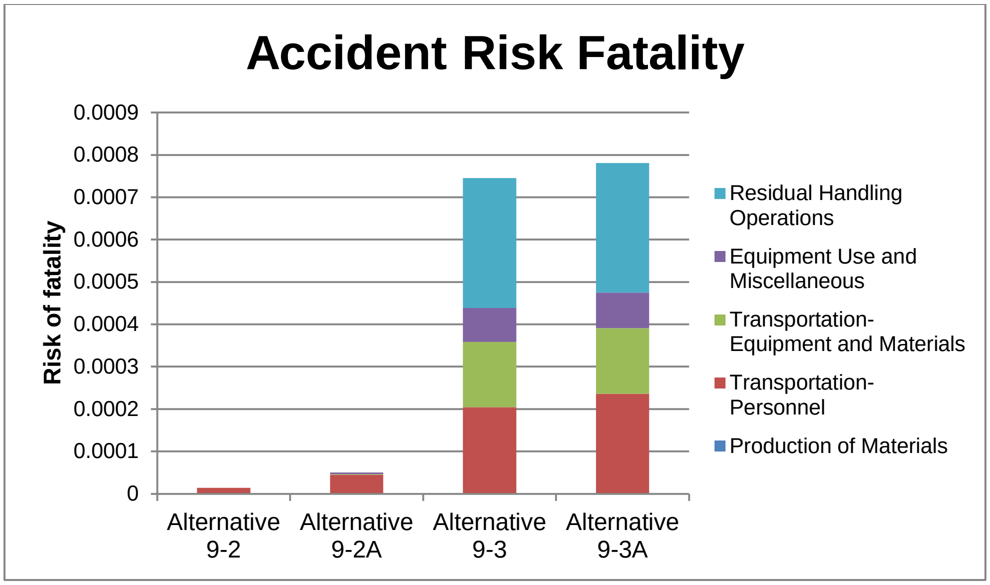


Figure 27 Risk of Fatality for Alternatives at Site 9, Naval Training Center Great Lakes

Accident Risk Injury

Figure 28 shows the risk of injury between the evaluated alternatives. The x-axis represents the two alternatives evaluated, and the y-axis represents the risk of injury.

For Alternative 9-2, the activity with the highest risk of resulting in injury is the transportation of personnel.

For Alternative 9-2A, the activity with the highest risk of resulting in injury is the transportation of personnel, followed by equipment use.

For Alternative 9-3 and Alternative 9-3A, the activity with the highest risk of resulting in injury is the residual handling operations, followed by the equipment use.

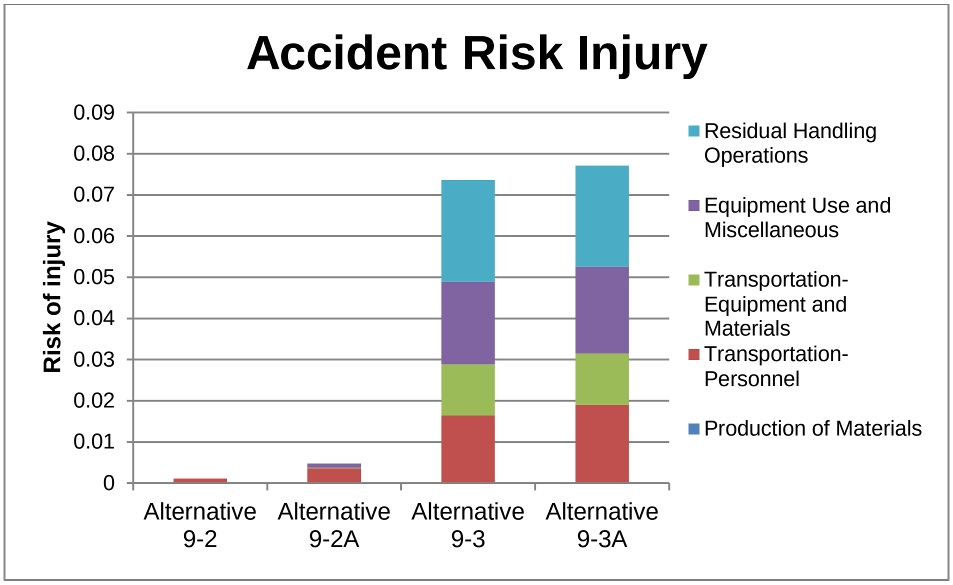


Figure 28 Risk of Injury for Alternatives at Site 9, Naval Training Center Great Lakes

EVALUATION RESULTS: SITE 21

The following are the alternatives that were analyzed with SiteWise™ and GSRx for Site 21 at Naval Training Center Great Lakes:

- Alternative 21-2: LUCs, and Cover
- Alternative 21-2: LUCs, Cover, and ISCO
- Alternative 21-3: Excavation (Unrestricted Re-Use), Off-Site Disposal, and Groundwater LUCs,
- Alternative 21-3A: Excavation (Unrestricted Re-Use), Off-Site Disposal, Groundwater LUCs, and ISCO

The following sections summarize the relative environmental impacts and primary impact drivers for the four alternatives and their respective metrics. In addition, the attachment includes the inventory and output sheets that were used for the SiteWise™/GSRx hybrid model. An evaluation of SiteWise™ and GSRx output summary sheets and related figures included in the footprint evaluation attachments (Appendix C-2-3 and C-3-3), provides detailed information on the contribution to each metric from each phase of the remedial process (RI, RAC, RAO, and LTM) and for each respective input category (materials production, transportation, equipment usage, etc). Further inspection of related inventory sheets provide information on the specific contribution to a metric from each item of material, transportation, equipment, etc. This level of detail also helps clarify results that could be misinterpreted based on SiteWise™ data entry limitations mentioned previously. The environmental impacts of the alternatives analyzed are summarized quantitatively in Table 5. Environmental impact drivers for each of the alternatives analyzed are summarized in Table 6.

Greenhouse Gas Emissions

Emissions of CO_2, CH_4, and N_2O were normalized to CO_2 equivalents (CO_2e), which is a cumulative method of weighing GHG emissions relative to global warming potential. Figure 29 shows the overall GHG emissions of each of the alternatives analyzed; the x-axis represents the four alternatives evaluated and the y-axis represents the GHG emissions in metric ton of CO_2e.

The total amount of GHG emissions resulting from Alternative 21-2 is 0.69 metric ton of CO_2e. The activity that contributes to GHG emissions is transportation of personnel.

The total amount of GHG emissions resulting from Alternative 21-2A is 10.93 metric ton of CO_2e. The activities that contribute to GHG emissions are:

- Transportation of personnel emits 3.37 metric ton of CO_2e (31 percent of the total GHG emissions resulting from Alternative 21-2A).
- Laboratory analytical services contributes 2.36 metric ton of CO_2e (22 percent of the total GHG emissions resulting from Alternative 21-2A). Laboratory analytical services take place before and after each injection event (20 samples total).
- Manufacture of HDPE emits 1.56 metric ton of CO_2e (14 percent of the total GHG emissions resulting from Alternative 21-2A). HDPE is used for the production of HDPE liner used in decontamination activities

The total amount of GHG emissions resulting from Alternative 21-3 is 238.69 metric ton of CO_2e. The activities that contribute the most to GHG emissions are:

- Production of borrow soil emits 92.22 metric ton of CO_2e (39 percent of the total GHG emissions resulting from Alternative 21-3). Soil is used for backfilling the excavated areas.
- Transportation of disposal of non-hazardous waste contributes 85.24 metric ton of CO_2e (36 percent of the total GHG emissions resulting from Alternative 21-3). Excavated soils are being transported to a local facility.
- Use of 2.5 cy excavator releases 18.61 metric ton of CO_2e (approximately eight percent of the total GHG emissions resulting from Alternative 21-3). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 192 hours.

The total amount of GHG emissions resulting from Alternative 21-3A is 246.22 metric ton of CO_2e. The activities that contribute the most to GHG emissions are:

- Production of borrow soil emits 92.22 metric ton of CO_2e (37 percent of the total GHG emissions resulting from Alternative 21-3A). Soil is used for backfilling the excavated areas.
- Transportation of disposal of non-hazardous waste contributes 85.24 metric ton of CO_2e (35 percent of the total GHG emissions resulting from Alternative 21-3A). Excavated soils are being transported to a local facility.
- Transportation of materials releases 17.42 metric ton of CO_2e (approximately seven percent of the total GHG emissions resulting from Alternative 21-3A).

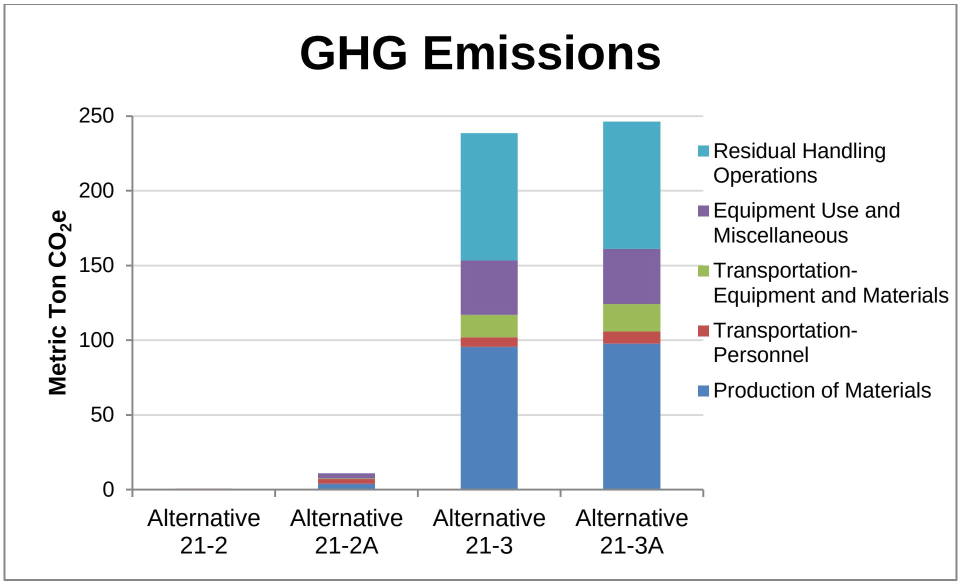


Figure 29: GHG Emissions for Alternatives at Site 21, Naval Training Center Great Lakes

Figure 30 shows the breakdown of the percent that each of main activities of each alternative (x-axis) contributes to the GHG emissions (y-axis).

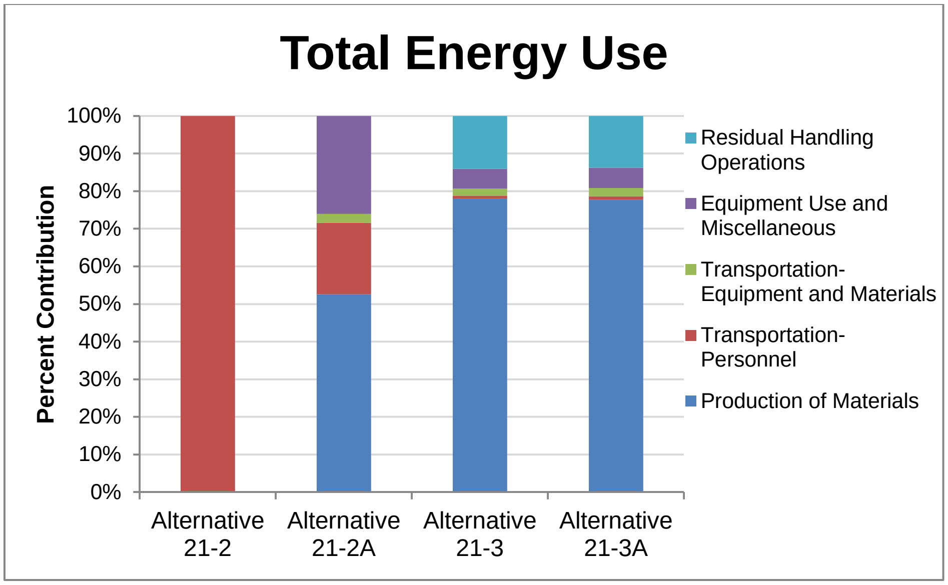


Figure 30: GHG Emissions percentage breakdown for Alternatives at Site 21, Naval Training Center Great Lakes

Criteria Pollutant Emissions

NO_X

Figure 31 shows the breakdown of the NO_X emissions for the four alternatives evaluated. The x–axis of this figure represents Alternative 21-2, Alternative 21-2A, Alternative 21-3 and Alternative 21-3A, the y-axis represents the NO_X emissions in metric ton.

The total amount of NO_X emissions resulting from Alternative 21-2 is 2.54×10^{-4} metric ton. The activity that contributes to the NO_X emissions is transportation of personnel.

The total amount of NO_X emissions resulting from Alternative 21-2A is 1.76×10^{-2} metric ton. The activities that contribute to the NO_X emissions are:

- Laboratory analytical services emits 8.16×10^{-3} metric ton of NO_X (47 percent of the total NO_X emissions resulting from Alternative 21-2A). Laboratory analytical services take place before and after each injection event (20 samples total).
- Use of DPT releases 7.54×10^{-3} metric ton of NO_X (43 percent of the total NO_X emissions resulting from Alternative 21-2A). The DPT is in use for 45 hours during the installation of the injection system.

- Transportation of personnel emits $1.25x10^{-3}$ metric ton of NO_X (approximately six percent of the total NO_X emissions resulting from Alternative 21-2A).

The total amount of NO_X emissions resulting from Alternative 21-3 is $5.07x10^{-1}$ metric ton. The activities that contribute to the most NO_X emissions are:

- Transportation of disposal of non-hazardous waste contributes $2.92x10^{-1}$ metric ton of NO_X (58 percent of the total NO_X emissions resulting from Alternative 21-3). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases $1.17x10^{-1}$ metric ton of NO_X (23 percent of the total NO_X emissions from Alternative 21-3). The excavator is used for removing the impacted soils and placing the clean fill. The excavator was in operation for 192 hours.
- Laboratory analytical services release $3.63x10^{-2}$ metric ton of NO_X (approximately seven percent of the total NO_X emissions from Alternative 21-3). The total number of samples analyzed for this Alternative is 89 through the lifetime of the Alternative.

The total amount of NO_X emissions resulting from Alternative 21-3A is $5.05x10^{-1}$ metric ton. The activities that contribute to the most NO_X emissions are:

- Transportation of disposal of non-hazardous waste contributes $2.92x10^{-1}$ metric ton of NO_X (58 percent of the total NO_X emissions resulting from Alternative 21-3A). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases $9.75x10^{-2}$ metric ton of NO_X (19 percent of the total NO_X emissions from Alternative 21-3A). The excavator is used for removing the impacted soils and placing the clean fill. The excavator was in operation for 192 hours.
- Laboratory analytical services release $4.45x10^{-2}$ metric ton of NO_X (approximately nine percent of the total NO_X emissions from Alternative 21-3A). The total number of samples analyzed for this Alternative is 109 through the lifetime of the Alternative.

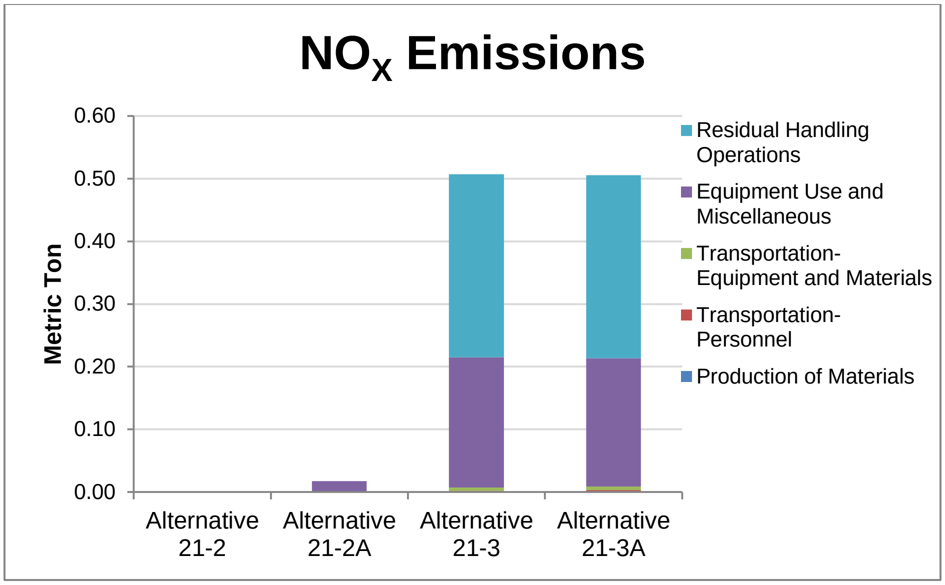


Figure 31 NO_X Emissions for Alternatives at Site 21, Naval Training Center Great Lakes

Figure 32 shows the percentage contribution from each of the main activity sectors.

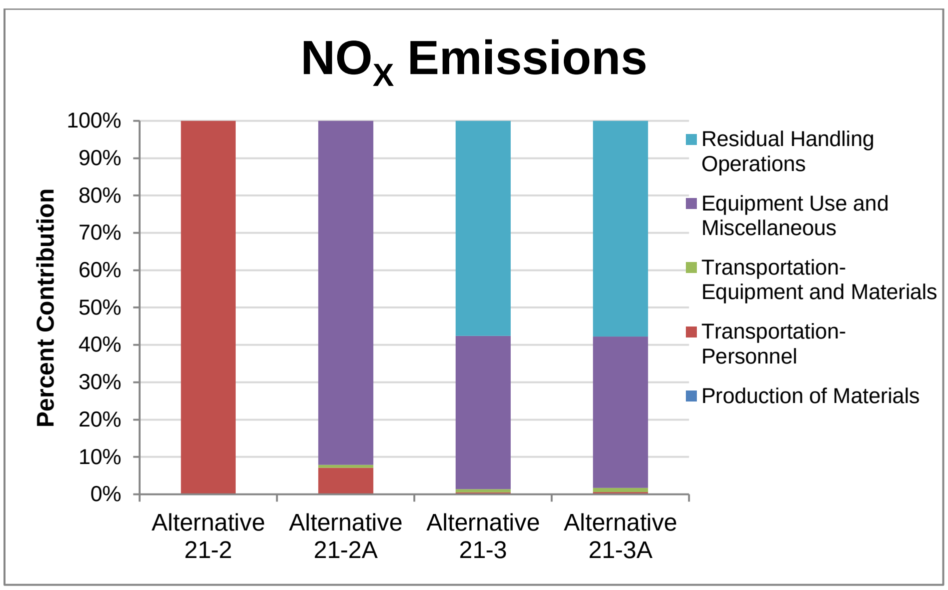


Figure 32: NO_X Emissions percentage breakdown for Alternatives at Site 21, Naval Training Center Great Lakes

SO_X

Figure 33 contains the distribution of the SO_X emissions resulting from the activities related to Alternatives 21-2, 21-2A, 21-3 and 21-3A. The x-axis of this graph represents the alternatives evaluated; the y-axis represents the SO_X emissions in metric ton.

The total amount of SO_X emissions resulting from Alternative 21-2 is 8.94×10^{-6} metric ton. The activity that contributes to the SO_X emissions is transportation of personnel.

The total amount of SO_X emissions resulting from Alternative 21-2A is 1.46×10^{-2} metric ton. The activities that contribute to the SO_X emissions are:

- Laboratory analytical services emits 5.44×10^{-3} metric ton of SO_X (37 percent of the total SO_X emissions resulting from Alternative 21-2A). Laboratory analytical services take place before and after each injection event (20 samples total).
- Manufacture of HDPE emits 3.49×10^{-3} metric ton of SO_X (24percent of the total SO_X emissions resulting from Alternative 21-2A). HDPE is used for the production of HDPE liner used in decontamination activities.
- Manufacture of hydrogen peroxide emits 2.35×10^{-3} metric ton of SO_X (16 percent of the total SO_X emissions resulting from Alternative 21-2A). Hydrogen peroxide is used as a surrogate for Fenton's Reagent used during the two ISCO injection events

The total amount of SO_X emissions resulting from Alternative 21-3 is 2.23×10^{-1} metric ton. The activities that contribute to the most SO_X emissions are:

- Transportation of disposal of non-hazardous waste contributes 1.51×10^{-1} metric ton of SO_X (68 percent of the total SO_X emissions resulting from Alternative 21-3). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases 3.45×10^{-2} metric ton of SO_X (16 percent of the total SO_X emissions from Alternative 21-3). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 192 hours.
- Laboratory analytical services emit 2.42×10^{-2} metric ton of SO_X (11 percent of the total SO_X emissions from Alternative 21-3). 89 samples were analyzed during this alternative.

The total amount of SO_X emissions resulting from Alternative 21-3A is 2.28×10^{-1} metric ton. The activities that contribute to the most SO_X emissions are:

- Transportation of disposal of non-hazardous waste contributes 1.51×10^{-1} metric ton of SO_X (66 percent of the total SO_X emissions resulting from Alternative 21-3A). Excavated soils are being transported to a local facility.
- Laboratory analytical services emit 2.97×10^{-2} metric ton of SO_X (13 percent of the total SO_X emissions from Alternative 21-3A). 109 samples were analyzed during this alternative.
- Use of the 2.5 cy excavator releases 2.88×10^{-2} metric ton of SO_X (13 percent of the total SO_X emissions from Alternative 21-3A). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 160 hours.

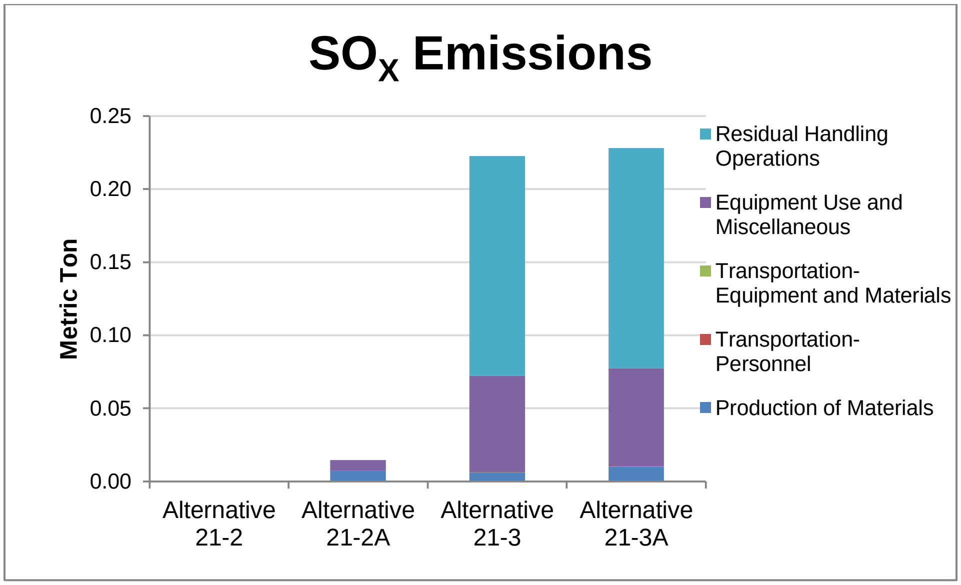


Figure 33: SO_X Emissions for Alternatives at Site 21, Naval Training Center Great Lakes

Figure 34 shows the percentage breakdown of the activities contributing to SO_X emissions.

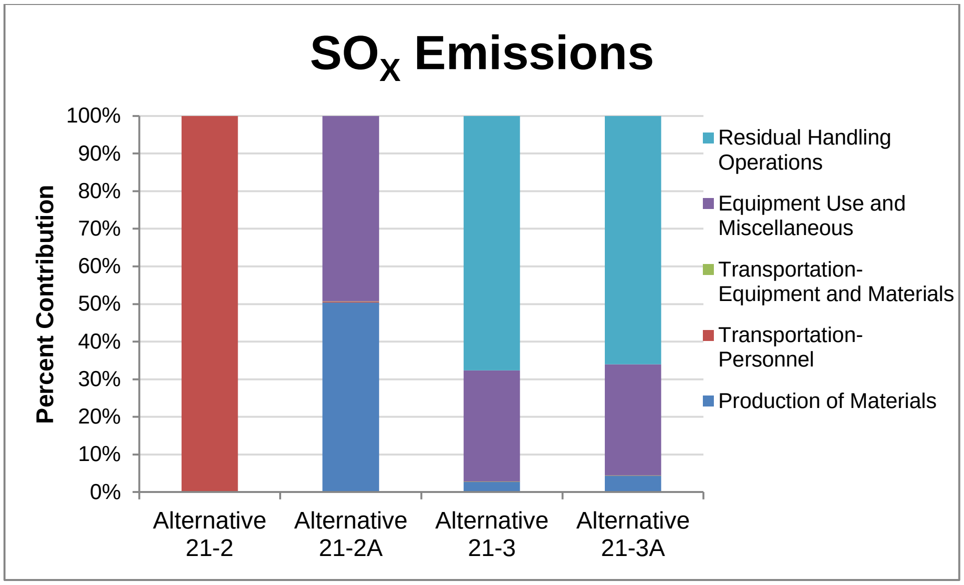


Figure 34: SO_X Emissions percentage breakdown for Alternatives at Site 21, Naval Training Center Great Lakes

PM_{10}

The breakdown of the distribution of the PM_{10} emissions resulting from the activities involved in Alternatives 21-2, 21-2A, 21-3 and 21-3A are shown in Figure C35. The x-axis of this figure represents the four alternatives evaluated, while the y-axis represents the PM_{10} emissions in metric ton.

The total amount of PM_{10} emissions resulting from Alternative 21-2 is $5.15x10^{-5}$ metric ton. The activity that contributes to the PM_{10} emissions is transportation of personnel.

The total amount of PM_{10} emissions resulting from Alternative 5-2A is $2.91x10^{-3}$ metric ton. The activities that contribute to the PM_{10} emissions are:

- Manufacture of hydrogen peroxide emits $8.89x10^{-4}$ metric ton of PM_{10} (31 percent of the total PM_{10} emissions resulting from Alternative 21-2A). Hydrogen peroxide is used as a surrogate for Fenton's Reagent during the two ISCO injection events.
- Use of the DPT releases $7.51x10^{-4}$ metric ton of PM_{10} (26 percent of the total PM_{10} emissions resulting from Alternative 21-2A). DPT is in operation for 45 hours.
- Manufacture of HDPE emits $5.08x10^{-4}$ metric ton of PM_{10} (17 percent of the total PM_{10} emissions resulting from Alternative 21-2A). HDPE is used for the production of HDPE liner used in decontamination activities.

The total amount of PM_{10} emissions resulting from Alternative 21-3 is $8.22x10^{-1}$ metric ton. The activities that contribute to the most PM_{10} emissions are:

- Transportation of disposal of non-hazardous waste contributes $8.03x10^{-1}$ metric ton of PM_{10} (98 percent of the total PM_{10} emissions resulting from Alternative 21-3). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases $1.11x10^{-2}$ metric ton of PM_{10} (approximately one percent of the total PM_{10} emissions from Alternative 21-3). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 192 hours.
- Use of the 140 hp dozer releases $2.65x10^{-3}$ metric ton of PM_{10} (less than one percent of the total PM_{10} emissions from Alternative 21-3). The dozer is used for placing the clean fill. The dozer is in operation for 64 hours.

The total amount of PM_{10} emissions resulting from Alternative 21-3A is $8.22x10^{-1}$ metric ton. The activities that contribute to the most PM_{10} emissions are:

- Transportation of disposal of non-hazardous waste contributes $8.03x10^{-1}$ metric ton of PM_{10} (98 percent of the total PM_{10} emissions resulting from Alternative 21-3A). Excavated soils are being transported to a local facility.
- Use of the 2.5 cy excavator releases $9.27x10^{-3}$ metric ton of PM_{10} (approximately one percent of the total PM_{10} emissions from Alternative 21-3A). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 160 hours.
- Use of the 140 hp dozer releases $2.65x10^{-3}$ metric ton of PM_{10} (less than one percent of the total PM_{10} emissions from Alternative 21-3A). The dozer is used for placing the clean fill. The dozer is in operation for 64 hours.

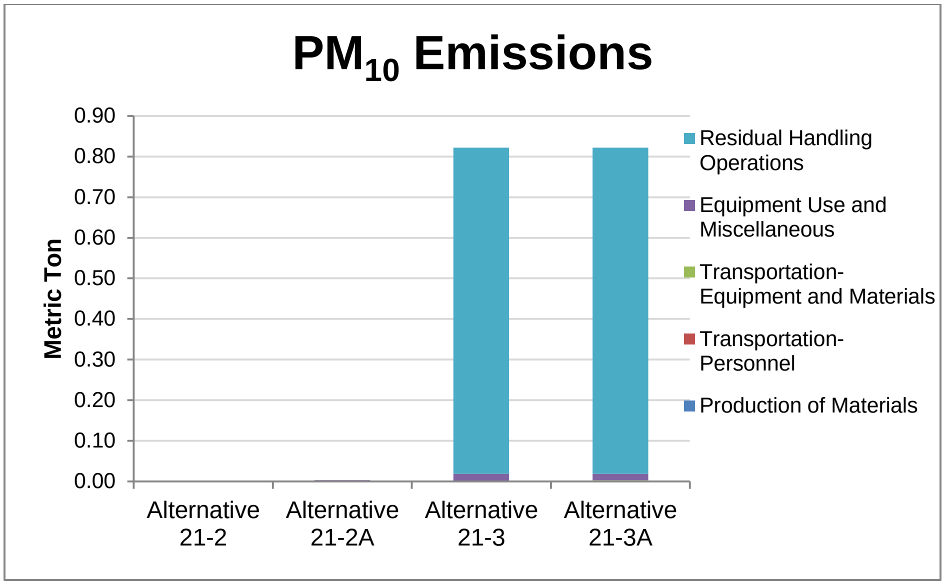


Figure 35: PM_{10} Emissions for Alternatives at Site 21, Naval Training Center Great Lakes

Figure 36 shows the percentage of PM_{10} emissions contributed by each of the activity sectors per alternative.

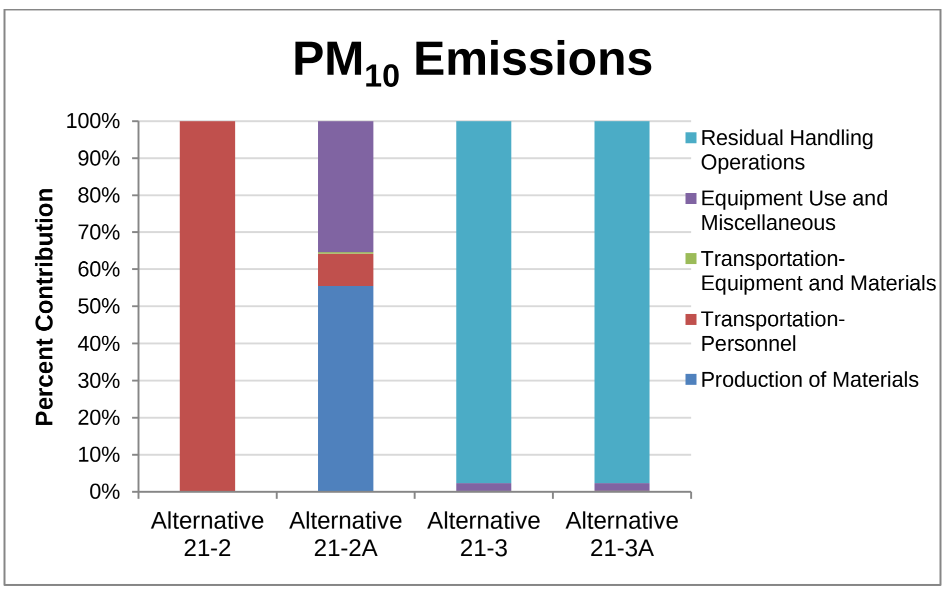


Figure 36: PM_{10} Emissions percentage breakdown for Alternatives Site 21, Naval Training Center Great Lakes

Energy Consumption

The energy consumption for each of the alternatives evaluated is shown in Figure 37. The x-axis shows the four alternatives evaluated, and the y-axis shows the amount of energy consumed in MMBTU.

The total amount of energy consumed resulting from the activities from Alternative 21-2 is 8.63 MMBTU. The activity that contributes to the energy consumption is transportation of personnel.

The total amount of energy consumed resulting from the activities from Alternative 21-2A is 223.90 MMBTU. The activities that contribute to the energy consumption are:

- Manufacture of PVC consumes 48.76 MMBTU (22 percent of the total energy consumed by Alternative 21-2A). PVC is used as to produce the piping that is used for the injection system.
- Transportation of personnel consumes 42.42 MMBTU (19 percent of the total energy consumed by Alternative 21-2A).
- Manufacture of hydrogen peroxide consumes 37.69 MMBTU (19 percent of the total energy consumed by Alternative 21-2A). Hydrogen peroxide is used as a surrogate for Fenton's Reagent during the two ISCO injection events.

The total amount of energy consumed resulting from the activities from Alternative 21-3 is 10,803.00 MMBTU. The activities that contribute to the energy consumption are:

- Production of borrow soil consumes 8,315.03 MMBTU (77 percent of the total energy consumed resulting from Alternative 21-3). Soil is used for backfilling the excavated areas.
- Transportation of disposal of non-hazardous waste consumes 1,517.44 (14 percent of the total energy consumption resulting from Alternative 21-3). Excavated soils are being transported to a local facility.
- Use of excavator consumes 288.22 MMBTU (approximately three percent of the total energy consumption resulting from Alternative 21-3). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 192hours.

The total amount of energy consumed resulting from the activities from Alternative 21-3A is 10,964.81 MMBTU. The activities that contribute to the energy consumption are:

- Production of borrow soil consumes 8,315.03 MMBTU (76 percent of the total energy consumed resulting from Alternative 21-3A). Soil is used for backfilling the excavated areas.

- Transportation of disposal of non-hazardous waste consumes 1,517.44 (14 percent of the total energy consumption resulting from Alternative 21-3A). Excavated soils are being transported to a local facility.
- Use of excavator consumes 240.18 MMBTU (approximately two percent of the total energy consumption resulting from Alternative 21-3A). The excavator is used for removing the impacted soils and placing the clean fill. The excavator is in operation for 160 hours.

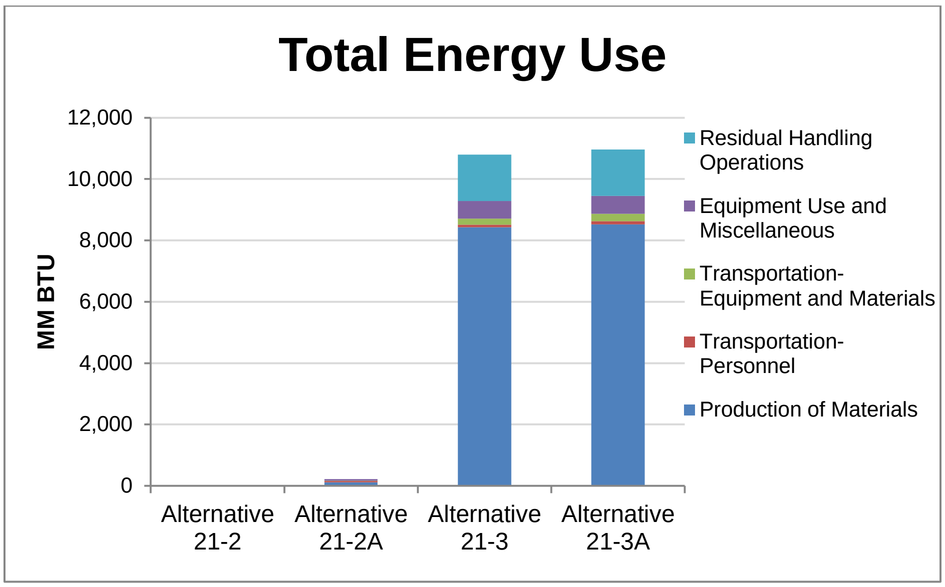


Figure 37: Energy Consumption for Alternatives at Site 21, Naval Training Center Great Lakes

Figure 38 shows the percentage breakdown contribution of energy consumption from the different activity groups.

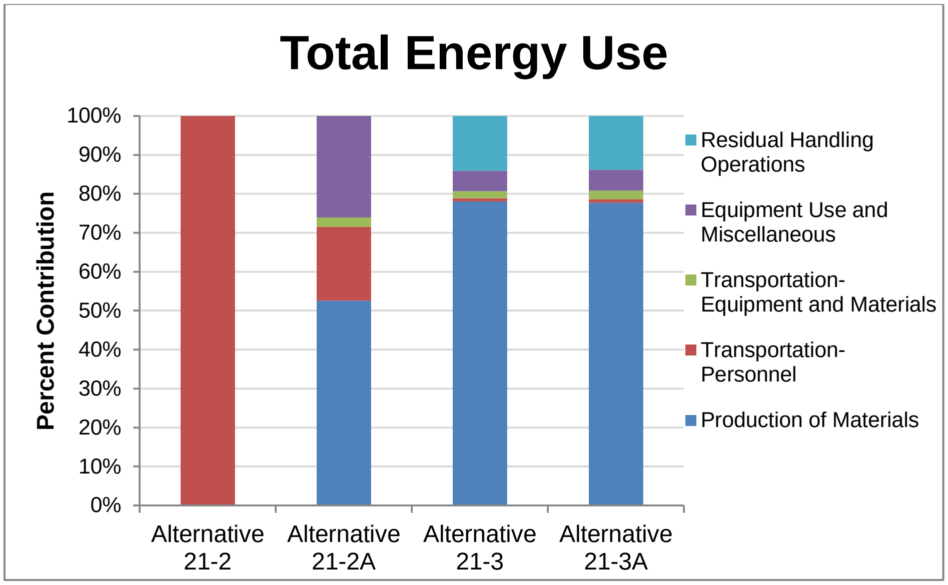


Figure 38: Energy Consumption percentage breakdown for Alternatives at Site 21, Naval Training Center Great Lakes

<u>Water Usage</u>

The water consumption of the evaluated alternatives is shown in Figure 39. The x-axis shows the four evaluated alternatives, and the y-axis show the amount of water consumed in gallons.

There is no direct water consumption for Alternative 21-2.

The total amount of water consumed resulting from the activities from Alternative 21-2A is 13,500 gallons of water.

- Treatment water consumes 11,200 gallons of water (83 percent of the total water consumption from Alternative 21-2A). Treatment water is used in two injection events.
- Decontamination water consumes 1,000 gallons of water (approximately seven percent of the total water consumption from Alternative 21-2A). Decontamination water is used for cleaning the equipment in between and after operations.
- Manufacture of PVC consumes 830 gallons of water (approximately six percent of the total water consumption from Alternative 21-2A). PVC is used to produce the pipes for the injection system.

The total amount of water consumed resulting from the activities from Alternative 21-3 is 2,626 gallons of water.

- Decontamination water consumes 2,000 gallons of water (76 percent of the total water consumption from Alternative 21-3). Decontamination water is used for cleaning the equipment in between and after operations.
- Production of fertilizer consumes 371 gallons of water (14 percent of the total water consumption from Alternative 9-3). Fertilizer is used for revegetation purposes.
- Production of HDPE consumes 251 gallons of water (10 percent of the total water consumption from Alternative 21-3). HDPE is used as a liner for the decontamination equipment pad.

The total amount of water consumed resulting from the activities from Alternative 21-3A is 13,834 gallons of water.

- Treatment water consumes 11,200 gallons of water (81 percent of the total water consumption from Alternative 21-3A). Treatment water is used in two injection events.
- Decontamination water consumes 1,000 gallons of water (approximately six percent of the total water consumption from Alternative 21-3A). Decontamination water is used for cleaning the equipment in between and after operations.
- Manufacture of PVC consumes 830 gallons of water (approximately six percent of the total water consumption from Alternative 21-3A). PVC is used to produce the pipes for the injection system.

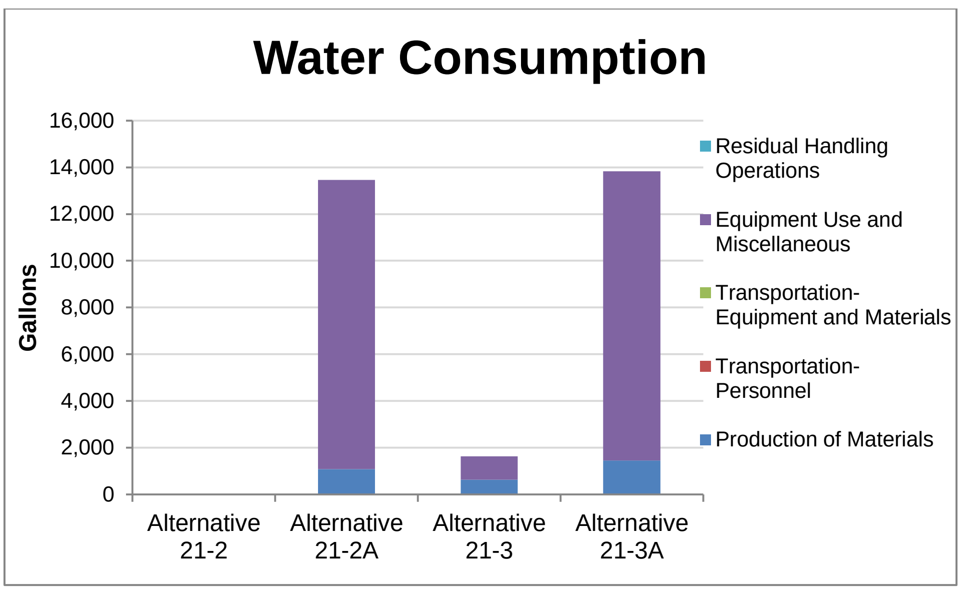


Figure 39: Water Consumption for Alternatives at Site 21, Naval Training Center Great Lakes

Figure 40 has a representation of the percentage breakdown of the contribution of the different sectors of the water use through the lifetime of the alternatives.

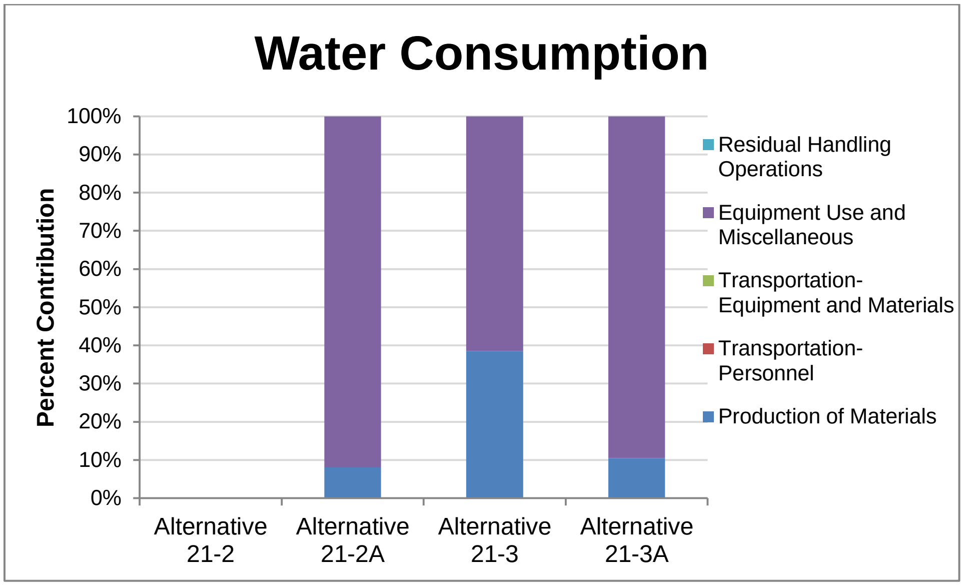


Figure 40: Water Consumption percentage breakdown for Alternatives at Site 21, Naval Training Center Great Lakes

Accident Risk

Accident Risk Fatality

Figure 41 shows the risk of fatality between the evaluated alternatives. The x-axis represents the four alternatives evaluated, and the y-axis represents the risk of fatality.

For Alternative 21-2, the activity with the highest risk of resulting in fatality is the transportation of personnel.

For Alternative 21-2A, the activity with the highest risk of resulting in fatality is the transportation of personnel, followed by equipment use.

For Alternative 21-3 and Alternative 21-3A, the activity with the highest risk of resulting in fatality is the transportation of personnel, followed by residual handling operations.

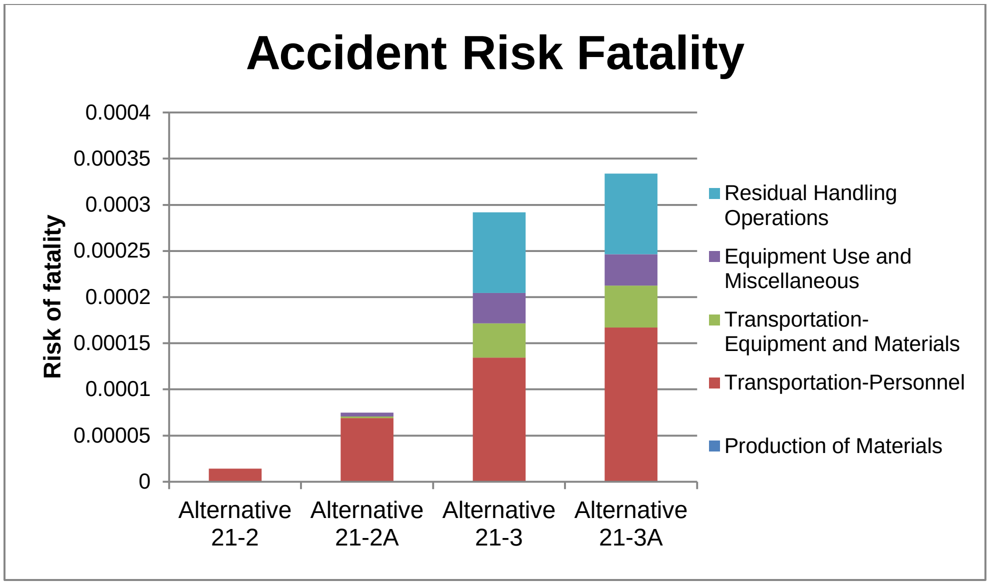


Figure 41 Risk of Fatality for Alternatives at Site 21, Naval Training Center Great Lakes

Accident Risk Injury

Figure 42 shows the risk of injury between the evaluated alternatives. The x-axis represents the four alternatives evaluated, and the y-axis represents the risk of injury.

For Alternative 21-2, the activity with the highest risk of resulting in injury is the transportation of personnel.

For Alternatives 21-2A 21-3 and 21-3A, the activity with the highest risk of resulting in injury is the transportation of personnel, followed by equipment use.

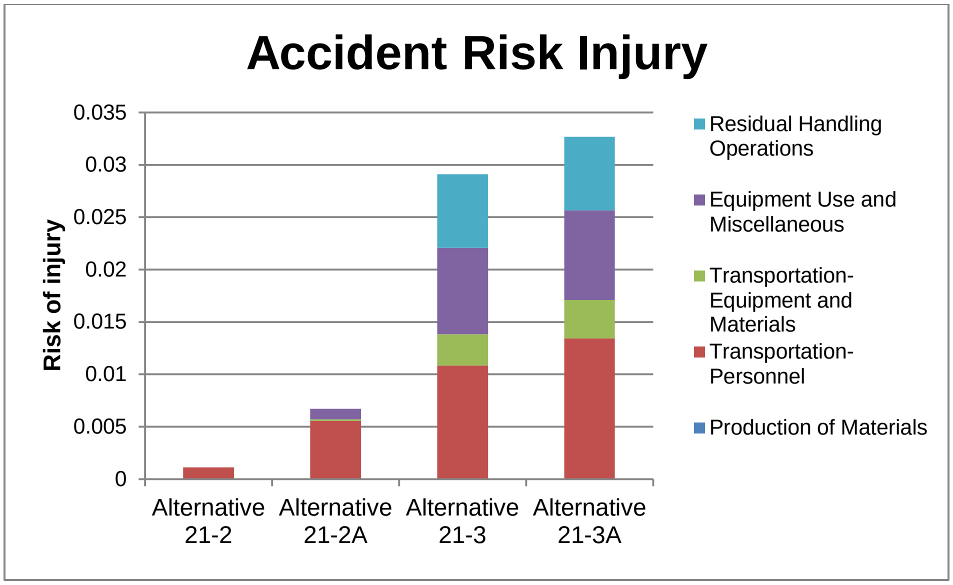


Figure 42 Risk of Injury for Alternatives at Site 21, Naval Training Center Great Lakes

CONCLUSIONS AND RECOMMENDATIONS

During selection and design of the remedy, a sensitivity analysis considering elements of the remedy that have the greatest impact on remedy effectiveness, life-cycle cost, and environmental footprint metrics may provide additional insight into appropriate optimization. To aid in the sensitivity analysis, an impact analysis summary was created to qualitatively highlight the relative impact of respective metrics for the two alternatives and to identify the primary drivers of emissions, energy consumption, and water usage for each alternative (see Table 2, Table 4 and Table 6 for details).

Figures 2, 4, 6, 8, 10 and 12 show the percentage breakdown of each of the sectors that take place during the remedial alternatives for Site 5. Figures 16, 18, 20, 22, 24 and 26 show the percentage breakdown of each of the sectors that take place during the remedial alternatives for Site 9. Figures 30, 32, 34, 36, 38 and 40 show the percentage breakdown of each of the sectors that take place during the remedial alternatives for Site 21. In these graphs, it is easy to identify the sector whose contribution is largest from all other sectors to that impact category. An advantage to identifying where the large contributions are, the optimization process for lowering the environmental impacts is faster and could be more efficient.

Measures identified in the evaluation that may reduce the environmental footprint of the alternatives are listed below for consideration.

- Alternatives 5-3, 9-3 and 21-3: Consider the mode of transportation of hazardous waste to rail if possible to lower the environmental impacts of the transporting the wastes.
- Alternatives 5-3, 9-3 and 21-3: Consider the source of borrow soil to be close to site. If possible consider the mode of transportation to be rail if possible.
- Alternatives 5-3, 9-3 and 21-3: Some reduction of the environmental footprint, particularly GHG emissions and energy consumption, could be realized for all alternatives through the possible use of emission control measures such as alternate fuel sources (e.g. biodiesel), equipment exhaust controls (e.g. diesel), and equipment idle reduction.
- Alternatives 5-3, 9-3 and 21-3: Consider optimizing of the use of equipment, particularly the use of the DPT drill rig, and even the type of equipment used during operations.
- Alternatives 5-3, 9-3 and 21-3: Optimize the number of samples analyzed during the RAC stage given that the laboratory analytical services could be one of the major drivers in some of the impact categories.
- All Alternatives: Consider ways to reduce vehicle mileage to reduce worker risk as well as energy use and emissions. Encourage site workers to carpool daily to the site to reduce total vehicle mileage.

REFERENCES

(a) NAVFAC, DON Guidance for Optimizing Remedy Evaluation, Selection, and Design, March 2010
(b) NAVFAC, DON Policy on SiteWise™ Optimization/GSR Tool Usage, email received from Brian Harrison/NAVFAC HQ dated 10 AUG 2010

Table 1
Environmental Footprint Evaluation Results
Site, PlaceSite 5-Transformer Storage Boneyard, Naval training Center Great Lakes
Great Lakes, Illinois

Alternative	Activities	GHG Emissions	Total Energy Used	Water Impacts	NO_X Emissions	SO_X Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		Metric Ton CO_2e	MMBTU	Gallons	Metric Ton	Metric Ton	Metric Ton		
Alternative 5-2	Materials Production	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	NA	NA
	Transportation-Personnel	0.69	8.63	NA	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
	Transportation-Equipment	0.00	0.00	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Equipment Use and Misc	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Residual Handling	0.00	0.00	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total	0.69	8.63	0.00	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
Alternative 5-2A	Materials Production	2.32	62.24	585.45	0.00E+00	4.81E-03	8.66E-04	NA	NA
	Transportation-Personnel	2.02	25.41	NA	7.47E-04	2.63E-05	1.52E-04	1.11E-04	8.95E-03
	Transportation-Equipment	0.32	4.13	NA	9.95E-05	1.76E-06	8.85E-06	5.86E-05	4.71E-03
	Equipment Use and Misc	3.35	57.80	4,582.55	1.61E-02	7.19E-03	9.80E-04	2.82E-05	7.08E-03
	Residual Handling	0.00	0.00	NA	0.00E+00	0.00E+00	0.00E+00	1.12E-04	8.98E-03
	Total	8.00	149.58	5,168.00	1.70E-02	1.20E-02	2.01E-03	0.000	0.030
Alternative 5-3	Materials Production	124.53	11,050.95	652.84	4.14E-07	6.27E-03	6.89E-04	NA	NA
	Transportation-Personnel	5.43	68.31	NA	2.01E-03	7.08E-05	4.08E-04	1.38E-04	1.11E-02
	Transportation-Equipment	23.66	308.78	NA	7.43E-03	1.32E-04	6.61E-04	5.91E-05	4.76E-03
	Equipment Use and Misc	27.16	430.67	1,000.00	1.63E-01	4.66E-02	1.40E-02	3.22E-05	8.10E-03
	Residual Handling	109.21	1,945.14	NA	3.74E-01	1.93E-01	1.03E+00	1.12E-04	8.98E-03
	Total	289.99	13,803.86	1,652.84	5.47E-01	2.46E-01	1.05E+00	3.41E-04	3.29E-02
Alternative 5-3A	Materials Production	125.27	11,081.90	982.96	4.14E-07	7.59E-03	1.05E-03	NA	NA
	Transportation-Personnel	6.73	84.61	NA	2.49E-03	8.77E-05	5.05E-04	1.38E-04	1.11E-02
	Transportation-Equipment	23.81	310.72	NA	7.48E-03	1.32E-04	6.65E-04	5.91E-05	4.76E-03
	Equipment Use and Misc	30.51	488.48	4,582.55	1.79E-01	5.38E-02	1.50E-02	3.22E-05	8.10E-03
	Residual Handling	109.21	1,945.14	NA	3.74E-01	1.93E-01	1.03E+00	1.12E-04	8.98E-03
	Total	295.53	13,910.84	5,565.51	5.63E-01	2.55E-01	1.05E+00	3.405E-04	3.291E-02

Table 2
Environmental Impact Drivers
Site 5-Transformer Storage Boneyard, Naval training Center Great Lakes
Great Lakes, Illinois

Alternatives		GHG Emsissions	Energy Use	Water Consumption	NO_X Emissions	SO_X Emissions	PM_{10} Emissions	Risk of fatality	Risk of injury
Alternative 5-2		Low	Low	Low	Low	Low	Low	Low	Low
		Transportation of personnel	Transportation of personnel	No water consumption	Transportation of personnel	Transportation of personnel	Transportation of personnel	Transportation of personnel	Transportation of personnel
Alternative 5-2A		Low	Low	High	Low	Low	Low	Low	Low
		Laboratory Analytical Services	Laboratory Analytical Services	Treatment Water	Laboratory Analytical Services	Laboratory Analytical Services	Use of DPT	Transportation of personnel	Transportation of personnel
Alternative 5-3		High	High	Low to moderate	High	High	High	High	High
		Production of borrow soil	Production of borrow soil	Decontamination Water	Transportation and disposal of non-hazardous wastes	Transportation and disposal of non-hazardous wastes	Transportation and disposal of non-hazardous wastes	Residual handling Operations	Transportation of personnel
Alternative 5-3A		High	High	High	High	High	High	High	High
		Production of borrow soil	Production of borrow soil	Treatment Water	Transportation and disposal of non-hazardous wastes	Transportation and disposal of non-hazardous wastes	Transportation and disposal of non-hazardous wastes	Residual handling Operations	Transportation of personnel

Table 3
Environmental Footprint Evaluation Results
Site 9-Camp Moffett Ravine Fill, Naval training Center Great Lakes
Great Lakes, Illinois

Alternative	Activities	GHG Emissions	Total Energy Used	Water Impacts	NO_X Emissions	SO_X Emissions	PM_{10} Emissions	Accident Risk Fatality	Accident Risk Injury
		Metric Ton CO_2e	MMBTU	Gallons	Metric Ton	Metric Ton	Metric Ton		
Alternative 9-2	Materials Production	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	NA	NA
	Transportation-Personnel	0.69	8.63	NA	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
	Transportation-Equipment	0.00	0.00	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Equipment Use and Misc	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Residual Handling	0.00	0.00	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total	0.69	8.63	0.00	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
Alternative 9-2A	Materials Production	3.37	120.11	1,465.79	0.00E+00	6.80E-03	1.24E-03	NA	NA
	Transportation-Personnel	2.19	27.56	NA	8.11E-04	2.86E-05	1.64E-04	4.49E-05	3.61E-03
	Transportation-Equipment	0.38	4.90	NA	1.18E-04	2.09E-06	1.05E-05	1.56E-06	1.26E-04
	Equipment Use and Misc	3.36	58.16	10,182.55	1.62E-02	7.20E-03	1.02E-03	4.12E-06	1.04E-03
	Residual Handling	0.00	0.00	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total	9.30	210.74	11,648.33	1.71E-02	1.40E-02	2.43E-03	5.05E-05	4.77E-03
Alternative 9-3	Materials Production	329.04	29,513.75	517.32	2.73E-07	5.32E-03	6.27E-04	NA	NA
	Transportation-Personnel	9.98	125.59	NA	3.69E-03	1.30E-04	7.49E-04	2.04E-04	1.64E-02
	Transportation-Equipment	62.37	814.09	NA	1.96E-02	3.47E-04	1.74E-03	1.54E-04	1.24E-02
	Equipment Use and Misc	74.16	1,180.05	2,000.00	4.57E-01	1.26E-01	4.08E-02	7.97E-05	2.00E-02
	Residual Handling	301.00	5,361.42	NA	1.03E+00	5.33E-01	2.84E+00	3.07E-04	2.47E-02
	Total	776.56	36,994.91	2,517.32	1.51E+00	6.65E-01	2.89E+00	7.45E-04	7.36E-02
Alternative 9-3A	Materials Production	330.84	29,602.56	1,727.78	2.73E-07	8.63E-03	1.36E-03	NA	NA
	Transportation-Personnel	11.53	145.01	NA	4.27E-03	1.50E-04	8.65E-04	2.36E-04	1.90E-02
	Transportation-Equipment	62.57	816.70	NA	1.97E-02	3.48E-04	1.75E-03	1.55E-04	1.25E-02
	Equipment Use and Misc	77.64	1,239.98	11,182.55	4.73E-01	1.34E-01	4.18E-02	8.38E-05	2.11E-02
	Residual Handling	300.69	5,357.31	NA	1.03E+00	5.33E-01	2.84E+00	3.06E-04	2.46E-02
	Total	783.27	37,161.55	12,910.33	1.53E+00	6.76E-01	2.89E+00	7.80E-04	7.71E-02

Table 4
Environmental Impact Drivers
Site 9-Camp Moffett Ravine Fill, Naval training Center Great Lakes
Great Lakes, Illinois

Alternatives	GHG Emsissions	Energy Use	Water Consumption	NO_X Emissions	SO_X Emissions	PM_{10} Emissions	Risk of injury	Risk of fatality
Alternative 9-2	Low	Low	Low	Low	Low	Low	Low	Low
	Transportation of personnel	Transportation of personnel	No direct Water Consumption	Transportation of personnel	Transportation of personnel	Transportation of personnel	Transportation of personnel	Transportation of personnel
Alternative 9-2A	Low	Low	High	Low	Low	Low	Low	Low
	Laboratory Analytical Services	Manufacture of PVC	Treatment Water	Laboratory Analytical Services	Laboratory Analytical Services	Use of DPT	Transportation of personnel	Transportation of personnel
Alternative 9-3	High	High	Low	High	High	High	High	High
	Production of borrow soil	Production of borrow soil	Decontamination water	Transportation of disposal of non-hazardous waste	Transportation of disposal of non-hazardous waste	Transportation of disposal of non-hazardous waste	Residual Handling Operations	Residual Handling Operations
Alternative 9-3A	High	High	High	High	High	High	High	High
	Production of borrow soil	Production of borrow soil	Treatment Water	Transportation of disposal of non-hazardous waste	Transportation of disposal of non-hazardous waste	Transportation of disposal of non-hazardous waste	Residual Handling Operations	Residual Handling Operations

Table 5
Environmental Footprint Evaluation Results
Site 21-Building 1517/1506 Area, Naval training Center Great Lakes
Great Lakes, Illinois

Alternative	Activities	GHG Emissions metric ton CO_2e	Total Energy Used MMBTU	Water Impacts gallons	NO_X Emissions metric ton	SO_X Emissions metric ton	PM_{10} Emissions metric ton	Accident Risk Fatality	Accident Risk Injury
Alternative 21-2	Materials Production	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	NA	NA
	Transportation-Personnel	0.69	8.63	NA	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
	Transportation-Equipment	0.00	0.00	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Equipment Use and Misc	0.00	0.00	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Residual Handling	0.00	0.00	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total	0.69	8.63	0.00	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
Alternative 21-2A	Materials Production	3.78	117.74	1,080.64	0.00E+00	7.36E-03	1.62E-03	NA	NA
	Transportation-Personnel	3.37	42.42	NA	1.25E-03	4.40E-05	2.53E-04	6.90E-05	5.56E-03
	Transportation-Equipment	0.41	5.43	NA	1.30E-04	3.44E-06	1.11E-05	1.62E-06	1.31E-04
	Equipment Use and Misc	3.37	58.31	12,382.55	1.62E-02	7.21E-03	1.03E-03	4.12E-06	1.04E-03
	Residual Handling	0.00	0.00	NA	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
	Total	10.93	223.90	13,463.19	1.76E-02	1.46E-02	2.91E-03	7.48E-05	6.72E-03
Alternative 21-3	Materials Production	95.46	8,434.59	625.74	3.86E-07	6.08E-03	6.76E-04	NA	NA
	Transportation-Personnel	6.57	82.69	NA	2.43E-03	8.57E-05	4.93E-04	1.35E-04	1.08E-02
	Transportation-Equipment	14.98	195.53	NA	4.71E-03	8.33E-05	4.19E-04	3.71E-05	2.99E-03
	Equipment Use and Misc	36.44	572.75	1,000.00	2.08E-01	6.58E-02	1.72E-02	3.28E-05	8.26E-03
	Residual Handling	85.24	1,517.44	NA	2.92E-01	1.51E-01	8.03E-01	8.74E-05	7.03E-03
	Total	238.69	10,803.00	1,625.74	5.07E-01	2.23E-01	8.22E-01	0.00E+00	0.00E+00
Alternative 21-3A	Materials Production	97.67	8,521.03	1,451.05	3.86E-07	9.95E-03	1.78E-03	NA	NA
	Transportation-Personnel	8.16	102.58	NA	3.02E-03	1.06E-04	6.12E-04	1.67E-04	1.34E-02
	Transportation-Equipment	18.44	240.73	NA	5.80E-03	1.03E-04	5.15E-04	4.57E-05	3.68E-03
	Equipment Use and Misc	36.71	583.02	12,382.55	2.05E-01	6.73E-02	1.64E-02	3.40E-05	8.56E-03
	Residual Handling	85.24	1,517.44	NA	2.92E-01	1.51E-01	8.03E-01	8.74E-05	7.03E-03
	Total	246.22	10,964.81	13,833.60	5.05E-01	2.28E-01	8.22E-01	3.34E-04	3.27E-02

Table 6
Environmental Impact Drivers
Site 21-Building 1517/1506 Area, Naval training Center Great Lakes
Great Lakes, Illinois

Alternatives	GHG Emsissions	Energy Use	Water Consumption	NO_X Emissions	SO_X Emissions	PM_{10} Emissions	Risk of Injury	Risk of Fatality
Alternative 21-2	Low	Low	Low	Low	Low	Low	Low	Low
	Transportation of Personnel	Transportation of Personnel	No direct water consumption	Transportation of Personnel	Transportation of Personnel	Transportation of Personnel	Transportation of Personnel	Transportation of Personnel
Alternative 21-2A	Low	Low	High	Low	Low	Low	Low to moderate	Low to moderate
	Transportation of Personnel	Manufacture of PVC	Treatment Water	Laboratory Analytical Services	Laboratory Analytical Services	Manufacture of Hydrogen Peroxide	Transportation of Personnel	Transportation of Personnel
Alternative 21-3	High	High	Low	High	High	High	High	High
	Production of borrow soil	Production of borrow soil	Decontamination Water	Transportation and disposal of non-hazardous waste	Transportation and disposal of non-hazardous waste	Transportation and disposal of non-hazardous waste	Transportation of Personnel	Transportation of Personnel
Alternative 21-3A	High	High	High	High	High	High	High	High
	Production of borrow soil	Production of borrow soil	Treatment Water	Transportation and disposal of non-hazardous waste	Transportation and disposal of non-hazardous waste	Transportation and disposal of non-hazardous waste	Transportation of Personnel	Transportation of Personnel

APPENDIX C-2 INPUT INVENTORIES AND ASSUMPTIONS

APPENDIX C-2-1 SITE 5

Alternative 5-2: Land Use Controls and Cover

LTM			
Transportation-Personnel			
Item	Quantity	Units	Comments
Annual Site Inspection	1,500	miles	1 visit per year for 30 years, 1 day per visit, 50 miles per day, 1 person
Five year review	300	miles	1 visit every 5 years during 30 years, 1 day per visit, 50 miles per year,

Alternative 5-2A: LUCs, Cover and ISCO

RAC

Materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	700.47	lb	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	514.68	lb	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Decon water	1,000.00	gal	
Well Instalation	138.24	lb	32 wells, 6 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft
Fenton Reagent	238.00	lb	Assume hydrogen peroxide, 7% by weight of 1,700 gal. Assume two events
Treatment Water	3,400.00	gal	1,700 gallons of water for ISCO treatment, Assume 2 events

Transportation-Personnel

Item	Quantity	Units	Comments
Survey Support Crew transportation	100.00	miles	1 day, 50 miles per day, 2 people
Site Superintendent Transportation	750.00	miles	15 days, 50 miles per day, 1 person
Site Health and Safety and QAQC	1,500.00	miles	15 days, 50 miles per day, 2 people
Well Instalation	1,050.00	miles	7 days, 50 miles per day 3 people
Treatment	100.00	miles	1 day, 50 miles per day, 1 person, 2 events

Transportation-equipment

Item	Quantity	Units	Comments
Decon Water Storage Tank	0.90	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 lb per 500 gal capacity tank
DPT Drill Rig, well installation	3.05	ton	1 drill rig, 6100 lb, 100 miles round trip
Injection System	4.00	ton	Assume 2 ton, 100 miles round trip, Asusme 2 Injection Events

Transportation-materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	0.35	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	0.26	ton	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Well Instalation	0.07	ton	32 wells, 6 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft
Fenton Reagent	0.12	ton	Assume hydrogen peroxide, 7% by weight of 1,700 gal. Assume two events
Treatment Water	14.14	ton	1,700 gallons of water for ISCO treatment, Assume 2 events

Equipment Use

Item	Quantity	Units	Comments
DPT Drill Rig, well installation	44.8	hours	Assume 5 wells per day, 32 wells, 8 hours per day, 80% utilization
Injection	48	hours	Assume 8 hours for injection event, Assume 10 hp pump, Assume 3 pumps, Assume 2 injection envents

Laboratory Analytical Services

Item	Quantity	Units	Comments
Sampling	4,000	dollars	5 events, Assume 4 samples per event, Assume $200 per sample

LTM

Transportation-Personnel

Item	Quantity	Units	Comments
Annual Site Inspection	1,500	miles	1 visit per year for 30 years, 1 day per visit, 50 miles per day, 1 person
Five year review	300	miles	1 visit every 5 years during 30 years, 1 day per visit, 50 miles per year,

Alternative 5-3: Excavation (Unrestricted Re-Use), Off-Site Disposal and Groundwater LUCs

RAC

Materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	700.47	lb	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	514.68	lb	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Decon water	1,000.00	gal	
Backfill, common fill	9,546,000.00	lb	3,182 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Backfill, vegetative soil	2,070,000.00	lb	690 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Seeding, mulch	2,200.00	lb	44 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	880.00	lb	44 msf, assume fertilizer, assume 20 lb per smf

Transportation-Personnel

Item	Quantity	Units	Comments
Survey Support Crew transportation	100.00	miles	1 day, 50 miles per day, 2 people
Site Superintendent Transportation	2,100.00	miles	42 days, 50 miles per day, 1 person
Site Health and Safety and QAQC	4,200.00	miles	42 days, 50 miles per day, 2 people
Sampling labor transportation	800.00	miles	8 days, 50 miles per day, 2 people
Excavation and disposal labor	2,400.00	miles	16 days, 50 miles per day, 3 people
Backfill and site restoration labor	2,700.00	miles	18 days, 50 miles per day, 3 people
Hydroseeding crew	150.00	miles	1 day, 50 miles per day, 3 people

Transportation-equipment

Item	Quantity	Units	Comments
Decon Water Storage Tank	0.90	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 lb per 500 gal capacity tank
DPT drill Rig	3.05	ton	1 drill rig, 6100 lb, 100 miles round trip
Excavator	20.00	ton	1 excavator, 20 ton per excavator, 100 miles round trip
Excavator	20.00	ton	1 excavator, 20 ton per excavator, 100 miles round trip
Dozer 140 hp	22.00	ton	1 dozer, 22 ton per dozer, 100 miles round trip
Compactor, 120 hp	20.00	ton	1 compactor, 20 tons per compactor
tractor	13.29	ton	1 tractor, 26585 lb per tractor, 100 miles round trip
hydromulcher	0.75	ton	1 hydromulcher, 1500 lb, 100 round trip

Transportation-materials			
Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	0.35	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	0.26	ton	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Backfill, common fill	4,773.00	ton	3,182 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Backfill, vegetative soil	1,035.00	ton	690 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Seeding, mulch	1.10	ton	44 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	0.44	ton	44 msf, assume fertilizer, assume 20 lb per smf

Equipment Use			
Item	Quantity	Units	Comments
DPT drill Rig	19.20	hours	3 days, 8 hours per day, 80% utilization
Excavator, 2.5 CY	83.20	hours	13 days, 8 hours per day, 80% utilization
Excavator, 2.5 CY	64.00	hours	10 days, 8 hours per day, 80% utilization
Dozer, 140 hp	64.00	hours	10 days, 8 hours per day, 80% utilization
Compactor 125 hp	64.00	hours	10 days, 8 hours per day, 80% utilization
tractor	6.40	hours	1 day, 8 hours per day, 80% utilization
hydromulcher	6.40	hours	1 day, 8 hours per day, 80% utilization

Residual Handling			
Item	Quantity	Units	Comments
Decon water	4.16	ton	1000 gal, 8.32 ppg, 2000 lb per ton
Transportation and Disposal of non hazardous soil	5,673.00	ton	

Transportation-residual handling			
Item	Quantity	Units	Comments
Decon water	100.00	miles	1 trip
Transportation and Disposal of non hazardous soil	100.00	miles	142 trips

Laboratory Analytical Services			
Item	Quantity	Units	Comments
Analytical sampling	8,600.00	dollars	43 samples, $200 per sample,
Waste disposal characterization	1,000.00	dollars	5 samples, $200 per sample

LTM

Transportation-Personnel			
Item	Quantity	Units	Comments
Annual Site Inspection	1,500	miles	1 visit per year for 30 years, 1 day per visit, 50 miles per day, 1 person
Five year review	300	miles	1 visit every 5 years during 30 years, 1 day per visit, 50 miles per year,

Alternative 5-3A: Excavation (Unrestricted Re-Ise), Off-Site Disposal, Groundwater LUCs, and ISCO

RAC

Materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	700.47	lb	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	514.68	lb	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Decon water	1,000.00	gal	
Backfill, common fill	9,546,000.00	lb	3,182 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Backfill, vegetative soil	2,070,000.00	lb	690 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Seeding, mulch	2,200.00	lb	44 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	880.00	lb	44 msf, assume fertilizer, assume 20 lb per smf
Well Instalation	138.24	lb	32 wells, 6 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft
Fenton Reagent	238.00	lb	Assume hydrogen peroxide, 7% by weight of 1,700 gal. Assume two events
Treatment Water	3,400.00	gal	1,700 gallons of water for ISCO treatment, Assume 2 events

Transportation-Personnel

Item	Quantity	Units	Comments
Survey Support Crew transportation	100.00	miles	1 day, 50 miles per day, 2 people
Site Superintendent Transportation	2,850.00	miles	57 days, 50 miles per day, 1 person
Site Health and Safety and QAQC	5,700.00	miles	57 days, 50 miles per day, 2 people
Sampling labor transportation	800.00	miles	8 days, 50 miles per day, 2 people
Excavation and disposal labor	2,400.00	miles	16 days, 50 miles per day, 3 people
Backfill and site restoration labor	2,700.00	miles	18 days, 50 miles per day, 3 people
Hydroseeding crew	150.00	miles	1 day, 50 miles per day, 3 people
Well Instalation	1,050.00	miles	7 days, 50 miles per day 3 people
Treatment	100.00	miles	1 day, 50 miles per day, 1 person, 2 events

Transportation-equipment

Item	Quantity	Units	Comments
Decon Water Storage Tank	0.90	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 lb per 500 gal capacity tank
DPT drill Rig	3.05	ton	1 drill rig, 6100 lb, 100 miles round trip
Excavator	20.00	ton	1 excavator, 20 ton per excavator, 100 miles round trip

Transportation-equipment (cont)			
Excavator	20.00	ton	1 excavator, 20 ton per excavator, 100 miles round trip
Dozer 140 hp	22.00	ton	1 dozer, 22 ton per dozer, 100 miles round trip
Compactor, 120 hp	20.00	ton	1 compactor, 20 tons per compactor
tractor	13.29	ton	1 tractor, 26585 lb per tractor, 100 miles round trip
hydromulcher	0.75	ton	1 hydromulcher, 1500 lb, 100 round trip
DPT Drill Rig, well installation	3.05	ton	1 drill rig, 6100 lb, 100 miles round trip
Injection System	4.00	ton	Assume 2 ton, 100 miles round trip, Asusme 2 Injection Events

Transportation-materials			
Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	0.35	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	0.26	ton	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Backfill, common fill	4,773.00	ton	3,182 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Backfill, vegetative soil	1,035.00	ton	690 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Seeding, mulch	1.10	ton	44 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	0.44	ton	44 msf, assume fertilizer, assume 20 lb per smf
Well Instalation	0.07	ton	32 wells, 6 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft
Fenton Reagent	0.12	ton	Assume hydrogen peroxide, 7% by weight of 1,700 gal. Assume two events
Treatment Water	14.14	ton	1,700 gallons of water for ISCO treatment, Assume 2 events

Equipment Use			
Item	Quantity	Units	Comments
DPT drill Rig	19.20	hours	3 days, 8 hours per day, 80% utilization
Excavator, 2.5 CY	83.20	hours	13 days, 8 hours per day, 80% utilization
Excavator, 2.5 CY	64.00	hours	10 days, 8 hours per day, 80% utilization
Dozer, 140 hp	64.00	hours	10 days, 8 hours per day, 80% utilization
Compactor 125 hp	64.00	hours	10 days, 8 hours per day, 80% utilization
tractor	6.40	hours	1 day, 8 hours per day, 80% utilization
hydromulcher	6.40	hours	1 day, 8 hours per day, 80% utilization
DPT Drill Rig, well installation	44.8	hours	Assume 5 wells per day, 32 wells, 8 hours per day, 80% utilization
Injection	48	hours	Assume 8 hours for injection event, Assume 10 hp pump, Assume 3 pumps, Assume 2 injection envents

Residual Handling			
Item	Quantity	Units	Comments
Decon water	4.16	ton	1000 gal, 8.32 ppg, 2000 lb per ton
Transportation and Disposal of non hazardous soil	5,673.00	ton	

Transportation-residual handling			
Item	Quantity	Units	Comments
Decon water	100.00	miles	1 trip
Transportation and Disposal of non hazardous soil	100.00	miles	142 trips

Laboratory Analytical Services			
Item	Quantity	Units	Comments
Analytical sampling	8,600.00	dollars	43 samples, $200 per sample,
Waste disposal characterization	1,000.00	dollars	5 samples, $200 per sample
Sampling	4,000	dollars	5 events, Assume 4 samples per event, Assume $200 per sample

LTM			
Transportation-Personnel			
Item	Quantity	Units	Comments
Annual Site Inspection	1,500	miles	1 visit per year for 30 years, 1 day per visit, 50 miles per day, 1 person
Five year review	300	miles	1 visit every 5 years during 30 years, 1 day per visit, 50 miles per year,

APPENDIX C-2-2 SITE 9

Alternative 9-2: Land Use Controls and Cover

LTM			
Transportation-Personnel			
Item	Quantity	Units	Comments
Annual Site Inspection	1,500	miles	1 visit per year for 30 years, 1 day per visit, 50 miles per day, 1 person
Five year review	300	miles	1 visit every 5 years during 30 years, 1 day per visit, 50 miles per year,

Alternative 2A: LUCs, Cover, and ISCO

RAC

Materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	700.47	lb	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	514.68	lb	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Decon water	1,000.00	gal	
Well Instalation	506.88	lb	32 wells, 22 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft
Fenton Reagent	360.00	lb	Assume hydrogen peroxide, 4% by weight of 4,500 gal. Assume two events
Treatment Water	9,000.00	gal	4,500 gallons of water for ISCO treatment, Assume 2 events

Transportation-Personnel

Item	Quantity	Units	Comments
Survey Support Crew transportation	100.00	miles	1 day, 50 miles per day, 2 people
Site Superintendent Transportation	900.00	miles	18 days, 50 miles per day, 1 person
Site Health and Safety and QAQC	1,800.00	miles	18 days, 50 miles per day, 2 people
Well Instalation	1,050.00	miles	7 days, 50 miles per day 3 people
Treatment	100.00	miles	1 day, 50 miles per day, 1 person, 2 events

Transportation-equipment

Item	Quantity	Units	Comments
Decon Water Storage Tank	0.90	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 lb per 500 gal capacity tank
DPT Drill Rig, well installation	3.05	ton	1 drill rig, 6100 lb, 100 miles round trip
Injection System	4.00	ton	Assume 2 ton, 100 miles round trip, Asusme 2 Injection Events

Transportation-materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	0.35	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	0.26	ton	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Well Instalation	0.25	ton	32 wells, 22 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft
Fenton Reagent	0.18	ton	Assume hydrogen peroxide, 4% by weight of 4,500 gal. Assume two events
Treatment Water	37.44	ton	4,500 gallons of water for ISCO treatment, Assume 2 events

Equipment Use

Item	Quantity	Units	Comments
DPT Drill Rig, well installation	44.8	hours	Assume 5 wells per day, 32 wells, 8 hours per day, 80% utilization
Injection	48	hours	Assume 8 hours for injection event, Assume 10 hp pump, Assume 3 pumps, Assume 2 injection envents

Laboratory Analytical Services

Item	Quantity	Units	Comments
Sampling	4,000	dollars	5 events, Assume 4 samples per event, Assume $200 per sample

LTM

Transportation-Personnel

Item	Quantity	Units	Comments
Annual Site Inspection	1,500	miles	1 visit per year for 30 years, 1 day per visit, 50 miles per day, 1 person
Five year review	300	miles	1 visit every 5 years during 30 years, 1 day per visit, 50 miles per year,

Alternative 9-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and Groundwater LUCs

RAC

Materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	700.47	lb	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	514.68	lb	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Decon water	2,000.00	gal	
Backfill, common fill	29,931,000.00	lb	9,977 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Backfill, vegetative soil	1,350,000.00	lb	450 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Seeding, mulch	1,450.00	lb	29 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	580.00	lb	29 msf, assume fertilizer, assume 20 lb per smf

Transportation-Personnel

Item	Quantity	Units	Comments
Survey Support Crew transportation	200.00	miles	2 day, 50 miles per day, 2 people
Site Superintendent Transportation	4,100.00	miles	82 days, 50 miles per day, 1 person
Site Health and Safety and QAQC	8,200.00	miles	82 days, 50 miles per day, 2 people
Sampling labor transportation	800.00	miles	8 days, 50 miles per day, 2 people
Excavation and disposal labor	6,300.00	miles	42 days, 50 miles per day, 3 people
Backfill and site restoration labor	4,650.00	miles	31 days, 50 miles per day, 3 people
Hydroseeding crew	150.00	miles	1 day, 50 miles per day, 3 people

Transportation-equipment

Item	Quantity	Units	Comments
Decon Water Storage Tank	0.90	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 lb per 500 gal capacity tank
DPT	3.05		1 drill rig, 6100 lb, 100 miles round trip
Excavator	20.00	ton	1 excavator, 20 ton per excavator, 100 miles round trip
Excavator	20.00	ton	1 excavator, 20 ton per excavator, 100 miles round trip
Dozer 140 hp	22.00	ton	1 dozer, 22 ton per dozer, 100 miles round trip
Compactor, 120 hp	20.00	ton	1 compactor, 20 tons per compactor
tractor	13.29	ton	1 tractor, 26585 lb per tractor, 100 miles round trip
hydromulcher	0.75	ton	1 hydromulcher, 1500 lb, 100 round trip

Transportation-materials			
Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	0.35	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	0.26	ton	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Backfill, common fill	14,965.50	ton	9,977 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Backfill, vegetative soil	675.00	ton	450 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Seeding, mulch	0.73	ton	29 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	0.29	ton	29 msf, assume fertilizer, assume 20 lb per smf

Equipment Use			
Item	Quantity	Units	Comments
DPT	25.60	hours	4 days, 8 hours per day, 80% utilization
Excavator, 2.5 CY	256.00	hours	40 days, 8 hours per day, 80% utilization
Excavator, 2.5 CY	192.00	hours	30 days, 8 hours per day, 80% utilization
Dozer, 140 hp	192.00	hours	30 days, 8 hours per day, 80% utilization
Compactor 125 hp	192.00	hours	30 days, 8 hours per day, 80% utilization
tractor	6.40	hours	1 day, 8 hours per day, 80% utilization
hydromulcher	6.40	hours	1 day, 8 hours per day, 80% utilization

Residual Handling			
Item	Quantity	Units	Comments
Decon water	8.32	ton	2000 gal, 8.32 ppg, 2000 lb per ton
Transportation and Disposal of non hazardous soil	15,640.00	ton	

Transportation-residual handling			
Item	Quantity	Units	Comments
Decon water	100.00	miles	1 trip
Transportation and Disposal of non hazardous soil	100.00	miles	391 trips

Laboratory Analytical Services			
Item	Quantity	Units	Comments
Analytical sampling	15,200.00	dollars	76 samples, $200 per sample,
Waste disposal characterization	2,800.00	dollars	15 samples, $200 per sample

LTM

Transportation-Personnel			
Item	Quantity	Units	Comments
Annual Site Inspection	1,500	miles	1 visit per year for 30 years, 1 day per visit, 50 miles per day, 1 person
Five year review	300	miles	1 visit every 5 years during 30 years, 1 day per visit, 50 miles per year,

Alternative 9-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, Groundwater LUCs, and ISCO

RAC

Materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	700.47	lb	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	514.68	lb	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Decon water	2,000.00	gal	
Backfill, common fill	29,931,000.00	lb	9,977cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Backfill, vegetative soil	1,350,000.00	lb	450 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Seeding, mulch	1,450.00	lb	29 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	580.00	lb	29 msf, assume fertilizer, assume 20 lb per smf
Well Instalation	506.88	lb	32 wells, 22 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft
Fenton Reagent	360.00	lb	Assume hydrogen peroxide, 4% by weight of 4,500 gal. Assume two events
Treatment Water	9,000.00	gal	4,500 gallons of water for ISCO treatment, Assume 2 events

Transportation-Personnel

Item	Quantity	Units	Comments
Survey Support Crew transportation	200.00	miles	2 day, 50 miles per day, 2 people
Site Superintendent Transportation	5,000.00	miles	100 days, 50 miles per day, 1 person
Site Health and Safety and QAQC	10,000.00	miles	100 days, 50 miles per day, 2 people
Sampling labor transportation	1,000.00	miles	10 days, 50 miles per day, 2 people
Excavation and disposal labor	6,300.00	miles	42 days, 50 miles per day, 3 people
Backfill and site restoration labor	4,650.00	miles	31 days, 50 miles per day, 3 people
Hydroseeding crew	150.00	miles	1 day, 50 miles per day, 3 people
Well Instalation	1,050.00	miles	7 days, 50 miles per day 3 people
Treatment	100.00	miles	1 day, 50 miles per day, 1 person, 2 events

Transportation-equipment

Item	Quantity	Units	Comments
Decon Water Storage Tank	0.90	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 lb per 500 gal capacity tank
DPT	3.05		1 drill rig, 6100 lb, 100 miles round trip
Excavator	20.00	ton	1 excavator, 20 ton per excavator, 100 miles round trip

Transportation-equipment (cont)			
Excavator	20.00	ton	1 excavator, 20 ton per excavator, 100 miles round trip
Dozer 140 hp	22.00	ton	1 dozer, 22 ton per dozer, 100 miles round trip
Compactor, 120 hp	20.00	ton	1 compactor, 20 tons per compactor
tractor	13.29	ton	1 tractor, 26585 lb per tractor, 100 miles round trip
hydromulcher	0.75	ton	1 hydromulcher, 1500 lb, 100 round trip
DPT Drill Rig, well installation	3.05	ton	1 drill rig, 6100 lb, 100 miles round trip
Injection System	4.00	ton	Assume 2 ton, 100 miles round trip, Asusme 2 Injection Events

Transportation-materials			
Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	0.35	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	0.26	ton	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Backfill, common fill	14,965.50	ton	9,977cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Backfill, vegetative soil	675.00	ton	450 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Seeding, mulch	0.73	ton	29 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	0.29	ton	29 msf, assume fertilizer, assume 20 lb per smf
Well Instalation	0.25	ton	32 wells, 22 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft
Fenton Reagent	0.18	ton	Assume hydrogen peroxide, 4% by weight of 4,500 gal. Assume two events
Treatment Water	37.44	ton	4,500 gallons of water for ISCO treatment, Assume 2 events

Equipment Use			
Item	Quantity	Units	Comments
DPT	25.60	hours	4 days, 8 hours per day, 80% utilization
Excavator, 2.5 CY	256.00	hours	40 days, 8 hours per day, 80% utilization
Excavator, 2.5 CY	192.00	hours	30 days, 8 hours per day, 80% utilization
Dozer, 140 hp	192.00	hours	30 days, 8 hours per day, 80% utilization
Compactor 125 hp	192.00	hours	30 days, 8 hours per day, 80% utilization
tractor	6.40	hours	1 day, 8 hours per day, 80% utilization
hydromulcher	6.40	hours	1 day, 8 hours per day, 80% utilization
DPT Drill Rig, well installation	44.8	hours	Assume 5 wells per day, 32 wells, 8 hours per day, 80% utilization
Injection	48	hours	Assume 8 hours for injection event, Assume 10 hp pump, Assume 3 pumps, Assume 2 injection envents

Residual Handling			
Item	Quantity	Units	Comments
Decon water	8.32	ton	2000 gal, 8.32 ppg, 2000 lb per ton
Transportation and Disposal of non hazardous soil	15,640.00	ton	

Transportation-residual handling			
Item	Quantity	Units	Comments
Decon water	100.00	miles	
Transportation and Disposal of non hazardous soil	100.00	miles	

Laboratory Analytical Services			
Item	Quantity	Units	Comments
Analytical sampling	15,200.00	dollars	76 samples, $200 per sample,
Waste disposal characterization	3,000.00	dollars	15 samples, $200 per sample
Sampling	4,000	dollars	5 events, Assume 4 samples per event, Assume $200 per sample

LTM			
Transportation-Personnel			
Item	Quantity	Units	Comments
Annual Site Inspection	1,500	miles	1 visit per year for 30 years, 1 day per visit, 50 miles per day, 1 person
Five year review	300	miles	1 visit every 5 years during 30 years, 1 day per visit, 50 miles per year,

APPENDIX C-2-3 SITE 21

Alternative 21-2: Land Use Controls and Cover

LTM			
Transportation-Personnel			
Item	Quantity	Units	Comments
Annual Site Inspection	1,500	miles	1 visit per year for 30 years, 1 day per visit, 50 miles per day, 1 person
Five year review	300	miles	1 visit every 5 years during 30 years, 1 day per visit, 50 miles per year,

Alternative 21-2A: LUCs, Cover, and ISCO

RAC			
Materials			
Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	700.47	lb	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	514.68	lb	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Decon water	1,000.00	gal	
Well Instalation	345.60	lb	32 wells, 15 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft
Fenton Reagent	784.00	lb	Assume hydrogen peroxide, 7% by weight of 5,600 gal. Assume two events
Treatment Water	11,200.00	gal	5,600 gallons of water for ISCO treatment, Assume 2 events
Transportation-Personnel			
Item	Quantity	Units	Comments
Survey Support Crew transportation	200.00	miles	2 day, 50 miles per day, 2 people
Site Superintendent Transportation	1,900.00	miles	38 days, 50 miles per day, 1 person
Site Health and Safety and QAQC	3,800.00	miles	38 days, 50 miles per day, 2 people
Well Instalation	1,050.00	miles	7 days, 50 miles per day 3 people
Treatment	100.00	miles	1 day, 50 miles per day, 1 person, 2 events
Transportation-equipment			
Item	Quantity	Units	Comments
Decon Water Storage Tank	0.90	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 lb per 500 gal capacity tank
DPT Drill Rig, well installation	3.05	ton	1 drill rig, 6100 lb, 100 miles round trip
Injection System	4.00	ton	Assume 2 ton, 100 miles round trip, Asusme 2 Injection Events
Transportation-materials			
Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	0.35	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	0.26	ton	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Well Instalation	0.17	ton	32 wells, 15 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft
Fenton Reagent	0.39	ton	Assume hydrogen peroxide, 7% by weight of 5,600 gal. Assume two events
Treatment Water	46.59	ton	5,600 gallons of water for ISCO treatment, Assume 2 events

Equipment Use

Item	Quantity	Units	Comments
DPT Drill Rig, well installation	44.8	hours	Assume 5 wells per day, 32 wells, 8 hours per day, 80% utilization
Injection	48	hours	Assume 8 hours for injection event, Assume 10 hp pump, Assume 3 pumps, Assume 2 injection envents

Laboratory Analytical Services

Item	Quantity	Units	Comments
Sampling	4,000	dollars	5 events, Assume 4 samples per event, Assume $200 per sample

LTM

Transportation-Personnel

Item	Quantity	Units	Comments
Annual Site Inspection	1,500	miles	1 visit per year for 30 years, 1 day per visit, 50 miles per day, 1 person
Five year review	300	miles	1 visit every 5 years during 30 years, 1 day per visit, 50 miles per year,

Alternative 21-3: Excavation (Unrestricted Re-Use), Off-Site Disposal, and Groundwater LUCs

RAC			
Materials			
Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	700.47	lb	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	514.68	lb	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Decon water	1,000.00	gal	
Backfill, common fill	6,951,000.00	lb	2,317 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Backfill, vegetative soil	1,890,000.00	lb	630 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Seeding, mulch	2,050.00	lb	41 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	820.00	lb	41 msf, assume fertilizer, assume 20 lb per smf
Transportation-Personnel			
Item	Quantity	Units	Comments
Survey Support Crew transportation	200.00	miles	2 day, 50 miles per day, 2 people
Site Superintendent Transportation	2,600.00	miles	52 days, 50 miles per day, 1 person
Site Health and Safety and QAQC	5,200.00	miles	52 days, 50 miles per day, 2 people
Sampling labor transportation	1,000.00	miles	10 days, 50 miles per day, 2 people
Excavation and disposal labor	3,300.00	miles	22 days, 50 miles per day, 3 people
Backfill and site restoration labor	3,000.00	miles	20 days, 50 miles per day, 3 people
Hydroseeding crew	150.00	miles	1 day, 50 miles per day, 3 people
Transportation-equipment			
Item	Quantity	Units	Comments
Decon Water Storage Tank	0.90	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 lb per 500 gal capacity tank
DPT	3.05		1 drill rig, 6100 lb, 100 miles round trip
Excavator	20.00	ton	1 excavator, 20 ton per excavator, 100 miles round trip
Excavator	20.00	ton	1 excavator, 20 ton per excavator, 100 miles round trip
Dozer 140 hp	22.00	ton	1 dozer, 22 ton per dozer, 100 miles round trip
Compactor, 120 hp	20.00	ton	1 compactor, 20 tons per compactor
tractor	13.29	ton	1 tractor, 26585 lb per tractor, 100 miles round trip
hydromulcher	0.75	ton	1 hydromulcher, 1500 lb, 100 round trip

Transportation-materials			
Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	0.35	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	0.26	ton	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Backfill, common fill	2,883.00	ton	1922 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Backfill, vegetative soil	720.00	ton	480 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Seeding, mulch	0.78	ton	31 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	0.31	ton	31 msf, assume fertilizer, assume 20 lb per smf

Equipment Use			
Item	Quantity	Units	Comments
DPT	25.60	hours	4 days, 8 hours per day, 80% utilization
Excavator, 2.5 CY	128.00	hours	20 days, 8 hours per day, 80% utilization
Excavator, 2.5 CY	64.00	hours	10 days, 8 hours per day, 80% utilization
Dozer, 140 hp	64.00	hours	10 days, 8 hours per day, 80% utilization
Compactor 125 hp	64.00	hours	10 days, 8 hours per day, 80% utilization
tractor	6.40	hours	1 day, 8 hours per day, 80% utilization
hydromulcher	6.40	hours	1 day, 8 hours per day, 80% utilization

Residual Handling			
Item	Quantity	Units	Comments
Decon water	4.16	ton	1000 gal, 8.32 ppg, 2000 lb per ton
Transportation and Disposal of non hazardous soil	4,420.00	ton	

Transportation-residual handling			
Item	Quantity	Units	Comments
Decon water	100.00	miles	
Transportation and Disposal of non hazardous soil	100.00	miles	

Laboratory Analytical Services			
Item	Quantity	Units	Comments
Analytical sampling	16,800.00	dollars	84 samples, $200 per sample,
Waste disposal characterization	1,000.00	dollars	5 samples, $200 per sample

LTM			
Transportation-Personnel			
Item	Quantity	Units	Comments
Annual Site Inspection	1,500	miles	1 visit per year for 30 years, 1 day per visit, 50 miles per day, 1 person
Five year review	300	miles	1 visit every 5 years during 30 years, 1 day per visit, 50 miles per year,

Alternative 21-3A: Excavation (Unrestricted Re-Use), Off-Site Disposal, Groundwater LUCs, and ISCO

RAC

Materials

Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	700.47	lb	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	514.68	lb	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Decon water	1,000.00	gal	
Backfill, common fill	6,951,000.00	lb	2,317 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Backfill, vegetative soil	1,890,000.00	lb	630 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Seeding, mulch	2,050.00	lb	41 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	820.00	lb	41 msf, assume fertilizer, assume 20 lb per smf
Well Instalation	345.60	lb	32 wells, 15 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft
Fenton Reagent	784.00	lb	Assume hydrogen peroxide, 7% by weight of 5,600 gal. Assume two events
Treatment Water	11,200.00	gal	5,600 gallons of water for ISCO treatment, Assume 2 events

Transportation-Personnel

Item	Quantity	Units	Comments
Survey Support Crew transportation	200.00	miles	2 day, 50 miles per day, 2 people
Site Superintendent Transportation	3,600.00	miles	72 days, 50 miles per day, 1 person
Site Health and Safety and QAQC	7,200.00	miles	72 days, 50 miles per day, 2 people
Sampling labor transportation	1,000.00	miles	10 days, 50 miles per day, 2 people
Excavation and disposal labor	3,300.00	miles	22 days, 50 miles per day, 3 people
Backfill and site restoration labor	3,000.00	miles	20 days, 50 miles per day, 3 people
Hydroseeding crew	150.00	miles	1 day, 50 miles per day, 3 people
Well Instalation	1,050.00	miles	7 days, 50 miles per day 3 people
Treatment	100.00	miles	1 day, 50 miles per day, 1 person, 2 events

Transportation-equipment

Item	Quantity	Units	Comments
Decon Water Storage Tank	0.90	ton	6000 gallons capacity, HPDE, 100 miles round trip, 150 lb per 500 gal capacity tank
DPT	3.05		1 drill rig, 6100 lb, 100 miles round trip
Excavator	20.00	ton	1 excavator, 20 ton per excavator, 100 miles round trip
Excavator	20.00	ton	1 excavator, 20 ton per excavator, 100 miles round trip

Transportation-equipment (cont)			
Dozer 140 hp	22.00	ton	1 dozer, 22 ton per dozer, 100 miles round trip
Compactor, 120 hp	20.00	ton	1 compactor, 20 tons per compactor
tractor	13.29	ton	1 tractor, 26585 lb per tractor, 100 miles round trip
hydromulcher	0.75	ton	1 hydromulcher, 1500 lb, 100 round trip
DPT Drill Rig, well installation	3.05	ton	1 drill rig, 6100 lb, 100 miles round trip
Injection System	4.00	ton	Assume 2 ton, 100 miles round trip, Asusme 2 Injection Events

Transportation-materials			
Item	Quantity	Units	Comments
Temporary Equipment Decon Pad Liner	0.35	ton	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3
Temporary Equipment Decon Pad Frame	0.26	ton	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3
Backfill, common fill	3,475.50	ton	2,317 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Backfill, vegetative soil	945.00	ton	630 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil
Seeding, mulch	1.03	ton	41 msf, assume mulch assume, 50 lb per msf
Seeding, fertilizer	0.41	ton	41 msf, assume fertilizer, assume 20 lb per smf
Well Instalation	0.17	ton	32 wells, 15 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft
Fenton Reagent	0.39	ton	Assume hydrogen peroxide, 7% by weight of 5,600 gal. Assume two events
Treatment Water	46.59	gal	5,600 gallons of water for ISCO treatment, Assume 2 events

Equipment Use			
Item	Quantity	Units	Comments
DPT	25.60	hours	4 days, 8 hours per day, 80% utilization
Excavator, 2.5 CY	96.00	hours	20 days, 8 hours per day, 80% utilization
Excavator, 2.5 CY	64.00	hours	10 days, 8 hours per day, 80% utilization
Dozer, 140 hp	64.00	hours	10 days, 8 hours per day, 80% utilization
Compactor 125 hp	64.00	hours	10 days, 8 hours per day, 80% utilization
tractor	6.40	hours	1 day, 8 hours per day, 80% utilization
hydromulcher	6.40	hours	1 day, 8 hours per day, 80% utilization
DPT Drill Rig, well installation	44.8	hours	Assume 5 wells per day, 32 wells, 8 hours per day, 80% utilization
Injection	48	hours	Assume 8 hours for injection event, Assume 10 hp pump, Assume 3 pumps, Assume 2 injection envents

Residual Handling			
Item	Quantity	Units	Comments
Decon water	4.16	ton	1000 gal, 8.32 ppg, 2000 lb per ton
Transportation and Disposal of non hazardous soil	4,420.00	ton	

Transportation-residual handling			
Item	Quantity	Units	Comments
Decon water	100.00	miles	
Transportation and Disposal of non hazardous soil	100.00	miles	

Laboratory Analytical Services			
Item	Quantity	Units	Comments
Analytical sampling	16,800.00	dollars	84 samples, $200 per sample,
Waste disposal characterization	1,000.00	dollars	5 samples, $200 per sample
Sampling	4,000	dollars	5 events, Assume 4 samples per event, Assume $200 per sample

LTM			
Transportation-Personnel			
Item	Quantity	Units	Comments
Annual Site Inspection	1,500	miles	1 visit per year for 30 years, 1 day per visit, 50 miles per day, 1 person
Five year review	300	miles	1 visit every 5 years during 30 years, 1 day per visit, 50 miles per year,

APPENDIX C-3 SITEWISE™ RESULTS

APPENDIX C-3-1 SITE 5

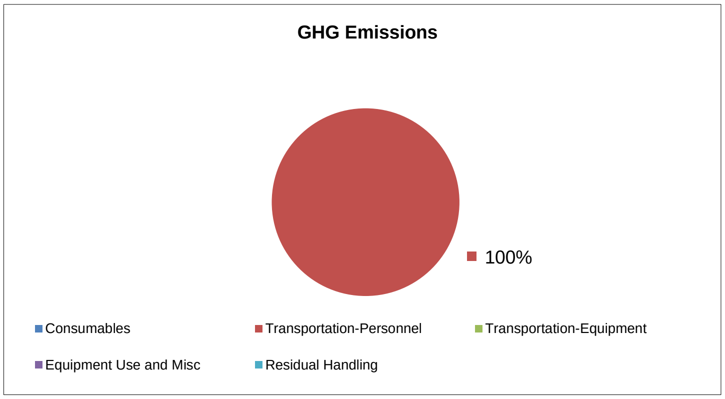
Sustainable Remediation - Environmental Footprint Summary
Alternative 5-2

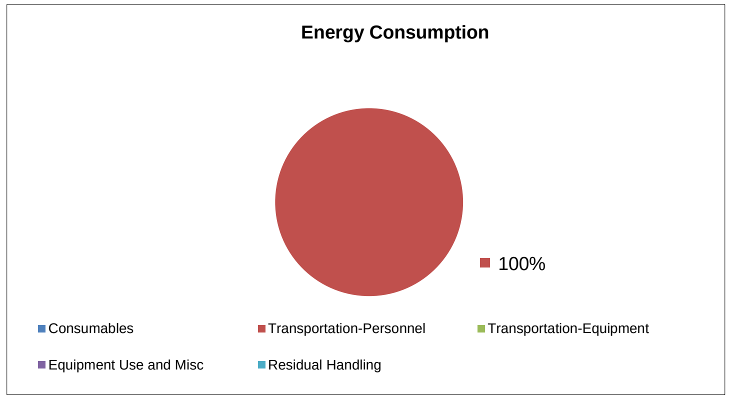
Phase	Activities	GHG Emissions (metric ton)	Total energy Used (MMBTU)	Water Consumption (gallons)	NOx emissions (metric ton)	SOx Emissions (metric ton)	PM10 Emissions (metric ton)	Accident Risk Fatality	Accident Risk Injury
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.69	8.6E+00	NA	2.5E-04	8.9E-06	5.1E-05	1.4E-05	1.1E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.69	8.63E+00	0.00E+00	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
Total		**6.9E-01**	**8.6E+00**	**0.0E+00**	**2.5E-04**	**8.9E-06**	**5.1E-05**	**1.4E-05**	**1.1E-03**

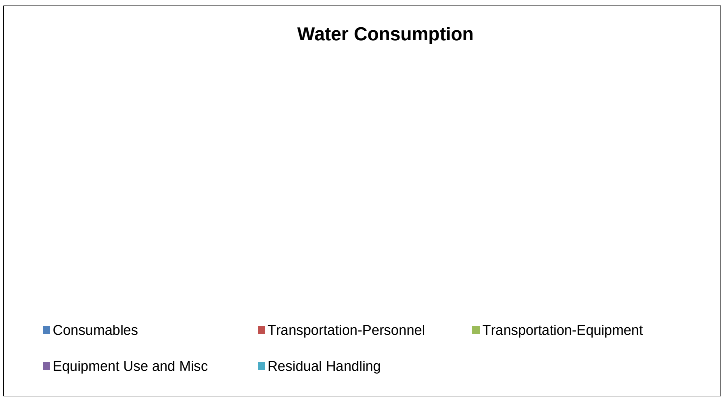
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space (tons)	Hazardous Waste Landfill Space (tons)	Topsoil Consumption (cubic yards)	Costing ($)	Lost Hours - Injury
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	9.0E-03
Total	**0.0E+00**	**0.0E+00**	**0.0E+00**	**$0**	**9.0E-03**

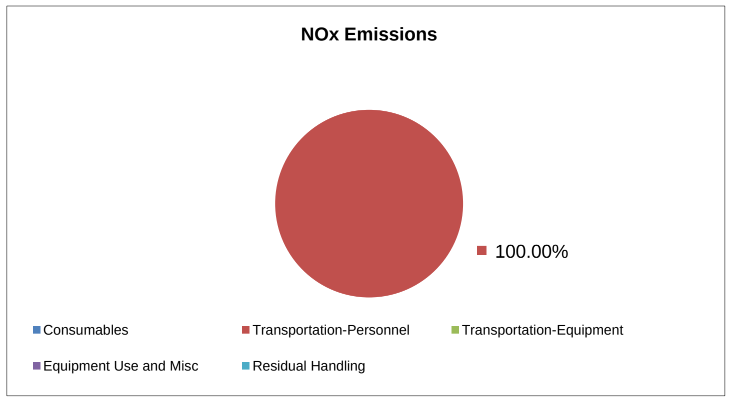
Total Cost with Footprint Reduction
$0

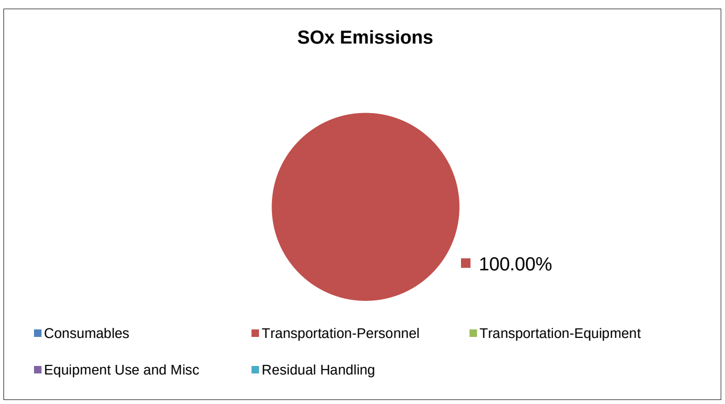
SiteWise™ Results Alternative 5-2
Long Term Monitoring Stage
Site 5-Transformer Storage Boneyard, Naval training Center Great Lakes
Great Lakes, Illinois

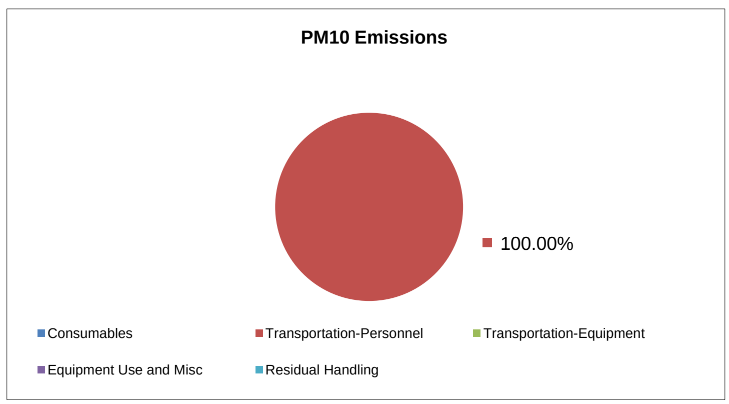


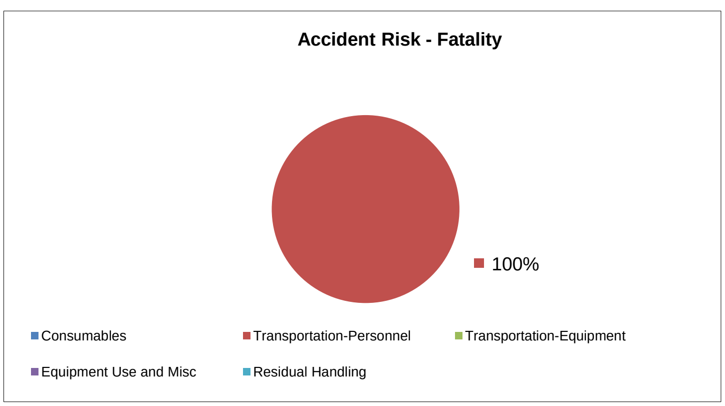


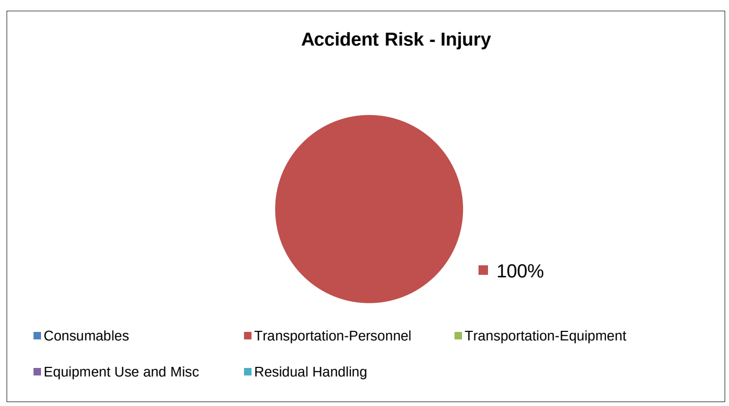


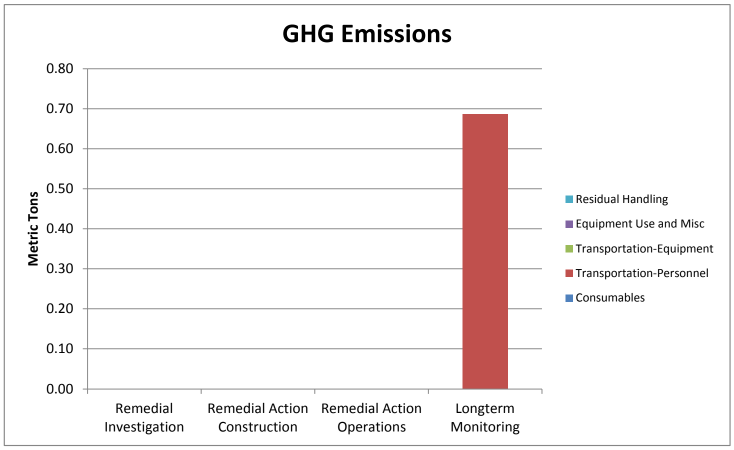


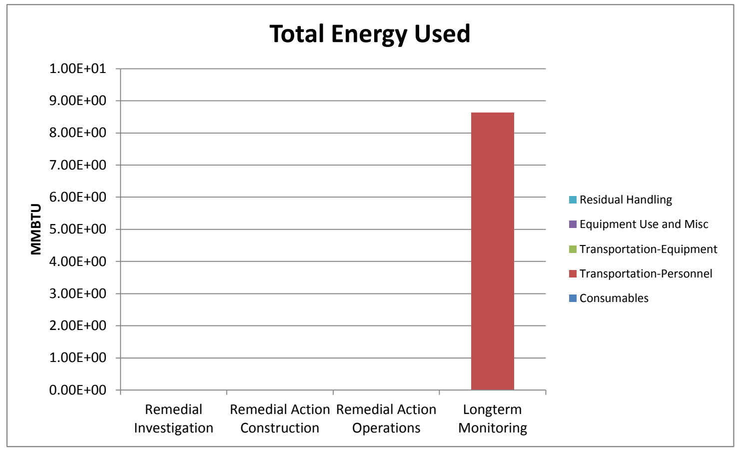


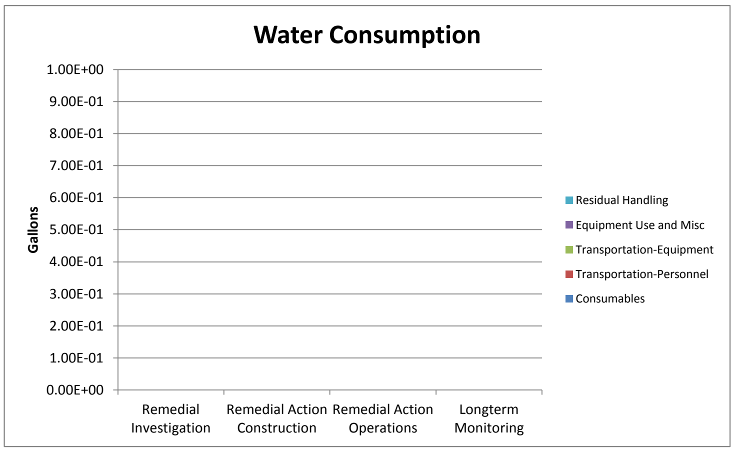


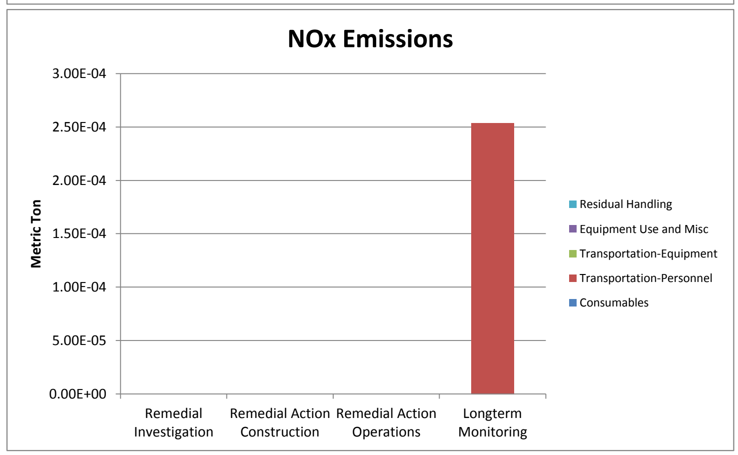


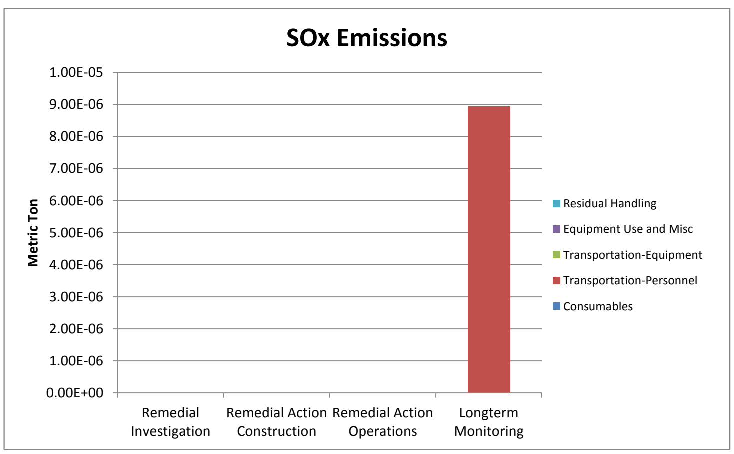


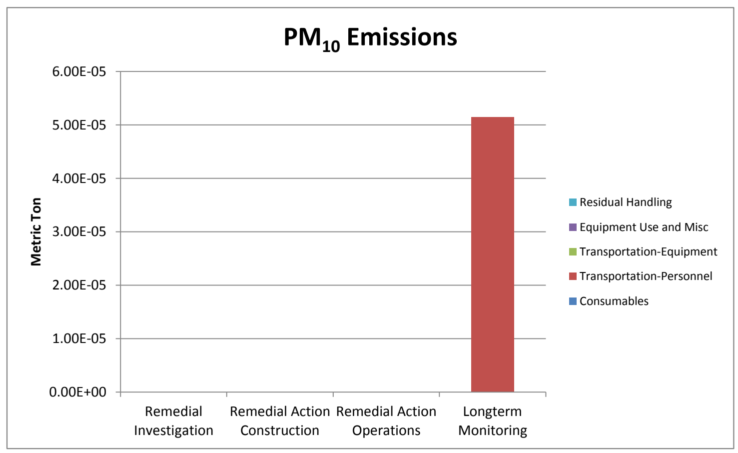

GHG Emissions
Metric Tons
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

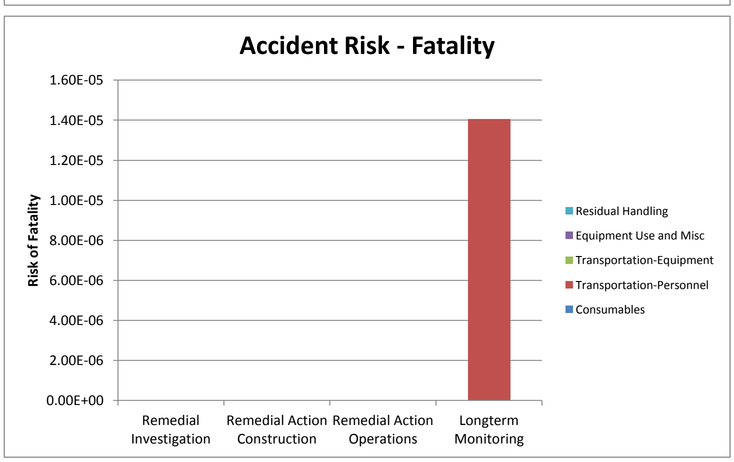

Total Energy Used
MMBTU
1.00E+01
9.00E+00
8.00E+00
7.00E+00
6.00E+00
5.00E+00
4.00E+00
3.00E+00
2.00E+00
1.00E+00
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

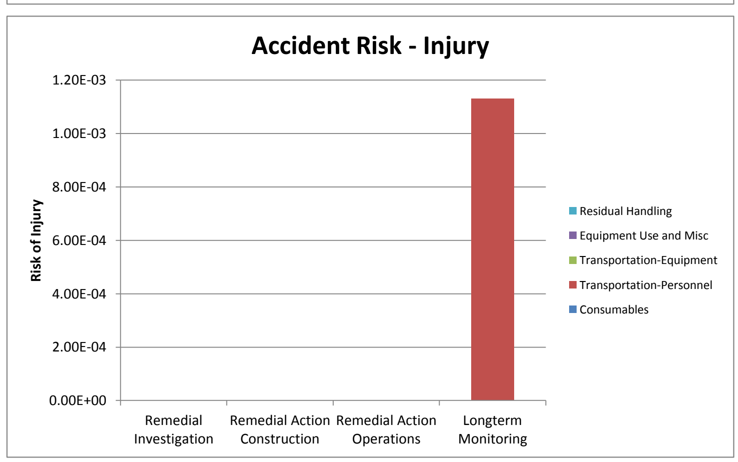

Water Consumption
Gallons
1.00E+00
9.00E-01
8.00E-01
7.00E-01
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
3.00E-04
2.50E-04
2.00E-04
1.50E-04
1.00E-04
5.00E-05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
1.00E-05
9.00E-06
8.00E-06
7.00E-06
6.00E-06
5.00E-06
4.00E-06
3.00E-06
2.00E-06
1.00E-06
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM_{10} Emissions
Metric Ton
6.00E-05
5.00E-05
4.00E-05
3.00E-05
2.00E-05
1.00E-05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
1.60E-05
1.40E-05
1.20E-05
1.00E-05
8.00E-06
6.00E-06
4.00E-06
2.00E-06
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Injury
Risk of Injury
1.20E-03
1.00E-03
8.00E-04
6.00E-04
4.00E-04
2.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

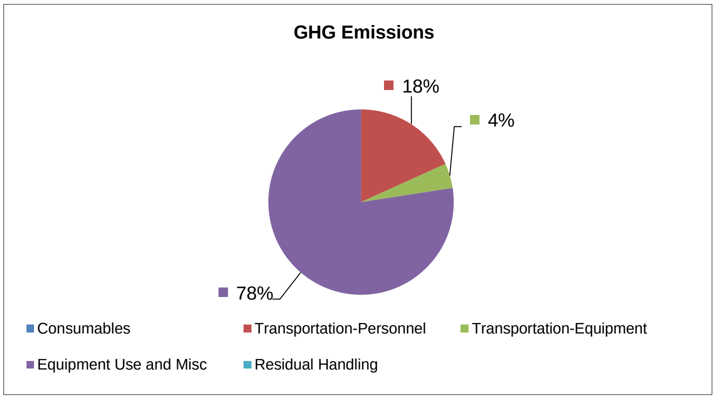
Sustainable Remediation - Environmental Footprint Summary
Alternative 5-2A

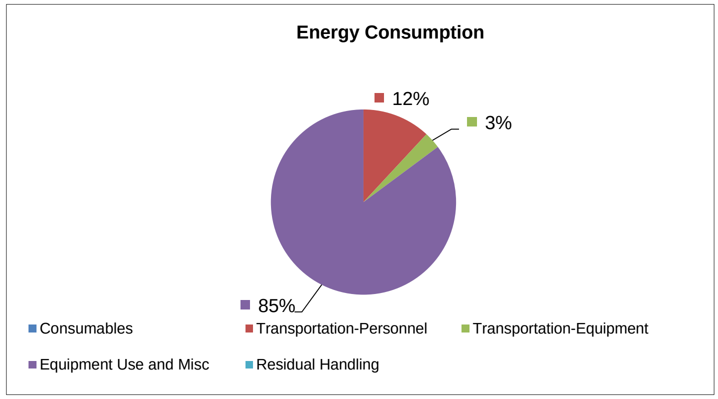
Phase	Activities	GHG Emissions (metric ton)	Total energy Used (MMBTU)	Water Consumption (gallons)	NOx emissions (metric ton)	SOx Emissions (metric ton)	PM10 Emissions (metric ton)	Accident Risk Fatality	Accident Risk Injury
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	1.33	1.7E+01	NA	4.9E-04	1.7E-05	1.0E-04	2.7E-05	2.2E-03
	Transportation-Equipment	0.32	4.1E+00	NA	9.9E-05	1.8E-06	8.8E-06	1.6E-06	1.3E-04
	Equipment Use and Misc	5.67	1.2E+02	5.2E+03	1.6E-02	1.2E-02	1.8E-03	4.1E-06	1.0E-03
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	7.32	1.41E+02	5.17E+03	1.67E-02	1.20E-02	1.95E-03	3.30E-05	3.36E-03
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.69	8.6E+00	NA	2.5E-04	8.9E-06	5.1E-05	1.4E-05	1.1E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.69	8.63E+00	0.00E+00	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
Total		**8.0E+00**	**1.5E+02**	**5.2E+03**	**1.7E-02**	**1.2E-02**	**2.0E-03**	**4.7E-05**	**4.5E-03**

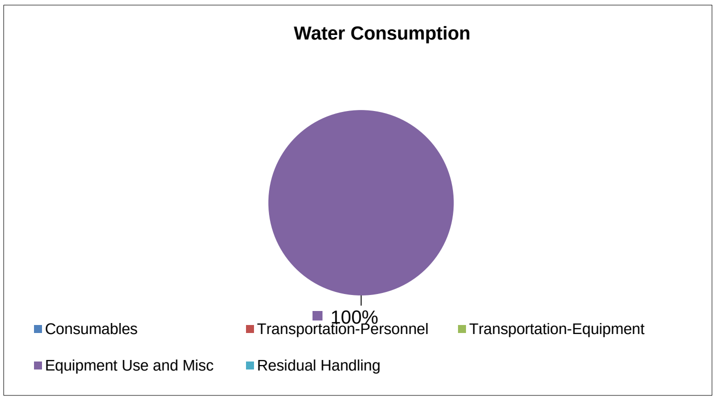
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space (tons)	Hazardous Waste Landfill Space (tons)	Topsoil Consumption (cubic yards)	Costing ($)	Lost Hours - Injury
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	0.0E+00	0.0E+00	0.0E+00	0	2.7E-02
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	9.0E-03
Total	**0.0E+00**	**0.0E+00**	**0.0E+00**	**$0**	**3.6E-02**

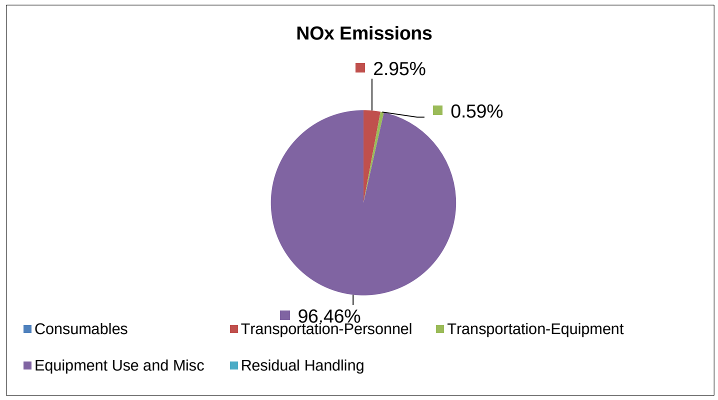
Total Cost with Footprint Reduction
$0

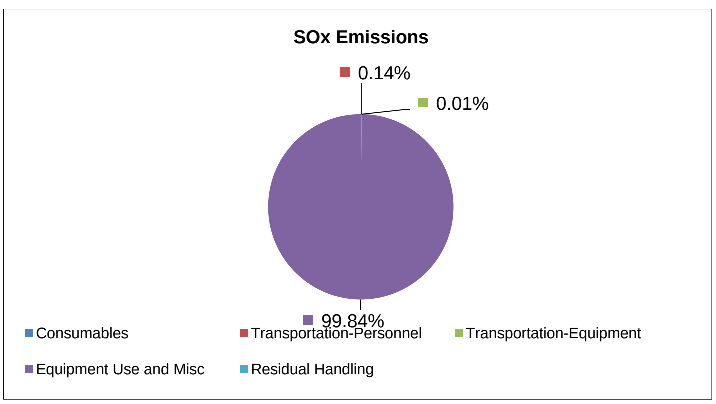
SiteWise™ Results Alternative 5-2A
Residual Action Construction Stage
Site 5-Transformer Storage Boneyard, Naval training Center Great Lakes
Great Lakes, Illinois

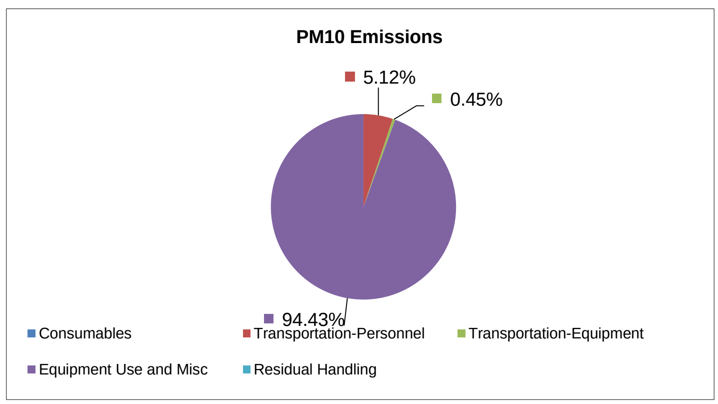


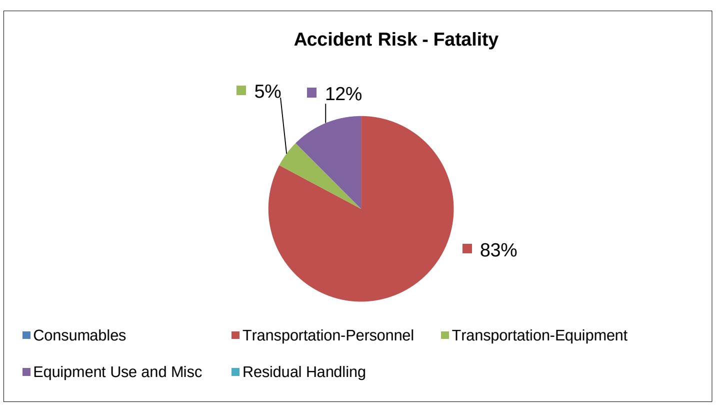


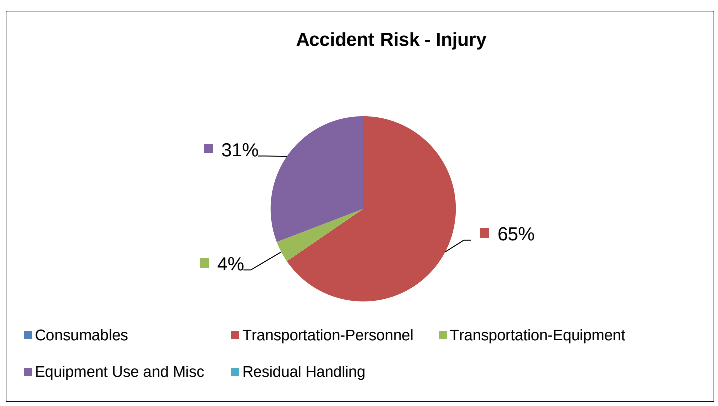




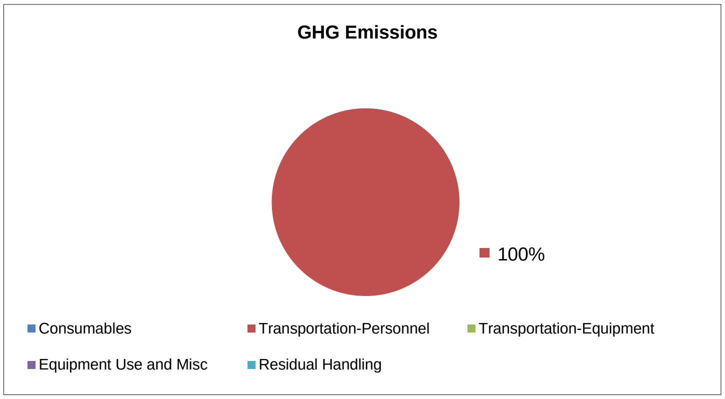


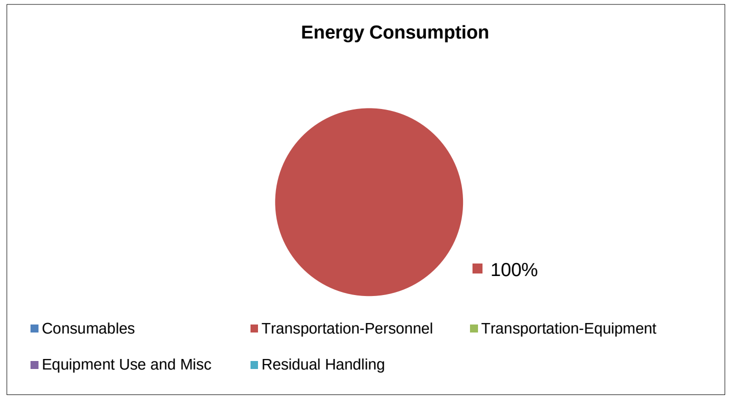


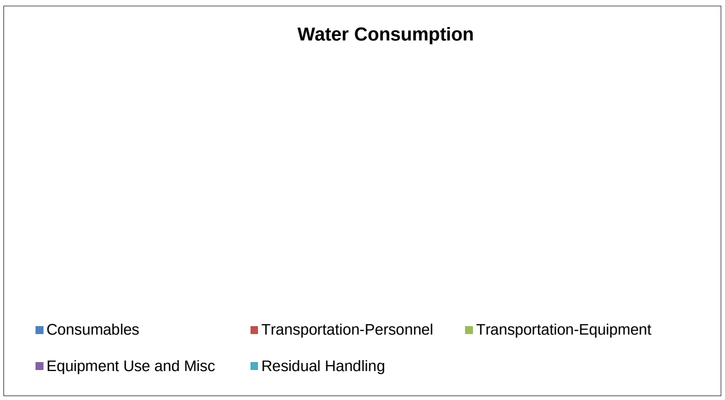


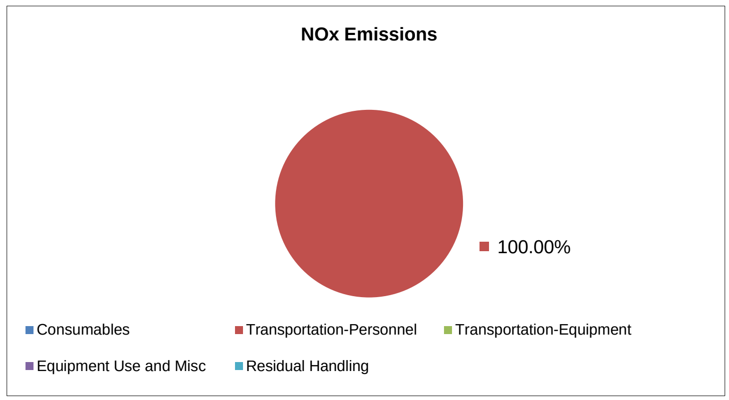


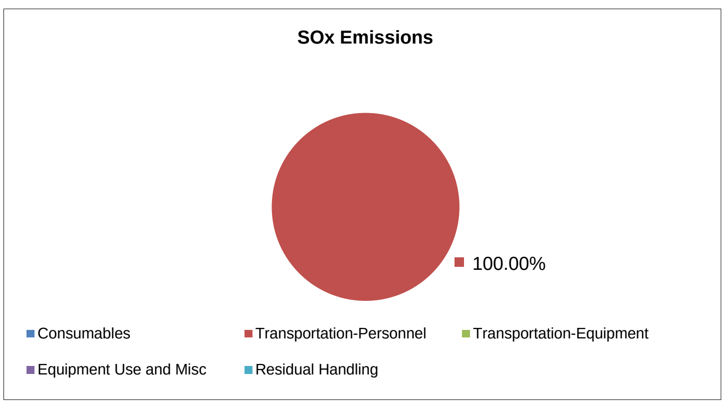
SiteWise™ Results Alternative 5-2A
Long Term Monitoring Stage
Site 5-Transformer Storage Boneyard, Naval training Center Great Lakes
Great Lakes, Illinois

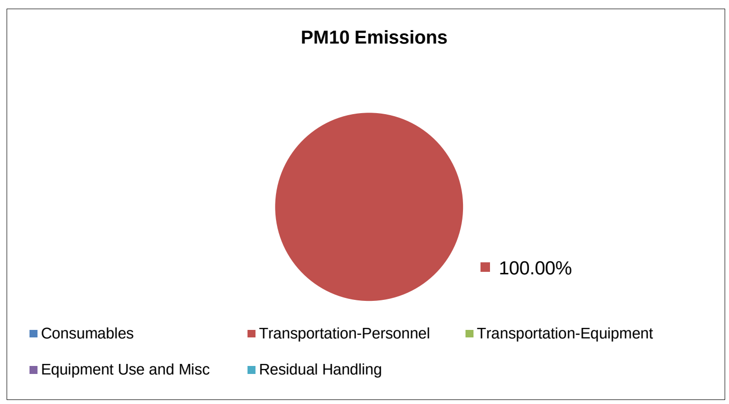


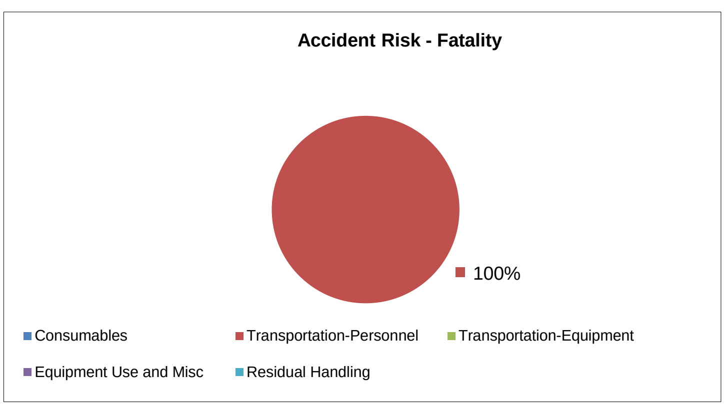


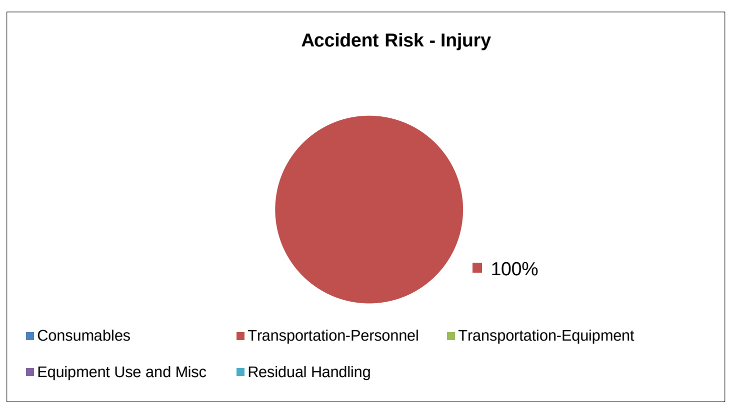




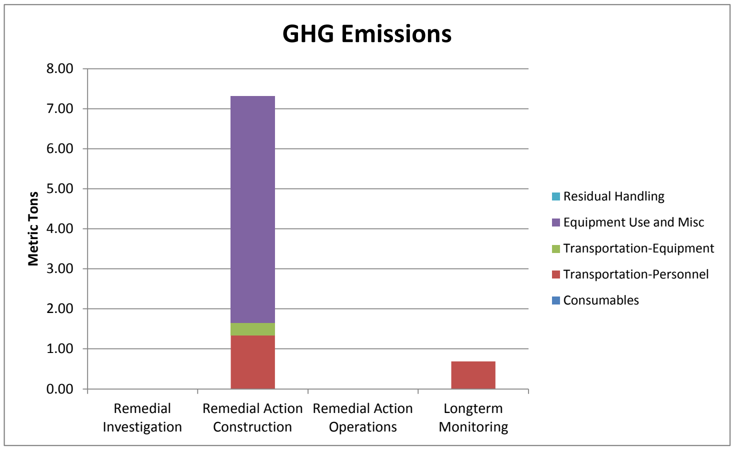


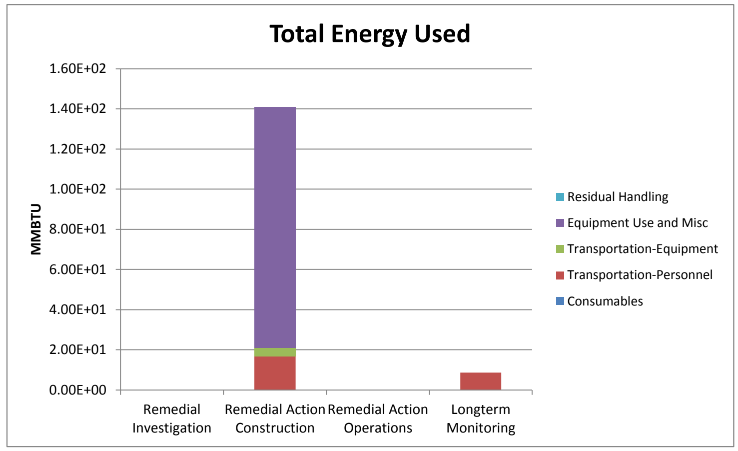


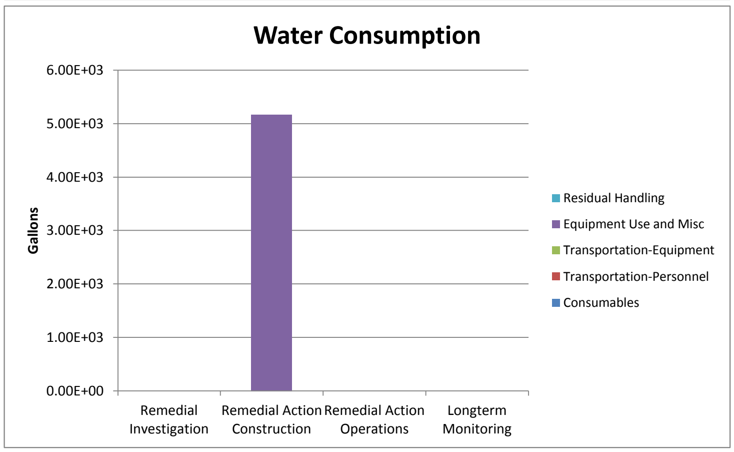


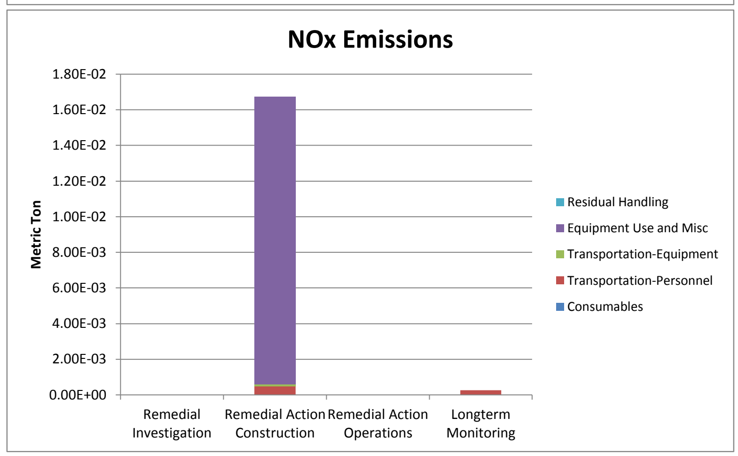


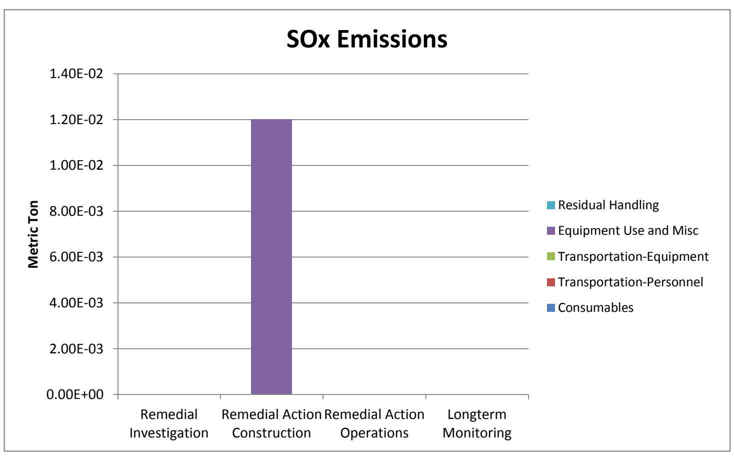
SiteWise™ Results Alternative 5-2A
Site 5-Transformer Storage Boneyard, Naval training Center Great Lakes
Great Lakes, Illinois

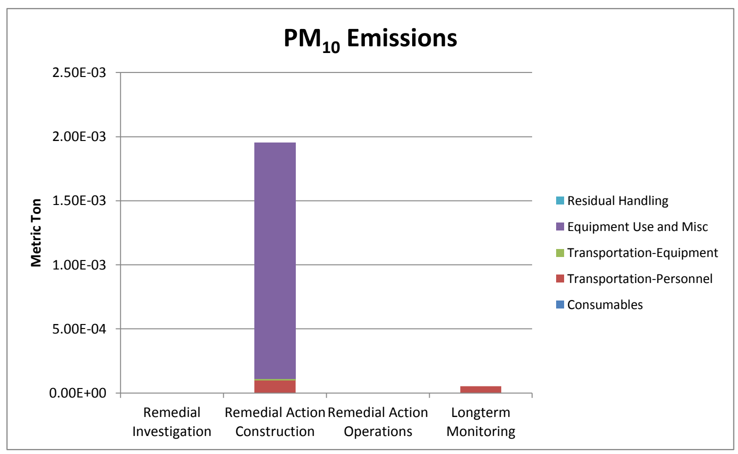


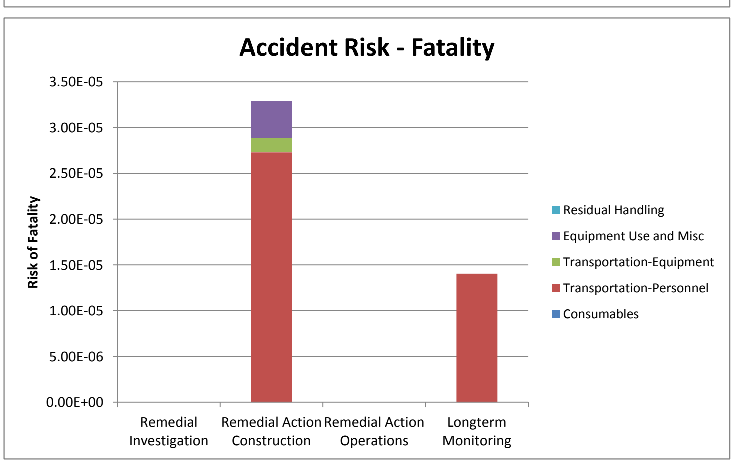


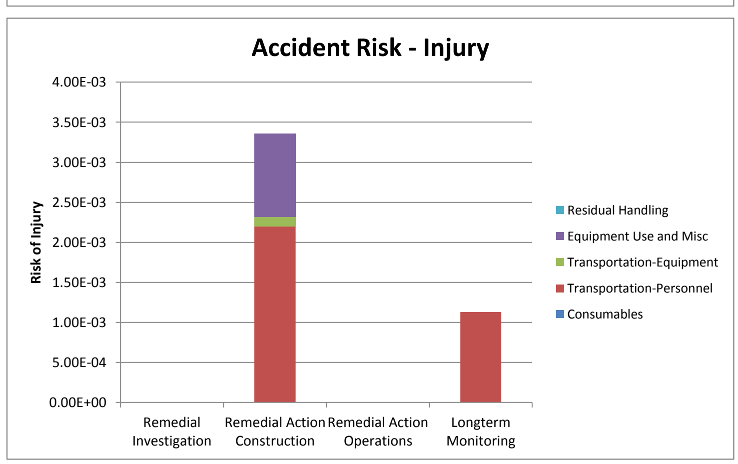












GSRx Results Alternative 5-2A
Site 5-Transformer Storage Boneyard, Naval Training Center Great Lakes
Great Lakes, Illinois

						Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy	Water
	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}	Consumption	Consumption
Stage	**Materials**								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Well Instalation	PVC	32 wells, 6 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft	192.00	lft	0.31	0.16	0.00	0.00	0.00	0.00	0.00	5.72	0.33
RAC	Temporary Equipment Decon Pad Liner	HDPE	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3	700.47	lbs	1.56	0.83	0.00	0.01	0.00	0.00	0.00	9.17	0.25
RAC	Temporary Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3	514.68	lbs	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Fenton Reagent	Hydrogen Peroxide	Assume hydrogen peroxide, 7% by weight of 1,700 gal. Assume two events	238.00	lbs	0.44	0.13	0.00	0.00	0.00	0.00	0.00	3.35	0.00
	Subtotal					**2.32**	**1.12**	**0.00**	**0.01**	**0.00**	**0.00**	**0.00**	**18.24**	**0.59**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	DPT Drill Rig, well installation	Drill Rig, DPT (diesel)	Assume 5 wells per day, 32 wells, 8 hours per day, 80% utilization	44.80	hrs	0.72	0.70	0.00	0.00	0.01	0.00	0.00	5.48	
	Subtotal					**0.72**	**0.70**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**5.48**	**0**
				Total		**3**	**2**	**0.00**	**0.01**	**0.01**	**0.00**	**0.00**	**24**	**1**

Alternative 1
Values Input into SiteWise as "Other"

Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}		
				Tonnes				**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	3.03	1.82	1.02	0.20	0.01	0.00	0.00	80.92	585.45
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

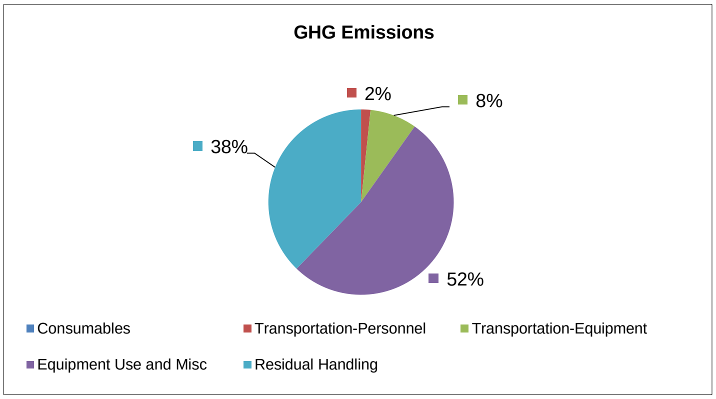
Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

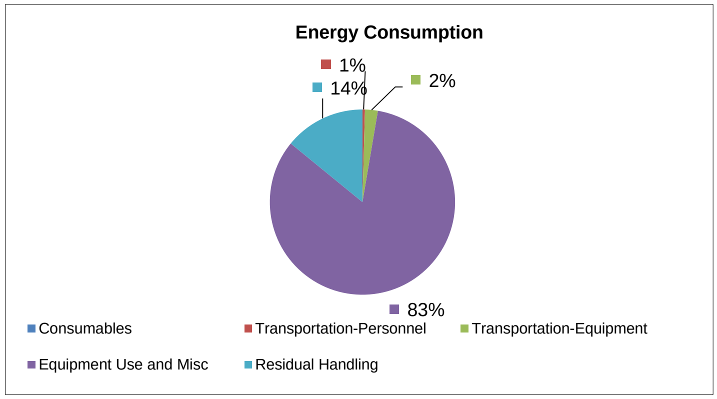
Sustainable Remediation - Environmental Footprint Summary
Alternative 5-3

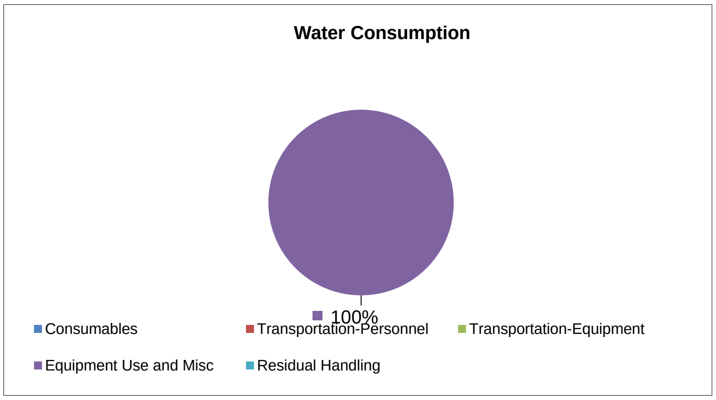
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	4.74	6.0E+01	NA	1.8E-03	6.2E-05	3.6E-04	9.7E-05	7.8E-03
	Transportation-Equipment	23.66	3.1E+02	NA	7.4E-03	1.3E-04	6.6E-04	5.9E-05	4.7E-03
	Equipment Use and Misc	151.69	1.1E+04	1.7E+03	1.6E-01	5.3E-02	1.5E-02	2.8E-05	7.1E-03
	Residual Handling	109.21	1.9E+03	NA	3.7E-01	1.9E-01	1.0E+00	1.1E-04	9.0E-03
	Sub-Total	289.30	1.38E+04	1.65E+03	5.46E-01	2.46E-01	1.05E+00	2.95E-04	2.86E-02
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.69	8.6E+00	NA	2.5E-04	8.9E-06	5.1E-05	1.4E-05	1.1E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.69	8.63E+00	0.00E+00	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
Total		**2.9E+02**	**1.4E+04**	**1.7E+03**	**5.5E-01**	**2.5E-01**	**1.0E+00**	**3.1E-04**	**3.0E-02**

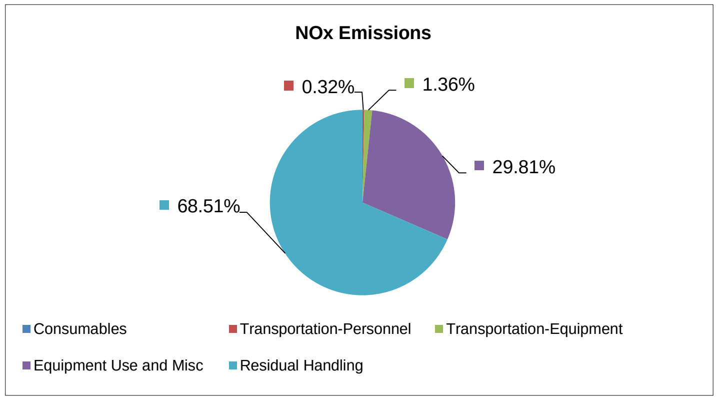
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	5.7E+03	0.0E+00	3.9E+03	0	2.3E-01
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	9.0E-03
Total	**5.7E+03**	**0.0E+00**	**3.9E+03**	**$0**	**2.4E-01**

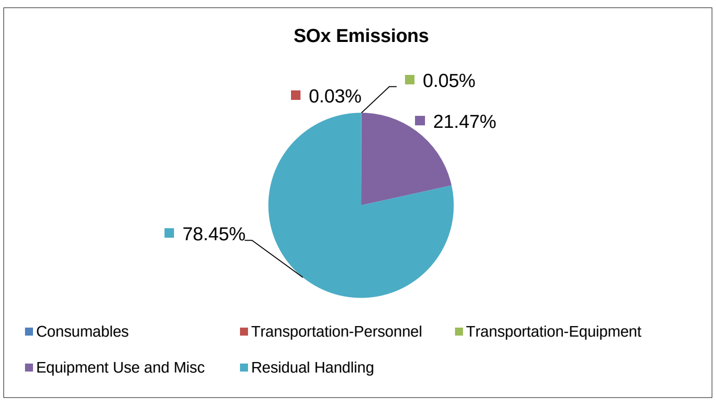
Total Cost with Footprint Reduction
$0

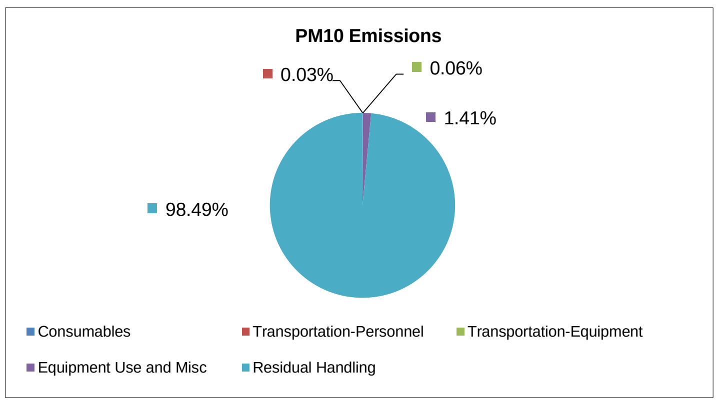

GHG Emissions
2%
8%
38%
52%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

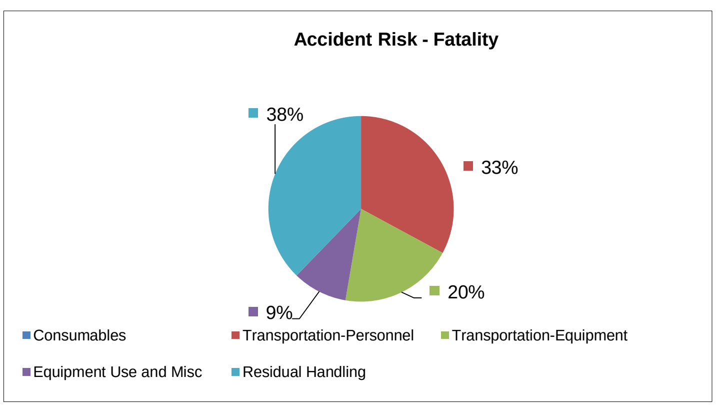

Energy Consumption
1%
14%
2%
83%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

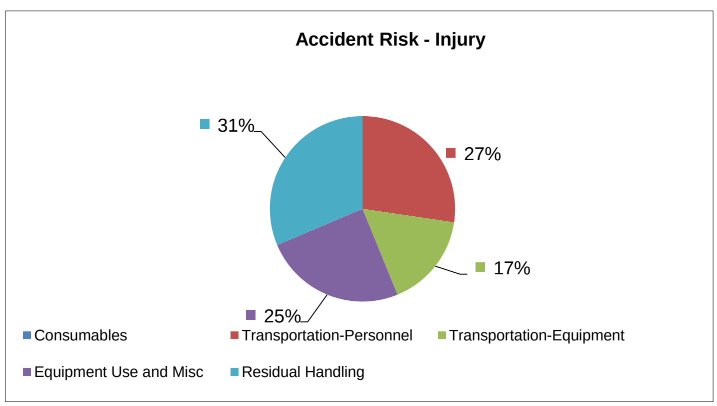

Water Consumption
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


NOx Emissions
0.32%
1.36%
29.81%
68.51%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

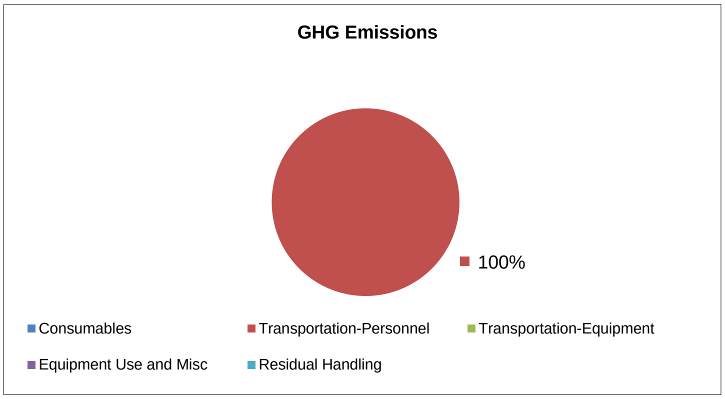

SOx Emissions
0.03%
0.05%
21.47%
78.45%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

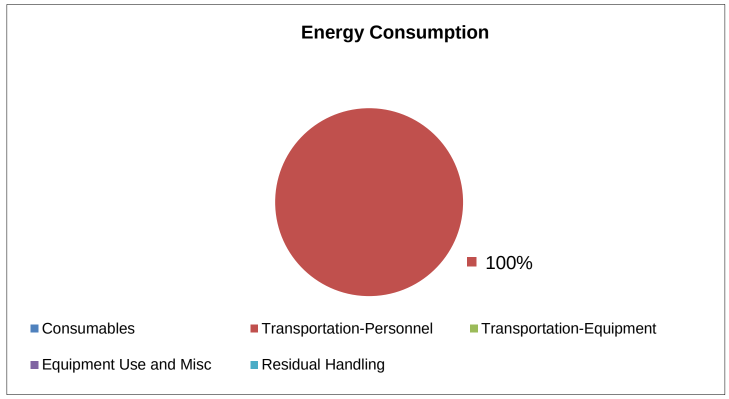

PM10 Emissions
0.03%
0.06%
1.41%
98.49%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

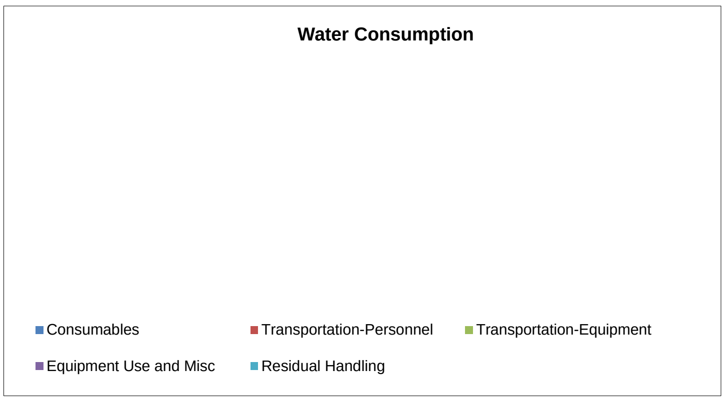

Accident Risk - Fatality
38%
33%
20%
9%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

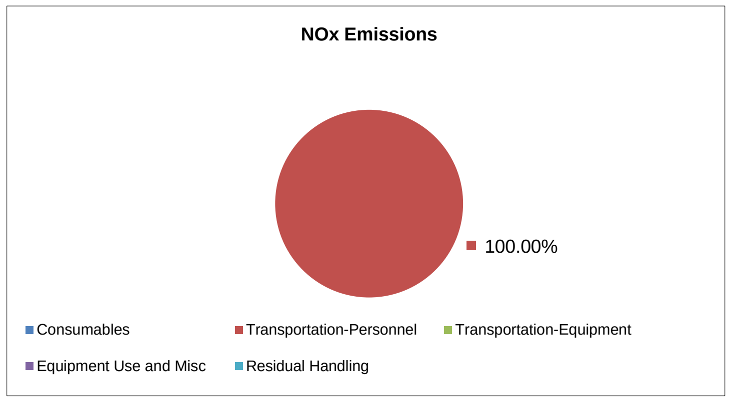

Accident Risk - Injury
31%
27%
17%
25%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

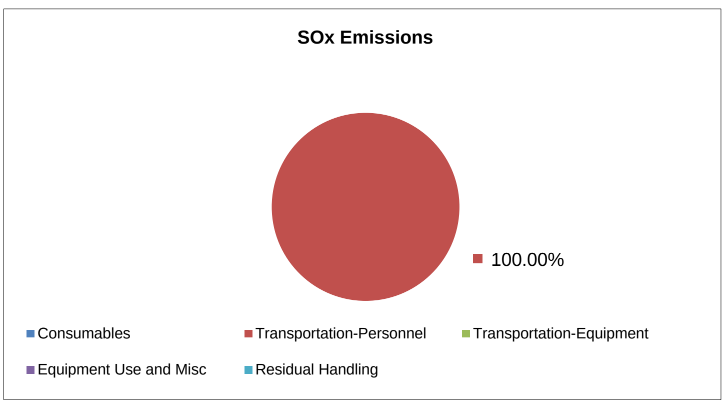
SiteWise™ Results Alternative 5-3
Site 5-Transformer Storage Boneyard, Naval training Center Great Lakes
Great Lakes, Illinois

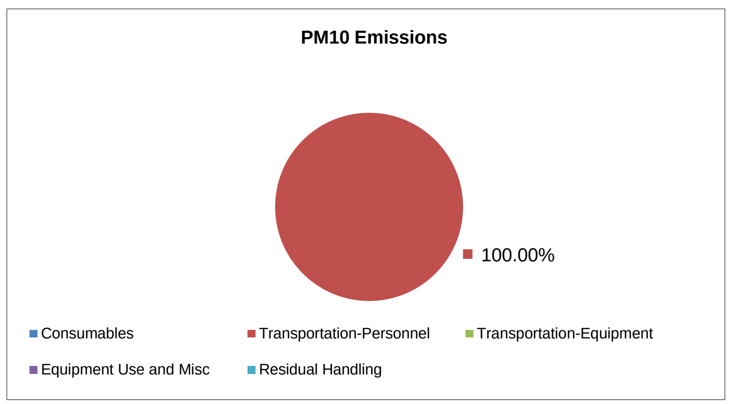


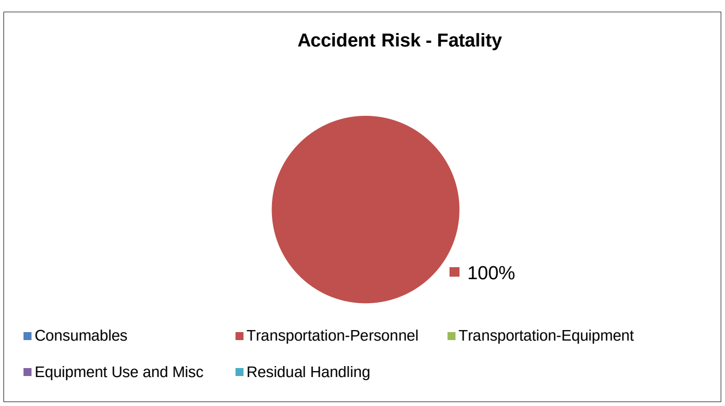


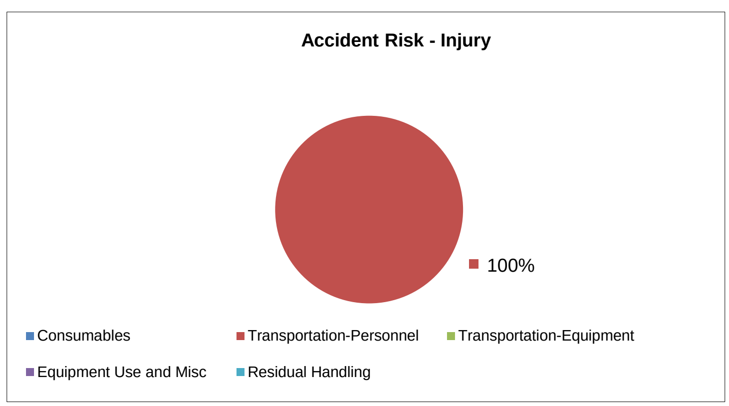


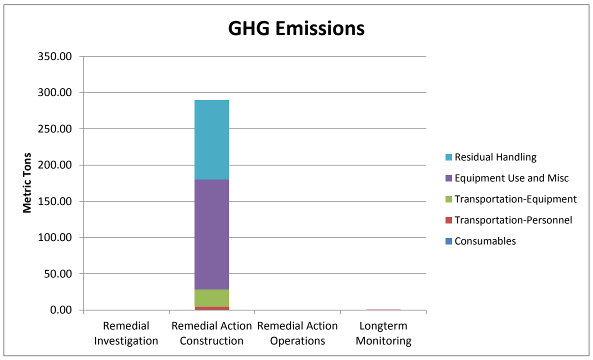


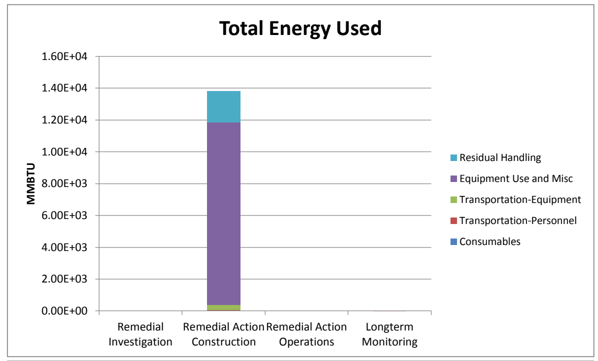


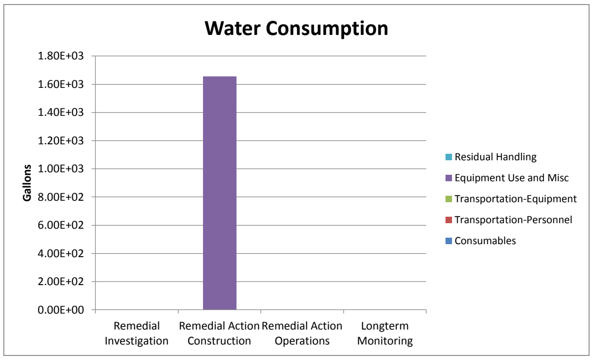


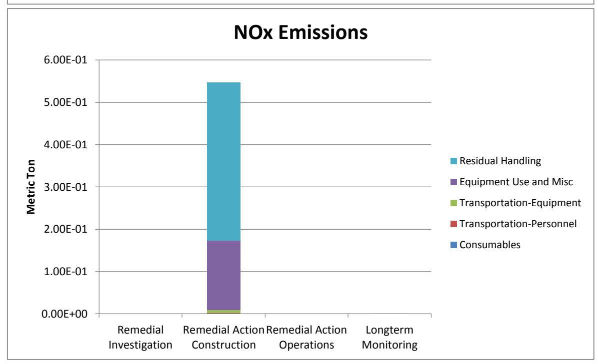


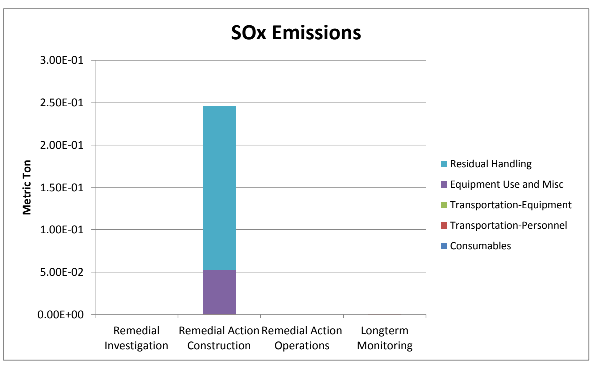


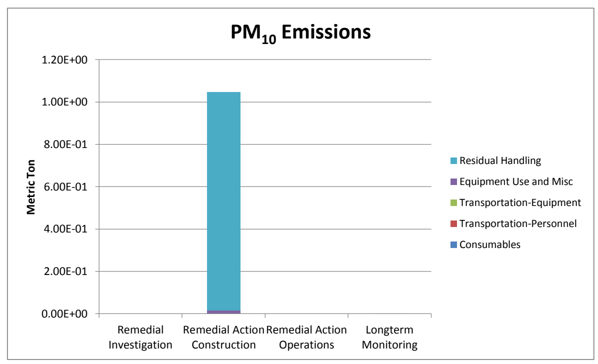

GHG Emissions
Metric Tons
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

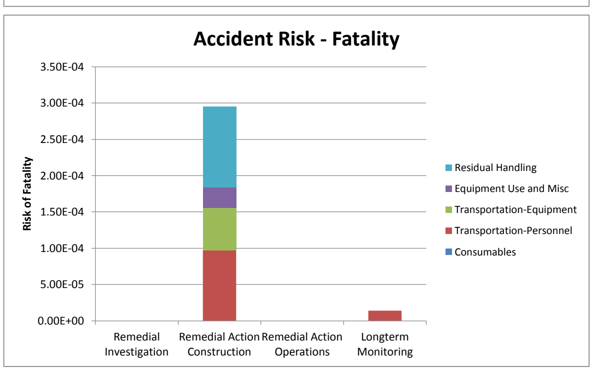

Total Energy Used
MMBTU
1.60E+04
1.40E+04
1.20E+04
1.00E+04
8.00E+03
6.00E+03
4.00E+03
2.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

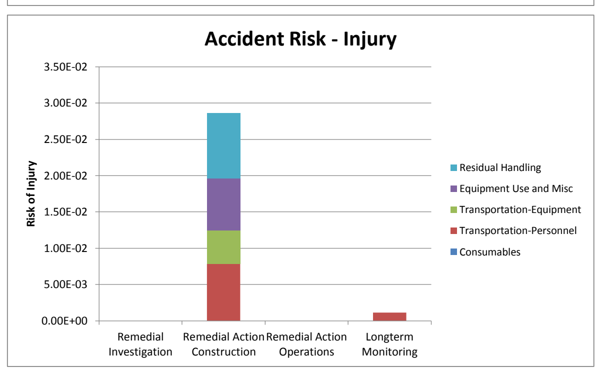

Water Consumption
Gallons
1.80E+03
1.60E+03
1.40E+03
1.20E+03
1.00E+03
8.00E+02
6.00E+02
4.00E+02
2.00E+02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

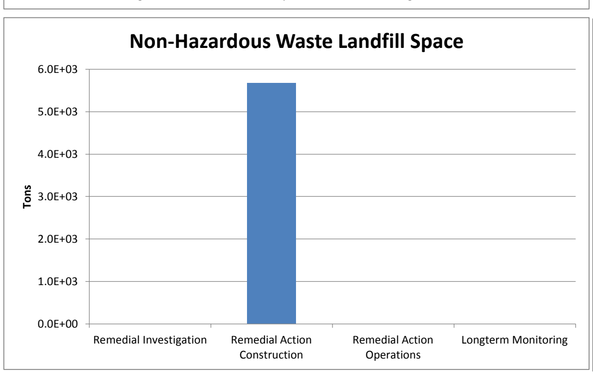

NOx Emissions
Metric Ton
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

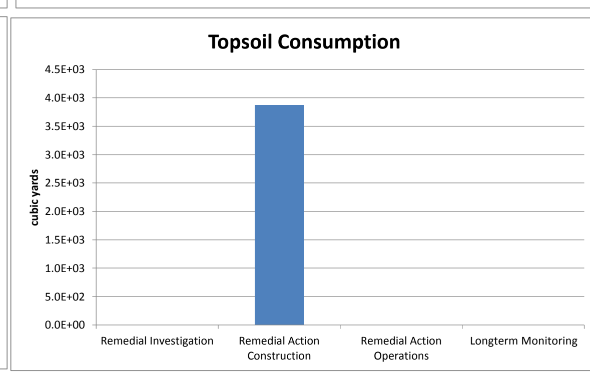

SOx Emissions
Metric Ton
3.00E-01
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM_{10} Emissions
Metric Ton
1.20E+00
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
3.50E-04
3.00E-04
2.50E-04
2.00E-04
1.50E-04
1.00E-04
5.00E-05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Injury
Risk of Injury
3.50E-02
3.00E-02
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Non-Hazardous Waste Landfill Space
Tons
6.0E+03
5.0E+03
4.0E+03
3.0E+03
2.0E+03
1.0E+03
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring


Topsoil Consumption
cubic yards
4.5E+03
4.0E+03
3.5E+03
3.0E+03
2.5E+03
2.0E+03
1.5E+03
1.0E+03
5.0E+02
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring

GSRx Results Alternative 5-3
Site 5-Transformer Storage Boneyard, Naval Training Center Great Lakes
Great Lakes, Illinois

Stage	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
						CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	**Materials**					**Tonnes**							**MWhr**	**gal x 1000**
RAC	Temporary Equipment Decon Pad Liner	HDPE	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3	700.47	lbs	1.56	0.83	0.00	0.01	0.00	0.00	0.00	9.17	0.25
RAC	Temporary Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3	514.68	lbs	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Backfill, common fill	Soil	3,182 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil	9,546,000.00	lbs	99.57	99.57	0.00	0.00	0.00	0.00	0.00	2631.33	0.00
RAC	Backfill, vegetative soil	Soil	690 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil	2,070,000.00	lbs	21.59	21.59	0.00	0.00	0.00	0.00	0.00	570.59	0.00
RAC	Seeding, mulch	Mulch	44 msf, assume mulch assume, 50 lb per msf	2,200.00	lbs	0.70	0.24	0.00	0.00	0.00	0.00	0.00	7.87	0.00
RAC	Seeding, fertilizer	Fertilizer	44 msf, assume fertilizer, assume 20 lb per smf	880.00	lbs	1.10	1.10	0.00	0.00	0.00	0.00	0.00	19.89	0.40
	Subtotal					**124.53**	**123.34**	**0.00**	**0.01**	**0.00**	**0.01**	**0.00**	**3238.85**	**0.65**
	Construction Equipment					**Tonnes**							**MWhr**	**gal x 1000**
RAC	Excavator, 2.5 CY	Excavator, Hydraulic, 2 CY (diesel)	13 days, 8 hours per day, 80% utilization	83.20	hrs	8.06	8.06	0.00	0.00	0.05	0.01	0.00	36.60	
RAC	DPT drill Rig	Drill Rig, DPT (diesel)	3 days, 8 hours per day, 80% utilization	19.20	hrs	0.31	0.30	0.00	0.00	0.00	0.00	0.00	2.35	
RAC	Excavator, 2.5 CY	Excavator, Hydraulic, 2 CY (diesel)	10 days, 8 hours per day, 80% utilization	64.00	hrs	6.20	6.20	0.00	0.00	0.04	0.01	0.00	28.16	
RAC	Dozer, 140 hp	Dozer, 140 HP (D6) w/A Blade (diesel)	10 days, 8 hours per day, 80% utilization	64.00	hrs	3.84	3.84	0.00	0.00	0.03	0.01	0.00	20.60	
RAC	Compactor 125 hp	Compactor 120 hp	10 days, 8 hours per day, 80% utilization	64.00	hrs	2.56	2.56	0.00	0.00	0.02	0.00	0.00	11.83	
RAC	tractor	Tractor (agricultural equipment), 250 hp, diesel	1 day, 8 hours per day, 80% utilization	6.40	hrs	0.48	0.48	0.00	0.00	0.00	0.00	0.00	1.72	
RAC	hydromulcher	Hydromulcher 15 hp (gasoline)	1 day, 8 hours per day, 80% utilization	6.40	hrs	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.21	
	Subtotal					**21.50**	**21.49**	**0.00**	**0.00**	**0.14**	**0.03**	**0.01**	**101.46**	**0**
				Total		**146**	**145**	**0.00**	**0.01**	**0.14**	**0.04**	**0.01**	**3,340**	**1**

Alternative 1
Values Input into SiteWise as "Other"

Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}		
	Tonnes							**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	146.03	144.83	1.05	0.15	0.14	0.04	0.01	11,397.15	652.84
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

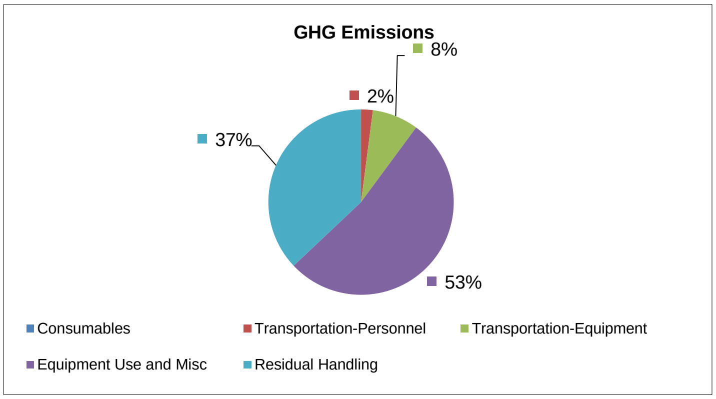
Sustainable Remediation - Environmental Footprint Summary
Alternative 5-3A

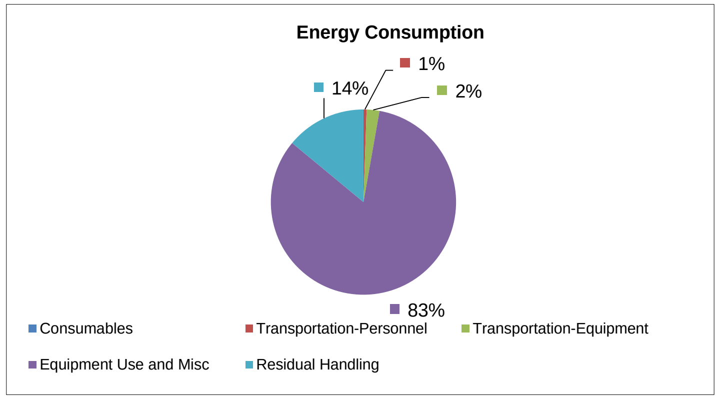
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	6.04	7.6E+01	NA	2.2E-03	7.9E-05	4.5E-04	1.2E-04	1.0E-02
	Transportation-Equipment	23.81	3.1E+02	NA	7.5E-03	1.3E-04	6.7E-04	5.9E-05	4.8E-03
	Equipment Use and Misc	155.78	1.2E+04	5.6E+03	1.8E-01	6.1E-02	1.6E-02	3.2E-05	8.1E-03
	Residual Handling	109.21	1.9E+03	NA	3.7E-01	1.9E-01	1.0E+00	1.1E-04	9.0E-03
	Sub-Total	294.84	1.39E+04	5.57E+03	5.63E-01	2.55E-01	1.05E+00	3.26E-04	3.18E-02
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.69	8.6E+00	NA	2.5E-04	8.9E-06	5.1E-05	1.4E-05	1.1E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.69	8.63E+00	0.00E+00	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
Total		**3.0E+02**	**1.4E+04**	**5.6E+03**	**5.6E-01**	**2.5E-01**	**1.0E+00**	**3.4E-04**	**3.3E-02**

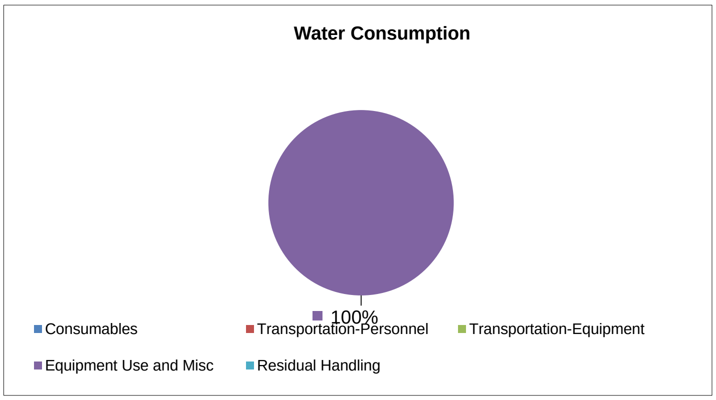
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	5.7E+03	0.0E+00	3.9E+03	0	2.5E-01
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	9.0E-03
Total	**5.7E+03**	**0.0E+00**	**3.9E+03**	**$0**	**2.6E-01**

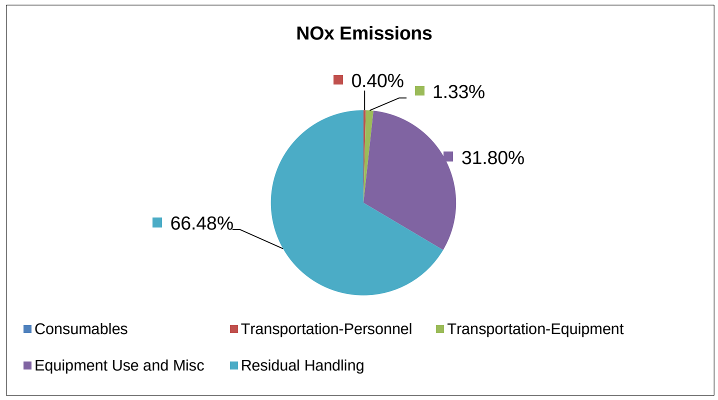
Total Cost with Footprint Reduction
$0

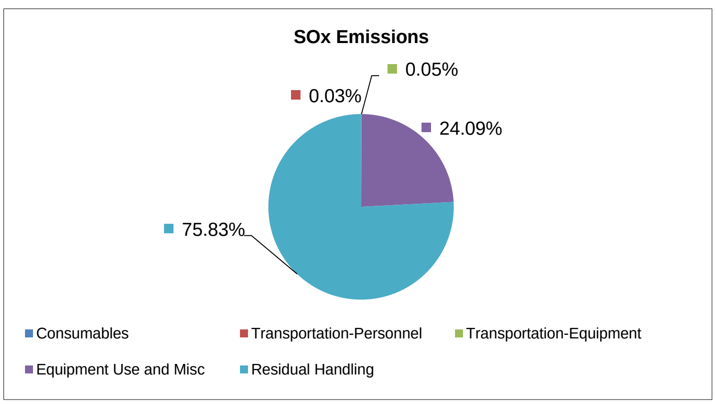
SiteWise™ Results Alternative 5-3A
Residual Action Construction Stage
Site 5-Transformer Storage Boneyard, Naval training Center Great Lakes
Great Lakes, Illinois

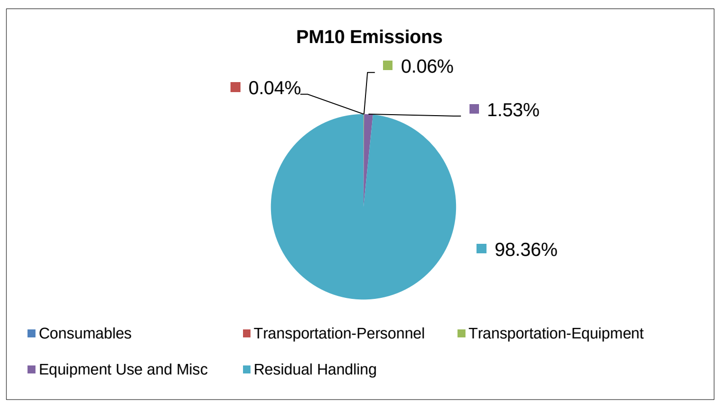


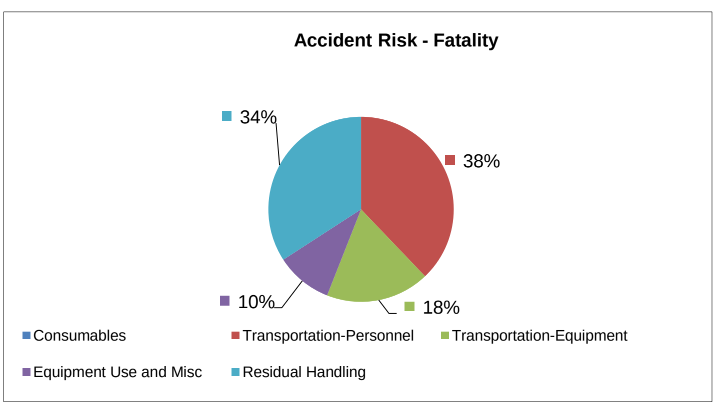


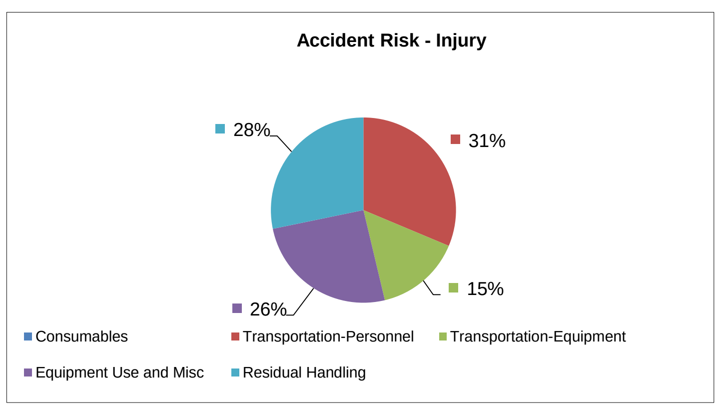




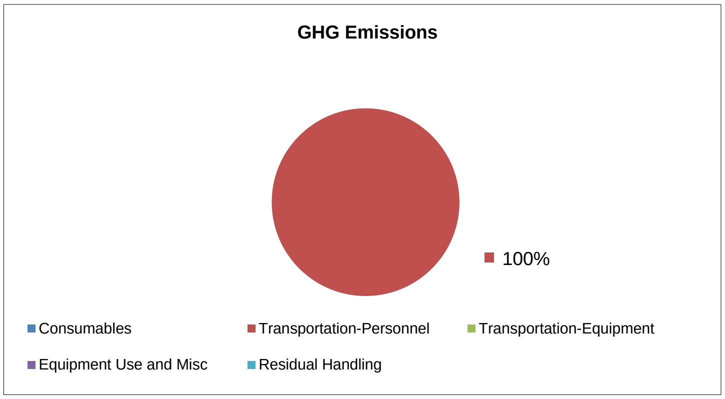


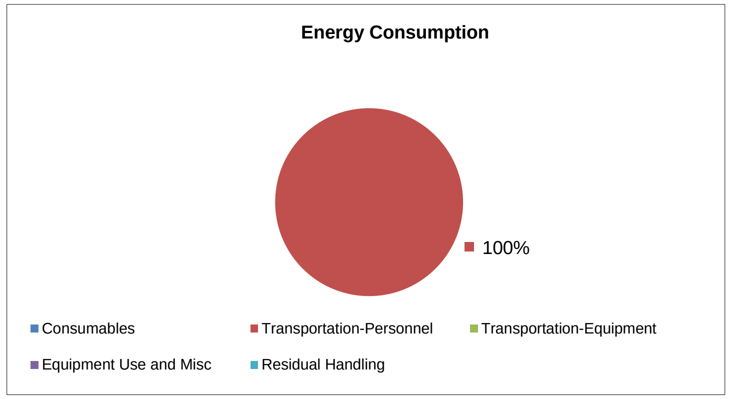


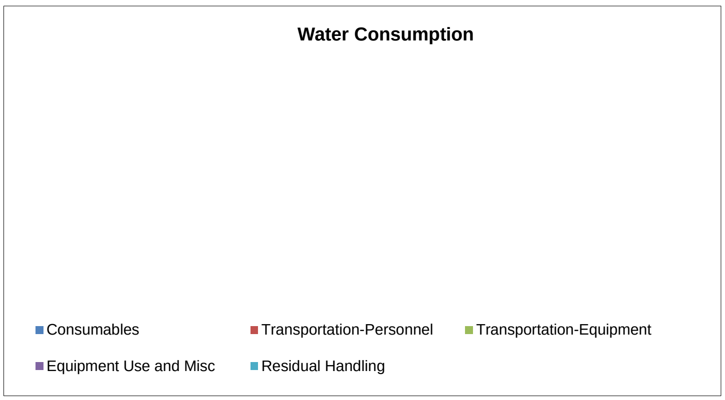


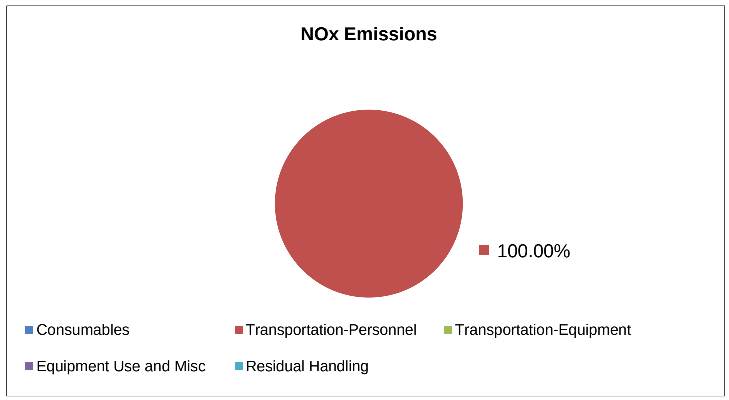


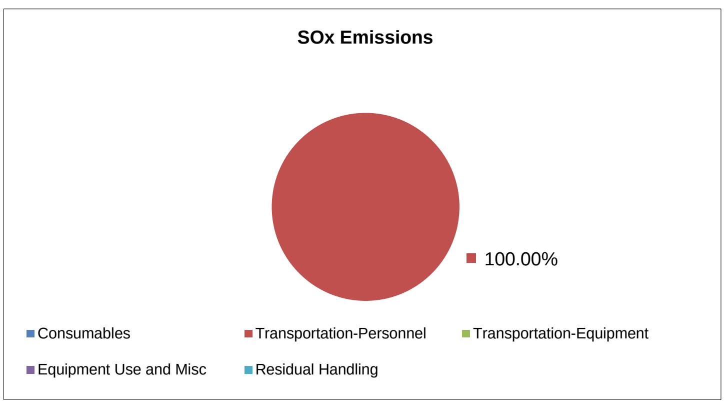
SiteWise™ Results Alternative 5-3A
Long Term Monitoring Stage
Site 5-Transformer Storage Boneyard, Naval training Center Great Lakes
Great Lakes, Illinois

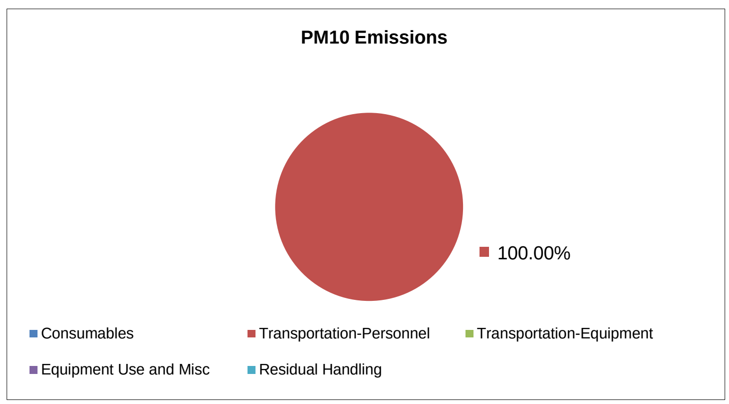


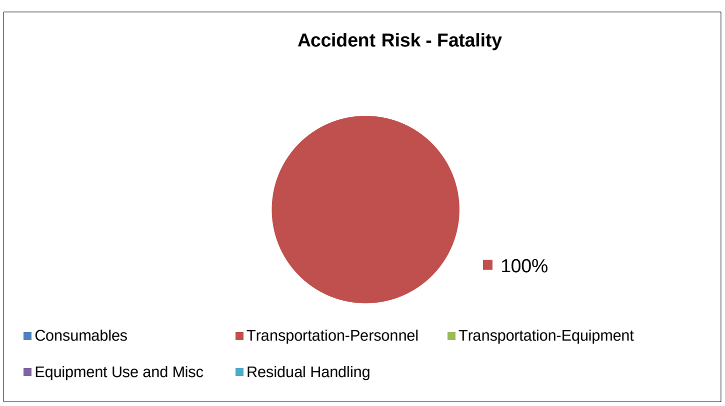


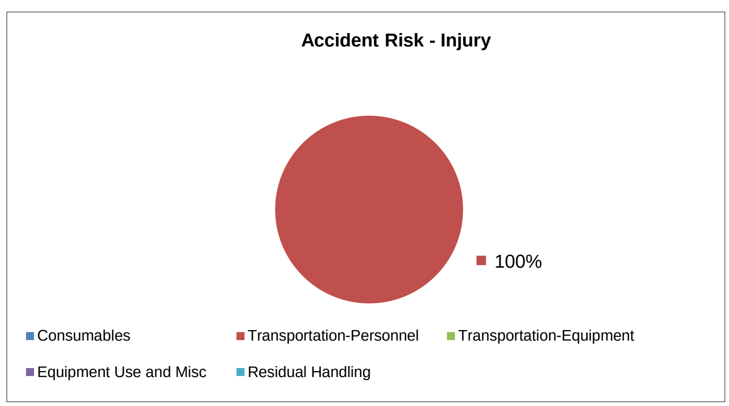


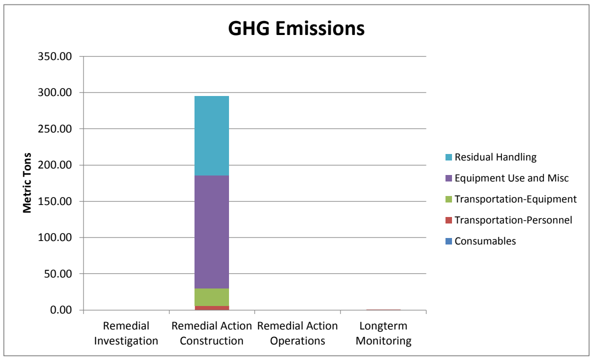


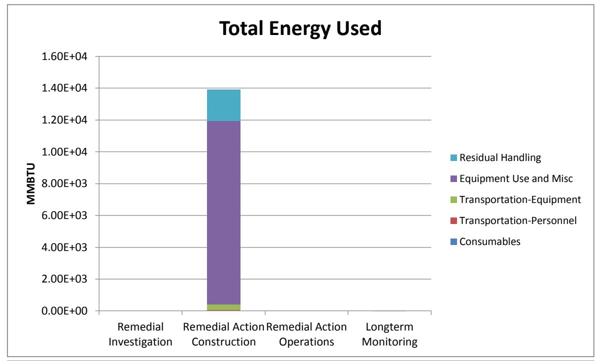


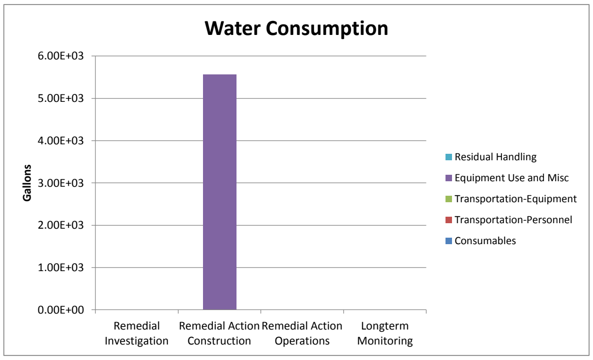


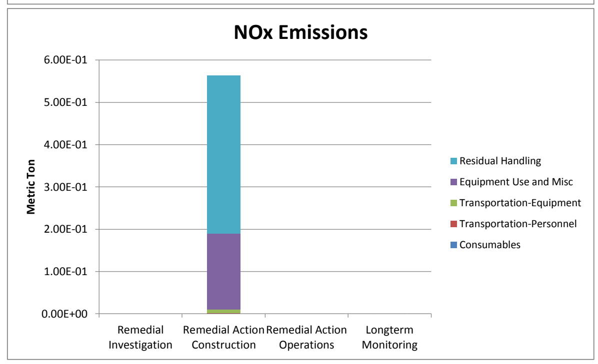


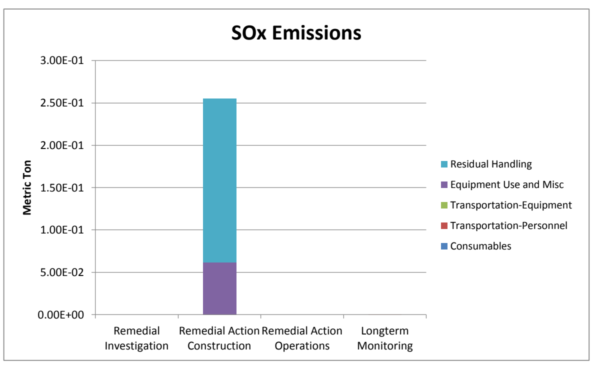


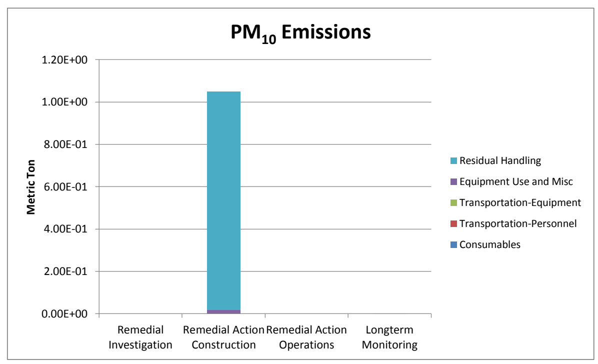

GHG Emissions
Metric Tons
350.00
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

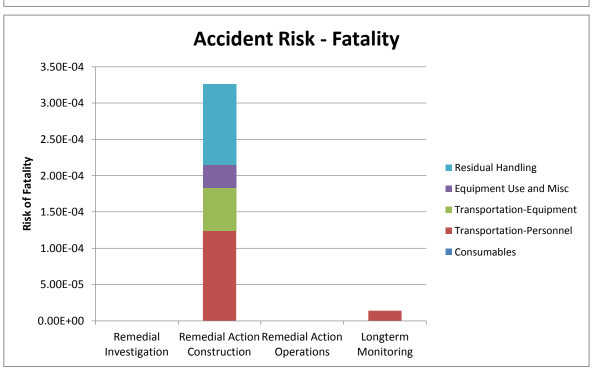

Total Energy Used
MMBTU
1.60E+04
1.40E+04
1.20E+04
1.00E+04
8.00E+03
6.00E+03
4.00E+03
2.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

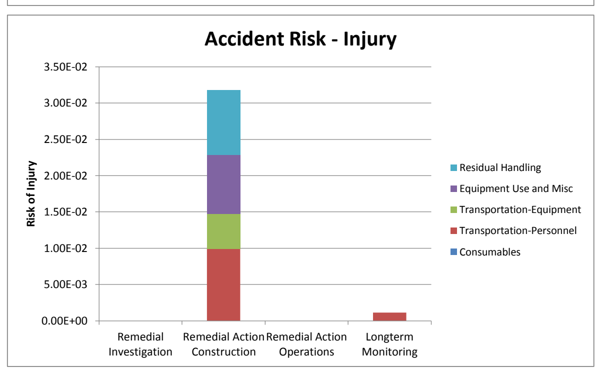

Water Consumption
Gallons
6.00E+03
5.00E+03
4.00E+03
3.00E+03
2.00E+03
1.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

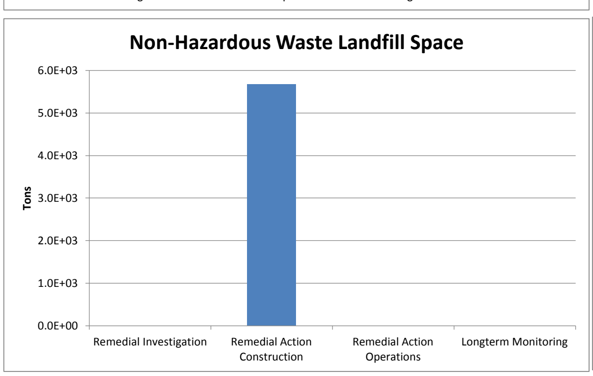

NOx Emissions
Metric Ton
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

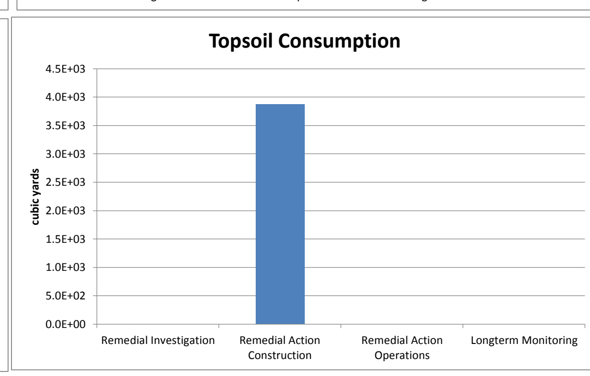

SOx Emissions
Metric Ton
3.00E-01
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM_{10} Emissions
Metric Ton
1.20E+00
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
3.50E-04
3.00E-04
2.50E-04
2.00E-04
1.50E-04
1.00E-04
5.00E-05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Injury
Risk of Injury
3.50E-02
3.00E-02
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Non-Hazardous Waste Landfill Space
Tons
6.0E+03
5.0E+03
4.0E+03
3.0E+03
2.0E+03
1.0E+03
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring


Topsoil Consumption
cubic yards
4.5E+03
4.0E+03
3.5E+03
3.0E+03
2.5E+03
2.0E+03
1.5E+03
1.0E+03
5.0E+02
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring

	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
						CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	**Materials**								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Well Instalation	PVC	32 wells, 6 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft	192.00	lft	0.31	0.16	0.00	0.00	0.00	0.00	0.00	5.72	0.33
RAC	Temporary Equipment Decon Pad Liner	HDPE	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3	700.47	lbs	1.56	0.83	0.00	0.01	0.00	0.00	0.00	9.17	0.25
RAC	Temporary Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3	514.68	lbs	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Backfill, common fill	Soil	3,182 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil	9,546,000.00	lbs	99.57	99.57	0.00	0.00	0.00	0.00	0.00	2631.33	0.00
RAC	Backfill, vegetative soil	Soil	690 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil	2,070,000.00	lbs	21.59	21.59	0.00	0.00	0.00	0.00	0.00	570.59	0.00
RAC	Seeding, mulch	Mulch	44 msf, assume mulch assume, 50 lb per msf	2,200.00	lbs	0.70	0.24	0.00	0.00	0.00	0.00	0.00	7.87	0.00
RAC	Seeding, fertilizer	Fertilizer	44 msf, assume fertilizer, assume 20 lb per smf	880.00	lbs	1.10	1.10	0.00	0.00	0.00	0.00	0.00	19.89	0.40
RAC	Fenton Reagent	Hydrogen Peroxide	Assume hydrogen peroxide, 7% by weight of 1,700 gal. Assume two events	238.00	lbs	0.44	0.13	0.00	0.00	0.00	0.00	0.00	3.35	0.00
	Subtotal					**125.27**	**123.62**	**0.00**	**0.01**	**0.00**	**0.01**	**0.00**	**3247.92**	**0.98**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	DPT drill Rig	Drill Rig, DPT (diesel)	3 days, 8 hours per day, 80% utilization	19.20	hrs	0.31	0.30	0.00	0.00	0.00	0.00	0.00	2.35	
RAC	Excavator, 2.5 CY	Excavator, Hydraulic, 2 CY (diesel)	13 days, 8 hours per day, 80% utilization	83.20	hrs	8.06	8.06	0.00	0.00	0.05	0.01	0.00	36.60	
RAC	Excavator, 2.5 CY	Excavator, Hydraulic, 2 CY (diesel)	10 days, 8 hours per day, 80% utilization	64.00	hrs	6.20	6.20	0.00	0.00	0.04	0.01	0.00	28.16	
RAC	Dozer, 140 hp	Dozer, 140 HP (D6) w/A Blade (diesel)	10 days, 8 hours per day, 80% utilization	64.00	hrs	3.84	3.84	0.00	0.00	0.03	0.01	0.00	20.60	
RAC	Compactor 125 hp	Compactor 120 hp	10 days, 8 hours per day, 80% utilization	64.00	hrs	2.56	2.56	0.00	0.00	0.02	0.00	0.00	11.83	
RAC	tractor	Tractor (agricultural equipment), 250 hp, diesel	1 day, 8 hours per day, 80% utilization	6.40	hrs	0.48	0.48	0.00	0.00	0.00	0.00	0.00	1.72	
RAC	hydromulcher	Hydromulcher 15 hp (gasoline)	1 day, 8 hours per day, 80% utilization	6.40	hrs	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.21	
RAC	DPT Drill Rig, well installation	Drill Rig, DPT (diesel)	Assume 5 wells per day, 32 wells, 8 hours per day, 80% utilization	44.80	hrs	0.72	0.70	0.00	0.00	0.01	0.00	0.00	5.48	
	Subtotal					**22.22**	**22.19**	**0.00**	**0.00**	**0.15**	**0.03**	**0.01**	**106.94**	**0**
				Total		**147**	**146**	**0.00**	**0.01**	**0.15**	**0.04**	**0.02**	**3,355**	**1**

Alternative 1
Values Input into SiteWise as "Other"

Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}		
				Tonnes				**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	147.49	145.82	1.45	0.22	0.15	0.04	0.02	11,446.77	982.96
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

APPENDIX C-3-2 SITE 9

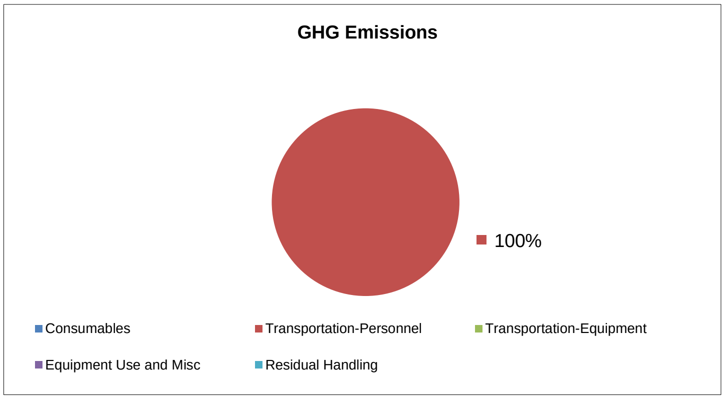
Sustainable Remediation - Environmental Footprint Summary
Alternative 9-2

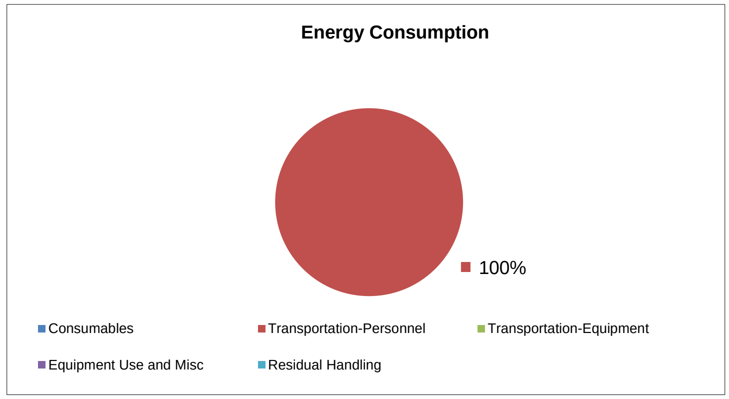
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.69	8.6E+00	NA	2.5E-04	8.9E-06	5.1E-05	1.4E-05	1.1E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.69	8.63E+00	0.00E+00	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
Total		**6.9E-01**	**8.6E+00**	**0.0E+00**	**2.5E-04**	**8.9E-06**	**5.1E-05**	**1.4E-05**	**1.1E-03**

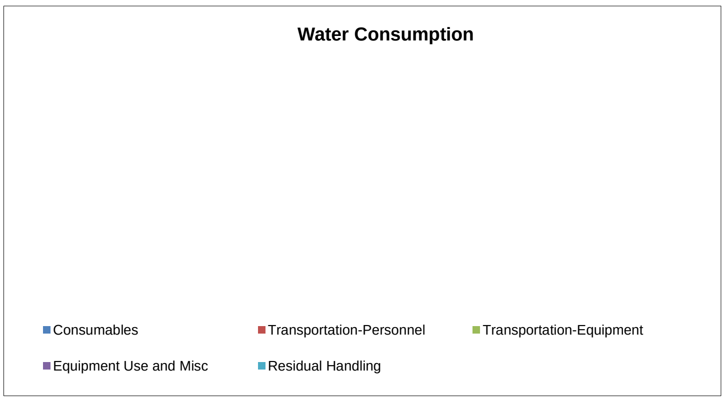
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	9.0E-03
Total	**0.0E+00**	**0.0E+00**	**0.0E+00**	**$0**	**9.0E-03**

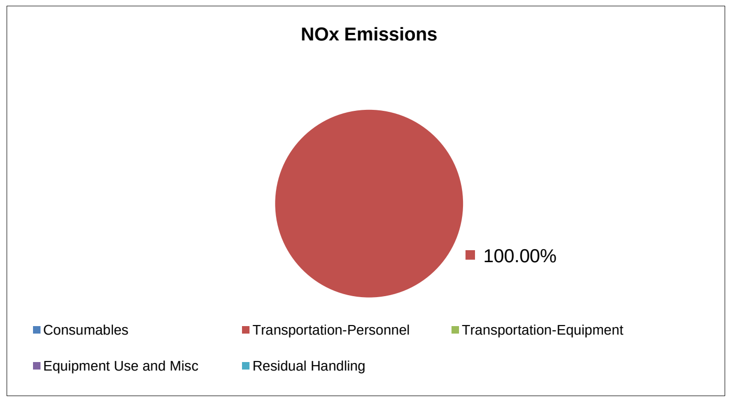
Total Cost with Footprint Reduction
$0

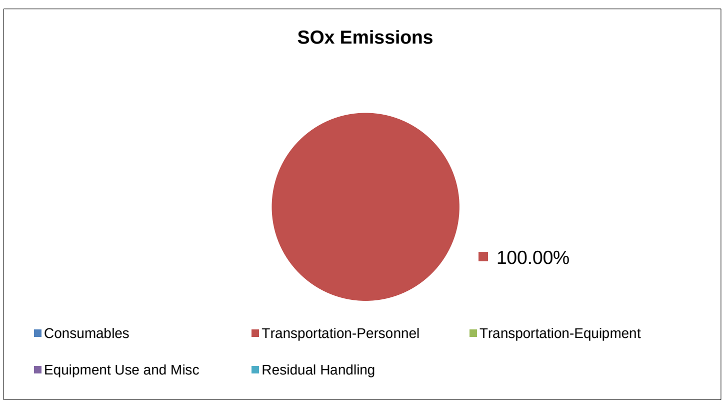
SiteWise™ Results Alternative 9-2
Long Term Monitoring Stage
Site 9-Camp Moffett Ravine Fill, Naval Training Center Great Lakes
Great Lakes, Illinois

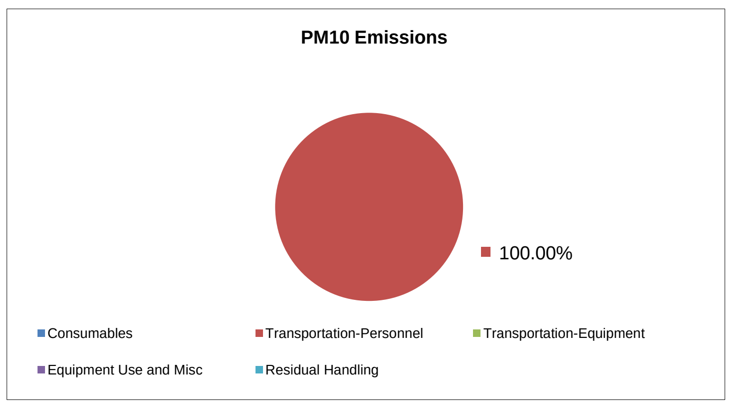


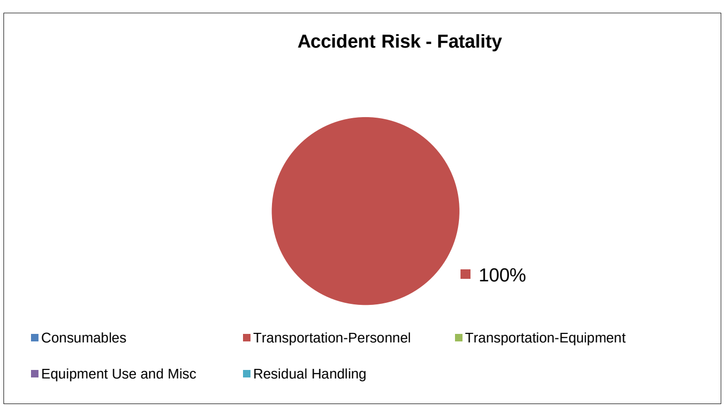


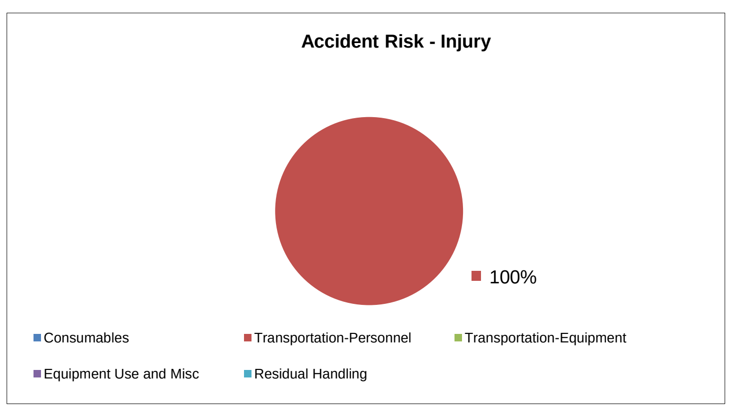


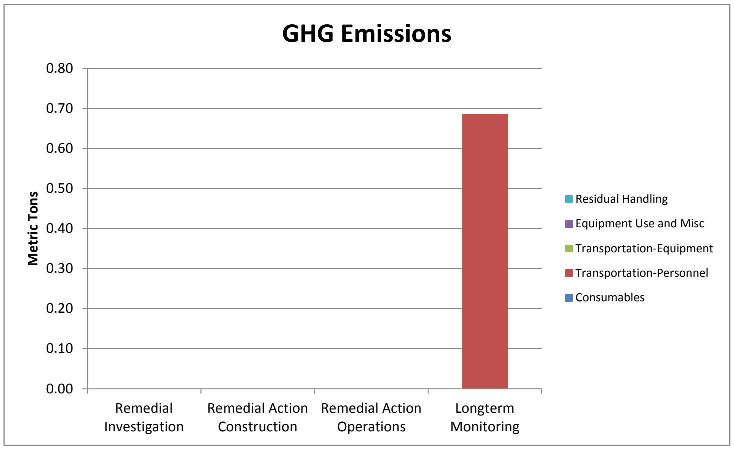


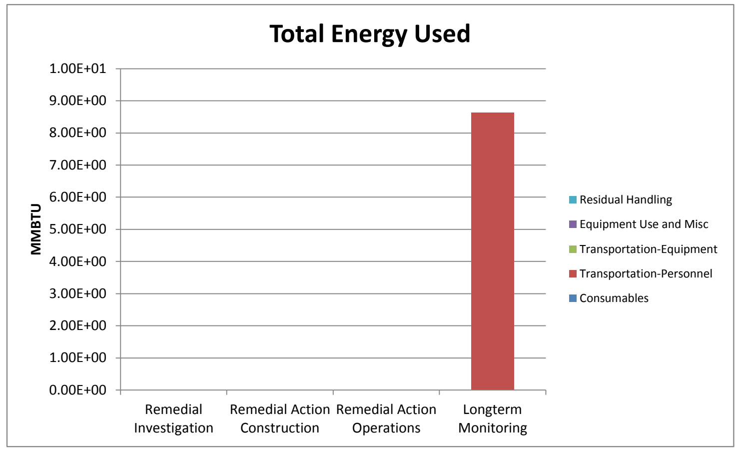


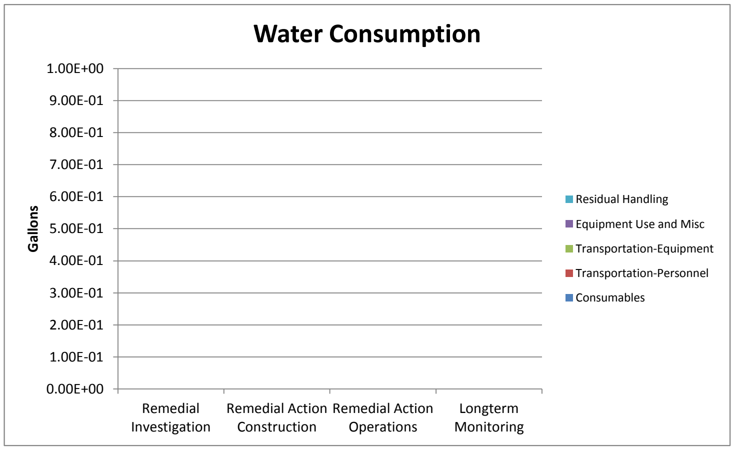


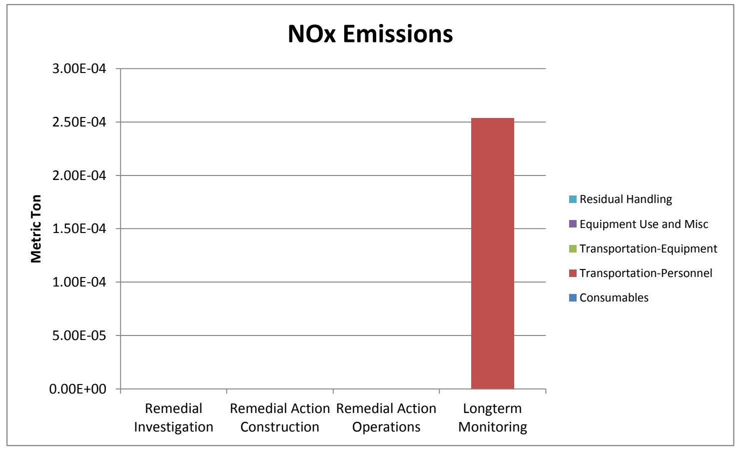


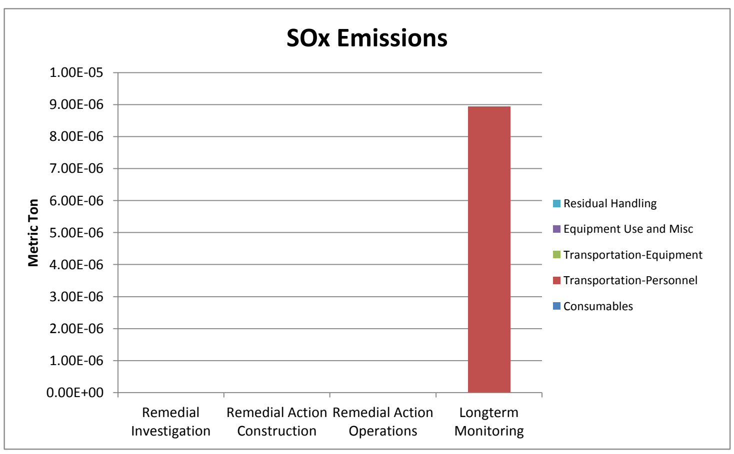


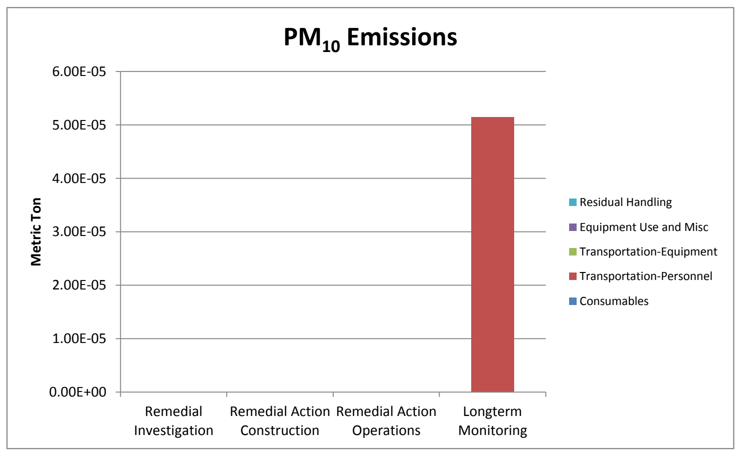

GHG Emissions
Metric Tons
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

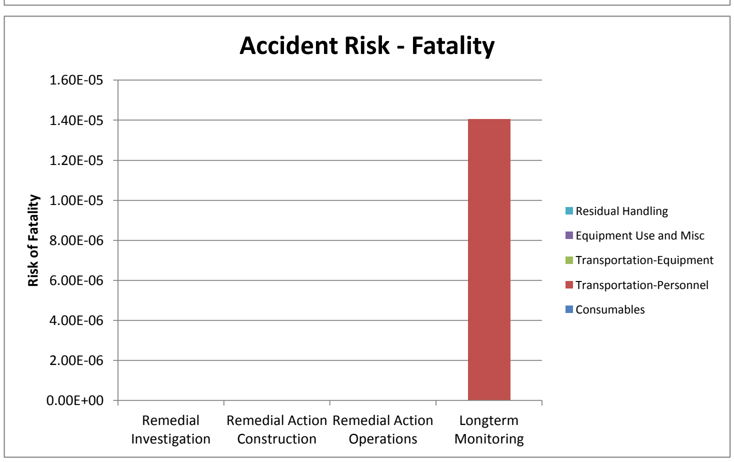

Total Energy Used
MMBTU
1.00E+01
9.00E+00
8.00E+00
7.00E+00
6.00E+00
5.00E+00
4.00E+00
3.00E+00
2.00E+00
1.00E+00
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

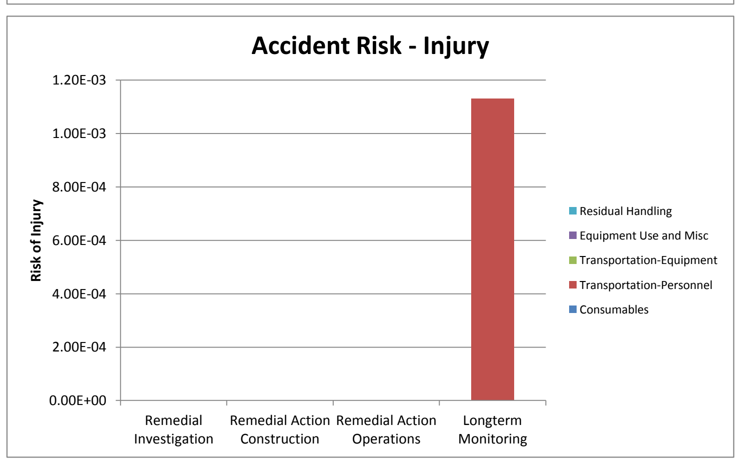

Water Consumption
Gallons
1.00E+00
9.00E-01
8.00E-01
7.00E-01
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
3.00E-04
2.50E-04
2.00E-04
1.50E-04
1.00E-04
5.00E-05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
1.00E-05
9.00E-06
8.00E-06
7.00E-06
6.00E-06
5.00E-06
4.00E-06
3.00E-06
2.00E-06
1.00E-06
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM_{10} Emissions
Metric Ton
6.00E-05
5.00E-05
4.00E-05
3.00E-05
2.00E-05
1.00E-05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
1.60E-05
1.40E-05
1.20E-05
1.00E-05
8.00E-06
6.00E-06
4.00E-06
2.00E-06
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Injury
Risk of Injury
1.20E-03
1.00E-03
8.00E-04
6.00E-04
4.00E-04
2.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

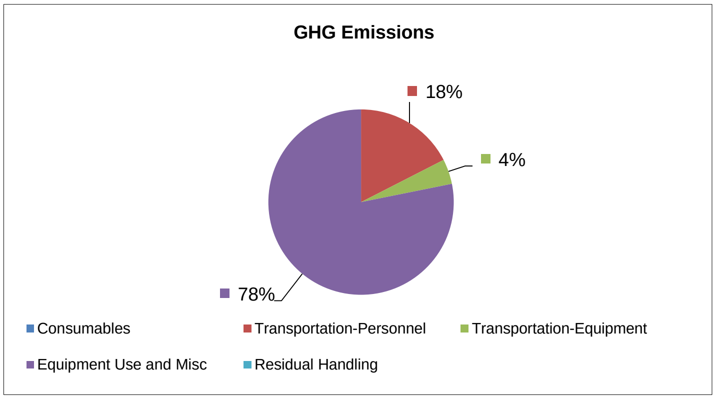
Sustainable Remediation - Environmental Footprint Summary
Alternative 9-2A

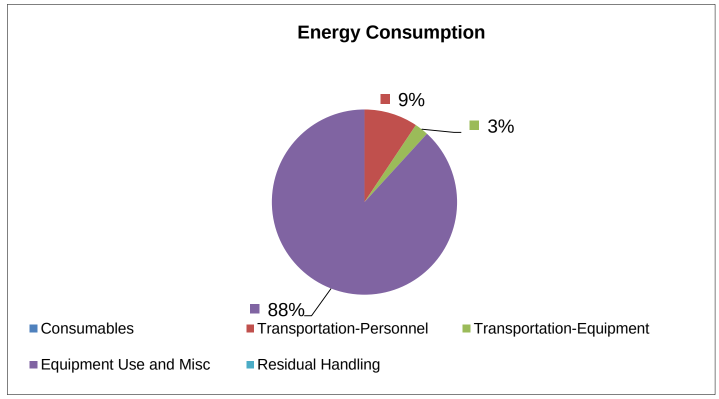
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	1.51	1.9E+01	NA	5.6E-04	2.0E-05	1.1E-04	3.1E-05	2.5E-03
	Transportation-Equipment	0.38	4.9E+00	NA	1.2E-04	2.1E-06	1.0E-05	1.6E-06	1.3E-04
	Equipment Use and Misc	6.73	1.8E+02	1.2E+04	1.6E-02	1.4E-02	2.3E-03	4.1E-06	1.0E-03
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	8.61	2.02E+02	1.16E+04	1.68E-02	1.40E-02	2.38E-03	3.65E-05	3.64E-03
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.69	8.6E+00	NA	2.5E-04	8.9E-06	5.1E-05	1.4E-05	1.1E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.69	8.63E+00	0.00E+00	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
Total		**9.3E+00**	**2.1E+02**	**1.2E+04**	**1.7E-02**	**1.4E-02**	**2.4E-03**	**5.1E-05**	**4.8E-03**

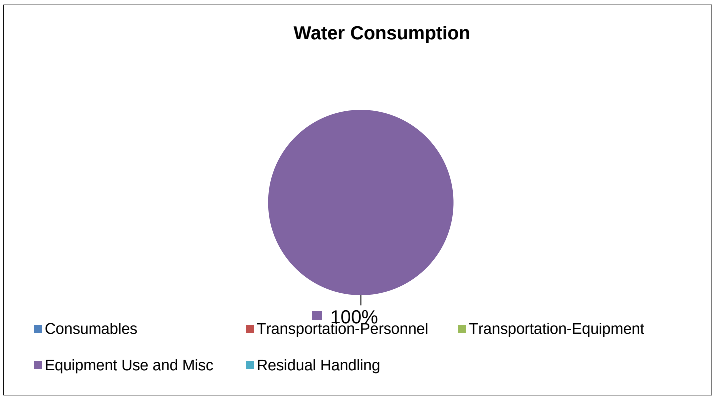
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	0.0E+00	0.0E+00	0.0E+00	0	2.9E-02
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	9.0E-03
Total	**0.0E+00**	**0.0E+00**	**0.0E+00**	**$0**	**3.8E-02**

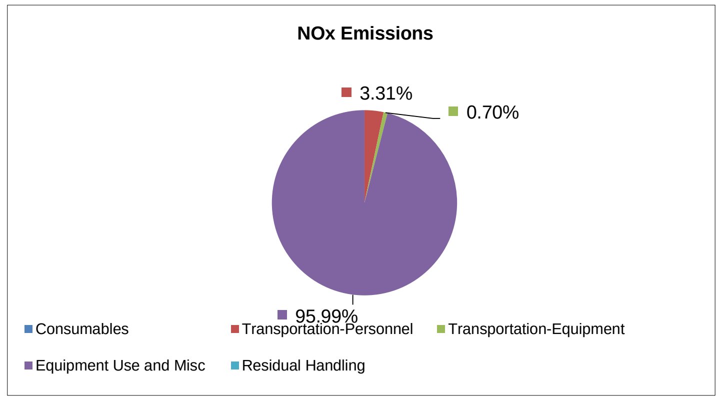
Total Cost with Footprint Reduction
$0

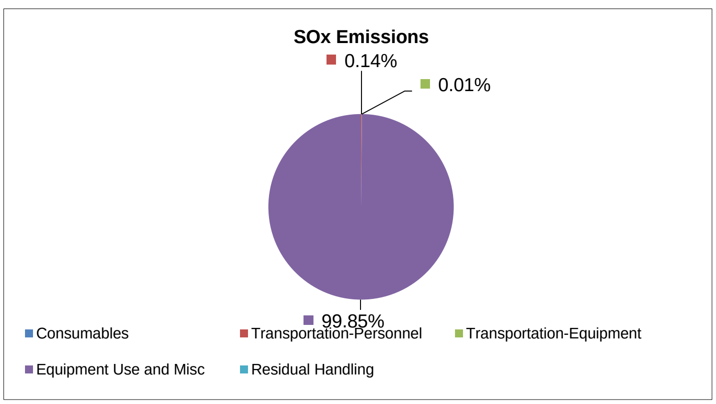
SiteWise™ Results Alternative 9-2A
Residual Action Construction Stage
Site 9-Camp Moffett Ravine Fill, Naval Training Center Great Lakes
Great Lakes, Illinois

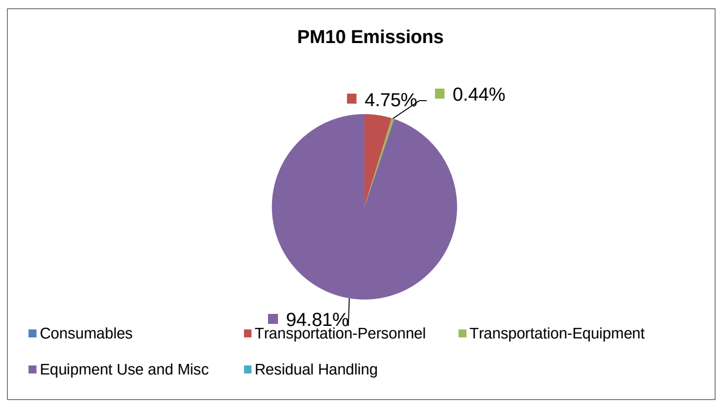


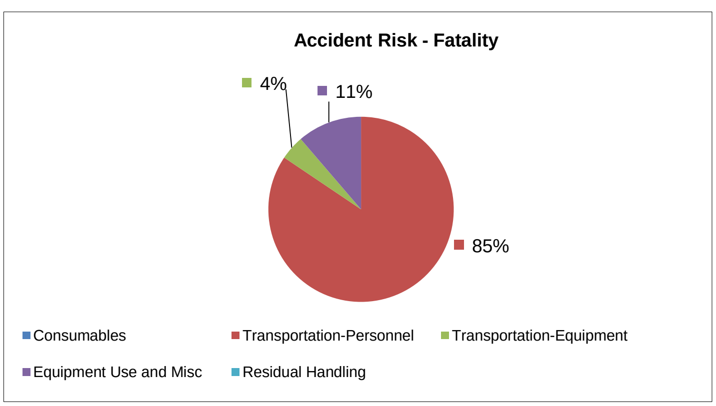


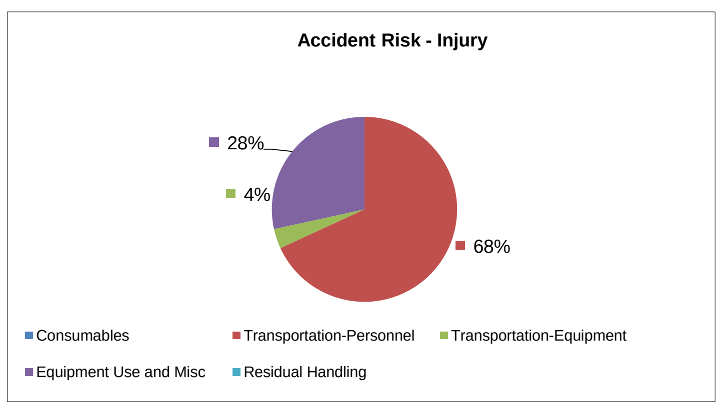


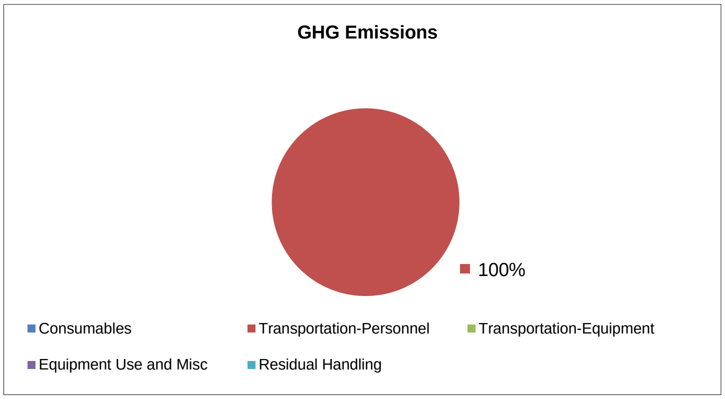


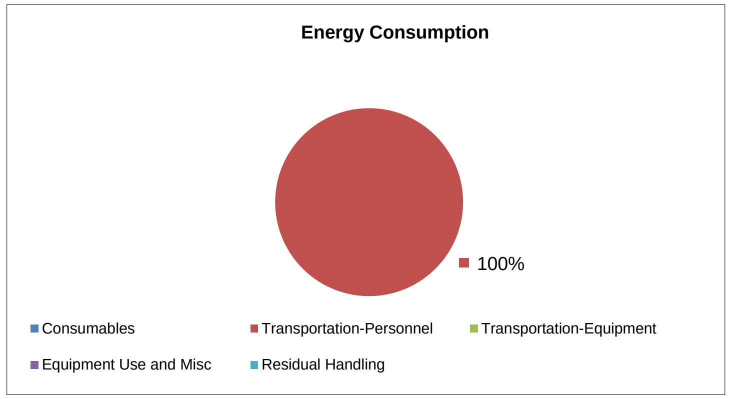


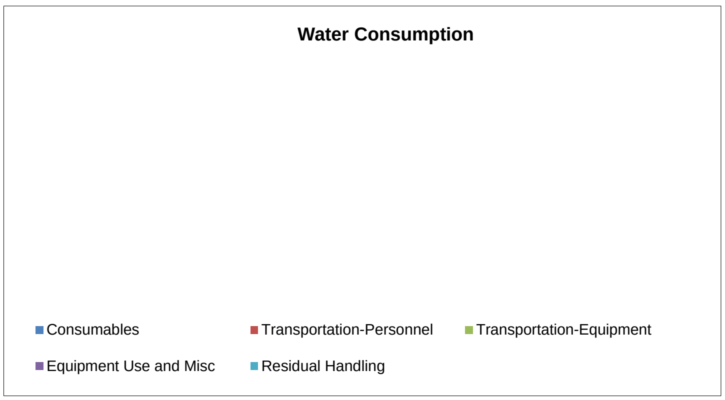


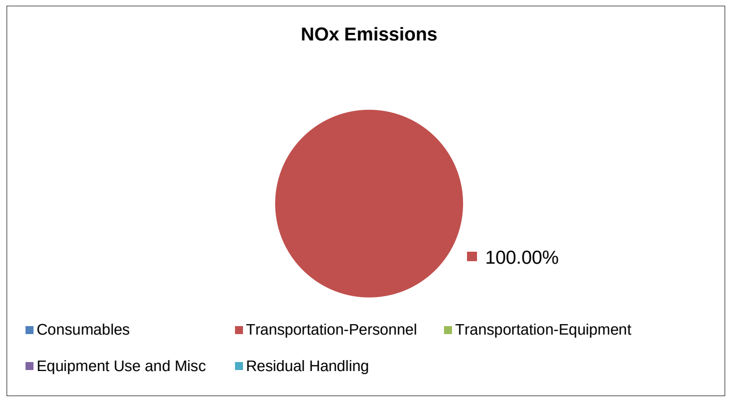


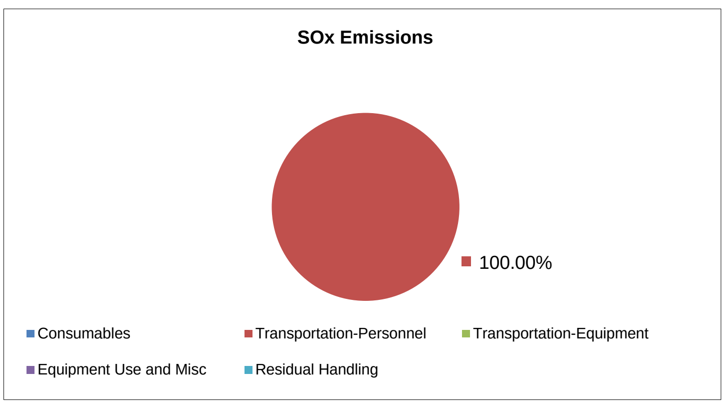


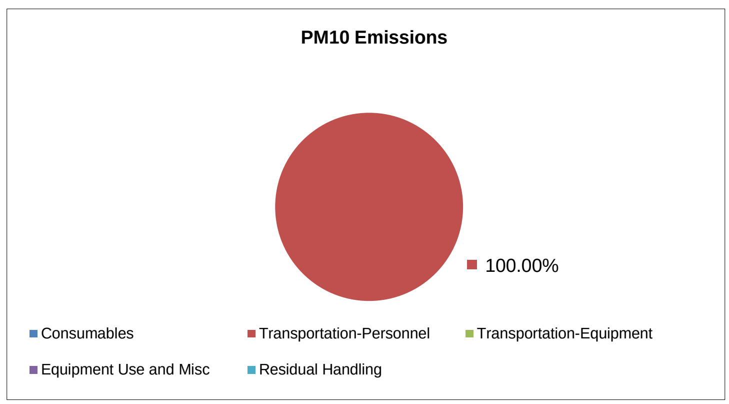

GHG Emissions
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

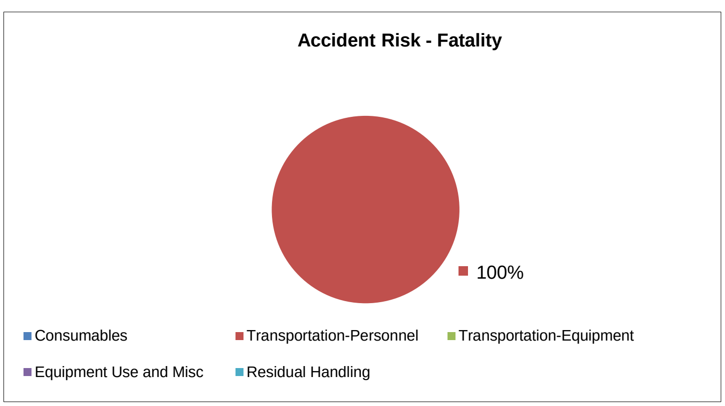

Energy Consumption
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

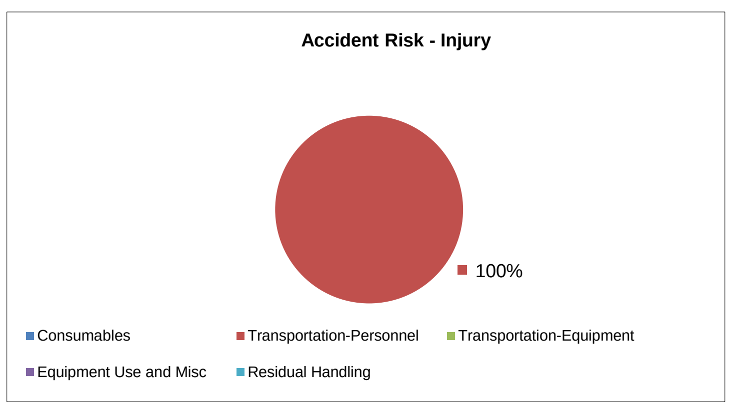

Water Consumption
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

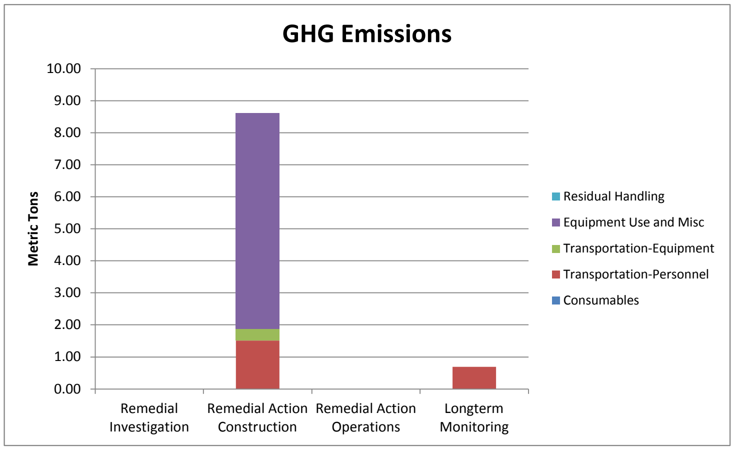

NOx Emissions
100.00%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

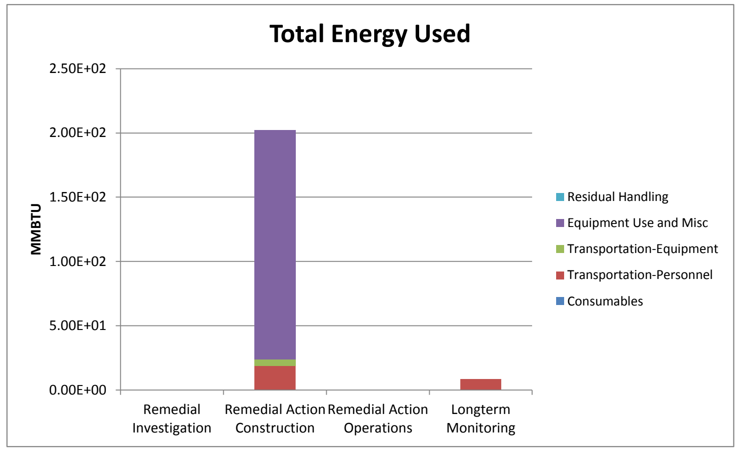

SOx Emissions
100.00%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

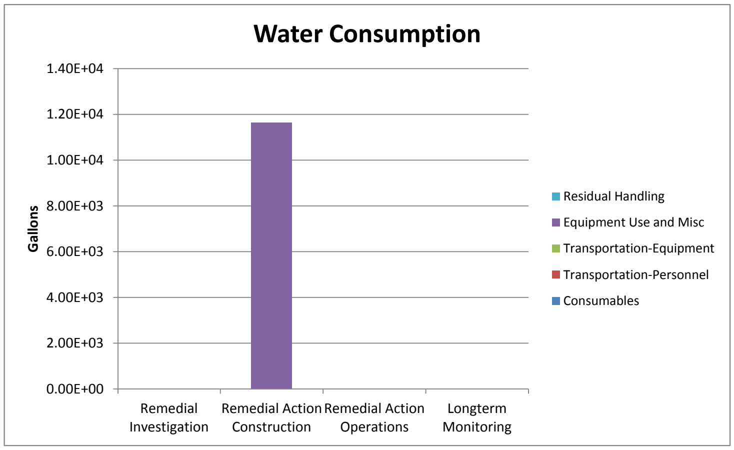

PM10 Emissions
100.00%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

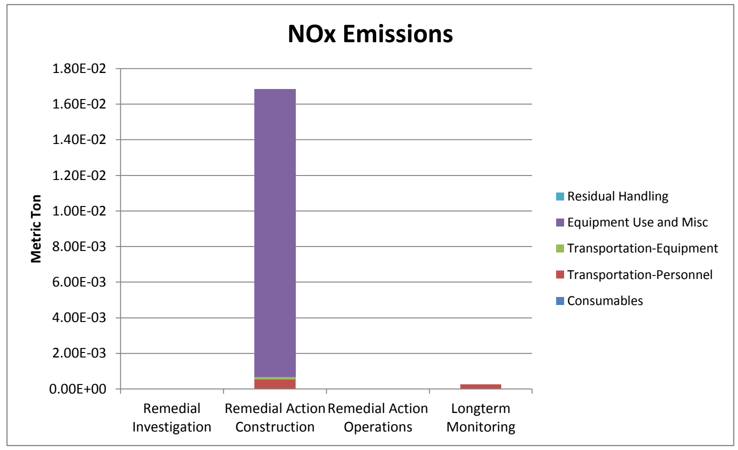

Accident Risk - Fatality
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

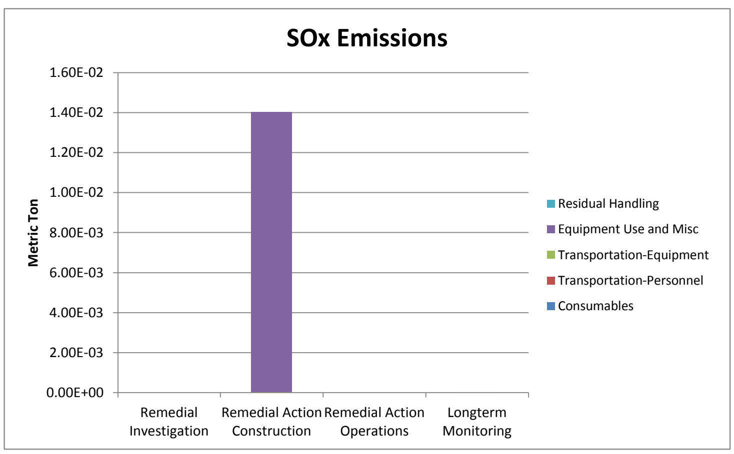

Accident Risk - Injury
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

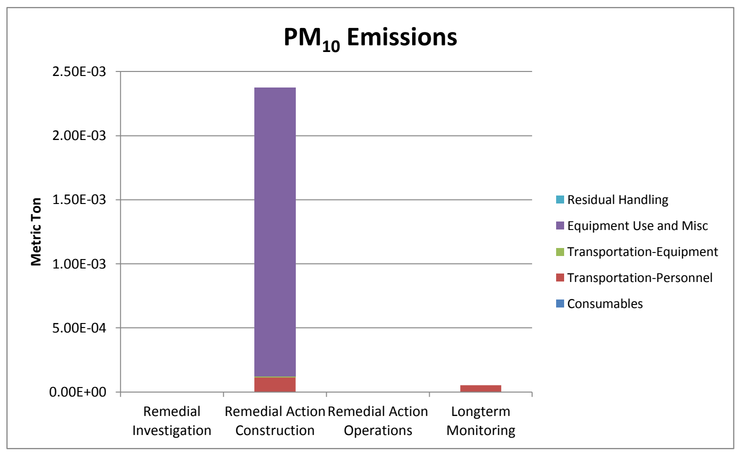

GHG Emissions
Metric Tons
10.00
9.00
8.00
7.00
6.00
5.00
4.00
3.00
2.00
1.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

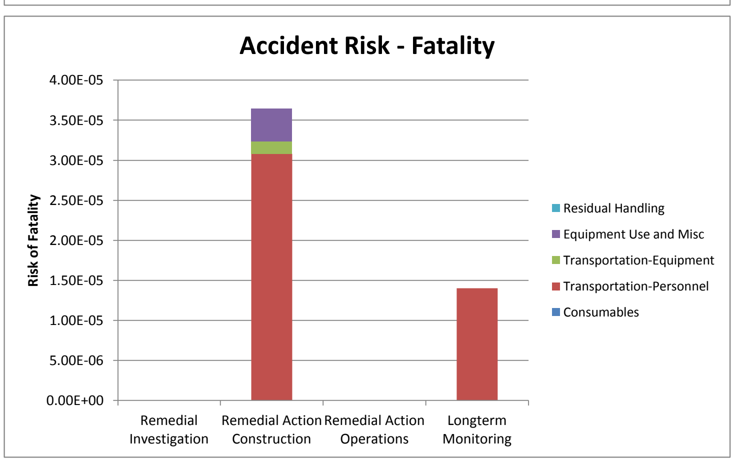

Total Energy Used
MMBTU
2.50E+02
2.00E+02
1.50E+02
1.00E+02
5.00E+01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

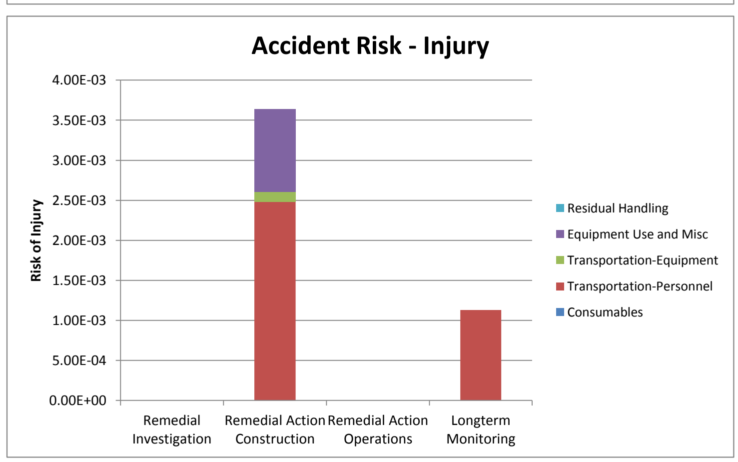

Water Consumption
Gallons
1.40E+04
1.20E+04
1.00E+04
8.00E+03
6.00E+03
4.00E+03
2.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
1.80E-02
1.60E-02
1.40E-02
1.20E-02
1.00E-02
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
1.60E-02
1.40E-02
1.20E-02
1.00E-02
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM_{10} Emissions
Metric Ton
2.50E-03
2.00E-03
1.50E-03
1.00E-03
5.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
4.00E-05
3.50E-05
3.00E-05
2.50E-05
2.00E-05
1.50E-05
1.00E-05
5.00E-06
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Injury
Risk of Injury
4.00E-03
3.50E-03
3.00E-03
2.50E-03
2.00E-03
1.50E-03
1.00E-03
5.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
						CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	**Materials**								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Well Instalation	PVC	32 wells, 22 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft	704.00	lft	1.14	0.57	0.00	0.01	0.00	0.00	0.00	20.96	1.21
RAC	Temporary Equipment Decon Pad Liner	HDPE	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3	700.47	lbs	1.56	0.83	0.00	0.01	0.00	0.00	0.00	9.17	0.25
RAC	Temporary Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3	514.68	lbs	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Fenton Reagent	Hydrogen Peroxide	Assume hydrogen peroxide, 4% by weight of 4,500 gal. Assume two events	360.00	lbs	0.66	0.20	0.00	0.00	0.00	0.00	0.00	5.07	0.00
	Subtotal					**3.37**	**1.60**	**0.00**	**0.01**	**0.00**	**0.01**	**0.00**	**35.20**	**1.47**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	DPT Drill Rig, well installation	Drill Rig, DPT (diesel)	Assume 5 wells per day, 32 wells, 8 hours per day, 80% utilization	44.80	hrs	0.72	0.70	0.00	0.00	0.01	0.00	0.00	5.48	
	Subtotal					**0.72**	**0.70**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**5.48**	**0**
				Total		**4**	**2**	**0.00**	**0.01**	**0.01**	**0.01**	**0.00**	**41**	**1**

Alternative 1
Values Input into SiteWise as "Other"

Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}		
				Tonnes				**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	4.09	2.30	1.48	0.31	0.01	0.01	0.00	138.79	1,465.79
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

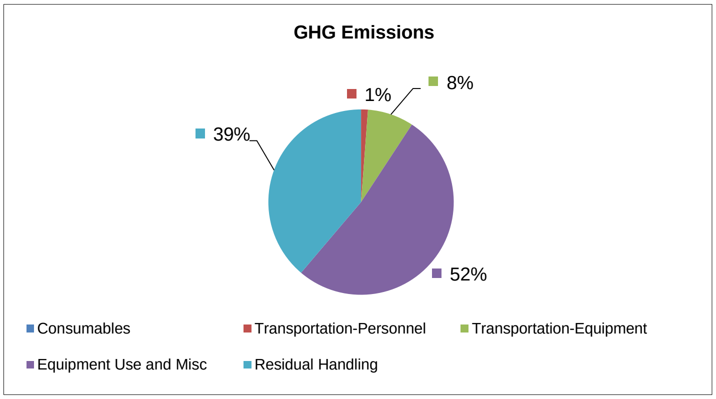
Sustainable Remediation - Environmental Footprint Summary
Alternative 9-3

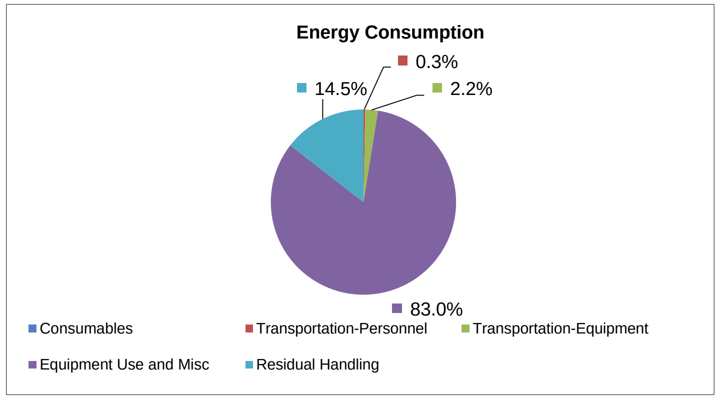
Phase	Activities	GHG Emissions (metric ton)	Total energy Used (MMBTU)	Water Consumption (gallons)	NOx emissions (metric ton)	SOx Emissions (metric ton)	PM10 Emissions (metric ton)	Accident Risk Fatality	Accident Risk Injury
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	9.30	1.2E+02	NA	3.4E-03	1.2E-04	7.0E-04	1.9E-04	1.5E-02
	Transportation-Equipment	62.37	8.1E+02	NA	2.0E-02	3.5E-04	1.7E-03	1.5E-04	1.2E-02
	Equipment Use and Misc	403.20	3.1E+04	2.5E+03	4.6E-01	1.3E-01	4.1E-02	8.0E-05	2.0E-02
	Residual Handling	301.00	5.4E+03	NA	1.0E+00	5.3E-01	2.8E+00	3.1E-04	2.5E-02
	Sub-Total	775.88	3.70E+04	2.52E+03	1.51E+00	6.65E-01	2.89E+00	7.31E-04	7.25E-02
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.69	8.6E+00	NA	2.5E-04	8.9E-06	5.1E-05	1.4E-05	1.1E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.69	8.63E+00	0.00E+00	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
Total		**7.8E+02**	**3.7E+04**	**2.5E+03**	**1.5E+00**	**6.6E-01**	**2.9E+00**	**7.5E-04**	**7.4E-02**

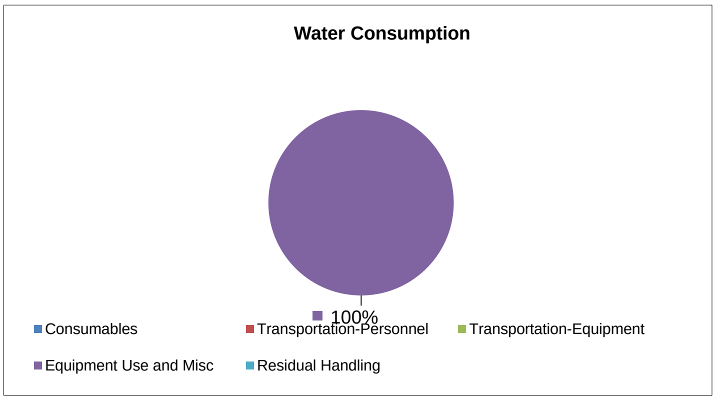
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space (tons)	Hazardous Waste Landfill Space (tons)	Topsoil Consumption (cubic yards)	Costing ($)	Lost Hours - Injury
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	1.6E+04	0.0E+00	1.0E+04	0	5.8E-01
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	9.0E-03
Total	**1.6E+04**	**0.0E+00**	**1.0E+04**	**$0**	**5.9E-01**

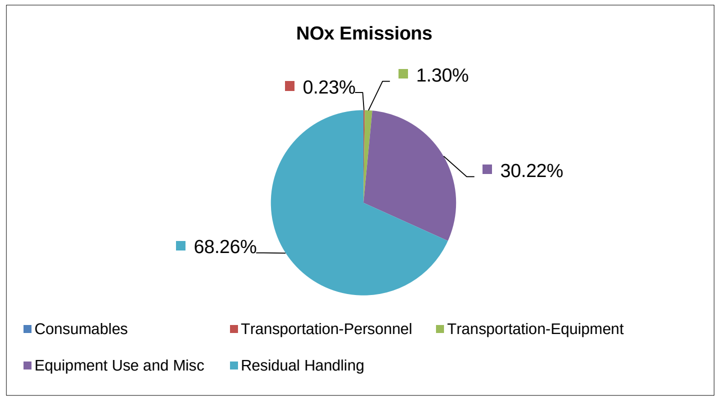
Total Cost with Footprint Reduction
$0

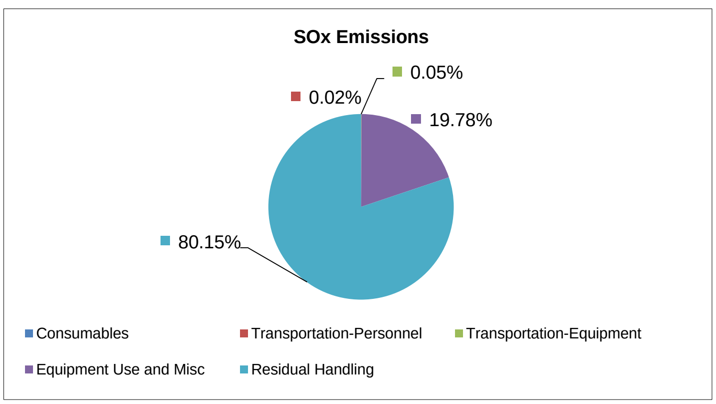
SiteWise™ Results Alternative 9-3
Site 9-Camp Moffett Ravine Fill, Naval Training Center Great Lakes
Great Lakes, Illinois

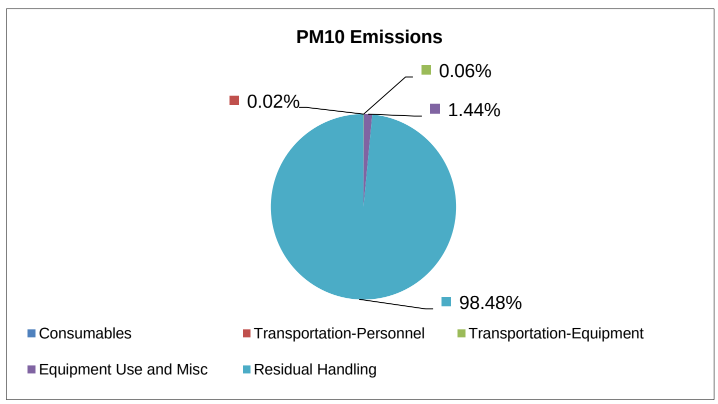


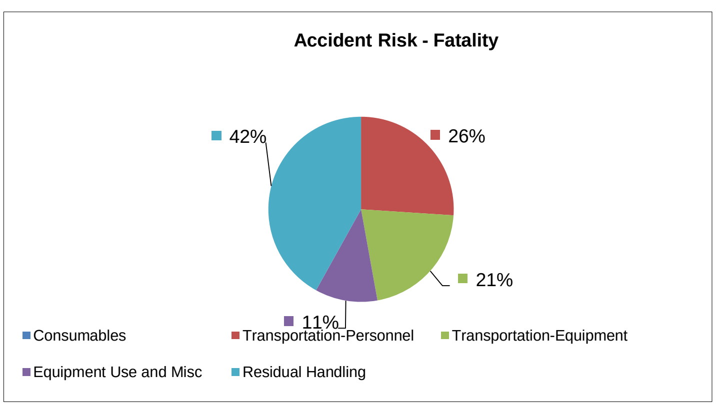


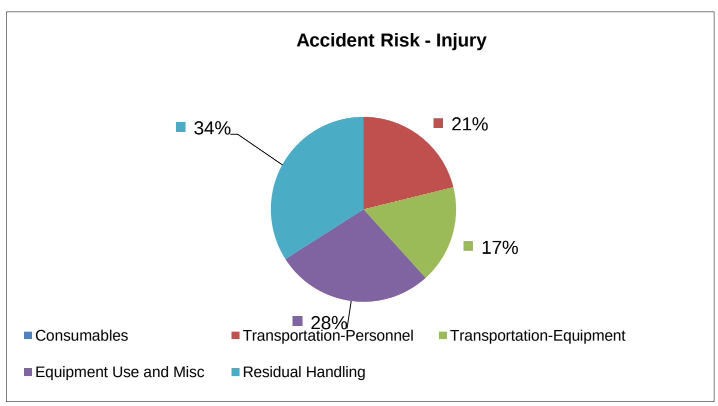




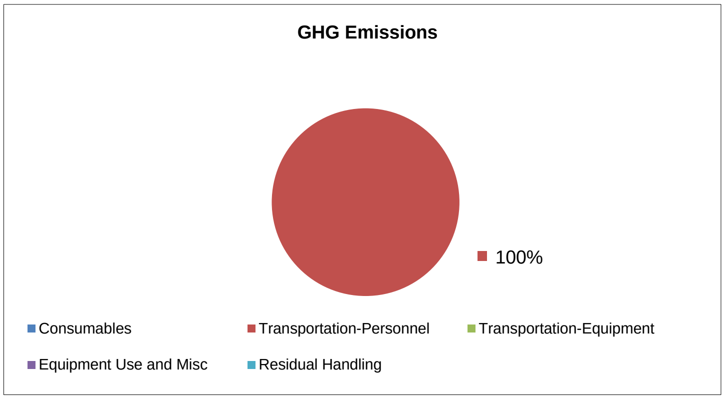


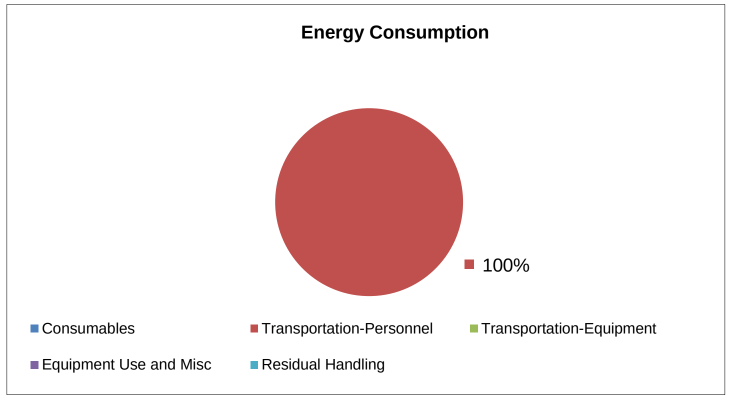


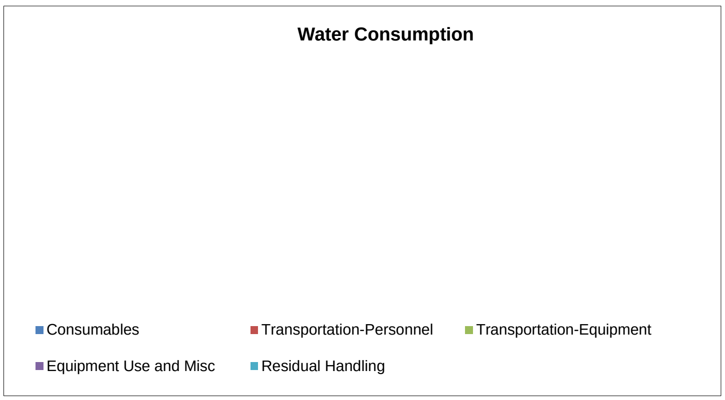


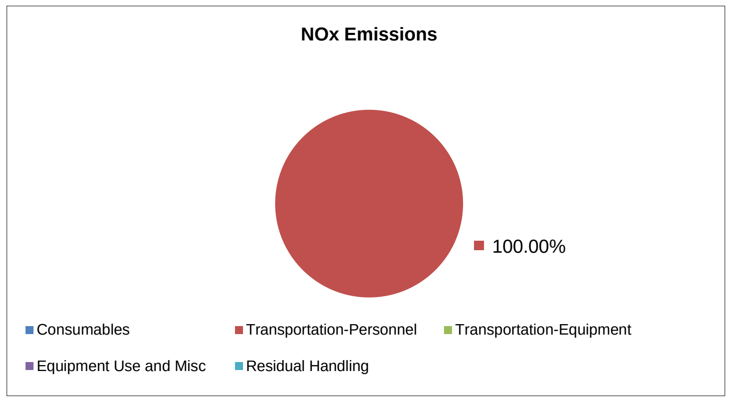


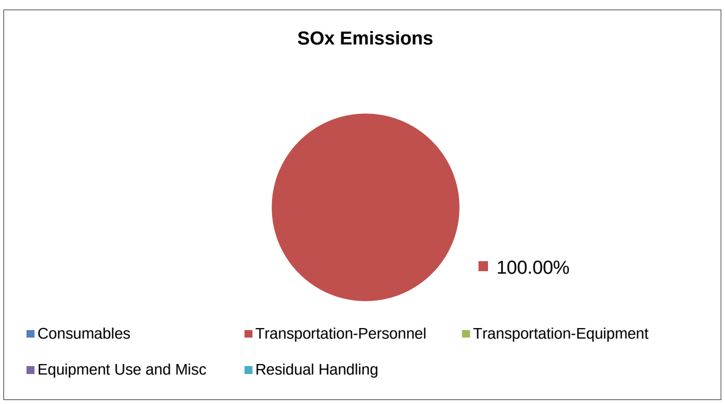
SiteWise™ Results Alternative 9-3
Site 9-Camp Moffett Ravine Fill, Naval Training Center Great Lakes
Great Lakes, Illinois

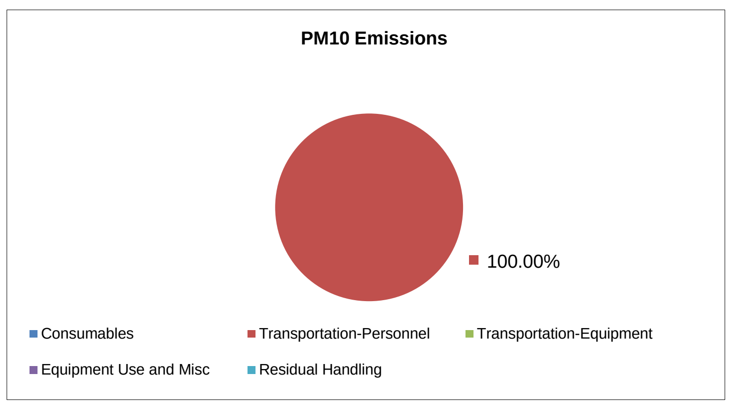


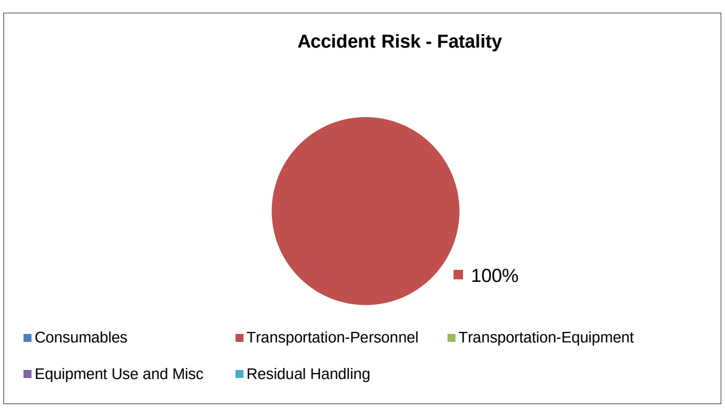


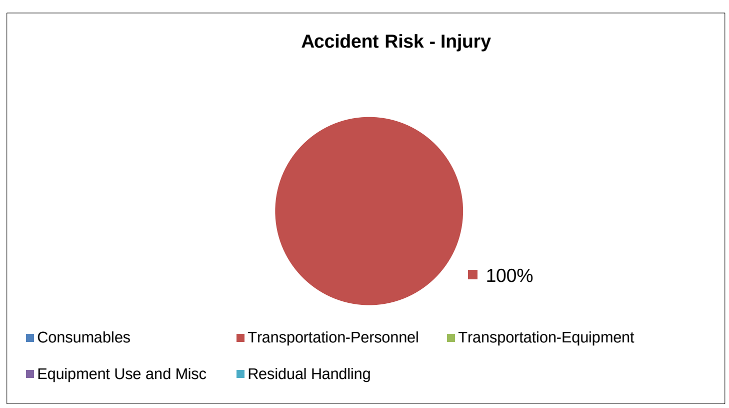


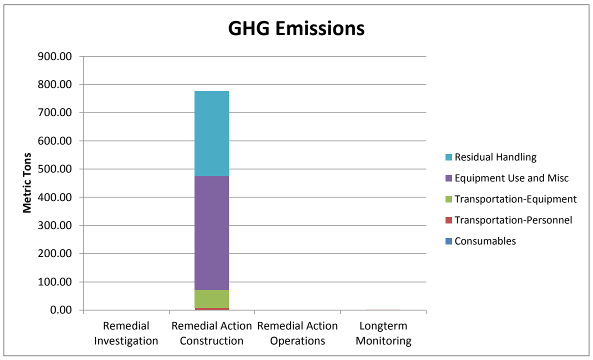


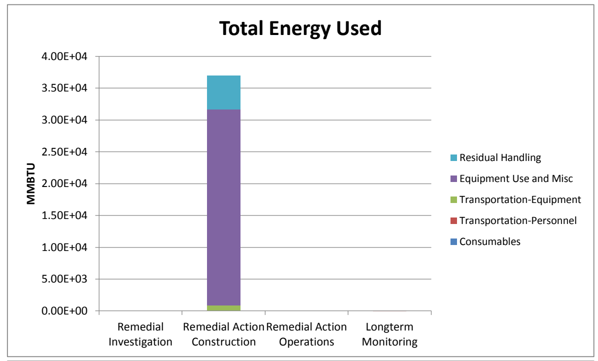


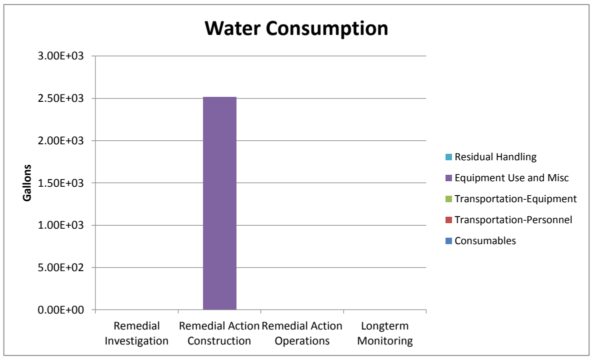


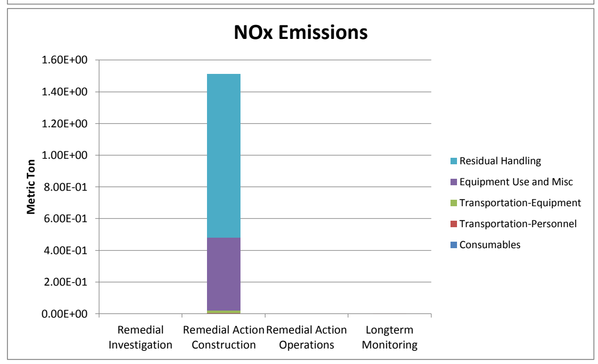


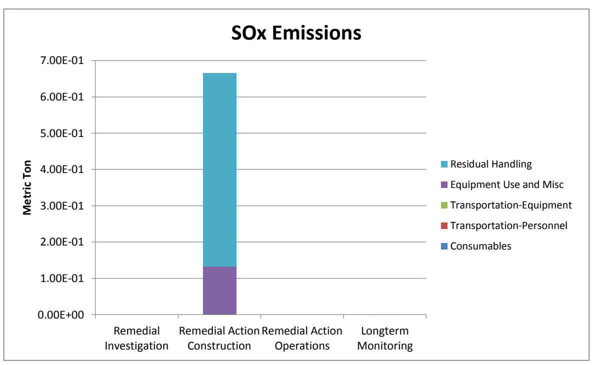


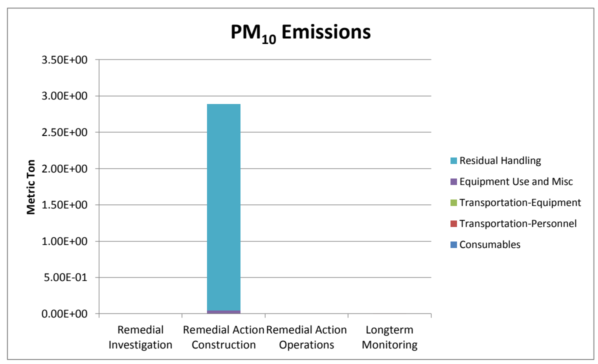

GHG Emissions
Metric Tons
900.00
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

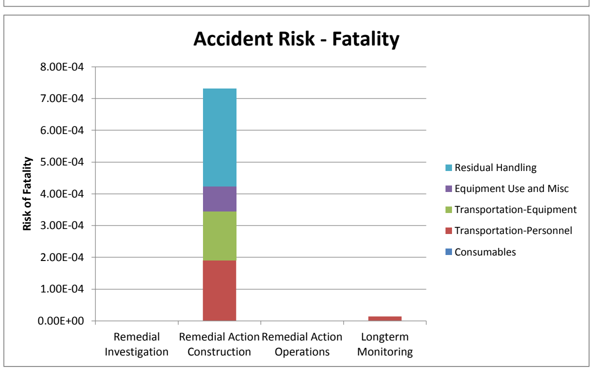

Total Energy Used
MMBTU
4.00E+04
3.50E+04
3.00E+04
2.50E+04
2.00E+04
1.50E+04
1.00E+04
5.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

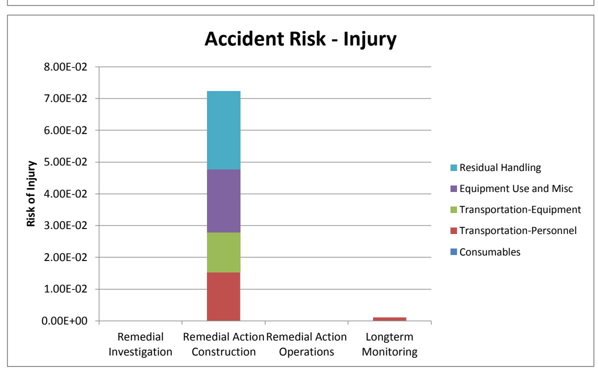

Water Consumption
Gallons
3.00E+03
2.50E+03
2.00E+03
1.50E+03
1.00E+03
5.00E+02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

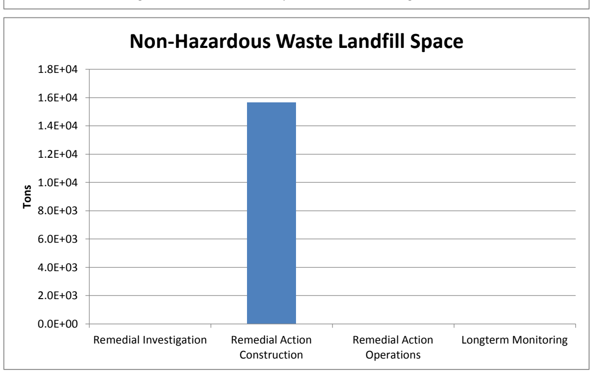

NOx Emissions
Metric Ton
1.60E+00
1.40E+00
1.20E+00
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

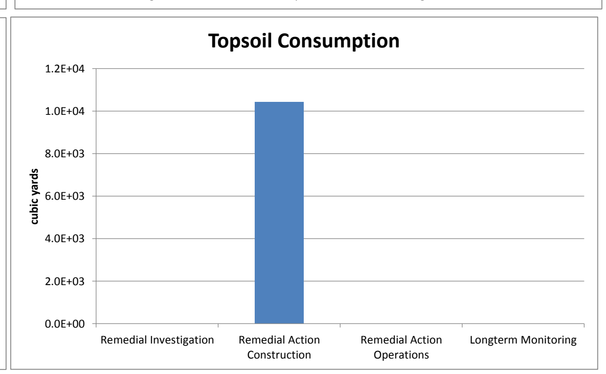

SOx Emissions
Metric Ton
7.00E-01
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM_{10} Emissions
Metric Ton
3.50E+00
3.00E+00
2.50E+00
2.00E+00
1.50E+00
1.00E+00
5.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
8.00E-04
7.00E-04
6.00E-04
5.00E-04
4.00E-04
3.00E-04
2.00E-04
1.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Injury
Risk of Injury
8.00E-02
7.00E-02
6.00E-02
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Non-Hazardous Waste Landfill Space
Tons
1.8E+04
1.6E+04
1.4E+04
1.2E+04
1.0E+04
8.0E+03
6.0E+03
4.0E+03
2.0E+03
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring


Topsoil Consumption
cubic yards
1.2E+04
1.0E+04
8.0E+03
6.0E+03
4.0E+03
2.0E+03
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring

	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
						CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	**Materials**					**Tonnes**							**MWhr**	**gal x 1000**
RAC	Temporary Equipment Decon Pad Liner	HDPE	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3	700.47	lbs	1.56	0.83	0.00	0.01	0.00	0.00	0.00	9.17	0.25
RAC	Temporary Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3	514.68	lbs	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Backfill, common fill	Soil	9,977 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil	29,931,000.00	lbs	312.21	312.21	0.00	0.00	0.00	0.00	0.00	8250.39	0.00
RAC	Backfill, vegetative soil	Soil	450 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil	1,350,000.00	lbs	14.08	14.08	0.00	0.00	0.00	0.00	0.00	372.12	0.00
RAC	Seeding, mulch	Mulch	29 msf, assume mulch assume, 50 lb per msf	1,450.00	lbs	0.46	0.16	0.00	0.00	0.00	0.00	0.00	5.19	0.00
RAC	Seeding, fertilizer	Fertilizer	29 msf, assume fertilizer, assume 20 lb per smf	580.00	lbs	0.72	0.72	0.00	0.00	0.00	0.00	0.00	13.11	0.26
	Subtotal					**329.04**	**328.00**	**0.00**	**0.01**	**0.00**	**0.01**	**0.00**	**8649.98**	**0.52**
	Construction Equipment					**Tonnes**							**MWhr**	**gal x 1000**
RAC	DPT	Drill Rig, DPT (diesel)	4 days, 8 hours per day, 80% utilization	25.60	hrs	0.41	0.40	0.00	0.00	0.00	0.00	0.00	3.13	
RAC	Excavator, 2.5 CY	Excavator, Hydraulic, 2 CY (diesel)	40 days, 8 hours per day, 80% utilization	256.00	hrs	24.81	24.81	0.00	0.00	0.16	0.05	0.01	112.63	
RAC	Excavator, 2.5 CY	Excavator, Hydraulic, 2 CY (diesel)	30 days, 8 hours per day, 80% utilization	192.00	hrs	18.61	18.61	0.00	0.00	0.12	0.03	0.01	84.47	
RAC	Dozer, 140 hp	Dozer, 140 HP (D6) w/A Blade (diesel)	30 days, 8 hours per day, 80% utilization	192.00	hrs	11.51	11.51	0.00	0.00	0.08	0.02	0.01	61.79	
RAC	Compactor 125 hp	Compactor 120 hp	30 days, 8 hours per day, 80% utilization	192.00	hrs	7.68	7.68	0.00	0.00	0.06	0.00	0.01	35.48	
RAC	tractor	Tractor (agricultural equipment), 250 hp, diesel	1 day, 8 hours per day, 80% utilization	6.40	hrs	0.48	0.48	0.00	0.00	0.00	0.00	0.00	1.72	
RAC	hydromulcher	Hydromulcher 15 hp (gasoline)	1 day, 8 hours per day, 80% utilization	6.40	hrs	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.21	
	Subtotal					**63.55**	**63.54**	**0.00**	**0.00**	**0.42**	**0.10**	**0.04**	**299.43**	**0**
				Total		**393**	**392**	**0.00**	**0.01**	**0.42**	**0.11**	**0.04**	**8,949**	**1**

Alternative 1
Values Input into SiteWise as "Other"

Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}		
	Tonnes							**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	392.59	391.54	0.90	0.15	0.42	0.11	0.04	30,535.40	517.32
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

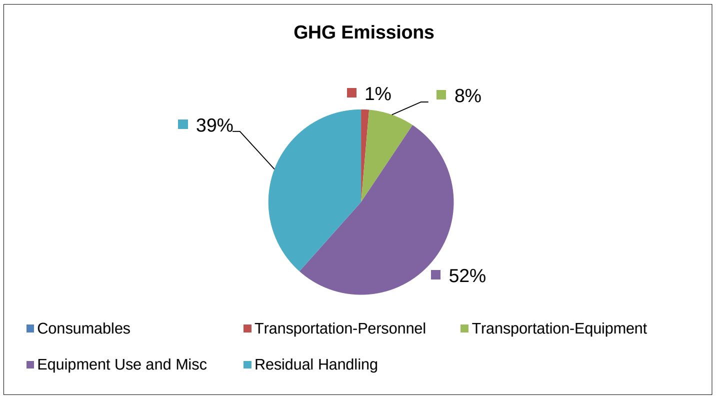
Sustainable Remediation - Environmental Footprint Summary
Alternative 9-3A

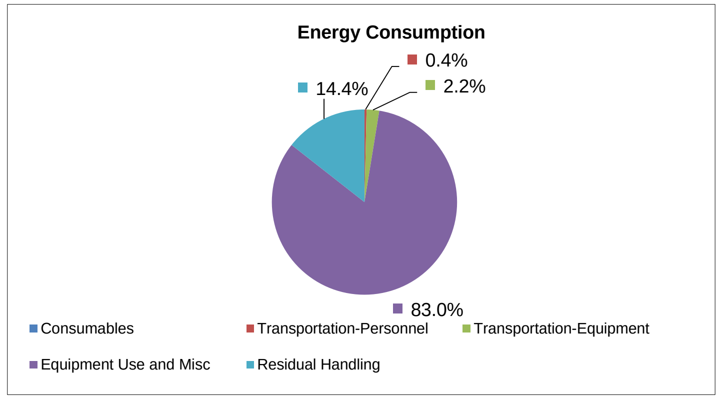
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	10.84	1.4E+02	NA	4.0E-03	1.4E-04	8.1E-04	2.2E-04	1.8E-02
	Transportation-Equipment	62.57	8.2E+02	NA	2.0E-02	3.5E-04	1.7E-03	1.5E-04	1.2E-02
	Equipment Use and Misc	408.48	3.1E+04	1.3E+04	4.7E-01	1.4E-01	4.3E-02	8.4E-05	2.1E-02
	Residual Handling	300.69	5.4E+03	NA	1.0E+00	5.3E-01	2.8E+00	3.1E-04	2.5E-02
	Sub-Total	782.58	3.72E+04	1.29E+04	1.53E+00	6.75E-01	2.89E+00	7.66E-04	7.60E-02
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.69	8.6E+00	NA	2.5E-04	8.9E-06	5.1E-05	1.4E-05	1.1E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.69	8.63E+00	0.00E+00	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
Total		**7.8E+02**	**3.7E+04**	**1.3E+04**	**1.5E+00**	**6.8E-01**	**2.9E+00**	**7.8E-04**	**7.7E-02**

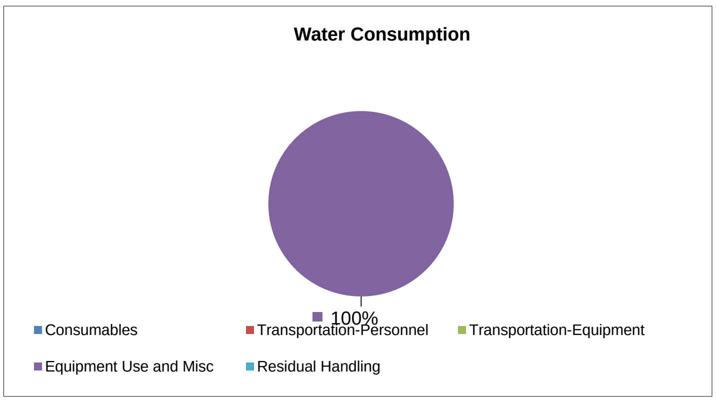
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	1.6E+04	0.0E+00	1.0E+04	0	6.1E-01
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	9.0E-03
Total	**1.6E+04**	**0.0E+00**	**1.0E+04**	**$0**	**6.2E-01**

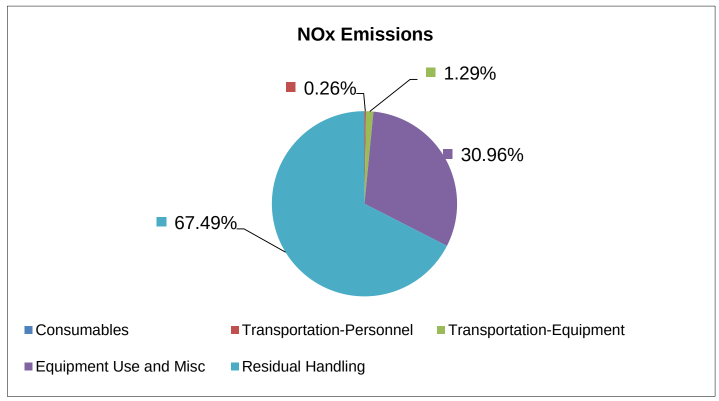
Total Cost with Footprint Reduction
$0

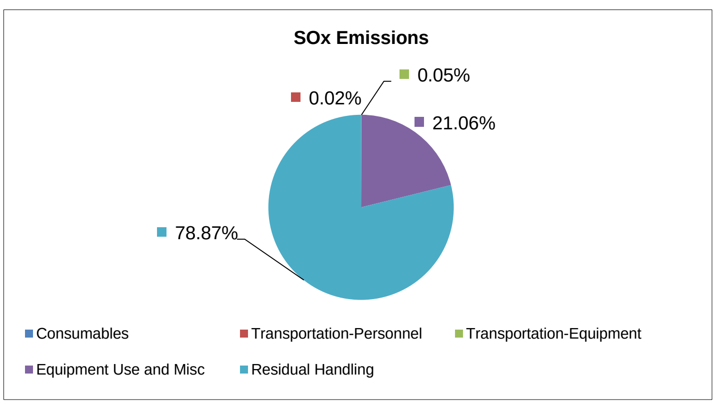
SiteWise™ Results Alternative 9-3A
Residual Action Construction Stage
Site 9-Camp Moffett Ravine Fill, Naval Training Center Great Lakes
Great Lakes, Illinois

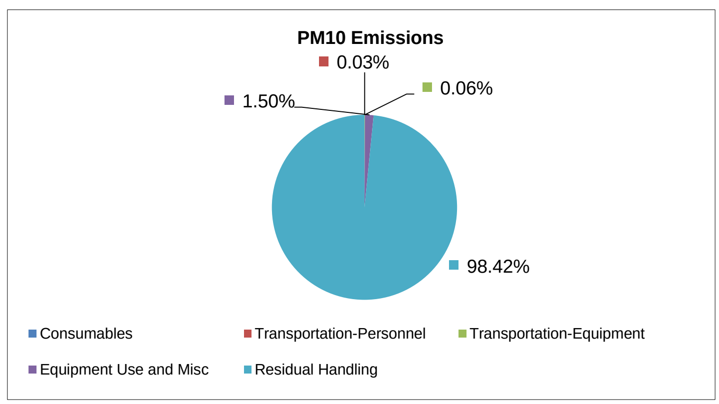


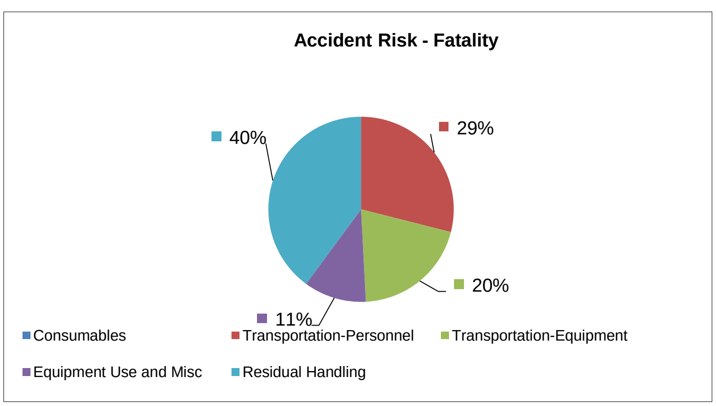


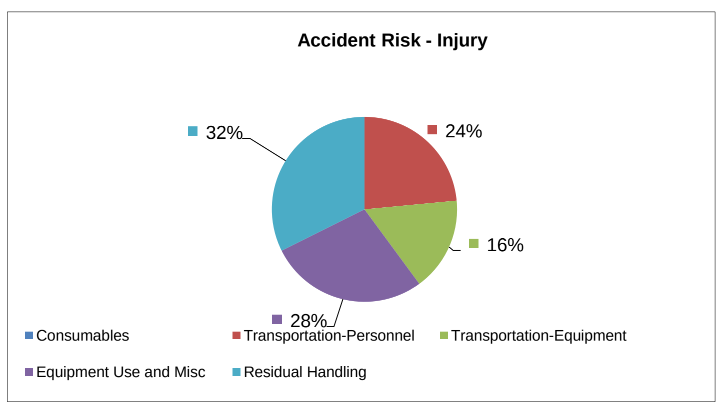




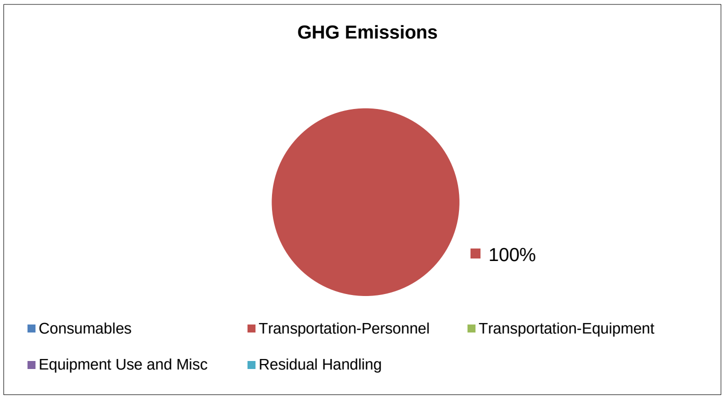


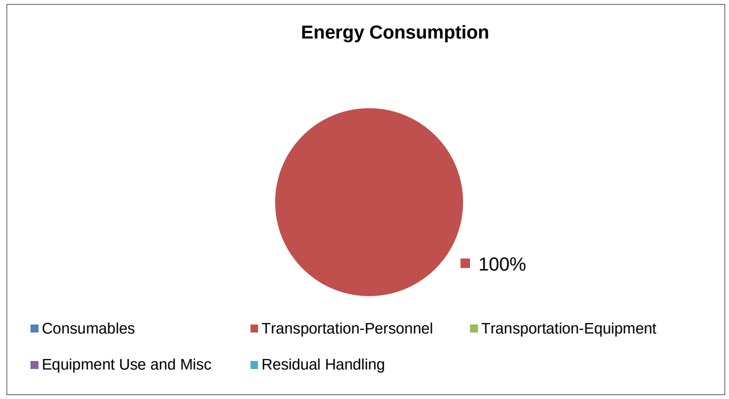


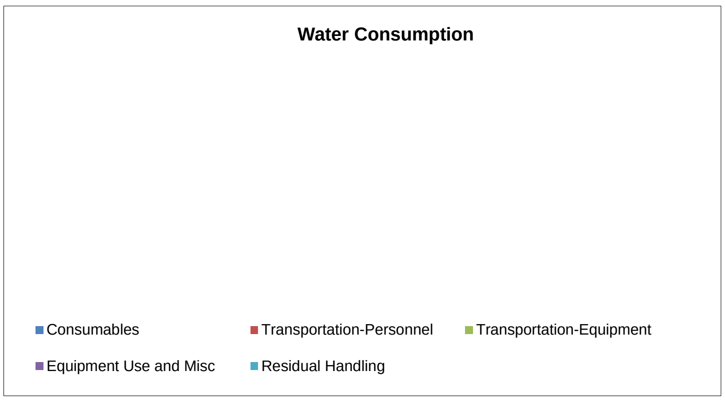


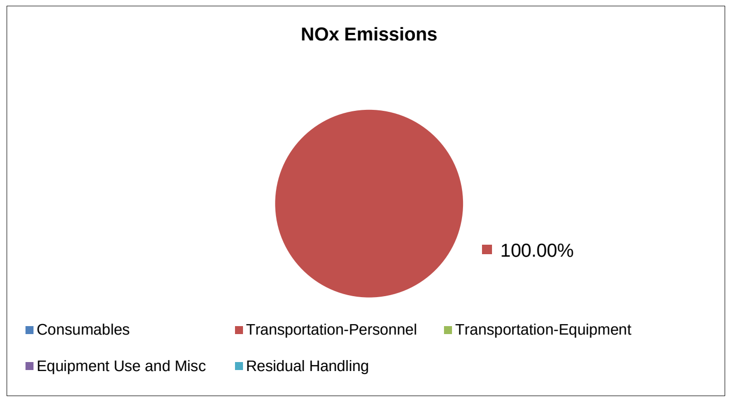


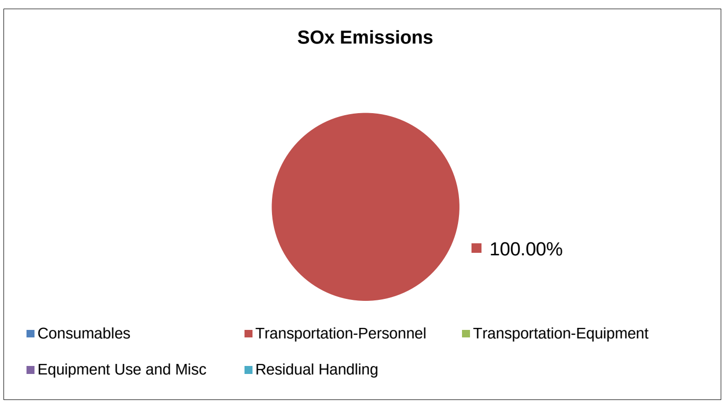
SiteWise™ Results Alternative 9-3A
Long Term Monitoring Stage
Site 9-Camp Moffett Ravine Fill, Naval Training Center Great Lakes
Great Lakes, Illinois

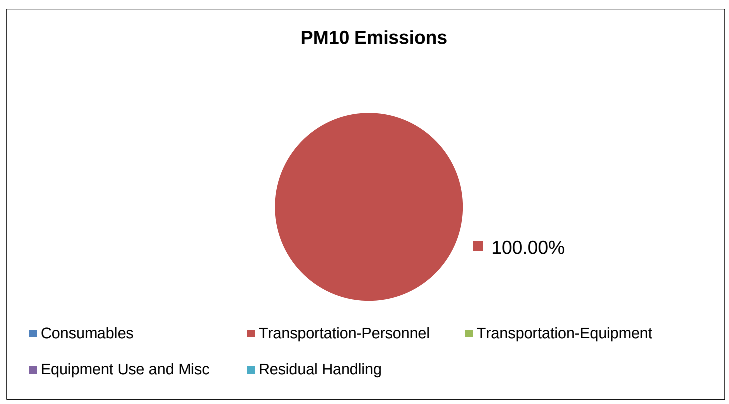


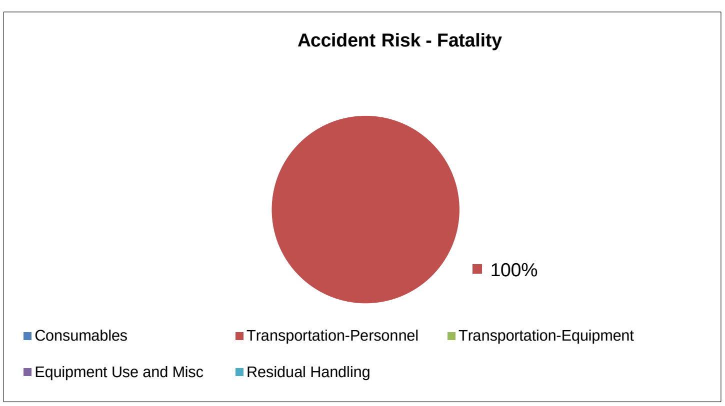


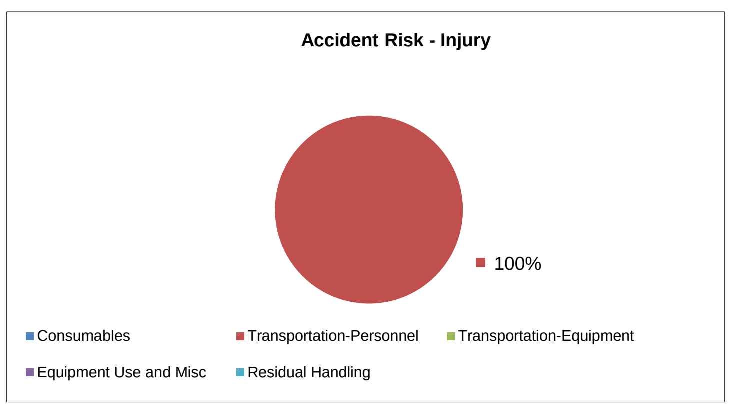


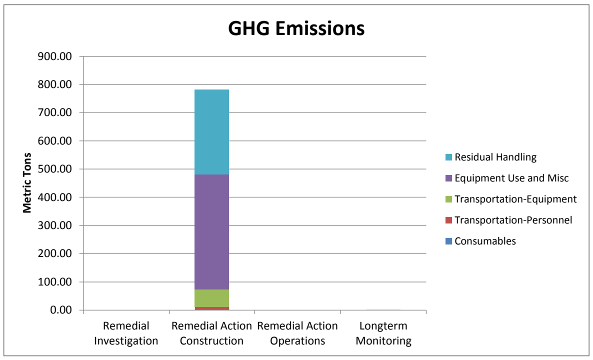


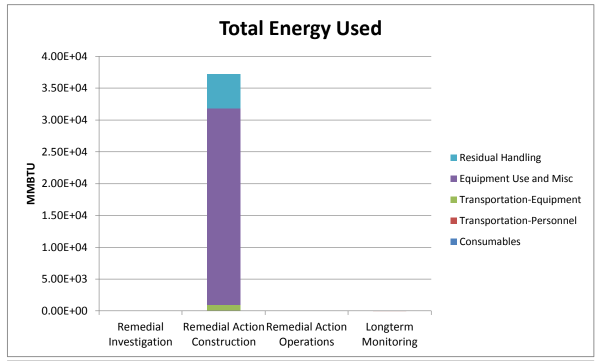


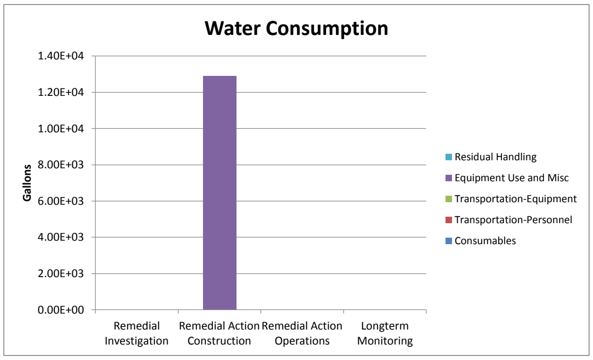


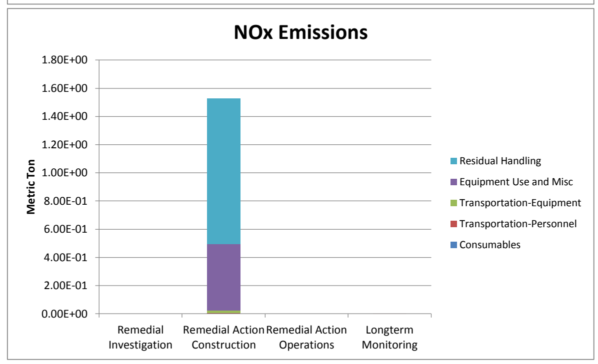


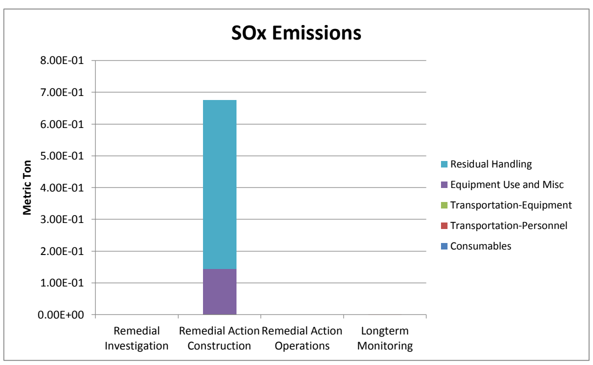


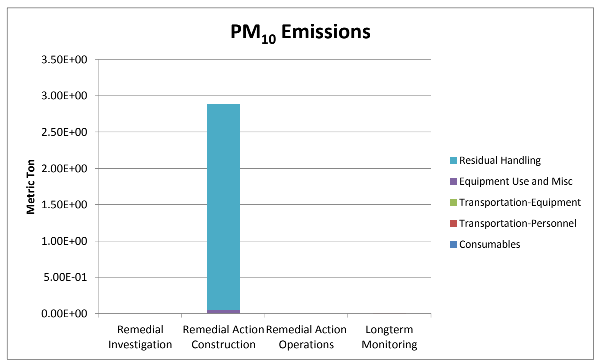

GHG Emissions
Metric Tons
900.00
800.00
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

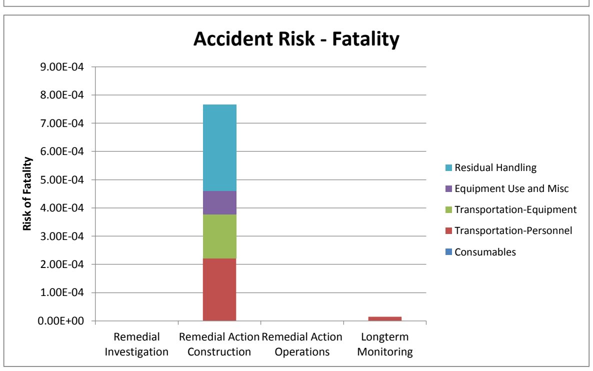

Total Energy Used
MMBTU
4.00E+04
3.50E+04
3.00E+04
2.50E+04
2.00E+04
1.50E+04
1.00E+04
5.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

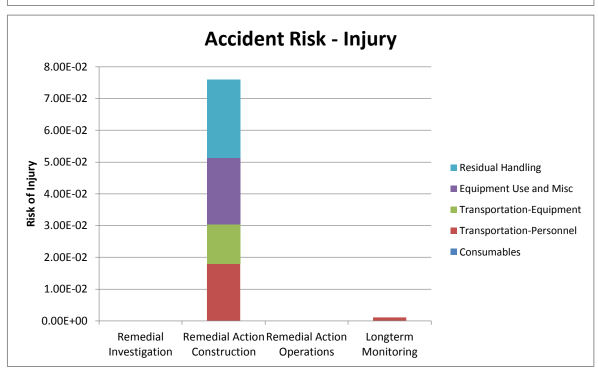

Water Consumption
Gallons
1.40E+04
1.20E+04
1.00E+04
8.00E+03
6.00E+03
4.00E+03
2.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

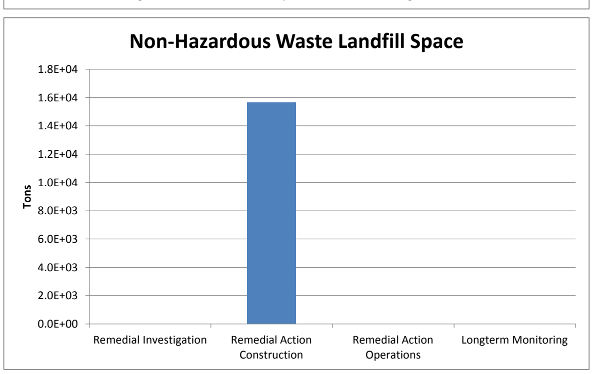

NOx Emissions
Metric Ton
1.80E+00
1.60E+00
1.40E+00
1.20E+00
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

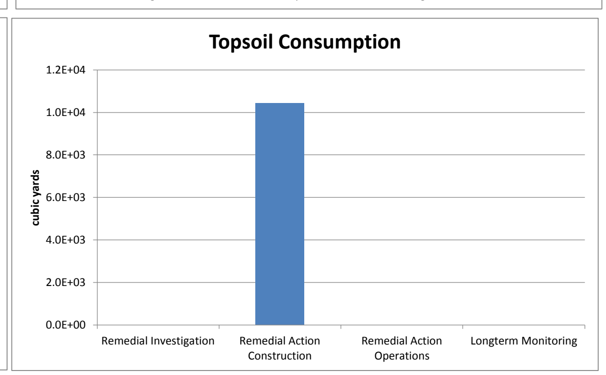

SOx Emissions
Metric Ton
8.00E-01
7.00E-01
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM_{10} Emissions
Metric Ton
3.50E+00
3.00E+00
2.50E+00
2.00E+00
1.50E+00
1.00E+00
5.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
9.00E-04
8.00E-04
7.00E-04
6.00E-04
5.00E-04
4.00E-04
3.00E-04
2.00E-04
1.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Injury
Risk of Injury
8.00E-02
7.00E-02
6.00E-02
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Non-Hazardous Waste Landfill Space
Tons
1.8E+04
1.6E+04
1.4E+04
1.2E+04
1.0E+04
8.0E+03
6.0E+03
4.0E+03
2.0E+03
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring


Topsoil Consumption
cubic yards
1.2E+04
1.0E+04
8.0E+03
6.0E+03
4.0E+03
2.0E+03
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring

Stage	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
						CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	**Materials**								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Well Instalation	PVC	32 wells, 22 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft	704.00	lft	1.14	0.57	0.00	0.01	0.00	0.00	0.00	20.96	1.21
RAC	Temporary Equipment Decon Pad Liner	HDPE	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3	700.47	lbs	1.56	0.83	0.00	0.01	0.00	0.00	0.00	9.17	0.25
RAC	Temporary Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3	514.68	lbs	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Backfill, common fill	Soil	9,977cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil	29,931,000.00	lbs	312.21	312.21	0.00	0.00	0.00	0.00	0.00	8250.39	0.00
RAC	Backfill, vegetative soil	Soil	450 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil	1,350,000.00	lbs	14.08	14.08	0.00	0.00	0.00	0.00	0.00	372.12	0.00
RAC	Seeding, mulch	Mulch	29 msf, assume mulch assume, 50 lb per msf	1,450.00	lbs	0.46	0.16	0.00	0.00	0.00	0.00	0.00	5.19	0.00
RAC	Seeding, fertilizer	Fertilizer	29 msf, assume fertilizer, assume 20 lb per smf	580.00	lbs	0.72	0.72	0.00	0.00	0.00	0.00	0.00	13.11	0.26
RAC	Fenton Reagent	Hydrogen Peroxide	Assume hydrogen peroxide, 4% by weight of 4,500 gal. Assume two events	360.00	lbs	0.66	0.20	0.00	0.00	0.00	0.00	0.00	5.07	0.00
	Subtotal					**330.84**	**328.77**	**0.01**	**0.01**	**0.00**	**0.01**	**0.00**	**8676.01**	**1.73**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	DPT	Drill Rig, DPT (diesel)	4 days, 8 hours per day, 80% utilization	25.60	hrs	0.41	0.40	0.00	0.00	0.00	0.00	0.00	3.13	
RAC	Excavator, 2.5 CY	Excavator, Hydraulic, 2 CY (diesel)	40 days, 8 hours per day, 80% utilization	256.00	hrs	24.81	24.81	0.00	0.00	0.16	0.05	0.01	112.63	
RAC	Excavator, 2.5 CY	Excavator, Hydraulic, 2 CY (diesel)	30 days, 8 hours per day, 80% utilization	192.00	hrs	18.61	18.61	0.00	0.00	0.12	0.03	0.01	84.47	
RAC	Dozer, 140 hp	Dozer, 140 HP (D6) w/A Blade (diesel)	30 days, 8 hours per day, 80% utilization	192.00	hrs	11.51	11.51	0.00	0.00	0.08	0.02	0.01	61.79	
RAC	Compactor 125 hp	Compactor 120 hp	30 days, 8 hours per day, 80% utilization	192.00	hrs	7.68	7.68	0.00	0.00	0.06	0.00	0.01	35.48	
RAC	tractor	Tractor (agricultural equipment), 250 hp, diesel	1 day, 8 hours per day, 80% utilization	6.40	hrs	0.48	0.48	0.00	0.00	0.00	0.00	0.00	1.72	
RAC	hydromulcher	Hydromulcher 15 hp (gasoline)	1 day, 8 hours per day, 80% utilization	6.40	hrs	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.21	
RAC	DPT Drill Rig, well installation	Drill Rig, DPT (diesel)	Assume 5 wells per day, 32 wells, 8 hours per day, 80% utilization	44.80	hrs	0.72	0.70	0.00	0.00	0.01	0.00	0.00	5.48	
	Subtotal					**64.27**	**64.24**	**0.00**	**0.00**	**0.43**	**0.10**	**0.04**	**304.90**	**0**
				Total		**395**	**393**	**0.01**	**0.02**	**0.43**	**0.11**	**0.04**	**8,981**	**2**

Alternative 1
Values Input into SiteWise as "Other"

Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}		
				Tonnes				**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	395.11	393.01	1.77	0.33	0.43	0.11	0.04	30,642.90	1,727.78
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

APPENDIX C-3-3 SITE 21

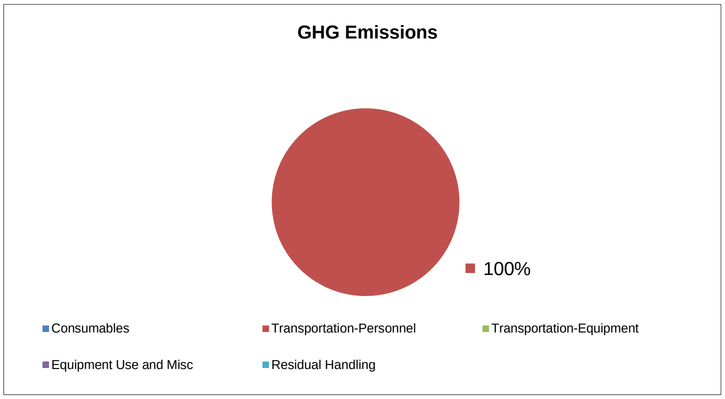
Sustainable Remediation - Environmental Footprint Summary
Alternative 21-2

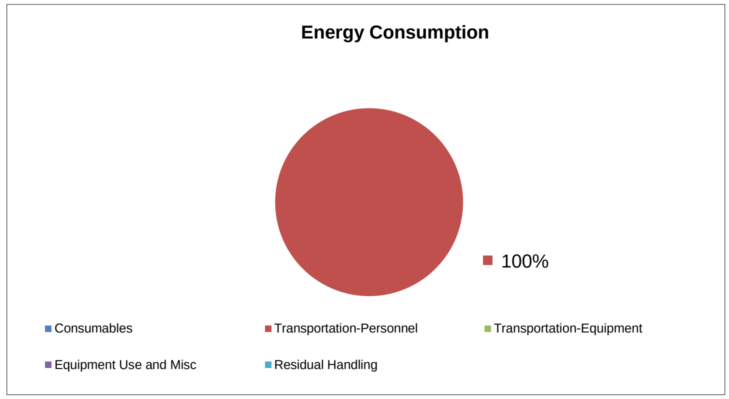
Phase	Activities	GHG Emissions (metric ton)	Total energy Used (MMBTU)	Water Consumption (gallons)	NOx emissions (metric ton)	SOx Emissions (metric ton)	PM10 Emissions (metric ton)	Accident Risk Fatality	Accident Risk Injury
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.69	8.6E+00	NA	2.5E-04	8.9E-06	5.1E-05	1.4E-05	1.1E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.69	8.63E+00	0.00E+00	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
Total		**6.9E-01**	**8.6E+00**	**0.0E+00**	**2.5E-04**	**8.9E-06**	**5.1E-05**	**1.4E-05**	**1.1E-03**

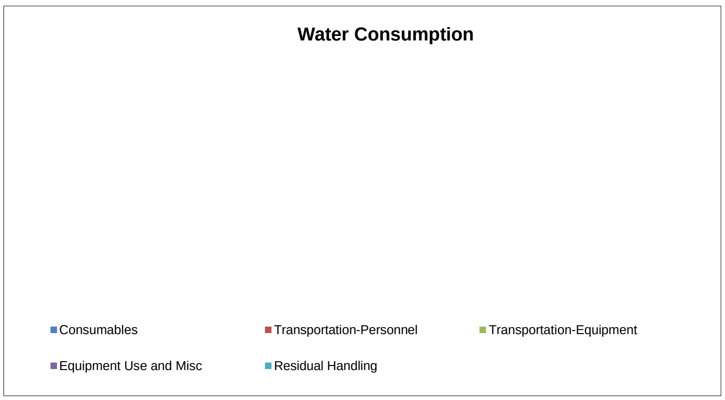
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space (tons)	Hazardous Waste Landfill Space (tons)	Topsoil Consumption (cubic yards)	Costing ($)	Lost Hours - Injury
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	9.0E-03
Total	**0.0E+00**	**0.0E+00**	**0.0E+00**	**$0**	**9.0E-03**

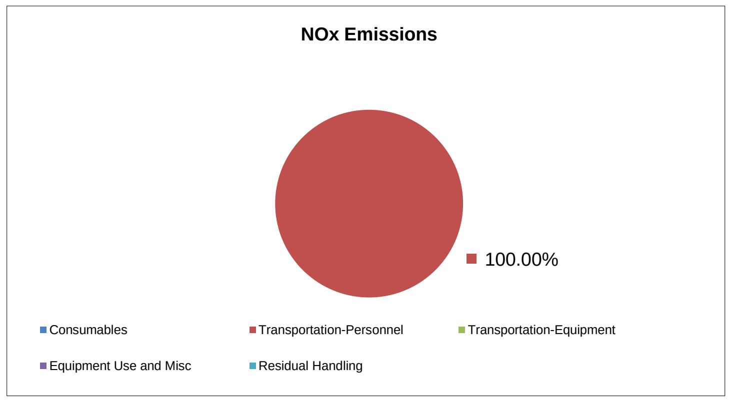
Total Cost with Footprint Reduction
$0

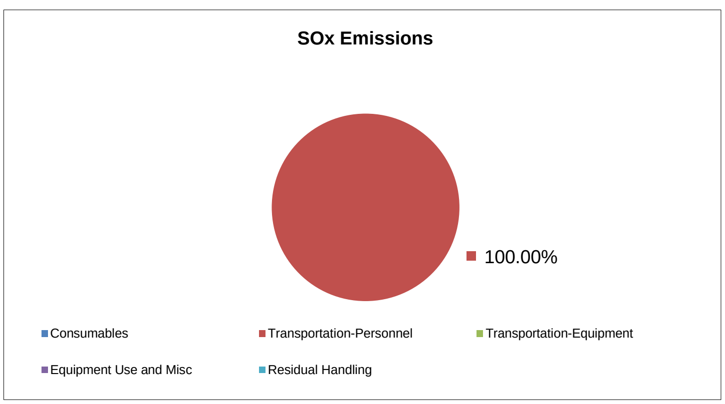
SiteWise™ Results Alternative 21-2
Long Term Monitoring Stage
Site 21-Building 1517/1506 Area, Naval Training Center Great Lakes
Great Lakes, Illinois

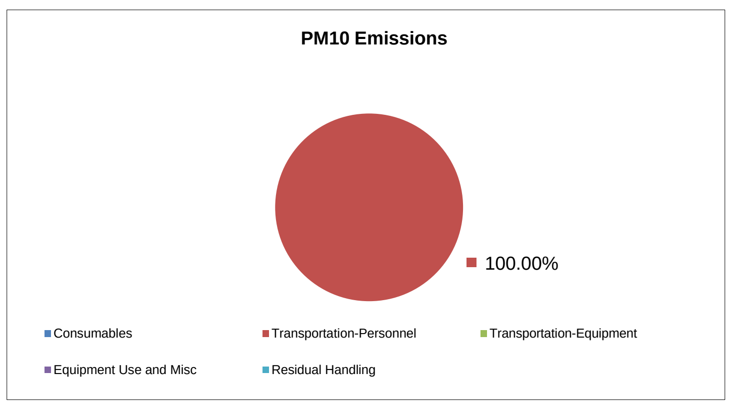


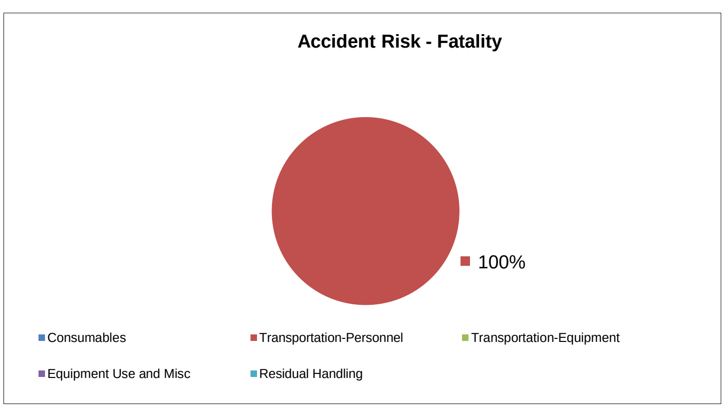


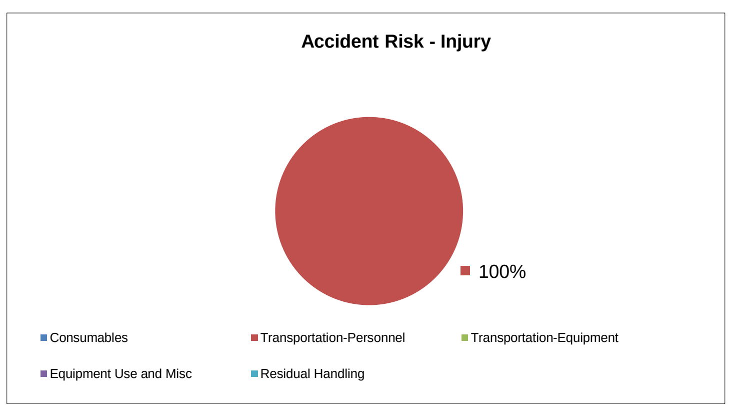


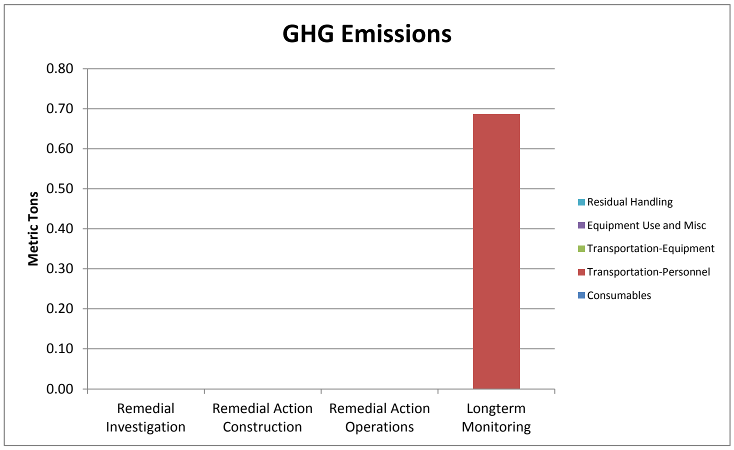


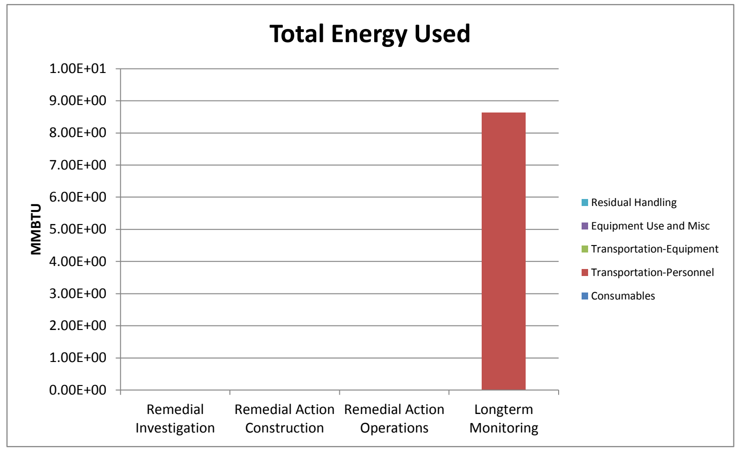


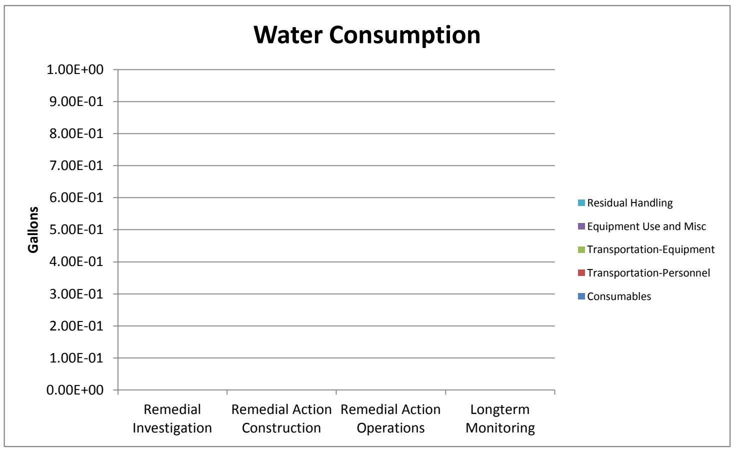


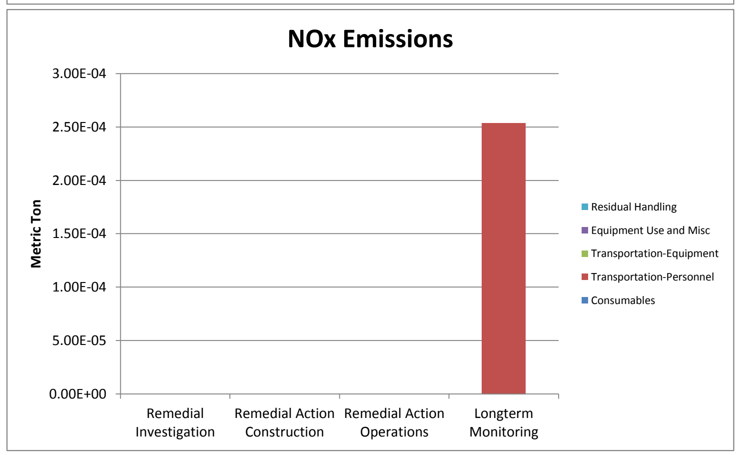


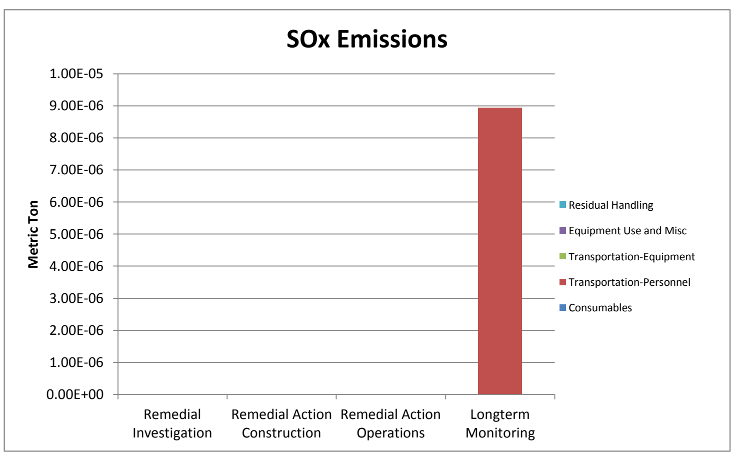


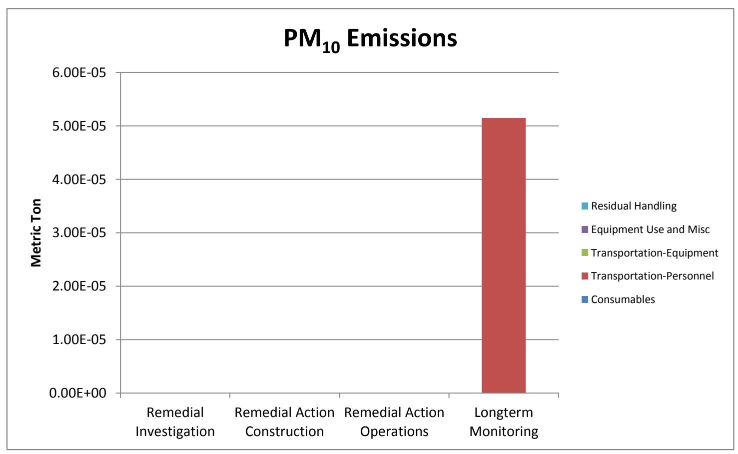

GHG Emissions
Metric Tons
0.80
0.70
0.60
0.50
0.40
0.30
0.20
0.10
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

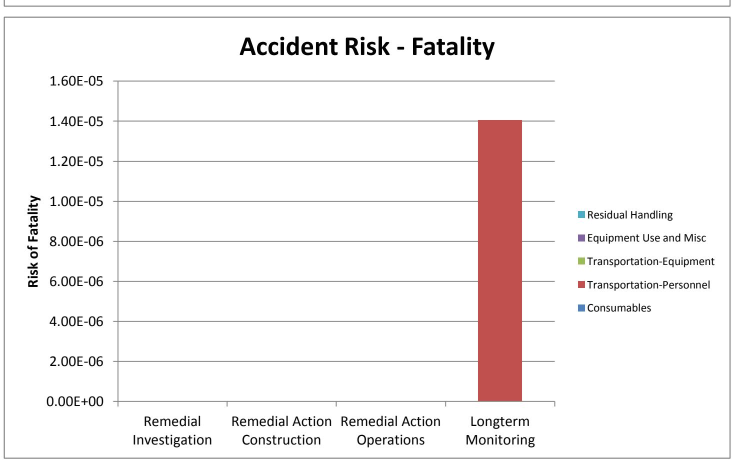

Total Energy Used
MMBTU
1.00E+01
9.00E+00
8.00E+00
7.00E+00
6.00E+00
5.00E+00
4.00E+00
3.00E+00
2.00E+00
1.00E+00
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

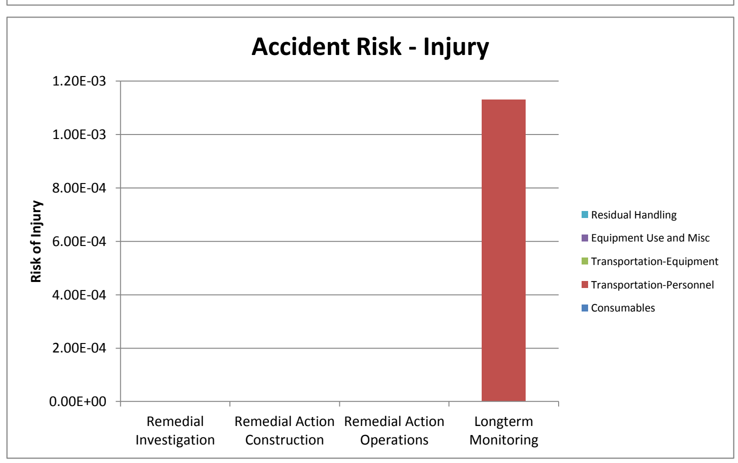

Water Consumption
Gallons
1.00E+00
9.00E-01
8.00E-01
7.00E-01
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
3.00E-04
2.50E-04
2.00E-04
1.50E-04
1.00E-04
5.00E-05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
1.00E-05
9.00E-06
8.00E-06
7.00E-06
6.00E-06
5.00E-06
4.00E-06
3.00E-06
2.00E-06
1.00E-06
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM_{10} Emissions
Metric Ton
6.00E-05
5.00E-05
4.00E-05
3.00E-05
2.00E-05
1.00E-05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
1.60E-05
1.40E-05
1.20E-05
1.00E-05
8.00E-06
6.00E-06
4.00E-06
2.00E-06
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

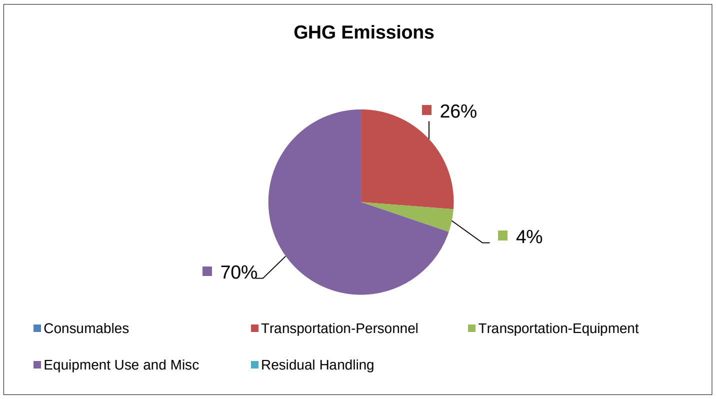

Accident Risk - Injury
Risk of Injury
1.20E-03
1.00E-03
8.00E-04
6.00E-04
4.00E-04
2.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

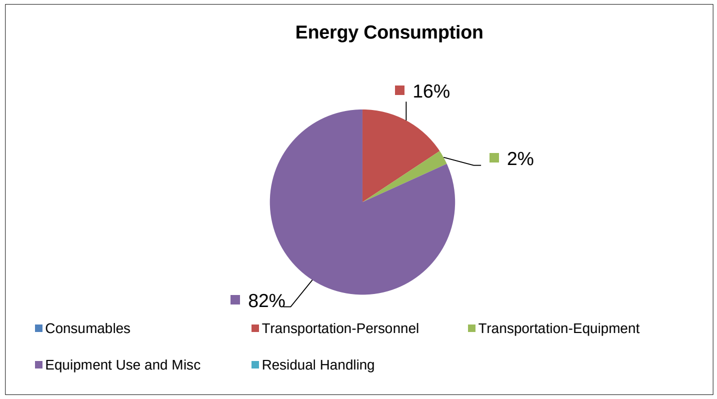
Sustainable Remediation - Environmental Footprint Summary
Alternative 21-2A

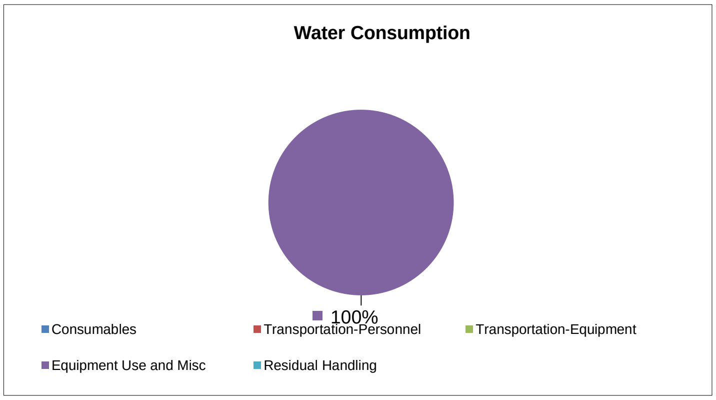
Phase	Activities	GHG Emissions (metric ton)	Total energy Used (MMBTU)	Water Consumption (gallons)	NOx emissions (metric ton)	SOx Emissions (metric ton)	PM10 Emissions (metric ton)	Accident Risk Fatality	Accident Risk Injury
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	2.69	3.4E+01	NA	9.9E-04	3.5E-05	2.0E-04	5.5E-05	4.4E-03
	Transportation-Equipment	0.41	5.4E+00	NA	1.3E-04	3.4E-06	1.1E-05	1.6E-06	1.3E-04
	Equipment Use and Misc	7.15	1.8E+02	1.3E+04	1.6E-02	1.5E-02	2.6E-03	4.1E-06	1.0E-03
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	10.25	2.15E+02	1.35E+04	1.73E-02	1.46E-02	2.86E-03	6.07E-05	5.59E-03
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.69	8.6E+00	NA	2.5E-04	8.9E-06	5.1E-05	1.4E-05	1.1E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.69	8.63E+00	0.00E+00	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
Total		**1.1E+01**	**2.2E+02**	**1.3E+04**	**1.8E-02**	**1.5E-02**	**2.9E-03**	**7.5E-05**	**6.7E-03**

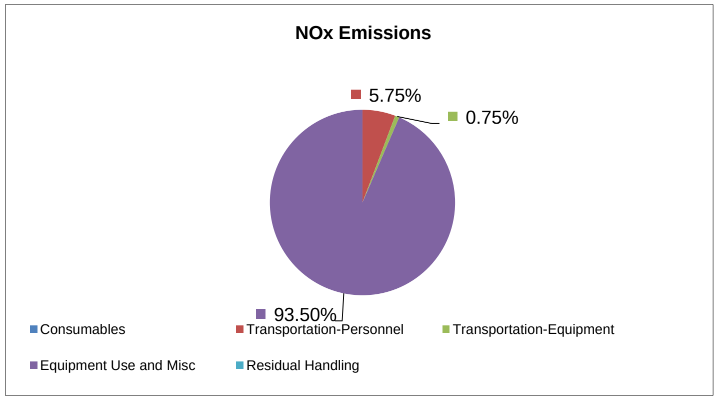
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space (tons)	Hazardous Waste Landfill Space (tons)	Topsoil Consumption (cubic yards)	Costing ($)	Lost Hours - Injury
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	0.0E+00	0.0E+00	0.0E+00	0	4.5E-02
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	9.0E-03
Total	**0.0E+00**	**0.0E+00**	**0.0E+00**	**$0**	**5.4E-02**

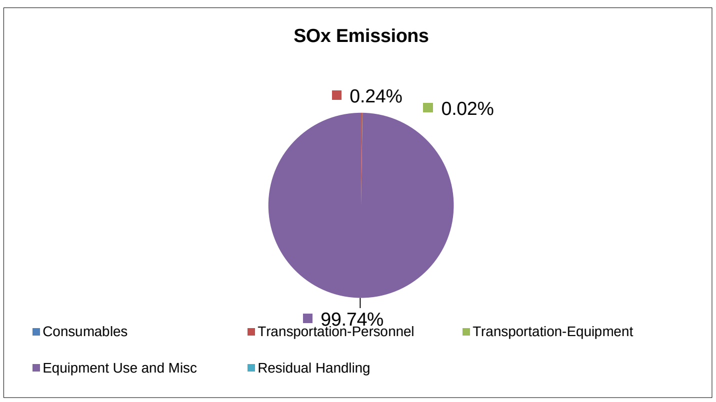
Total Cost with Footprint Reduction
$0

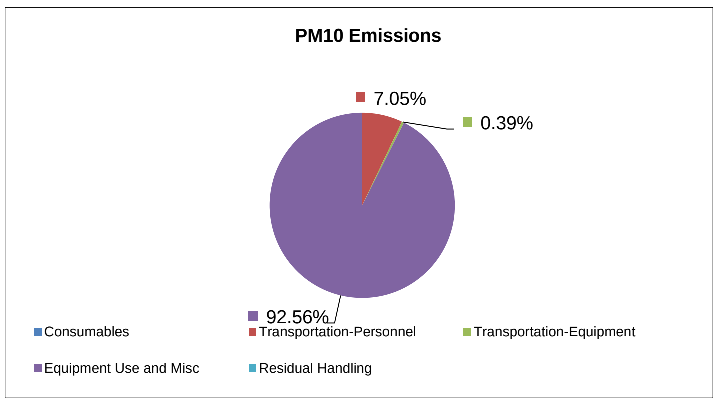

GHG Emissions
26%
4%
70%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

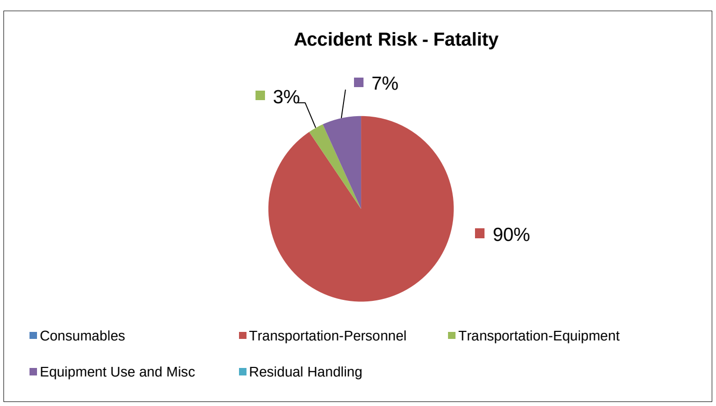

Energy Consumption
16%
2%
82%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

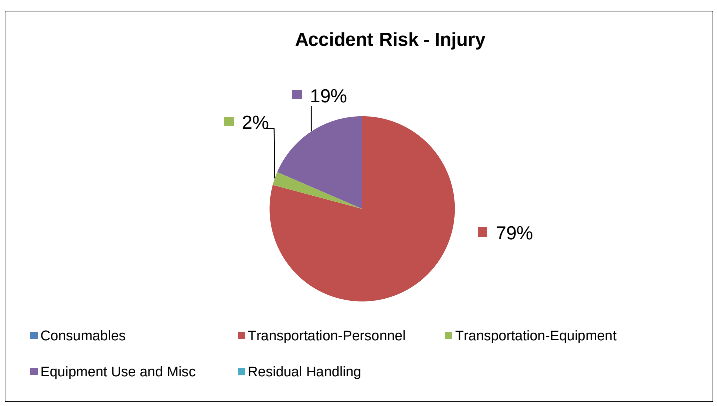

Water Consumption
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


NOx Emissions
5.75%
0.75%
93.50%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

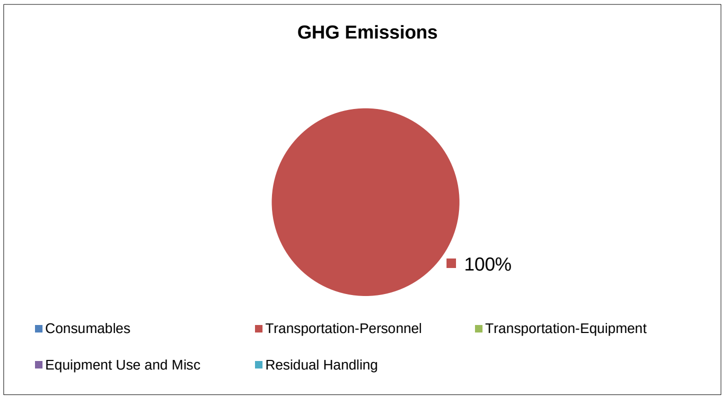

SOx Emissions
0.24%
0.02%
99.74%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

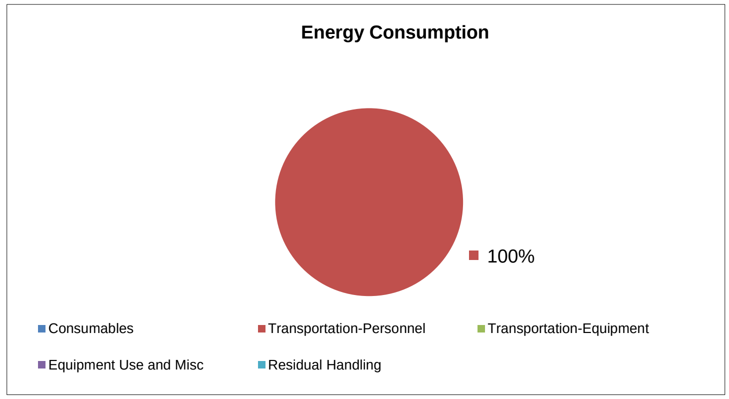

PM10 Emissions
7.05%
0.39%
92.56%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

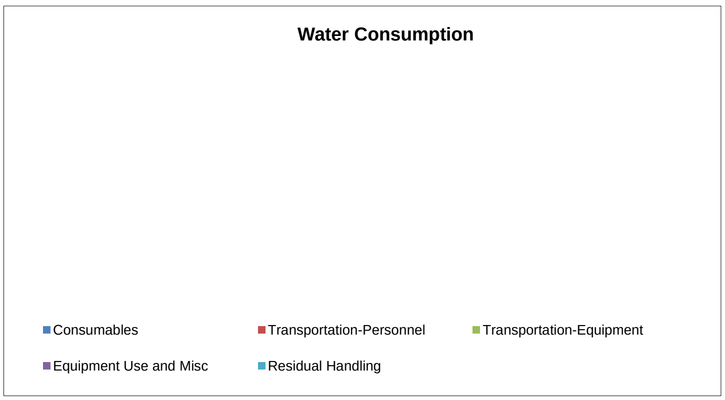

Accident Risk - Fatality
3%
7%
90%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

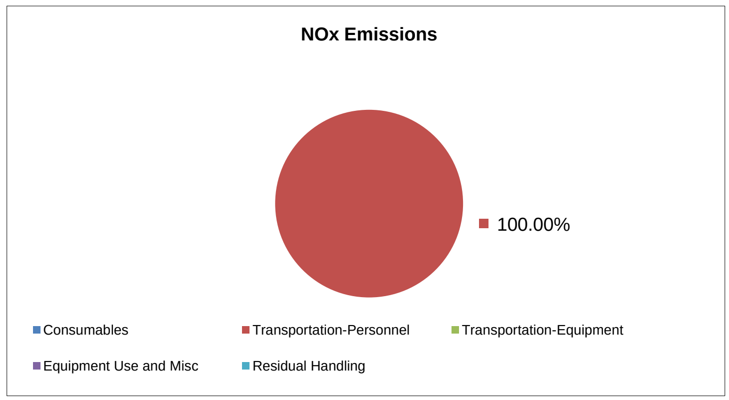

Accident Risk - Injury
2%
19%
79%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

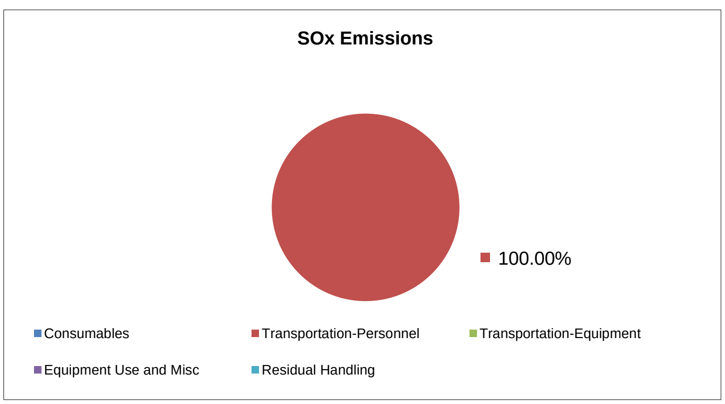
SiteWise™ Results Alternative 21-2A
Long Term Monitoring Stage
Site 21-Building 1517/1506 Area, Naval Training Center Great Lakes
Great Lakes, Illinois

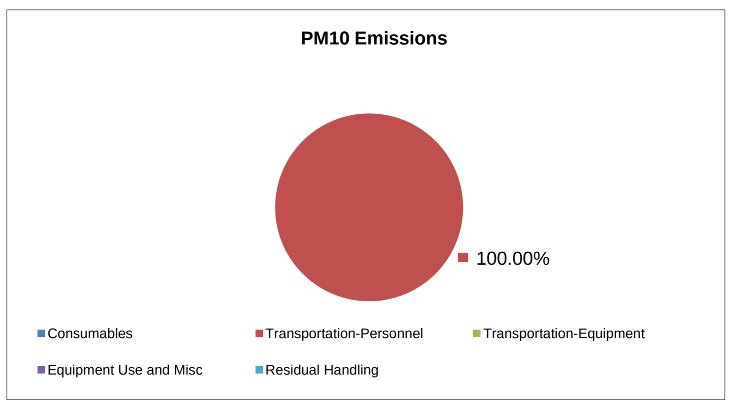


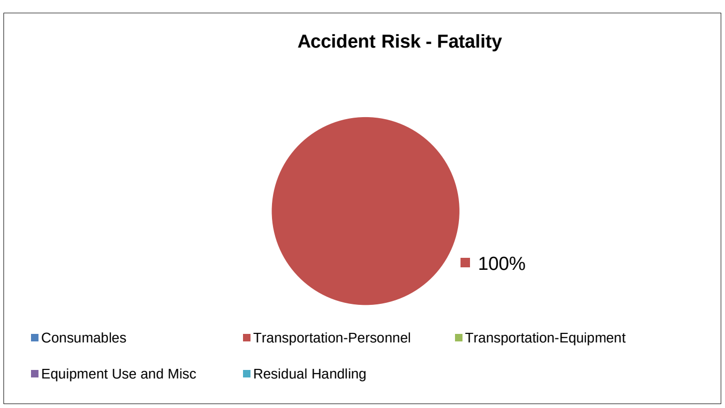


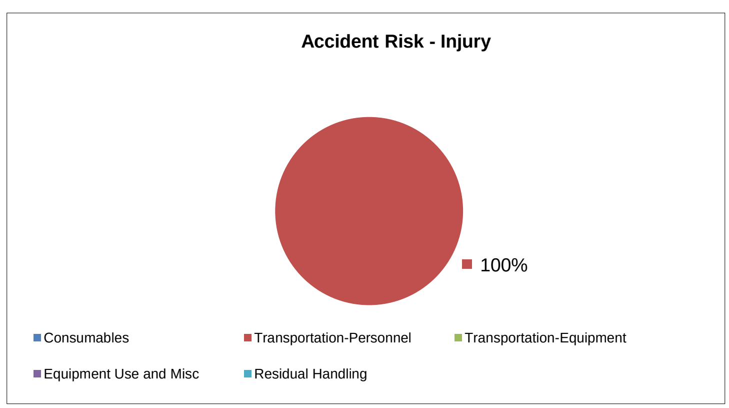


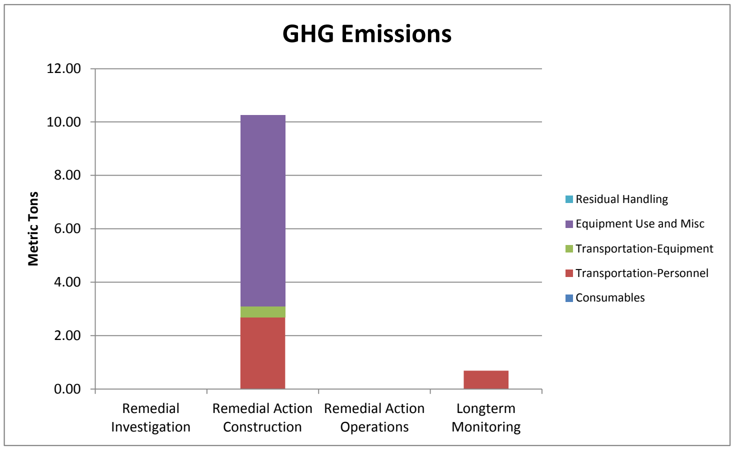


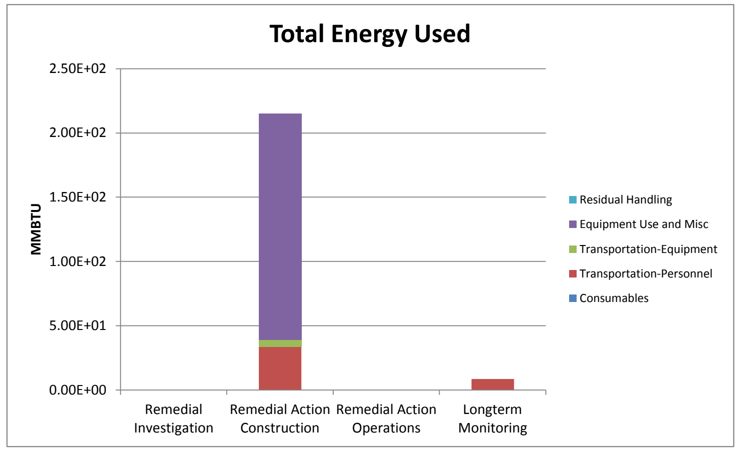


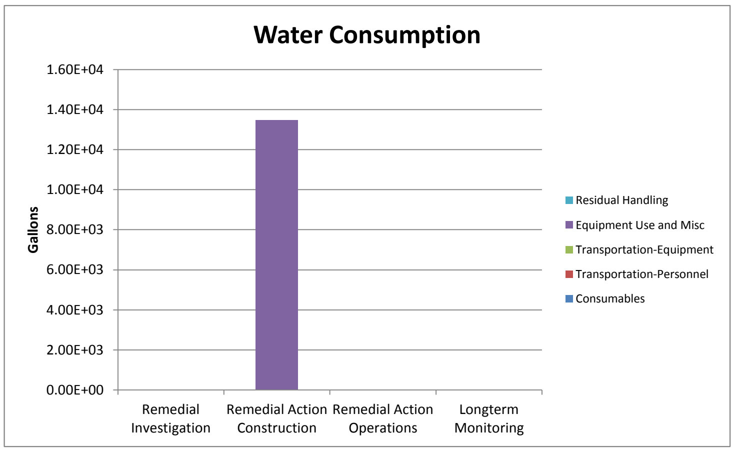


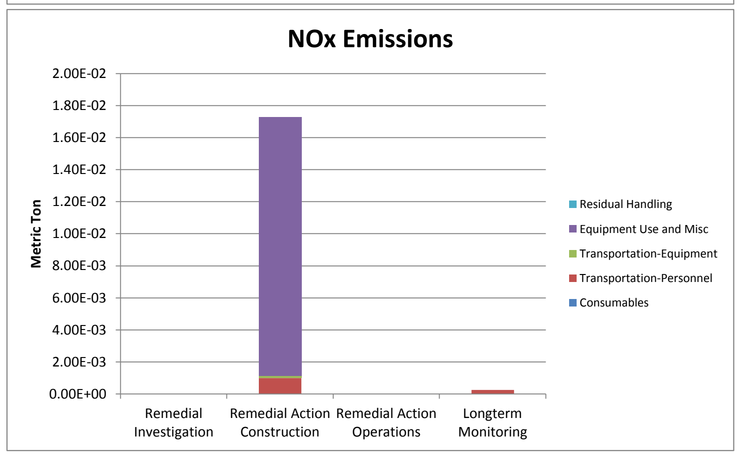


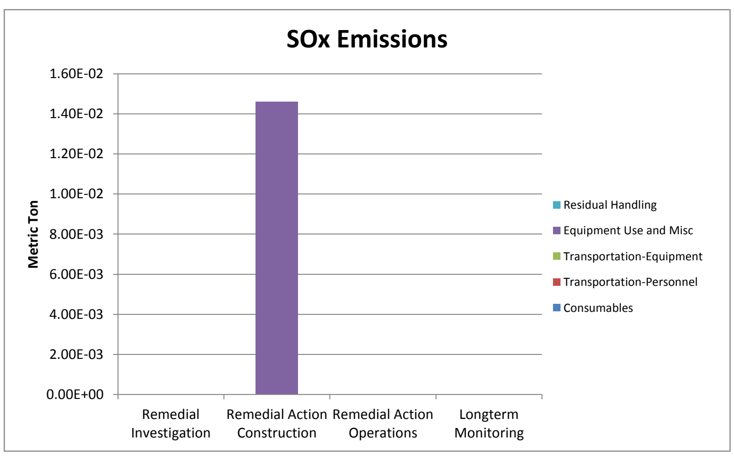


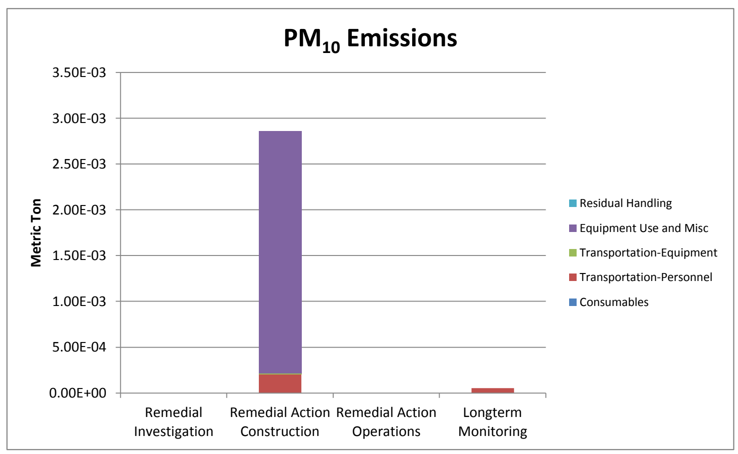

GHG Emissions
Metric Tons
12.00
10.00
8.00
6.00
4.00
2.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

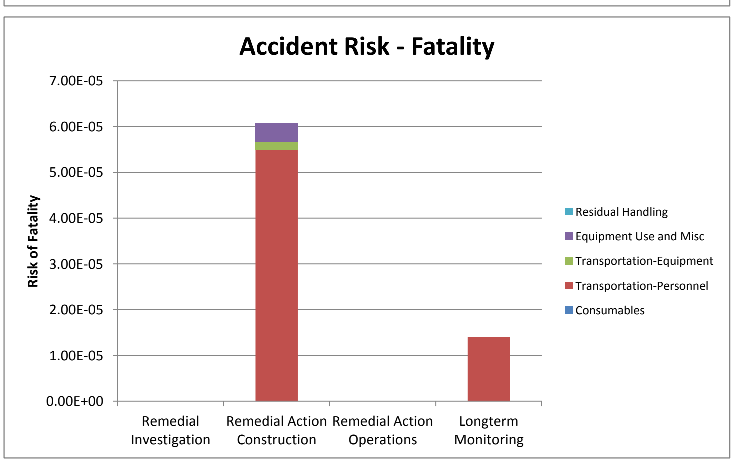

Total Energy Used
MMBTU
2.50E+02
2.00E+02
1.50E+02
1.00E+02
5.00E+01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

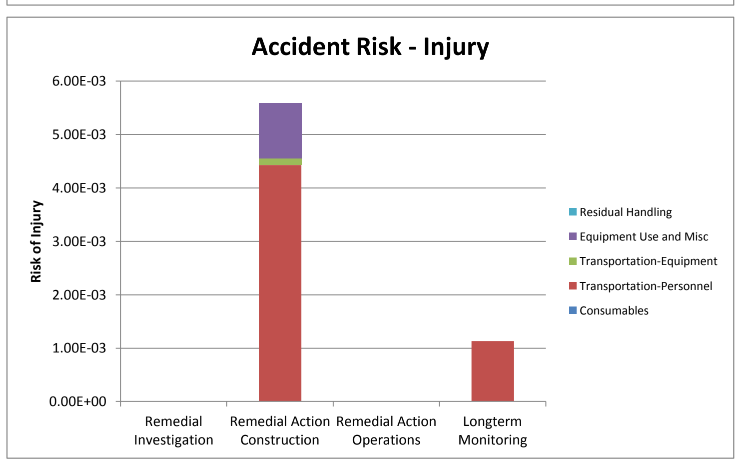

Water Consumption
Gallons
1.60E+04
1.40E+04
1.20E+04
1.00E+04
8.00E+03
6.00E+03
4.00E+03
2.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NOx Emissions
Metric Ton
2.00E-02
1.80E-02
1.60E-02
1.40E-02
1.20E-02
1.00E-02
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SOx Emissions
Metric Ton
1.60E-02
1.40E-02
1.20E-02
1.00E-02
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM_{10} Emissions
Metric Ton
3.50E-03
3.00E-03
2.50E-03
2.00E-03
1.50E-03
1.00E-03
5.00E-04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
7.00E-05
6.00E-05
5.00E-05
4.00E-05
3.00E-05
2.00E-05
1.00E-05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Injury
Risk of Injury
6.00E-03
5.00E-03
4.00E-03
3.00E-03
2.00E-03
1.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
						CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	**Materials**								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Well Instalation	PVC	32 wells, 15 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft	480.00	lft	0.78	0.39	0.00	0.00	0.00	0.00	0.00	14.29	0.83
RAC	Temporary Equipment Decon Pad Liner	HDPE	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3	700.47	lbs	1.56	0.83	0.00	0.01	0.00	0.00	0.00	9.17	0.25
RAC	Temporary Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3	514.68	lbs	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Fenton Reagent	Hydrogen Peroxide	Assume hydrogen peroxide, 7% by weight of 5,600 gal. Assume two events	784.00	lbs	1.44	0.43	0.00	0.00	0.00	0.00	0.00	11.05	0.00
	Subtotal					**3.78**	**1.65**	**0.01**	**0.01**	**0.00**	**0.01**	**0.00**	**34.51**	**1.08**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	DPT Drill Rig, well installation	Drill Rig, DPT (diesel)	Assume 5 wells per day, 32 wells, 8 hours per day, 80% utilization	44.80	hrs	0.72	0.70	0.00	0.00	0.01	0.00	0.00	5.48	
	Subtotal					**0.72**	**0.70**	**0.00**	**0.00**	**0.01**	**0.00**	**0.00**	**5.48**	**0**
				Total		**5**	**2**	**0.01**	**0.01**	**0.01**	**0.01**	**0.00**	**40**	**1**

Alternative 1
Values Input into SiteWise as "Other"

Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}		
				Tonnes				**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	4.50	2.35	1.86	0.29	0.01	0.01	0.00	136.42	1,080.64
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

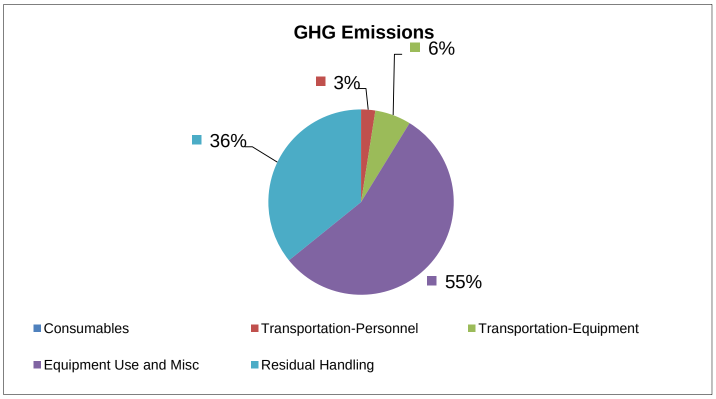
Sustainable Remediation - Environmental Footprint Summary
Alternative 21-3

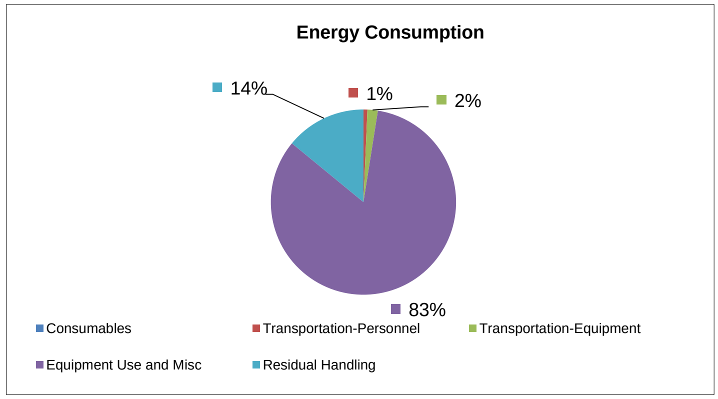
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	5.89	7.4E+01	NA	2.2E-03	7.7E-05	4.4E-04	1.2E-04	9.7E-03
	Transportation-Equipment	14.98	2.0E+02	NA	4.7E-03	8.3E-05	4.2E-04	3.7E-05	3.0E-03
	Equipment Use and Misc	131.90	9.0E+03	1.6E+03	2.1E-01	7.2E-02	1.8E-02	3.3E-05	8.3E-03
	Residual Handling	85.24	1.5E+03	NA	2.9E-01	1.5E-01	8.0E-01	8.7E-05	7.0E-03
	Sub-Total	238.01	1.08E+04	1.63E+03	5.07E-01	2.23E-01	8.22E-01	2.78E-04	2.80E-02
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.69	8.6E+00	NA	2.5E-04	8.9E-06	5.1E-05	1.4E-05	1.1E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.69	8.63E+00	0.00E+00	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
Total		**2.4E+02**	**1.1E+04**	**1.6E+03**	**5.1E-01**	**2.2E-01**	**8.2E-01**	**2.9E-04**	**2.9E-02**

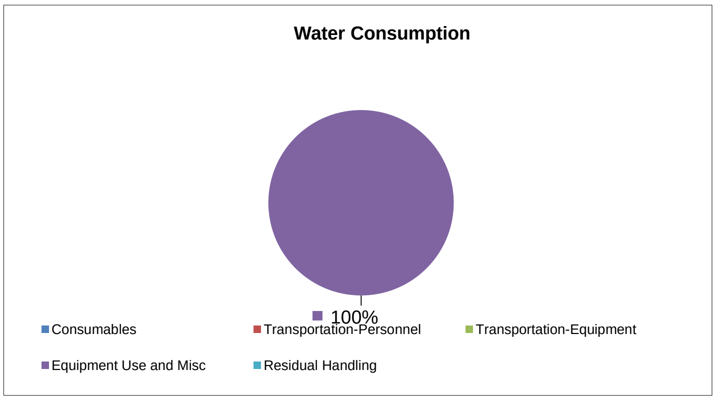
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	4.4E+03	0.0E+00	2.9E+03	0	2.2E-01
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	9.0E-03
Total	**4.4E+03**	**0.0E+00**	**2.9E+03**	**$0**	**2.3E-01**

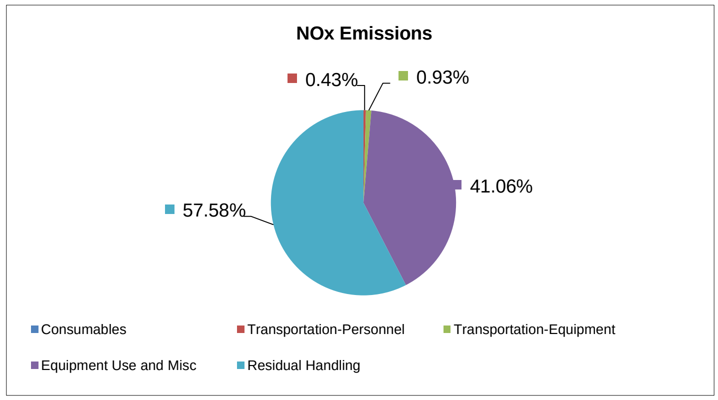
Total Cost with Footprint Reduction
$0

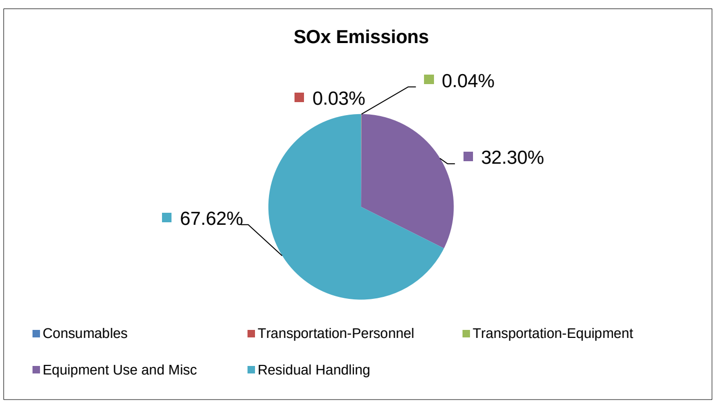
SiteWise™ Results Alternative 21-3
Residual Action Construction Stage
Site 21-Building 1517/1506 Area, Naval Training Center Great Lakes
Great Lakes, Illinois

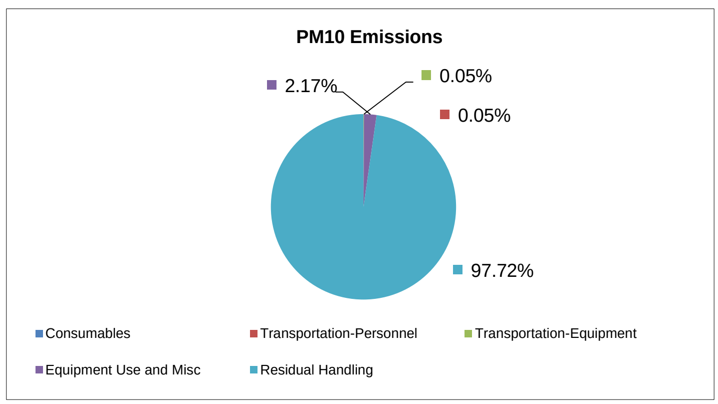


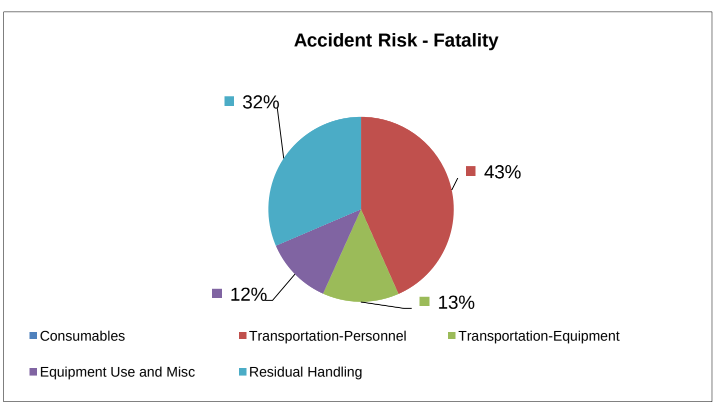


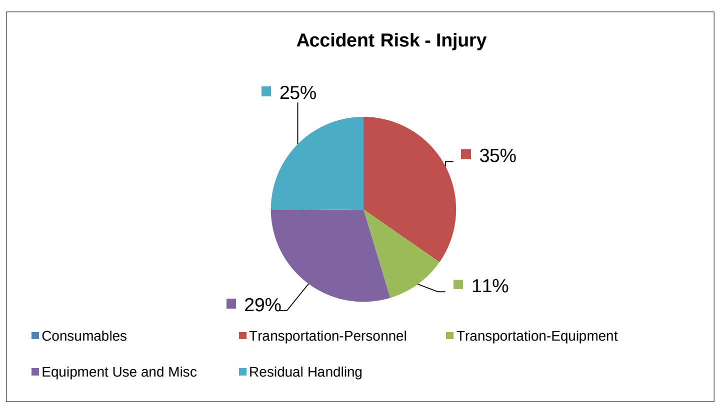




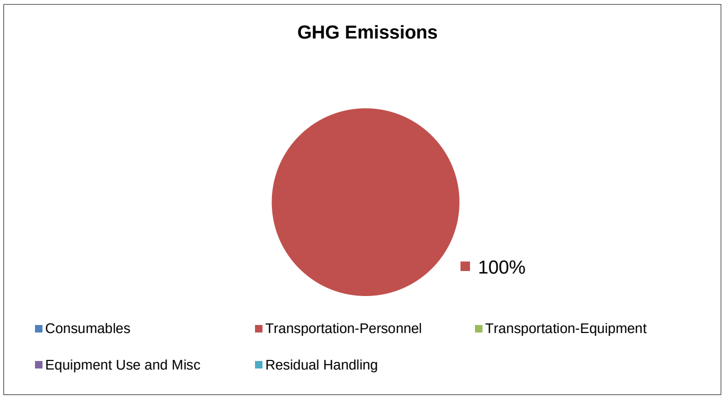


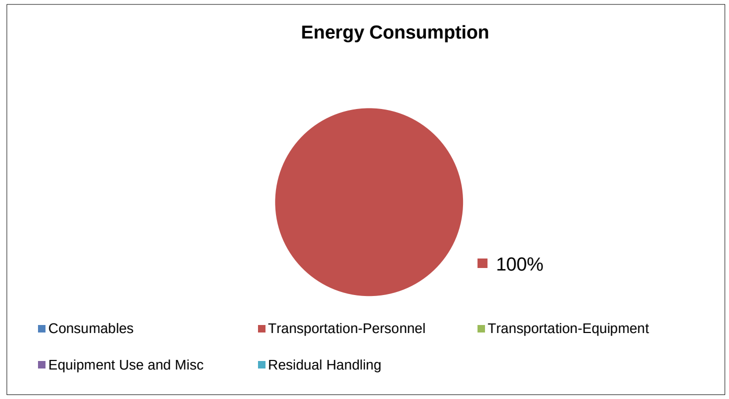


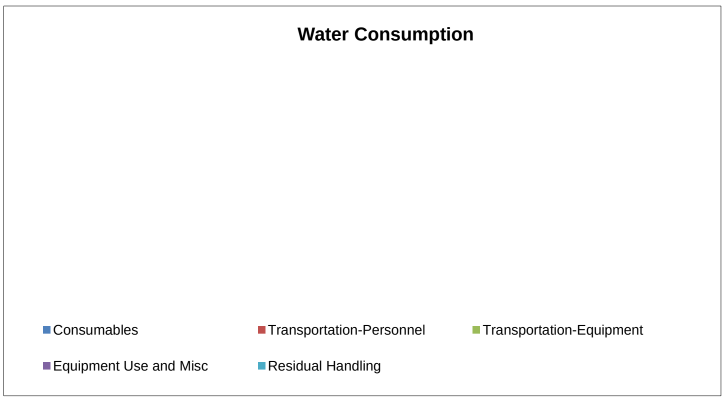


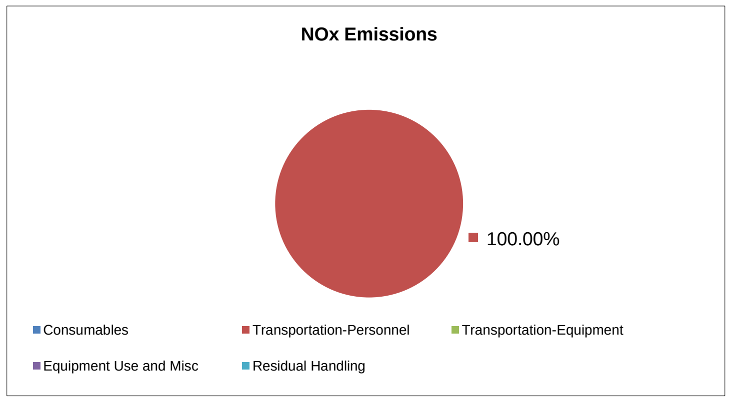


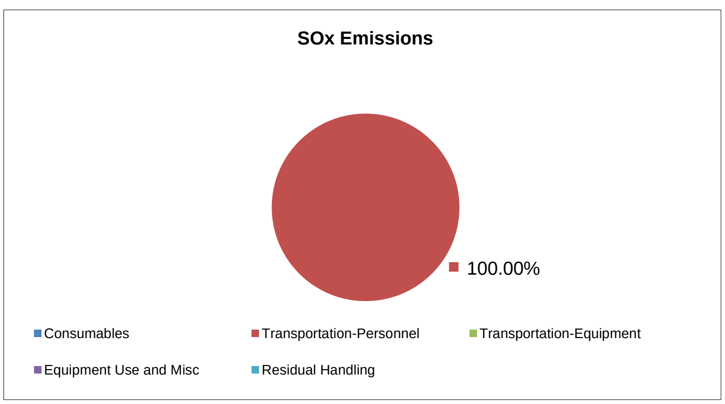
SiteWise™ Results Alternative 21-3
Site 21-Building 1517/1506 Area, Naval Training Center Great Lakes
Great Lakes, Illinois

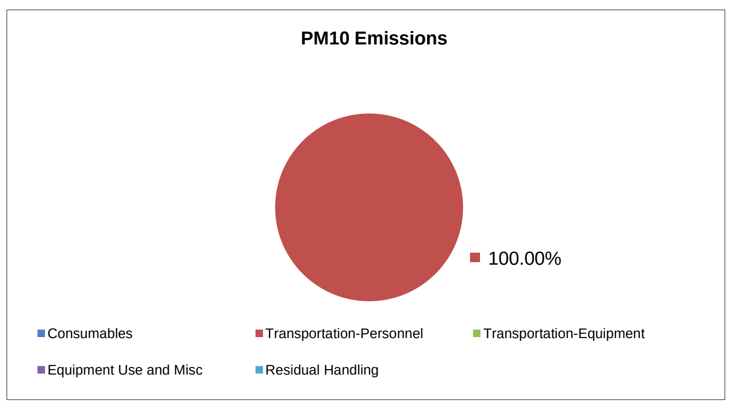


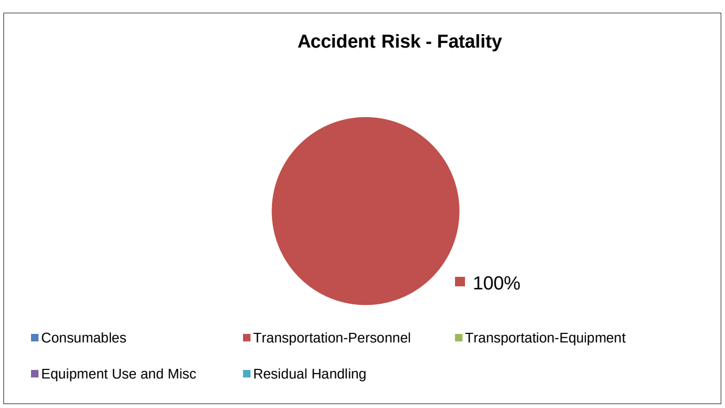


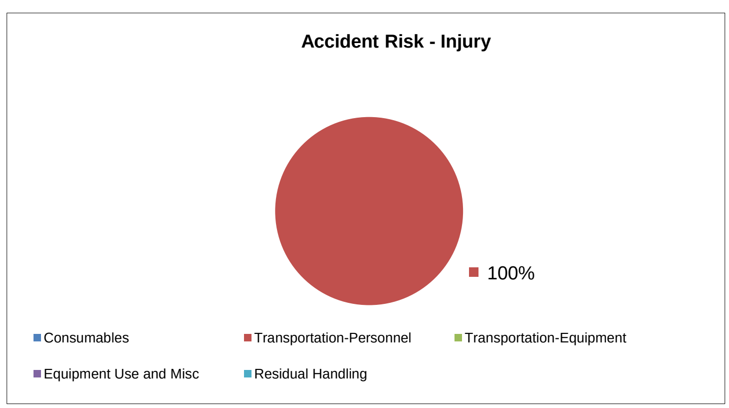


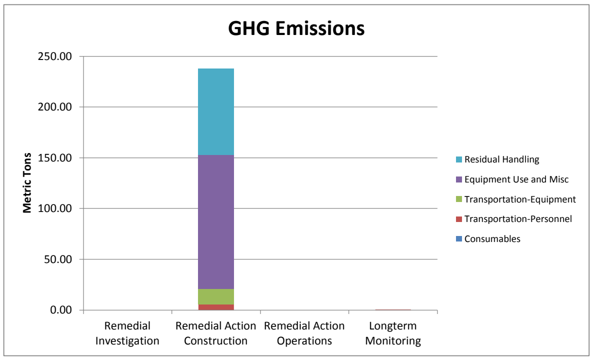


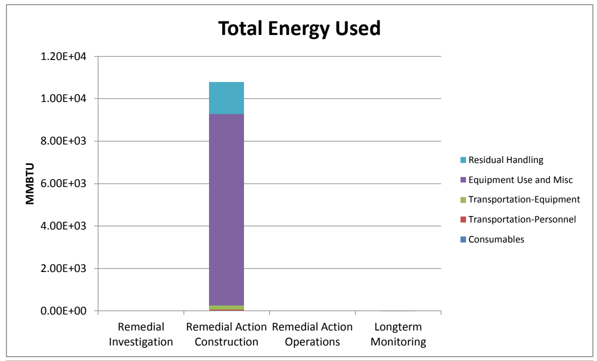


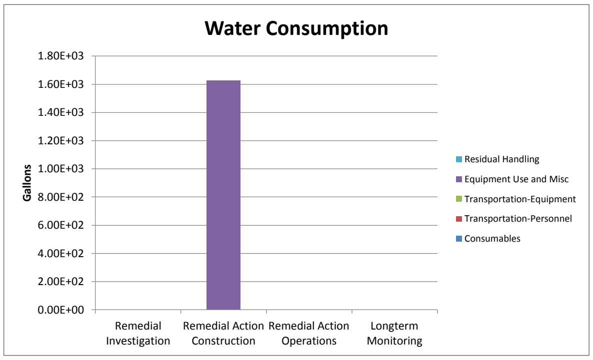


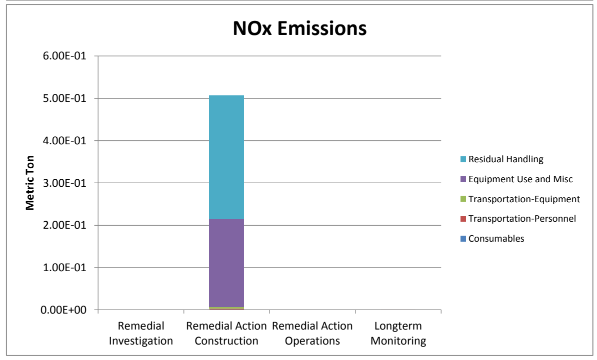


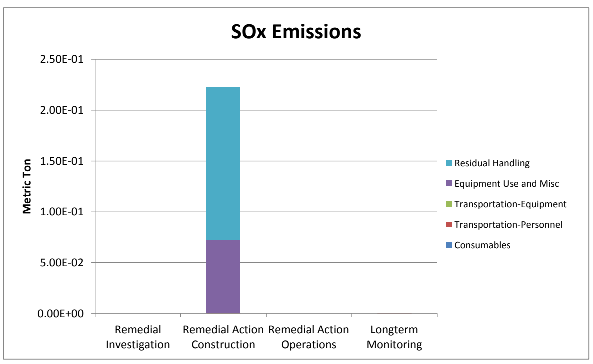


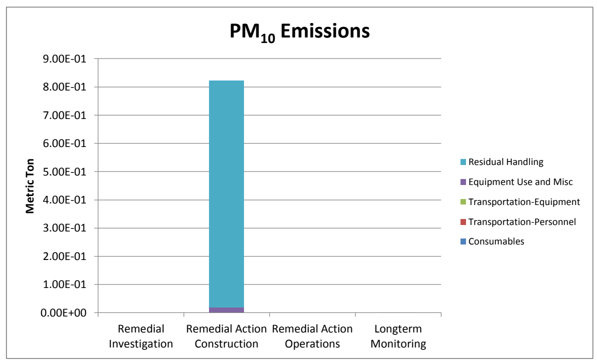

GHG Emissions
Metric Tons
250.00
200.00
150.00
100.00
50.00
0.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

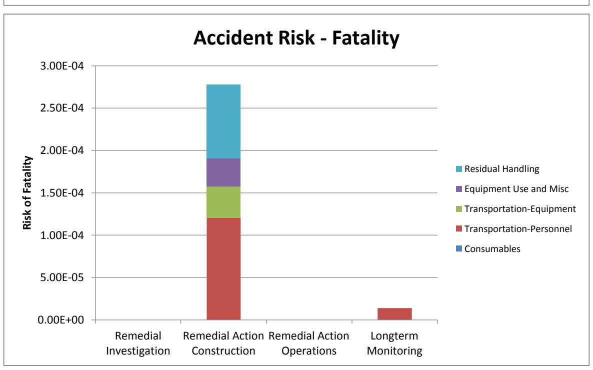

Total Energy Used
MMBTU
1.20E+04
1.00E+04
8.00E+03
6.00E+03
4.00E+03
2.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

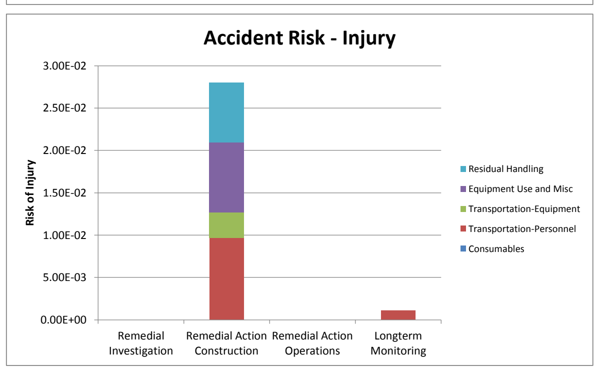

Water Consumption
Gallons
1.80E+03
1.60E+03
1.40E+03
1.20E+03
1.00E+03
8.00E+02
6.00E+02
4.00E+02
2.00E+02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

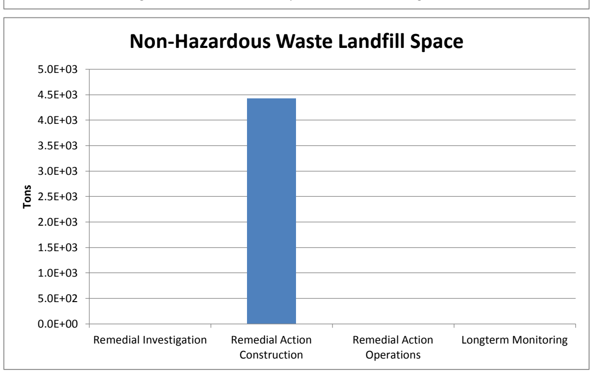

NOx Emissions
Metric Ton
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

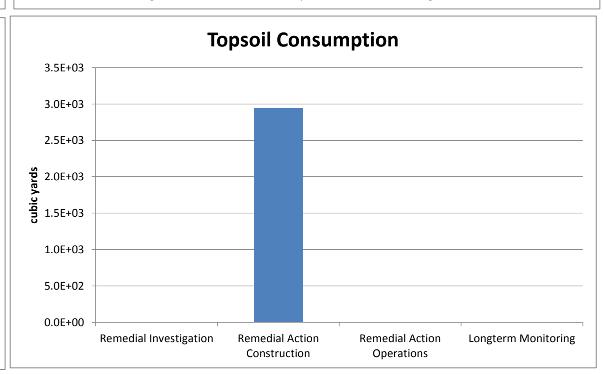

SOx Emissions
Metric Ton
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


PM_{10} Emissions
Metric Ton
9.00E-01
8.00E-01
7.00E-01
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
3.00E-04
2.50E-04
2.00E-04
1.50E-04
1.00E-04
5.00E-05
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Injury
Risk of Injury
3.00E-02
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Non-Hazardous Waste Landfill Space
Tons
5.0E+03
4.5E+03
4.0E+03
3.5E+03
3.0E+03
2.5E+03
2.0E+03
1.5E+03
1.0E+03
5.0E+02
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring


Topsoil Consumption
cubic yards
3.5E+03
3.0E+03
2.5E+03
2.0E+03
1.5E+03
1.0E+03
5.0E+02
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring

	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
						CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	**Materials**								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Temporary Equipment Decon Pad Liner	HDPE	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3	700.47	lbs	1.56	0.83	0.00	0.01	0.00	0.00	0.00	9.17	0.25
RAC	Temporary Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3	514.68	lbs	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Backfill, common fill	Soil	2,317 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil	6,951,000.00	lbs	72.50	72.50	0.00	0.00	0.00	0.00	0.00	1916.02	0.00
RAC	Backfill, vegetative soil	Soil	630 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil	1,890,000.00	lbs	19.71	19.71	0.00	0.00	0.00	0.00	0.00	520.97	0.00
RAC	Seeding, mulch	Mulch	41 msf, assume mulch assume, 50 lb per msf	2,050.00	lbs	0.65	0.23	0.00	0.00	0.00	0.00	0.00	7.33	0.00
RAC	Seeding, fertilizer	Fertilizer	41 msf, assume fertilizer, assume 20 lb per smf	820.00	lbs	1.02	1.02	0.00	0.00	0.00	0.00	0.00	18.53	0.37
	Subtotal					**95.46**	**94.30**	**0.00**	**0.01**	**0.00**	**0.01**	**0.00**	**2472.04**	**0.63**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	DPT	Drill Rig, DPT (diesel)	4 days, 8 hours per day, 80% utilization	25.60	hrs	0.41	0.40	0.00	0.00	0.00	0.00	0.00	3.13	
RAC	Excavator, 2.5 CY	Excavator, Hydraulic, 2 CY (diesel)	20 days, 8 hours per day, 80% utilization	128.00	hrs	12.41	12.41	0.00	0.00	0.08	0.02	0.01	56.31	
RAC	Excavator, 2.5 CY	Excavator, Hydraulic, 2 CY (diesel)	10 days, 8 hours per day, 80% utilization	64.00	hrs	6.20	6.20	0.00	0.00	0.04	0.01	0.00	28.16	
RAC	Dozer, 140 hp	Dozer, 140 HP (D6) w/A Blade (diesel)	10 days, 8 hours per day, 80% utilization	64.00	hrs	3.84	3.84	0.00	0.00	0.03	0.01	0.00	20.60	
RAC	Compactor 125 hp	Compactor 120 hp	10 days, 8 hours per day, 80% utilization	64.00	hrs	2.56	2.56	0.00	0.00	0.02	0.00	0.00	11.83	
RAC	tractor	Tractor (agricultural equipment), 250 hp, diesel	1 day, 8 hours per day, 80% utilization	6.40	hrs	0.48	0.48	0.00	0.00	0.00	0.00	0.00	1.72	
RAC	hydromulcher	Hydromulcher 15 hp (gasoline)	1 day, 8 hours per day, 80% utilization	6.40	hrs	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.21	
	Subtotal					**25.94**	**25.94**	**0.00**	**0.00**	**0.17**	**0.04**	**0.02**	**121.96**	**0**
				Total		**121**	**120**	**0.00**	**0.01**	**0.17**	**0.05**	**0.02**	**2,594**	**1**

Alternative 1
Values Input into SiteWise as "Other"

Module	Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	NO_x	SO_x	PM_{10}		
				Tonnes				**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	121.40	120.24	1.02	0.15	0.17	0.05	0.02	8,850.70	625.74
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

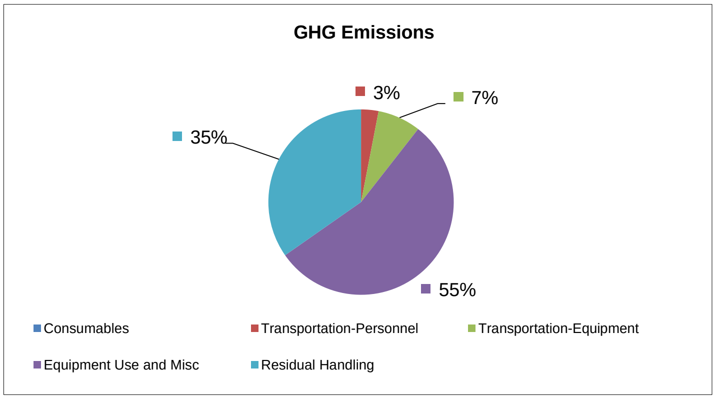
Sustainable Remediation - Environmental Footprint Summary
Alternative 21-3A

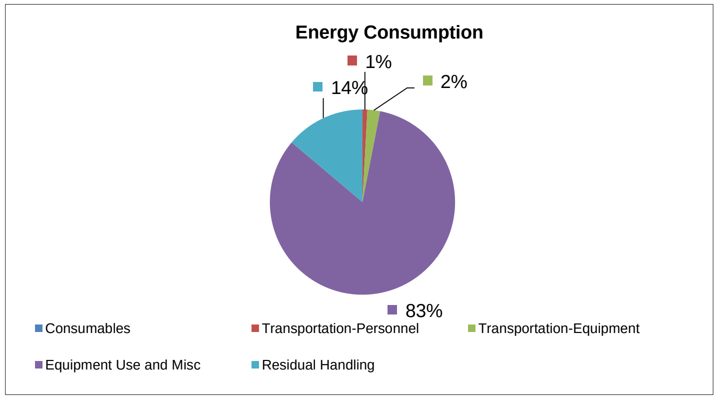
Phase	Activities	GHG Emissions	Total energy Used	Water Consumption	NOx emissions	SOx Emissions	PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	metric ton	metric ton	metric ton		
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	7.47	9.4E+01	NA	2.8E-03	9.7E-05	5.6E-04	1.5E-04	1.2E-02
	Transportation-Equipment	18.44	2.4E+02	NA	5.8E-03	1.0E-04	5.2E-04	4.6E-05	3.7E-03
	Equipment Use and Misc	134.38	9.1E+03	1.4E+04	2.0E-01	7.7E-02	1.8E-02	3.4E-05	8.6E-03
	Residual Handling	85.24	1.5E+03	NA	2.9E-01	1.5E-01	8.0E-01	8.7E-05	7.0E-03
	Sub-Total	245.53	1.10E+04	1.38E+04	5.05E-01	2.28E-01	8.22E-01	3.20E-04	3.16E-02
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.69	8.6E+00	NA	2.5E-04	8.9E-06	5.1E-05	1.4E-05	1.1E-03
	Transportation-Equipment	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	0.00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	0.69	8.63E+00	0.00E+00	2.54E-04	8.94E-06	5.15E-05	1.40E-05	1.13E-03
Total		**2.5E+02**	**1.1E+04**	**1.4E+04**	**5.1E-01**	**2.3E-01**	**8.2E-01**	**3.3E-04**	**3.3E-02**

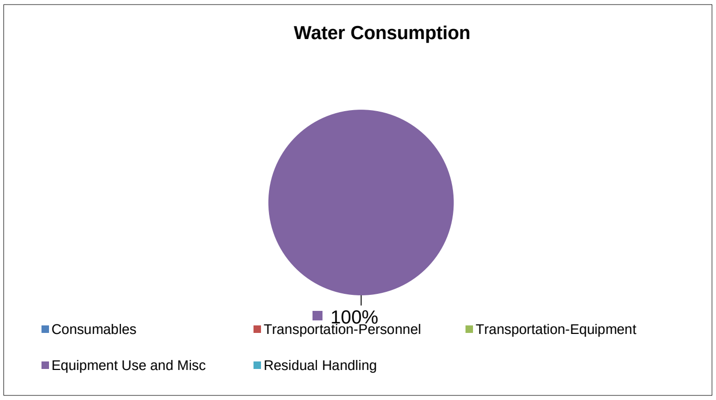
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury
	tons	tons	cubic yards	$	
Remedial Investigation	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Remedial Action Construction	4.4E+03	0.0E+00	2.9E+03	0	2.5E-01
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00
Longterm Monitoring	0.0E+00	0.0E+00	0.0E+00	0	9.0E-03
Total	**4.4E+03**	**0.0E+00**	**2.9E+03**	**$0**	**2.6E-01**

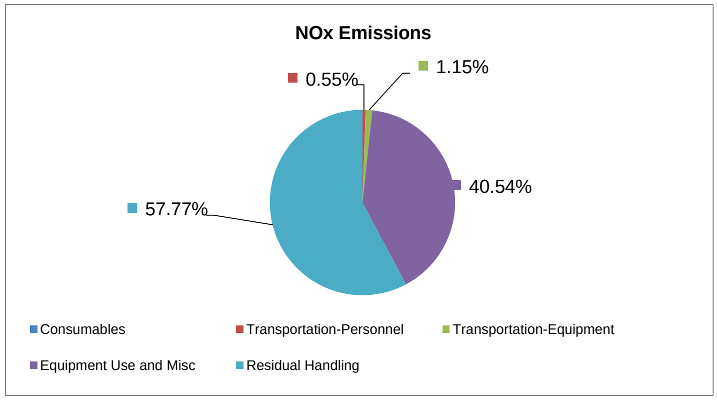
Total Cost with Footprint Reduction
$0

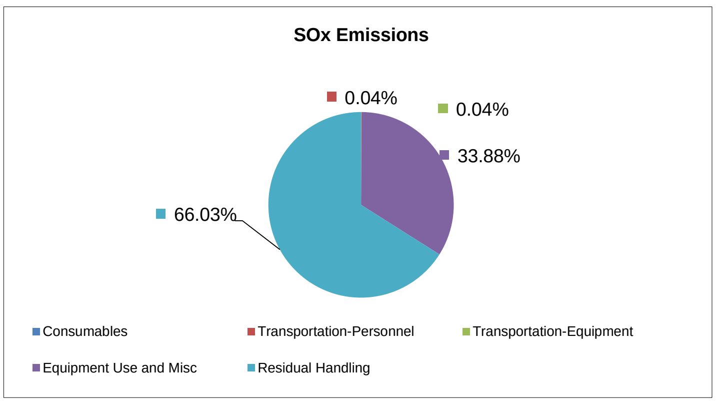
SiteWise™ Results Alternative 21-3A
Residual Action Construction Stage
Site 21-Building 1517/1506 Area, Naval Training Center Great Lakes
Great Lakes, Illinois

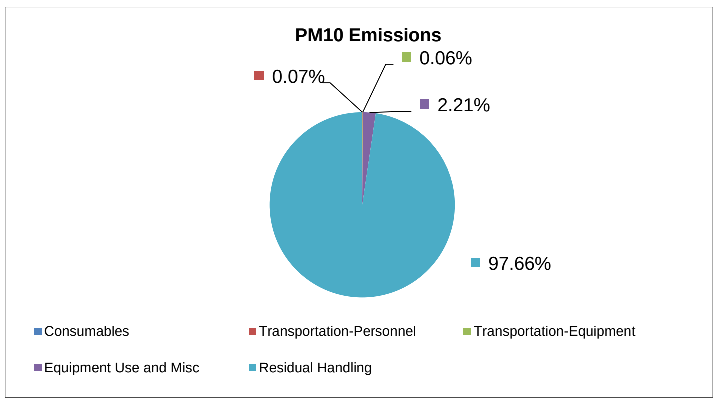


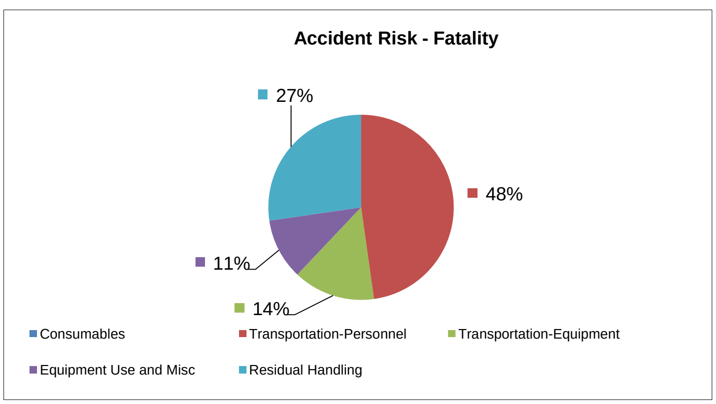


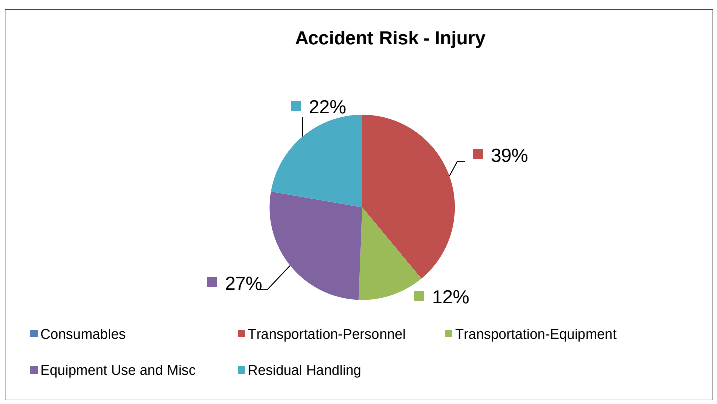


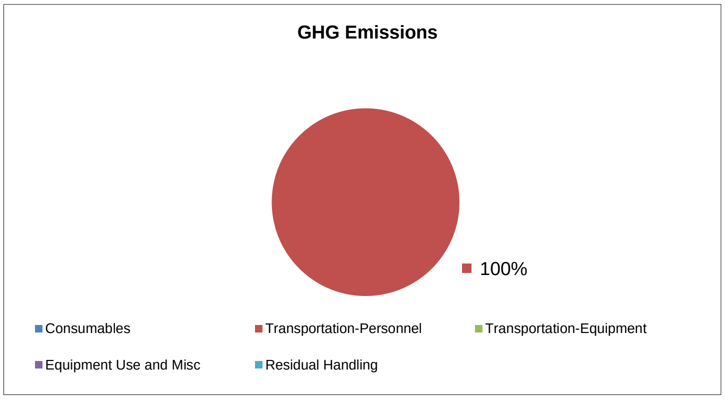


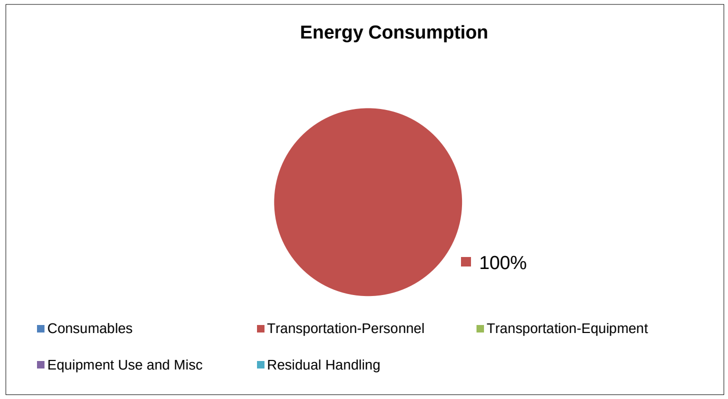


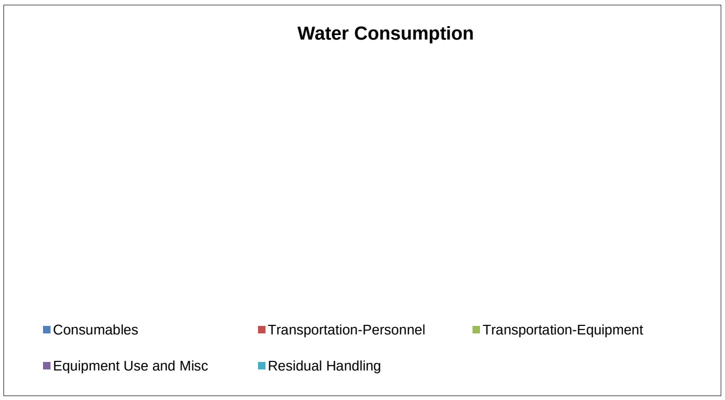


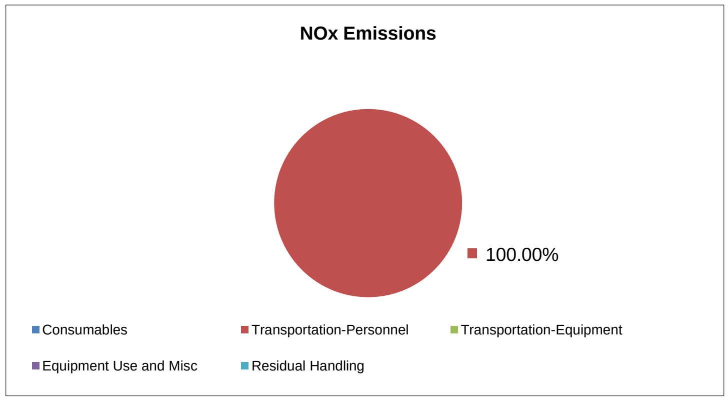


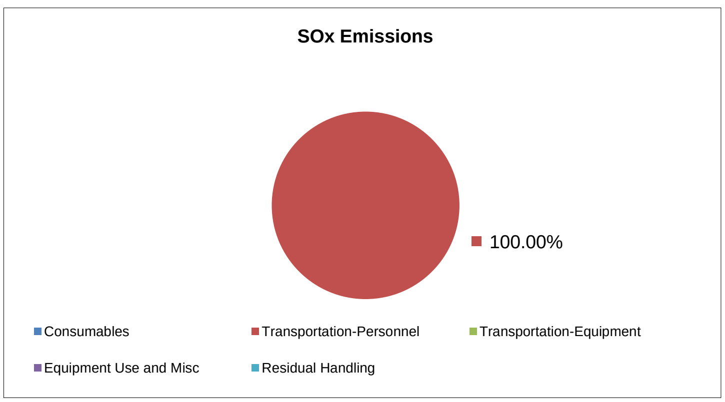


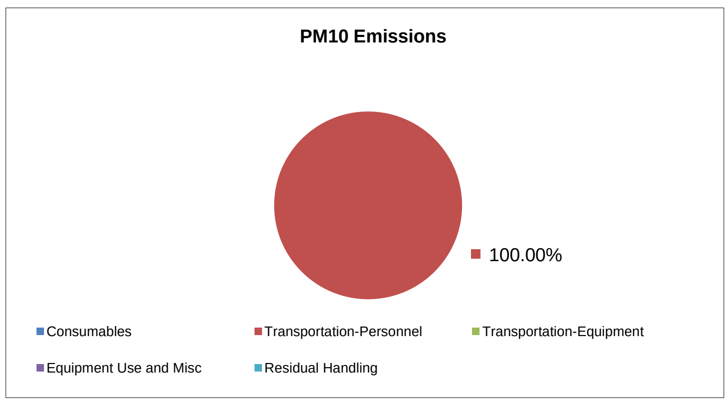

GHG Emissions
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

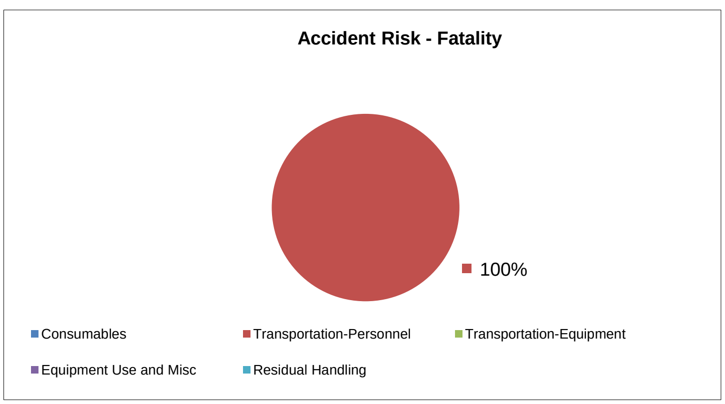

Energy Consumption
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

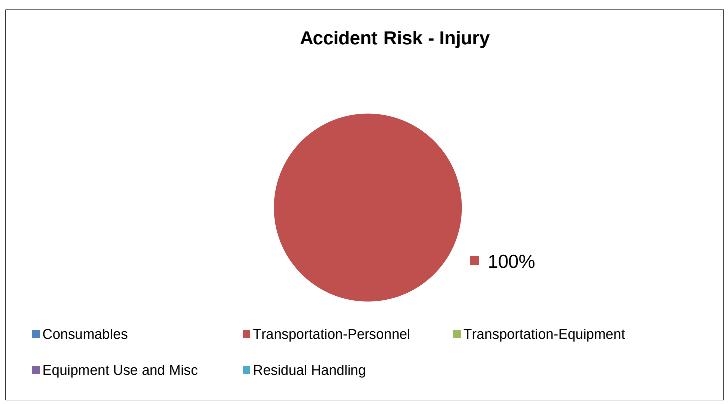

Water Consumption
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

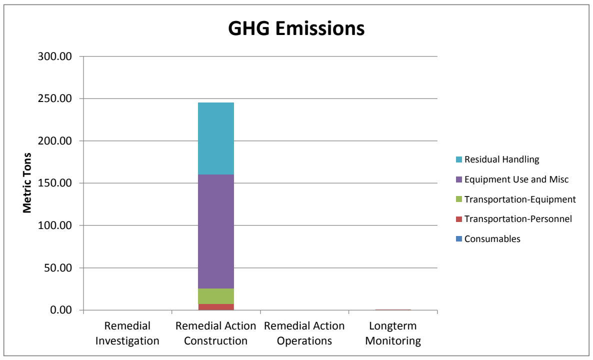

NOx Emissions
100.00%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

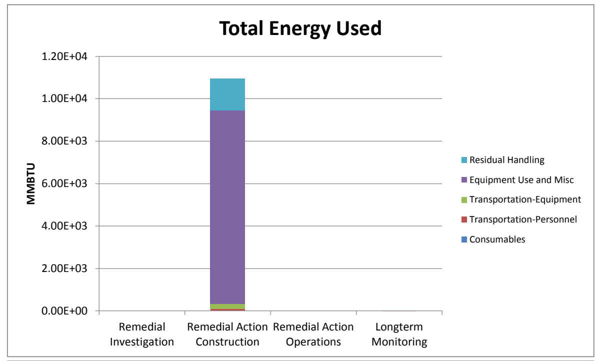

SOx Emissions
100.00%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

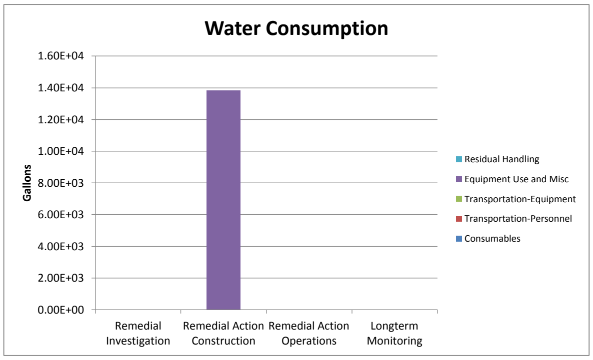

PM10 Emissions
100.00%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

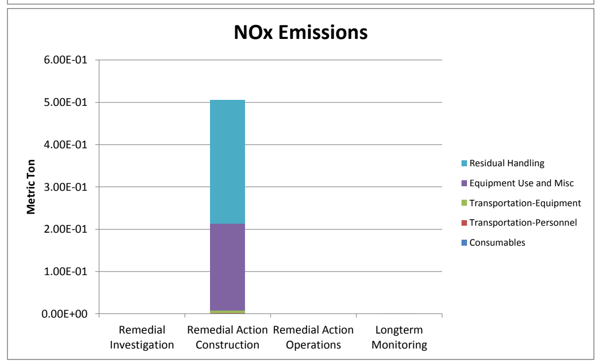

Accident Risk - Fatality
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

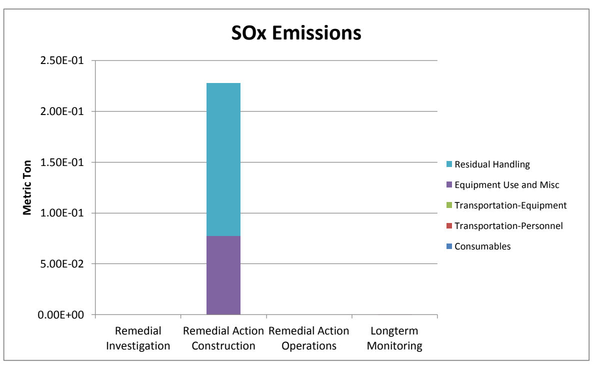

Accident Risk - Injury
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

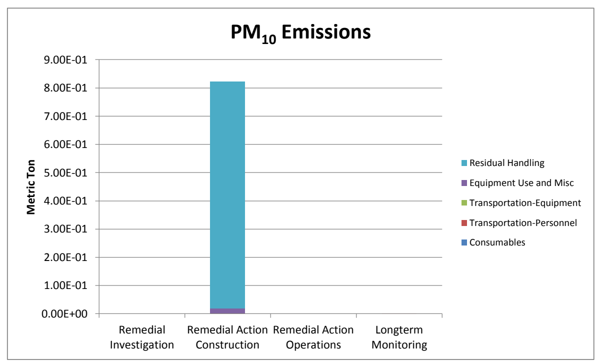

GHG Emissions
Metric Tons
300.00
250.00
200.00
150.00
100.00
50.00
0.00
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring

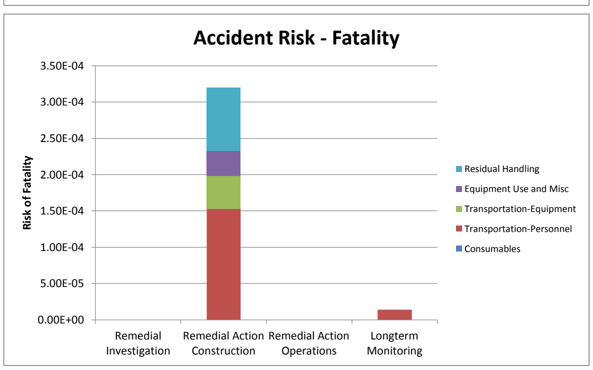

Total Energy Used
MMBTU
1.20E+04
1.00E+04
8.00E+03
6.00E+03
4.00E+03
2.00E+03
0.00E+00
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring

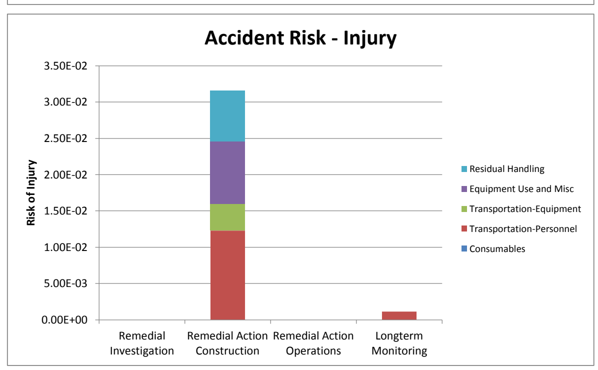

Water Consumption
Gallons
1.60E+04
1.40E+04
1.20E+04
1.00E+04
8.00E+03
6.00E+03
4.00E+03
2.00E+03
0.00E+00
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring

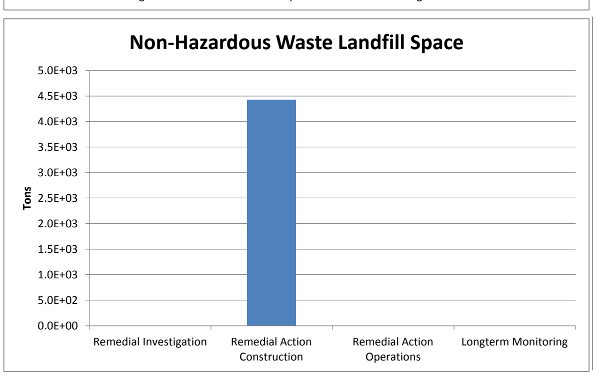

NOx Emissions
Metric Ton
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring

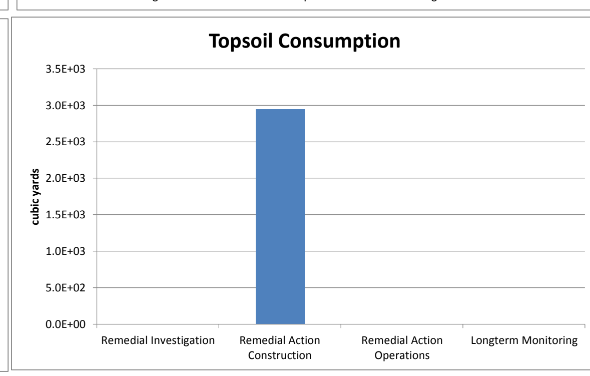

SOx Emissions
Metric Ton
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring


PM_{10} Emissions
Metric Ton
9.00E-01
8.00E-01
7.00E-01
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring


Accident Risk - Fatality
Risk of Fatality
3.50E-04
3.00E-04
2.50E-04
2.00E-04
1.50E-04
1.00E-04
5.00E-05
0.00E+00
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring


Accident Risk - Injury
Risk of Injury
3.50E-02
3.00E-02
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring


Non-Hazardous Waste Landfill Space
Tons
5.0E+03
4.5E+03
4.0E+03
3.5E+03
3.0E+03
2.5E+03
2.0E+03
1.5E+03
1.0E+03
5.0E+02
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring


Topsoil Consumption
cubic yards
3.5E+03
3.0E+03
2.5E+03
2.0E+03
1.5E+03
1.0E+03
5.0E+02
0.0E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring

GSRx Results Alternative 21-3A
Site 21-Building 1517/1506 Area, Naval Training Center Great Lakes
Great Lakes, Illinois

Stage	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions CO_2e	CO_2	N_20	CH_4	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
Stage	**Materials**								**Tonnes**				**MWhr**	**gal x 1000**
RAC	Well Instalation	PVC	32 wells, 15 feet deep, Assume PVC, 2 in Diameter, Schedule 40, 0.72 lb/ft	480.00	lft	0.78	0.39	0.00	0.00	0.00	0.00	0.00	14.29	0.83
RAC	Temporary Equipment Decon Pad Liner	HDPE	assume HDPE, Assume 30ftx40ft, 3 mm thick, 0.95 g/cm3	700.47	lbs	1.56	0.83	0.00	0.01	0.00	0.00	0.00	9.17	0.25
RAC	Temporary Equipment Decon Pad Frame	Wood	Assume wood, 4x4 in, (30ftx40ft pad) 140 ft of timber, density for pine 530 kg/m3	514.68	lbs	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00
RAC	Backfill, common fill	Soil	2,317 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil	6,951,000.00	lbs	72.50	72.50	0.00	0.00	0.00	0.00	0.00	1916.02	0.00
RAC	Backfill, vegetative soil	Soil	630 cy, assume 1.5 ton/cy, 2000 lb/ton, assume soil	1,890,000.00	lbs	19.71	19.71	0.00	0.00	0.00	0.00	0.00	520.97	0.00
RAC	Seeding, mulch	Mulch	41 msf, assume mulch assume, 50 lb per msf	2,050.00	lbs	0.65	0.23	0.00	0.00	0.00	0.00	0.00	7.33	0.00
RAC	Seeding, fertilizer	Fertilizer	41 msf, assume fertilizer, assume 20 lb per smf	820.00	lbs	1.02	1.02	0.00	0.00	0.00	0.00	0.00	18.53	0.37
RAC	Fenton Reagent	Hydrogen Peroxide	Assume hydrogen peroxide, 7% by weight of 5,600 gal. Assume two events	784.00	lbs	1.44	0.43	0.00	0.00	0.00	0.00	0.00	11.05	0.00
	Subtotal					**97.67**	**95.12**	**0.01**	**0.01**	**0.00**	**0.01**	**0.00**	**2497.37**	**1.45**
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**
RAC	DPT	Drill Rig, DPT (diesel)	4 days, 8 hours per day, 80% utilization	25.60	hrs	0.41	0.40	0.00	0.00	0.00	0.00	0.00	3.13	
RAC	Excavator, 2.5 CY	Excavator, Hydraulic, 2 CY (diesel)	20 days, 8 hours per day, 80% utilization	96.00	hrs	9.30	9.30	0.00	0.00	0.06	0.02	0.01	42.24	
RAC	Excavator, 2.5 CY	Excavator, Hydraulic, 2 CY (diesel)	10 days, 8 hours per day, 80% utilization	64.00	hrs	6.20	6.20	0.00	0.00	0.04	0.01	0.00	28.16	
RAC	Dozer, 140 hp	Dozer, 140 HP (D6) w/A Blade (diesel)	10 days, 8 hours per day, 80% utilization	64.00	hrs	3.84	3.84	0.00	0.00	0.03	0.01	0.00	20.60	
RAC	Compactor 125 hp	Compactor 120 hp	10 days, 8 hours per day, 80% utilization	64.00	hrs	2.56	2.56	0.00	0.00	0.02	0.00	0.00	11.83	
RAC	tractor	Tractor (agricultural equipment), 250 hp, diesel	1 day, 8 hours per day, 80% utilization	6.40	hrs	0.48	0.48	0.00	0.00	0.00	0.00	0.00	1.72	
RAC	hydromulcher	Hydromulcher 15 hp (gasoline)	1 day, 8 hours per day, 80% utilization	6.40	hrs	0.05	0.05	0.00	0.00	0.00	0.00	0.00	0.21	
RAC	DPT Drill Rig, well installation	Drill Rig, DPT (diesel)	Assume 5 wells per day, 32 wells, 8 hours per day, 80% utilization	44.80	hrs	0.72	0.70	0.00	0.00	0.01	0.00	0.00	5.48	
	Subtotal					**23.56**	**23.53**	**0.00**	**0.00**	**0.16**	**0.04**	**0.02**	**113.35**	**0**
				Total		**121**	**119**	**0.01**	**0.02**	**0.16**	**0.05**	**0.02**	**2,611**	**1**

Alternative 1
Values Input into SiteWise as "Other"

Module	Greenhouse Gas Emissions CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
				Tonnes				**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	121.24	118.65	2.27	0.32	0.16	0.05	0.02	8,907.79	1,451.05
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

APPENDIX D

COST ESTIMATES

Cost Estimate - Alternative 5-2

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 5 - Transformer Storage Boneyard
Alternative 5-2: LUCs and Cover
Capital Cost

	Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1	**PROJECT PLANNING & DOCUMENTS**											
1.1	Prepare LUC Documents	250	hr			$40.00		$0	$0	$10,000	$0	$10,000
	Subtotal							$0	$0	$10,000	$0	$10,000
	Overhead on Labor Cost @	30%								$3,000		$3,000
	G & A Cost @	10%						$0	$0	$1,000	$0	$1,000
	Tax on Materials and Equipment Cost @	6.25%							$0		$0	$0
	Total Direct Cost							$0	$0	$14,000	$0	$14,000
	Indirects on Total Direct Cost @	20%										$2,800
	Profit on Total Direct Cost @	10%										$1,400
	Subtotal											$18,200
	Health & Safety Monitoring @	0%										$0
	Total Field Cost											$18,200
	Contingency on Total Field Costs @	10%										$1,820
	Engineering on Total Field Cost @	0%										$0
	TOTAL CAPITAL COST											**$20,020**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 5 - Transformer Storage Boneyard
Alternative 5-2: LUCs and Cover
Annual Cost

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Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Annual Site Inspection & Report	$2,350		Labor and supplies for a yearly local inspection of Land Use Controls with Report
Cover Maintenance	$5,500		
Five Year Site Review		$23,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$7,850	$23,000	
Contingency @ 10%	$785	$2,300	
TOTAL	**$8,635**	**$25,300**	

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 5 - Transformer Storage Boneyard
Alternative 5-2: LUCs and Cover
Present Worth Analysis

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Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 1.1%	Present Worth
0	$20,020		$20,020	1.000	$20,020
1		$8,635	$8,635	0.989	$8,541
2		$8,635	$8,635	0.978	$8,448
3		$8,635	$8,635	0.968	$8,356
4		$8,635	$8,635	0.957	$8,265
5		$33,935	$33,935	0.947	$32,129
6		$8,635	$8,635	0.936	$8,086
7		$8,635	$8,635	0.926	$7,998
8		$8,635	$8,635	0.916	$7,911
9		$8,635	$8,635	0.906	$7,825
10		$33,935	$33,935	0.896	$30,418
11		$8,635	$8,635	0.887	$7,656
12		$8,635	$8,635	0.877	$7,573
13		$8,635	$8,635	0.867	$7,490
14		$8,635	$8,635	0.858	$7,409
15		$33,935	$33,935	0.849	$28,799
16		$8,635	$8,635	0.839	$7,248
17		$8,635	$8,635	0.830	$7,170
18		$8,635	$8,635	0.821	$7,092
19		$8,635	$8,635	0.812	$7,014
20		$33,935	$33,935	0.803	$27,266
21		$8,635	$8,635	0.795	$6,863
22		$8,635	$8,635	0.786	$6,788
23		$8,635	$8,635	0.778	$6,714
24		$8,635	$8,635	0.769	$6,641
25		$33,935	$33,935	0.761	$25,815
26		$8,635	$8,635	0.752	$6,497
27		$8,635	$8,635	0.744	$6,427
28		$8,635	$8,635	0.736	$6,357
29		$8,635	$8,635	0.728	$6,288
30		$33,935	$33,935	0.720	$24,441
				TOTAL PRESENT WORTH	**$365,545**

Cost Estimate - Alternative 5-2A

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 5 - Transformer Storage Boneyard
Alternative 5-2A: LUCs, Cover, and ISCO
Capital Cost

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	Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1	**PROJECT PLANNING & DOCUMENTS**											
1.1	Prepare LUC Documents	250	hr			$40.00		$0	$0	$10,000	$0	$10,000
1.2	Prepare ISCO Work Plan	200	hr			$40.00		$0	$0	$8,000	$0	$8,000
2	**MOBILIZATION AND DEMOBILIZATION**											
2.1	Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
3	**FIELD SUPPORT AND SITE ACCESS**											
3.1	Office Trailer	1	mo				$340.00	$0	$0	$0	$340	$340
3.2	Field Office Equipment, Utilities, & Support	1	mo		$508.00			$0	$508	$0	$0	$508
3.3	Survey Support	1	day	$1,175.00				$1,175	$0	$0	$0	$1,175
3.4	Site Superintendent	15	day		$242.00	$480.00		$0	$3,630	$7,200	$0	$10,830
3.5	Site Health & Safety and QA/QC	15	day		$242.00	$360.00		$0	$3,630	$5,400	$0	$9,030
3.6	Underground Utility Clearance	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
4	**ISCO**											
4.1	Delineation sampling	1	ls	$23,000.00				$23,000	$0	$0	$0	$23,000
4.2	ISCO Bench/pilot test	1	ls	$7,500.00				$7,500	$0	$0	$0	$7,500
4.3	Project Design	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
4.4	Well installation	1	ls	$14,400.00				$14,400	$0	$0	$0	$14,400
4.5	Injection	1	ls	$23,000.00				$23,000	$0	$0	$0	$23,000
4.6	Reagents	1	ls	$1,700.00				$1,700	$0	$0	$0	$1,700
4.7	Mobilization/Demobilization	1	ls	$18,000.00				$18,000	$0	$0	$0	$18,000
4.8	Documentation	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
4.9	Second Injection	1	ls	$18,000.00				$18,000	$0	$0	$0	$18,000
4.10	Second Injection Reagents	1	ls	$1,300.00				$1,300	$0	$0	$0	$1,300
4.11	Second Injection Mobilization/Demobilization	1	ls	$18,000.00				$18,000	$0	$0	$0	$18,000
4.12	Performance Sampling	1	ls	$25,200.00				$25,200	$0	$0	$0	$25,200
	Subtotal							$163,275	$8,768	$30,600	$3,840	$206,483
	Overhead on Labor Cost @ 30%									$9,180		$9,180
	G & A Cost @ 10%							$16,327.50	$877	$3,060	$384	$20,648
	Tax on Materials and Equipment Cost @ 6.25%								$548		$240	$788
	Total Direct Cost							$179,603	$10,193	$42,840	$4,464	$237,099
	Indirects on Total Direct Cost @ 20%											$47,420
	Profit on Total Direct Cost @ 10%											$23,710
	Subtotal											$308,229
	Health & Safety Monitoring @ 2%											$6,165
	Total Field Cost											$314,394
	Contingency on Total Field Costs @ 10%											$31,439
	Engineering on Total Field Cost @ 10%											$31,439
	TOTAL CAPITAL COST											**$377,272**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 5 - Transformer Storage Boneyard
Alternative 5-2A: LUCs, Cover, and ISCO
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Annual Site Inspection & Report	$2,350		Labor and supplies for a yearly local inspection of Land Use Controls with Report
Cover Maintenance	$5,500		
Five Year Site Review		$23,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$7,850	$23,000	
Contingency @ 10%	$785	$2,300	
TOTAL	**$8,635**	**$25,300**	

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 5 - Transformer Storage Boneyard
Alternative 5-2A: LUCs, Cover, and ISCO
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 1.1%	Present Worth
0	$377,272		$377,272	1.000	$377,272
1		$8,635	$8,635	0.989	$8,541
2		$8,635	$8,635	0.978	$8,448
3		$8,635	$8,635	0.968	$8,356
4		$8,635	$8,635	0.957	$8,265
5		$33,935	$33,935	0.947	$32,129
6		$8,635	$8,635	0.936	$8,086
7		$8,635	$8,635	0.926	$7,998
8		$8,635	$8,635	0.916	$7,911
9		$8,635	$8,635	0.906	$7,825
10		$33,935	$33,935	0.896	$30,418
11		$8,635	$8,635	0.887	$7,656
12		$8,635	$8,635	0.877	$7,573
13		$8,635	$8,635	0.867	$7,490
14		$8,635	$8,635	0.858	$7,409
15		$33,935	$33,935	0.849	$28,799
16		$8,635	$8,635	0.839	$7,248
17		$8,635	$8,635	0.830	$7,170
18		$8,635	$8,635	0.821	$7,092
19		$8,635	$8,635	0.812	$7,014
20		$33,935	$33,935	0.803	$27,266
21		$8,635	$8,635	0.795	$6,863
22		$8,635	$8,635	0.786	$6,788
23		$8,635	$8,635	0.778	$6,714
24		$8,635	$8,635	0.769	$6,641
25		$33,935	$33,935	0.761	$25,815
26		$8,635	$8,635	0.752	$6,497
27		$8,635	$8,635	0.744	$6,427
28		$8,635	$8,635	0.736	$6,357
29		$8,635	$8,635	0.728	$6,288
30		$33,935	$33,935	0.720	$24,441

TOTAL PRESENT WORTH **$722,798**

Cost Estimate - Alternative 5-3

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 5 - Transformer Storage Boneyard
Alternative 5-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and Groundwater LUCs
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents, Plans, & LUCRD	300	hr			$40.00		$0	$0	$12,000	$0	$12,000
1.2 Completion Reports	60	hr			$40.00		$0	$0	$2,400	$0	$2,400
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.2 Equipment Mobilization/Demobilization	6	ea			$195.00	$640.00	$0	$0	$1,170	$3,840	$5,010
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Office Trailer	2	mo				$340.00	$0	$0	$0	$510	$510
3.2 Field Office Equipment, Utilities, & Support	2	mo		$508.00			$0	$762	$0	$0	$762
3.3 Storage Trailer	2	mo				$102.00	$0	$0	$0	$153	$153
3.8 Survey Support	1	day	$1,175.00				$1,175	$0	$0	$0	$1,175
3.9 Site Superintendent	42	day		$242.00	$480.00		$0	$10,164	$20,160	$0	$30,324
3.10 Site Health & Safety and QA/QC	42	day		$242.00	$360.00		$0	$10,164	$15,120	$0	$25,284
3.11 Underground Utility Clearance	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
4 DECONTAMINATION											
4.1 Decontamination Services	1	mo		$1,220.00	$2,245.00	$1,550.00	$0	$1,220	$2,245	$1,550	$5,015
4.2 Equipment Decon Pad	1	ls		$4,500.00	$3,000.00	$725.00	$0	$4,500	$3,000	$725	$8,225
4.3 Decon Water	1,000	gal		$0.20			$0	$200	$0	$0	$200
4.4 Decon Water Storage Tank, 6,000 gallon	1	mo				$813.00	$0	$0	$0	$813	$813
4.5 Disposal of Decon Waste (liquid & solid)	1	mo	$985.00				$985	$0	$0	$0	$985
5 SAMPLING											
5.1 Sampling Labor	60	hr			$36.00		$0	$0	$2,160	$0	$2,160
5.2 Sampling ODCs	1	ls		$1,500.00		$500.00	$0	$1,500	$0	$500	$2,000
5.3 DPT Rig	3	day	$1,000.00				$3,000	$0	$0	$0	$3,000
5.3 Samples - Analytical (PAHs)	43	ea	$175.00				$7,525	$0	$0	$0	$7,525
6 EXCAVATION AND DISPOSAL											
6.1 Excavator, 2.5 cy	13	day			$1,084.80	$1,652.00	$0	$0	$14,102	$21,476	$35,578
6.2 Site Labor, (3 laborers)	48	day			$448.40		$0	$0	$21,523	$0	$21,523
6.3 T & D of Excavated Soil, non-hazardous (PAHs)	5,673	ton	$65.00				$368,745	$0	$0	$0	$368,745
6.4 Waste Disposal Characterization / Analytical	5	ea	$850.00	$30.00	$50.00	$30.00	$4,250	$150	$250	$150	$4,800
7 BACKFILL AND SITE RESTORATION											
7.1 Excavator, 2.5 cy	10	day			$1,084.80	$1,800.00	$0	$0	$10,848	$18,000	$28,848
7.2 Dozer, 140 hp	10	day			$555.80	$889.00	$0	$0	$5,558	$8,890	$14,448
7.3 Site Labor, (3 laborers)	54	day			$448.40		$0	$0	$24,214	$0	$24,214
7.4 Backfill, common fill	3,182	cy		$16.07			$0	$51,135	$0	$0	$51,135
7.5 Backfill, vegetative soil	690	cy		$26.92			$0	$18,575	$0	$0	$18,575
7.6 Compactor, 125 hp	10	day			$656.40	$640.20	$0	$0	$6,564	$6,402	$12,966
7.7 Hydro Seed	44	msf	$63.50				$2,794	$0	$0	$0	$2,794
Subtotal							$392,474	$99,370	$141,314	$66,509	$699,667
Overhead on Labor Cost @	30%								$42,394		$42,394
G & A Cost @	10%						$39,247.40	$9,937	$14,131	$6,651	$69,967
Tax on Materials and Equipment Cost @	6.25%							$6,211		$4,157	$10,367
Total Direct Cost							$431,721	$115,517	$197,840	$77,317	$822,395
Indirects on Total Direct Cost @	15%										$123,359
Profit on Total Direct Cost @	10%										$82,240
Subtotal											$1,027,994

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Health & Safety Monitoring @ 2%											$20,560
Total Field Cost											$1,048,554
Contingency on Total Field Costs @ 20%											$209,711
Engineering on Total Field Cost @ 4%											$41,942
TOTAL CAPITAL COST											**$1,300,207**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 5 - Transformer Storage Boneyard
Alternative 5-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and Groundwater LUCs
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Annual Site Inspection & Report	$2,350		Labor and supplies for a yearly local inspection of Land Use Controls with Report
Five Year Site Review		$23,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$2,350	$23,000	
Contingency @ 10%	$235	$2,300	
TOTAL	**$2,585**	**$25,300**	

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 5 - Transformer Storage Boneyard
Alternative 5-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and Groundwater LUCs
Present Worth Analysis

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Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 1.1%	Present Worth
0	$1,300,207		$1,300,207	1.000	$1,300,207
1		$2,585	$2,585	0.989	$2,557
2		$2,585	$2,585	0.978	$2,529
3		$2,585	$2,585	0.968	$2,502
4		$2,585	$2,585	0.957	$2,474
5		$27,885	$27,885	0.947	$26,401
6		$2,585	$2,585	0.936	$2,421
7		$2,585	$2,585	0.926	$2,394
8		$2,585	$2,585	0.916	$2,368
9		$2,585	$2,585	0.906	$2,343
10		$27,885	$27,885	0.896	$24,995
11		$2,585	$2,585	0.887	$2,292
12		$2,585	$2,585	0.877	$2,267
13		$2,585	$2,585	0.867	$2,242
14		$2,585	$2,585	0.858	$2,218
15		$27,885	$27,885	0.849	$23,665
16		$2,585	$2,585	0.839	$2,170
17		$2,585	$2,585	0.830	$2,146
18		$2,585	$2,585	0.821	$2,123
19		$2,585	$2,585	0.812	$2,100
20		$27,885	$27,885	0.803	$22,405
21		$2,585	$2,585	0.795	$2,054
22		$2,585	$2,585	0.786	$2,032
23		$2,585	$2,585	0.778	$2,010
24		$2,585	$2,585	0.769	$1,988
25		$27,885	$27,885	0.761	$21,212
26		$2,585	$2,585	0.752	$1,945
27		$2,585	$2,585	0.744	$1,924
28		$2,585	$2,585	0.736	$1,903
29		$2,585	$2,585	0.728	$1,882
30		$27,885	$27,885	0.720	$20,083
				TOTAL PRESENT WORTH	**$1,491,853**

Cost Estimate - Alternative 5-3A

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 5 - Transformer Storage Boneyard
Alternative 5-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, Groundwater LUCs, and ISCO
Capital Cost

			Unit Cost				Extended Cost				
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents, Plans, & LUCRD	300	hr			$40.00		$0	$0	$12,000	$0	$12,000
1.2 Prepare ISCO Work Plan	200	hr			$40.00		$0	$0	$8,000	$0	$8,000
1.3 Completion Reports	60	hr			$40.00		$0	$0	$2,400	$0	$2,400
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.2 Equipment Mobilization/Demobilization	6	ea			$195.00	$640.00	$0	$0	$1,170	$3,840	$5,010
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Office Trailer	3	mo				$340.00	$0	$0	$0	$1,020	$1,020
3.2 Field Office Equipment, Utilities, & Support	3	mo		$508.00			$0	$1,524	$0	$0	$1,524
3.3 Storage Trailer	3	mo				$102.00	$0	$0	$0	$306	$306
3.8 Survey Support	1	day	$1,175.00				$1,175	$0	$0	$0	$1,175
3.9 Site Superintendent	57	day		$242.00	$480.00		$0	$13,794	$27,360	$0	$41,154
3.10 Site Health & Safety and QA/QC	57	day		$242.00	$360.00		$0	$13,794	$20,520	$0	$34,314
3.11 Underground Utility Clearance	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
4 DECONTAMINATION											
4.1 Decontamination Services	1	mo		$1,220.00	$2,245.00	$1,550.00	$0	$1,220	$2,245	$1,550	$5,015
4.2 Equipment Decon Pad	1	ls		$4,500.00	$3,000.00	$725.00	$0	$4,500	$3,000	$725	$8,225
4.3 Decon Water	1,000	gal		$0.20			$0	$200	$0	$0	$200
4.4 Decon Water Storage Tank, 6,000 gallon	1	mo				$813.00	$0	$0	$0	$813	$813
4.5 Disposal of Decon Waste (liquid & solid)	1	mo	$985.00				$985	$0	$0	$0	$985
5 SAMPLING											
5.1 Sampling Labor	60	hr			$36.00		$0	$0	$2,160	$0	$2,160
5.2 Sampling ODCs	1	ls		$1,500.00		$500.00	$0	$1,500	$0	$500	$2,000
5.3 DPT Rig	3	day	$1,000.00				$3,000	$0	$0	$0	$3,000
5.3 Samples - Analytical (PAHs)	43	ea	$175.00				$7,525	$0	$0	$0	$7,525
6 EXCAVATION AND DISPOSAL											
6.1 Excavator, 2.5 cy	13	day			$1,084.80	$1,652.00	$0	$0	$14,102	$21,476	$35,578
6.2 Site Labor, (3 laborers)	48	day			$448.40		$0	$0	$21,523	$0	$21,523
6.3 T & D of Excavated Soil, non-hazardous (PAHs)	5,673	ton	$65.00				$368,745	$0	$0	$0	$368,745
6.4 Waste Disposal Characterization / Analytical	5	ea	$850.00	$30.00	$50.00	$30.00	$4,250	$150	$250	$150	$4,800
7 BACKFILL AND SITE RESTORATION											
7.1 Excavator, 2.5 cy	10	day			$1,084.80	$1,800.00	$0	$0	$10,848	$18,000	$28,848
7.2 Dozer, 140 hp	10	day			$555.80	$889.00	$0	$0	$5,558	$8,890	$14,448
7.3 Site Labor, (3 laborers)	54	day			$448.40		$0	$0	$24,214	$0	$24,214
7.4 Backfill, common fill	3,182	cy		$16.07			$0	$51,135	$0	$0	$51,135
7.5 Backfill, vegetative soil	690	cy		$26.92			$0	$18,575	$0	$0	$18,575
7.6 Compactor, 125 hp	10	day			$656.40	$640.20	$0	$0	$6,564	$6,402	$12,966
7.7 Hydro Seed	44	msf	$63.50				$2,794	$0	$0	$0	$2,794
8 ISCO											
8.1 Delineation sampling	1	ls	$23,000.00				$23,000	$0	$0	$0	$23,000
8.2 ISCO Bench/pilot test	1	ls	$7,500.00				$7,500	$0	$0	$0	$7,500
8.3 Project Design	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
8.4 Well installation	1	ls	$14,400.00				$14,400	$0	$0	$0	$14,400
8.5 Injection	1	ls	$23,000.00				$23,000	$0	$0	$0	$23,000
8.6 Reagents	1	ls	$1,700.00				$1,700	$0	$0	$0	$1,700
8.7 Mobilization/Demobilization	1	ls	$18,000.00				$18,000	$0	$0	$0	$18,000
8.8 Documentation	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
8.9 Second Injection	1	ls	$18,000.00				$18,000	$0	$0	$0	$18,000
8.10 Second Injection Reagents	1	ls	$1,300.00				$1,300	$0	$0	$0	$1,300
8.11 Second Injection Mobilization/Demobilization	1	ls	$18,000.00				$18,000	$0	$0	$0	$18,000
8.12 Performance Sampling	1	ls	$25,200.00				$25,200	$0	$0	$0	$25,200
Subtotal							$550,574	$107,392	$161,914	$67,172	$887,052

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Overhead on Labor Cost @ 30%									$48,574		$48,574
G & A Cost @ 10%							$55,057.40	$10,739	$16,191	$6,717	$88,705
Tax on Materials and Equipment Cost @ 6.25%								$6,712		$4,198	$10,910
Total Direct Cost							$605,631	$124,843	$226,680	$78,087	$1,035,241
Indirects on Total Direct Cost @ 15%											$155,286
Profit on Total Direct Cost @ 10%											$103,524
Subtotal											$1,294,052
Health & Safety Monitoring @ 2%											$25,881
Total Field Cost											$1,319,933
Contingency on Total Field Costs @ 20%											$263,987
Engineering on Total Field Cost @ 4%											$52,797
TOTAL CAPITAL COST											**$1,636,717**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 5 - Transformer Storage Boneyard
Alternative 5-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, Groundwater LUCs, and ISCO
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Annual Site Inspection & Report	$2,350		Labor and supplies for a yearly local inspection of Land Use Controls with Report
Five Year Site Review		$23,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$2,350	$23,000	
Contingency @ 10%	$235	$2,300	
TOTAL	**$2,585**	**$25,300**	

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 5 - Transformer Storage Boneyard
Alternative 5-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, Groundwater LUCs, and ISCO
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 1.1%	Present Worth
0	$1,636,717		$1,636,717	1.000	$1,636,717
1		$2,585	$2,585	0.989	$2,557
2		$2,585	$2,585	0.978	$2,529
3		$2,585	$2,585	0.968	$2,502
4		$2,585	$2,585	0.957	$2,474
5		$27,885	$27,885	0.947	$26,401
6		$2,585	$2,585	0.936	$2,421
7		$2,585	$2,585	0.926	$2,394
8		$2,585	$2,585	0.916	$2,368
9		$2,585	$2,585	0.906	$2,343
10		$27,885	$27,885	0.896	$24,995
11		$2,585	$2,585	0.887	$2,292
12		$2,585	$2,585	0.877	$2,267
13		$2,585	$2,585	0.867	$2,242
14		$2,585	$2,585	0.858	$2,218
15		$27,885	$27,885	0.849	$23,665
16		$2,585	$2,585	0.839	$2,170
17		$2,585	$2,585	0.830	$2,146
18		$2,585	$2,585	0.821	$2,123
19		$2,585	$2,585	0.812	$2,100
20		$27,885	$27,885	0.803	$22,405
21		$2,585	$2,585	0.795	$2,054
22		$2,585	$2,585	0.786	$2,032
23		$2,585	$2,585	0.778	$2,010
24		$2,585	$2,585	0.769	$1,988
25		$27,885	$27,885	0.761	$21,212
26		$2,585	$2,585	0.752	$1,945
27		$2,585	$2,585	0.744	$1,924
28		$2,585	$2,585	0.736	$1,903
29		$2,585	$2,585	0.728	$1,882
30		$27,885	$27,885	0.720	$20,083
				TOTAL PRESENT WORTH	**$1,828,363**

Cost Estimate - Alternative 9-2

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 9 - Camp Moffett Ravine Fill
Alternative 9-2: LUCs and Cover
Capital Cost

	Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1	**PROJECT PLANNING & DOCUMENTS**											
1.1	Prepare LUC Documents	250	hr			$40.00		$0	$0	$10,000	$0	$10,000
	Subtotal							$0	$0	$10,000	$0	$10,000
	Overhead on Labor Cost @ 30%									$3,000		$3,000
	G & A Cost @ 10%							$0	$0	$1,000	$0	$1,000
	Tax on Materials and Equipment Cost @ 6.25%								$0		$0	$0
	Total Direct Cost							$0	$0	$14,000	$0	$14,000
	Indirects on Total Direct Cost @ 20%											$2,800
	Profit on Total Direct Cost @ 10%											$1,400
	Subtotal											$18,200
	Health & Safety Monitoring @ 0%											$0
	Total Field Cost											$18,200
	Contingency on Total Field Costs @ 10%											$1,820
	Engineering on Total Field Cost @ 0%											$0
	TOTAL CAPITAL COST											**$20,020**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 9 - Camp Moffett Ravine Fill
Alternative 9-2: LUCs and Cover
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Annual Site Inspection & Report	$2,350		Labor and supplies for a yearly local inspection of Land Use Controls with Report
Cover Maintenance	$5,500		
Five Year Site Review		$23,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$7,850	$23,000	
Contingency @ 10%	$785	$2,300	
TOTAL	**$8,635**	**$25,300**	

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 9 - Camp Moffett Ravine Fill
Alternative 9-2: LUCs and Cover
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 1.1%	Present Worth
0	$20,020		$20,020	1.000	$20,020
1		$8,635	$8,635	0.989	$8,541
2		$8,635	$8,635	0.978	$8,448
3		$8,635	$8,635	0.968	$8,356
4		$8,635	$8,635	0.957	$8,265
5		$33,935	$33,935	0.947	$32,129
6		$8,635	$8,635	0.936	$8,086
7		$8,635	$8,635	0.926	$7,998
8		$8,635	$8,635	0.916	$7,911
9		$8,635	$8,635	0.906	$7,825
10		$33,935	$33,935	0.896	$30,418
11		$8,635	$8,635	0.887	$7,656
12		$8,635	$8,635	0.877	$7,573
13		$8,635	$8,635	0.867	$7,490
14		$8,635	$8,635	0.858	$7,409
15		$33,935	$33,935	0.849	$28,799
16		$8,635	$8,635	0.839	$7,248
17		$8,635	$8,635	0.830	$7,170
18		$8,635	$8,635	0.821	$7,092
19		$8,635	$8,635	0.812	$7,014
20		$33,935	$33,935	0.803	$27,266
21		$8,635	$8,635	0.795	$6,863
22		$8,635	$8,635	0.786	$6,788
23		$8,635	$8,635	0.778	$6,714
24		$8,635	$8,635	0.769	$6,641
25		$33,935	$33,935	0.761	$25,815
26		$8,635	$8,635	0.752	$6,497
27		$8,635	$8,635	0.744	$6,427
28		$8,635	$8,635	0.736	$6,357
29		$8,635	$8,635	0.728	$6,288
30		$33,935	$33,935	0.720	$24,441
				TOTAL PRESENT WORTH	**$365,545**

Cost Estimate - Alternative 9-2A

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 9 - Camp Moffett Ravine Fill
Alternative 9-2A: LUCs, Cover, and ISCO
Capital Cost

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	Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1	**PROJECT PLANNING & DOCUMENTS**											
1.1	Prepare LUC Documents	250	hr			$40.00		$0	$0	$10,000	$0	$10,000
1.2	Prepare ISCO Work Plan	200	hr			$40.00		$0	$0	$8,000	$0	$8,000
2	**MOBILIZATION AND DEMOBILIZATION**											
2.1	Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
3	**FIELD SUPPORT AND SITE ACCESS**											
3.1	Office Trailer	1	mo				$340.00	$0	$0	$0	$340	$340
3.2	Field Office Equipment, Utilities, & Support	1	mo		$508.00			$0	$508	$0	$0	$508
3.3	Survey Support	1	day	$1,175.00				$1,175	$0	$0	$0	$1,175
3.4	Site Superintendent	18	day		$242.00	$480.00		$0	$4,356	$8,640	$0	$12,996
3.5	Site Health & Safety and QA/QC	18	day		$242.00	$360.00		$0	$4,356	$6,480	$0	$10,836
3.6	Underground Utility Clearance	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
4	**ISCO**											
4.1	Delineation sampling	1	ls	$23,000.00				$23,000	$0	$0	$0	$23,000
4.2	ISCO Bench/pilot test	1	ls	$7,500.00				$7,500	$0	$0	$0	$7,500
4.3	Project Design	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
4.4	Well installation	1	ls	$52,800.00				$52,800	$0	$0	$0	$52,800
4.5	Injection	1	ls	$36,800.00				$36,800	$0	$0	$0	$36,800
4.6	Reagents	1	ls	$2,300.00				$2,300	$0	$0	$0	$2,300
4.7	Mobilization/Demobilization	1	ls	$18,000.00				$18,000	$0	$0	$0	$18,000
4.8	Documentation	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
4.9	Second Injection	1	ls	$28,000.00				$28,000	$0	$0	$0	$28,000
4.10	Second Injection Reagents	1	ls	$1,700.00				$1,700	$0	$0	$0	$1,700
4.11	Second Injection Mobilization/Demobilization	1	ls	$18,000.00				$18,000	$0	$0	$0	$18,000
4.12	Performance Sampling	1	ls	$25,200.00				$25,200	$0	$0	$0	$25,200
	Subtotal							$226,475	$10,220	$33,120	$3,840	$273,655
	Overhead on Labor Cost @ 30%									$9,936		$9,936
	G & A Cost @ 10%							$22,647.50	$1,022	$3,312	$384	$27,366
	Tax on Materials and Equipment Cost @ 6.25%								$639		$240	$879
	Total Direct Cost							$249,123	$11,881	$46,368	$4,464	$311,835
	Indirects on Total Direct Cost @ 20%											$62,367
	Profit on Total Direct Cost @ 10%											$31,184
	Subtotal											$405,386
	Health & Safety Monitoring @ 2%											$8,108
	Total Field Cost											$413,494
	Contingency on Total Field Costs @ 10%											$41,349
	Engineering on Total Field Cost @ 8%											$33,079
	TOTAL CAPITAL COST											**$487,922**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 9 - Camp Moffett Ravine Fill
Alternative 9-2A: LUCs, Cover, and ISCO
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Annual Site Inspection & Report	$2,350		Labor and supplies for a yearly local inspection of Land Use Controls with Report
Cover Maintenance	$5,500		
Five Year Site Review		$23,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$7,850	$23,000	
Contingency @ 10%	$785	$2,300	
TOTAL	**$8,635**	**$25,300**	

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 9 - Camp Moffett Ravine Fill
Alternative 9-2A: LUCs, Cover, and ISCO
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 1.1%	Present Worth
0	$487,922		$487,922	1.000	$487,922
1		$8,635	$8,635	0.989	$8,541
2		$8,635	$8,635	0.978	$8,448
3		$8,635	$8,635	0.968	$8,356
4		$8,635	$8,635	0.957	$8,265
5		$33,935	$33,935	0.947	$32,129
6		$8,635	$8,635	0.936	$8,086
7		$8,635	$8,635	0.926	$7,998
8		$8,635	$8,635	0.916	$7,911
9		$8,635	$8,635	0.906	$7,825
10		$33,935	$33,935	0.896	$30,418
11		$8,635	$8,635	0.887	$7,656
12		$8,635	$8,635	0.877	$7,573
13		$8,635	$8,635	0.867	$7,490
14		$8,635	$8,635	0.858	$7,409
15		$33,935	$33,935	0.849	$28,799
16		$8,635	$8,635	0.839	$7,248
17		$8,635	$8,635	0.830	$7,170
18		$8,635	$8,635	0.821	$7,092
19		$8,635	$8,635	0.812	$7,014
20		$33,935	$33,935	0.803	$27,266
21		$8,635	$8,635	0.795	$6,863
22		$8,635	$8,635	0.786	$6,788
23		$8,635	$8,635	0.778	$6,714
24		$8,635	$8,635	0.769	$6,641
25		$33,935	$33,935	0.761	$25,815
26		$8,635	$8,635	0.752	$6,497
27		$8,635	$8,635	0.744	$6,427
28		$8,635	$8,635	0.736	$6,357
29		$8,635	$8,635	0.728	$6,288
30		$33,935	$33,935	0.720	$24,441
				TOTAL PRESENT WORTH	**$833,448**

Cost Estimate - Alternative 9-3

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 9 - Camp Moffett Ravine Fill
Alternative 9-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and Groundwater LUCs
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents, Plans, & LUCRD	300	hr			$40.00		$0	$0	$12,000	$0	$12,000
1.2 Completion Reports	60	hr			$40.00		$0	$0	$2,400	$0	$2,400
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.2 Equipment Mobilization/Demobilization	6	ea			$195.00	$640.00	$0	$0	$1,170	$3,840	$5,010
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Office Trailer	4	mo				$340.00	$0	$0	$0	$1,360	$1,360
3.2 Field Office Equipment, Utilities, & Support	4	mo		$508.00			$0	$2,032	$0	$0	$2,032
3.3 Storage Trailer	4	mo				$102.00	$0	$0	$0	$408	$408
3.8 Survey Support	1.5	day	$1,175.00				$1,763	$0	$0	$0	$1,763
3.9 Site Superintendent	82	day		$242.00	$480.00		$0	$19,844	$39,360	$0	$59,204
3.10 Site Health & Safety and QA/QC	82	day		$242.00	$360.00		$0	$19,844	$29,520	$0	$49,364
3.11 Underground Utility Clearance	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
4 DECONTAMINATION											
4.1 Decontamination Services	2	mo		$1,220.00	$2,245.00	$1,550.00	$0	$2,440	$4,490	$3,100	$10,030
4.2 Equipment Decon Pad	1	ls		$4,500.00	$3,000.00	$725.00	$0	$4,500	$3,000	$725	$8,225
4.3 Decon Water	2,000	gal		$0.20			$0	$400	$0	$0	$400
4.4 Decon Water Storage Tank, 6,000 gallon	2	mo				$813.00	$0	$0	$0	$1,626	$1,626
4.5 Disposal of Decon Waste (liquid & solid)	2	mo	$985.00				$1,970	$0	$0	$0	$1,970
5 SAMPLING											
5.1 Sampling Labor	80	hr			$36.00		$0	$0	$2,880	$0	$2,880
5.2 Sampling ODCs	1	ls		$750.00		$750.00	$0	$750	$0	$750	$1,500
5.3 DPT Rig	4	day	$1,000.00				$4,000	$0	$0	$0	$4,000
5.3 Samples - Analytical (PAHs)	76	ea	$175.00				$13,300	$0	$0	$0	$13,300
6 EXCAVATION AND DISPOSAL											
6.1 Excavator, 2.5 cy	40	day			$1,084.80	$1,652.00	$0	$0	$43,392	$66,080	$109,472
6.2 Site Labor, (3 laborers)	126	day			$448.40		$0	$0	$56,498	$0	$56,498
6.3 T & D of Excavated Soil, non-hazardous (PAHs)	15,640	ton	$65.00				$1,016,600	$0	$0	$0	$1,016,600
6.4 Waste Disposal Characterization / Analytical	15	ea	$850.00	$30.00	$50.00	$30.00	$12,750	$450	$750	$450	$14,400
7 BACKFILL AND SITE RESTORATION											
7.1 Excavator, 2.5 cy	30	day			$1,084.80	$1,800.00	$0	$0	$32,544	$54,000	$86,544
7.2 Dozer, 140 hp	30	day			$555.80	$889.00	$0	$0	$16,674	$26,670	$43,344
7.3 Site Labor, (3 laborers)	92	day			$448.40		$0	$0	$41,253	$0	$41,253
7.4 Backfill, common fill	9,977	cy		$16.07			$0	$160,330	$0	$0	$160,330
7.5 Backfill, vegetative soil	450	cy		$26.92			$0	$12,114	$0	$0	$12,114
7.6 Compactor, 125 hp	30	day			$656.40	$640.20	$0	$0	$19,692	$19,206	$38,898
7.7 Hydro Seed	29	msf	$63.50				$1,842	$0	$0	$0	$1,842
Subtotal							$1,056,224	$223,704	$305,623	$181,715	$1,767,267
Overhead on Labor Cost @ 30%									$91,687		$91,687
G & A Cost @ 10%							$105,622.40	$22,370	$30,562	$18,172	$176,727
Tax on Materials and Equipment Cost @ 6.25%								$13,982		$11,357	$25,339
Total Direct Cost							$1,161,846	$260,056	$427,872	$211,244	$2,061,019
Indirects on Total Direct Cost @ 15%											$309,153
Profit on Total Direct Cost @ 10%											$206,102
Subtotal											$2,576,274

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 9 - Camp Moffett Ravine Fill
Alternative 9-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and Groundwater LUCs
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Health & Safety Monitoring @ 2%											$51,525
Total Field Cost											$2,627,799
Contingency on Total Field Costs @ 20%											$525,560
Engineering on Total Field Cost @ 3%											$65,695
TOTAL CAPITAL COST											**$3,219,054**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 9 - Camp Moffett Ravine Fill
Alternative 9-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and Groundwater LUCs
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Annual Site Inspection & Report	$2,350		Labor and supplies for a yearly local inspection of Land Use Controls with Report
Five Year Site Review		$23,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$2,350	$23,000	
Contingency @ 10%	$235	$2,300	
TOTAL	**$2,585**	**$25,300**	

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 9 - Camp Moffett Ravine Fill
Alternative 9-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and Groundwater LUCs
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 1.1%	Present Worth
0	$3,219,054		$3,219,054	1.000	$3,219,054
1		$2,585	$2,585	0.989	$2,557
2		$2,585	$2,585	0.978	$2,529
3		$2,585	$2,585	0.968	$2,502
4		$2,585	$2,585	0.957	$2,474
5		$27,885	$27,885	0.947	$26,401
6		$2,585	$2,585	0.936	$2,421
7		$2,585	$2,585	0.926	$2,394
8		$2,585	$2,585	0.916	$2,368
9		$2,585	$2,585	0.906	$2,343
10		$27,885	$27,885	0.896	$24,995
11		$2,585	$2,585	0.887	$2,292
12		$2,585	$2,585	0.877	$2,267
13		$2,585	$2,585	0.867	$2,242
14		$2,585	$2,585	0.858	$2,218
15		$27,885	$27,885	0.849	$23,665
16		$2,585	$2,585	0.839	$2,170
17		$2,585	$2,585	0.830	$2,146
18		$2,585	$2,585	0.821	$2,123
19		$2,585	$2,585	0.812	$2,100
20		$27,885	$27,885	0.803	$22,405
21		$2,585	$2,585	0.795	$2,054
22		$2,585	$2,585	0.786	$2,032
23		$2,585	$2,585	0.778	$2,010
24		$2,585	$2,585	0.769	$1,988
25		$27,885	$27,885	0.761	$21,212
26		$2,585	$2,585	0.752	$1,945
27		$2,585	$2,585	0.744	$1,924
28		$2,585	$2,585	0.736	$1,903
29		$2,585	$2,585	0.728	$1,882
30		$27,885	$27,885	0.720	$20,083
				TOTAL PRESENT WORTH	**$3,410,700**

Cost Estimate - Alternative 9-3A

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 9 - Camp Moffett Ravine Fill
Alternative 9-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, Groundwater LUCs, and ISCO
Capital Cost

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Item		Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1	**PROJECT PLANNING & DOCUMENTS**											
1.1	Prepare Documents, Plans, & LUCRD	300	hr			$40.00		$0	$0	$12,000	$0	$12,000
1.2	Prepare ISCO Work Plan	200	hr			$40.00		$0	$0	$8,000	$0	$8,000
1.3	Completion Reports	60	hr			$40.00		$0	$0	$2,400	$0	$2,400
2	**MOBILIZATION AND DEMOBILIZATION**											
2.1	Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.2	Equipment Mobilization/Demobilization	6	ea			$195.00	$640.00	$0	$0	$1,170	$3,840	$5,010
3	**FIELD SUPPORT AND SITE ACCESS**											
3.1	Office Trailer	5	mo				$340.00	$0	$0	$0	$1,700	$1,700
3.2	Field Office Equipment, Utilities, & Support	5	mo		$508.00			$0	$2,540	$0	$0	$2,540
3.3	Storage Trailer	5	mo				$102.00	$0	$0	$0	$510	$510
3.8	Survey Support	1.5	day	$1,175.00				$1,763	$0	$0	$0	$1,763
3.9	Site Superintendent	100	day		$242.00	$480.00		$0	$24,200	$48,000	$0	$72,200
3.10	Site Health & Safety and QA/QC	100	day		$242.00	$360.00		$0	$24,200	$36,000	$0	$60,200
3.11	Underground Utility Clearance	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
4	**DECONTAMINATION**											
4.1	Decontamination Services	2	mo		$1,220.00	$2,245.00	$1,550.00	$0	$2,440	$4,490	$3,100	$10,030
4.2	Equipment Decon Pad	1	ls		$4,500.00	$3,000.00	$725.00	$0	$4,500	$3,000	$725	$8,225
4.3	Decon Water	2,000	gal		$0.20			$0	$400	$0	$0	$400
4.4	Decon Water Storage Tank, 6,000 gallon	2	mo				$813.00	$0	$0	$0	$1,626	$1,626
4.5	Disposal of Decon Waste (liquid & solid)	2	mo	$985.00				$1,970	$0	$0	$0	$1,970
5	**SAMPLING**											
5.1	Sampling Labor	80	hr			$36.00		$0	$0	$2,880	$0	$2,880
5.2	Sampling ODCs	1	ls		$750.00		$750.00	$0	$750	$0	$750	$1,500
5.3	DPT Rig	4	day	$1,000.00				$4,000	$0	$0	$0	$4,000
5.3	Samples - Analytical (PAHs)	76	ea	$175.00				$13,300	$0	$0	$0	$13,300
6	**EXCAVATION AND DISPOSAL**											
6.1	Excavator, 2.5 cy	40	day			$1,084.80	$1,652.00	$0	$0	$43,392	$66,080	$109,472
6.2	Site Labor, (3 laborers)	126	day			$448.40		$0	$0	$56,498	$0	$56,498
6.3	T & D of Excavated Soil, non-hazardous (PAHs)	15,640	ton	$65.00				$1,016,600	$0	$0	$0	$1,016,600
6.4	Waste Disposal Characterization / Analytical	15	ea	$850.00	$30.00	$50.00	$30.00	$12,750	$450	$750	$450	$14,400
7	**BACKFILL AND SITE RESTORATION**											
7.1	Excavator, 2.5 cy	30	day			$1,084.80	$1,800.00	$0	$0	$32,544	$54,000	$86,544
7.2	Dozer, 140 hp	30	day			$555.80	$889.00	$0	$0	$16,674	$26,670	$43,344
7.3	Site Labor, (3 laborers)	92	day			$448.40		$0	$0	$41,253	$0	$41,253
7.4	Backfill, common fill	9,977	cy		$16.07			$0	$160,330	$0	$0	$160,330
7.5	Backfill, vegetative soil	450	cy		$26.92			$0	$12,114	$0	$0	$12,114
7.6	Compactor, 125 hp	30	day			$656.40	$640.20	$0	$0	$19,692	$19,206	$38,898
7.7	Hydro Seed	29	msf	$63.50				$1,842	$0	$0	$0	$1,842
8	**ISCO**											
8.1	Delineation sampling	1	ls	$23,000.00				$23,000	$0	$0	$0	$23,000
8.2	ISCO Bench/pilot test	1	ls	$7,500.00				$7,500	$0	$0	$0	$7,500
8.3	Project Design	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
8.4	Well installation	1	ls	$52,800.00				$52,800	$0	$0	$0	$52,800
8.5	Injection	1	ls	$36,800.00				$36,800	$0	$0	$0	$36,800
8.6	Reagents	1	ls	$2,300.00				$2,300	$0	$0	$0	$2,300
8.7	Mobilization/Demobilization	1	ls	$18,000.00				$18,000	$0	$0	$0	$18,000
8.8	Documentation	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
8.9	Second Injection	1	ls	$28,000.00				$28,000	$0	$0	$0	$28,000
8.10	Second Injection Reagents	1	ls	$1,700.00				$1,700	$0	$0	$0	$1,700
8.11	Second Injection Mobilization/Demobilization	1	ls	$18,000.00				$18,000	$0	$0	$0	$18,000
8.12	Performance Sampling	1	ls	$25,200.00				$25,200	$0	$0	$0	$25,200
	Subtotal							$1,277,524	$232,924	$328,743	$182,157	$2,021,349

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Overhead on Labor Cost @ 30%									$98,623		$98,623
G & A Cost @ 10%							$127,752.40	$23,292	$32,874	$18,216	$202,135
Tax on Materials and Equipment Cost @ 6.25%								$14,558		$11,385	$25,943
Total Direct Cost							$1,405,276	$270,775	$460,240	$211,758	$2,348,049
Indirects on Total Direct Cost @ 15%											$352,207
Profit on Total Direct Cost @ 10%											$234,805
Subtotal											$2,935,061
Health & Safety Monitoring @ 2%											$58,701
Total Field Cost											$2,993,762
Contingency on Total Field Costs @ 20%											$598,752
Engineering on Total Field Cost @ 3%											$74,844
TOTAL CAPITAL COST											**$3,667,359**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 9 - Camp Moffett Ravine Fill
Alternative 9-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, Groundwater LUCs, and ISCO
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Annual Site Inspection & Report	$2,350		Labor and supplies for a yearly local inspection of Land Use Controls with Report
Five Year Site Review		$23,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$2,350	$23,000	
Contingency @ 10%	$235	$2,300	
TOTAL	**$2,585**	**$25,300**	

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 9 - Camp Moffett Ravine Fill
Alternative 9-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, Groundwater LUCs, and ISCO
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 1.1%	Present Worth
0	$3,667,359		$3,667,359	1.000	$3,667,359
1		$2,585	$2,585	0.989	$2,557
2		$2,585	$2,585	0.978	$2,529
3		$2,585	$2,585	0.968	$2,502
4		$2,585	$2,585	0.957	$2,474
5		$27,885	$27,885	0.947	$26,401
6		$2,585	$2,585	0.936	$2,421
7		$2,585	$2,585	0.926	$2,394
8		$2,585	$2,585	0.916	$2,368
9		$2,585	$2,585	0.906	$2,343
10		$27,885	$27,885	0.896	$24,995
11		$2,585	$2,585	0.887	$2,292
12		$2,585	$2,585	0.877	$2,267
13		$2,585	$2,585	0.867	$2,242
14		$2,585	$2,585	0.858	$2,218
15		$27,885	$27,885	0.849	$23,665
16		$2,585	$2,585	0.839	$2,170
17		$2,585	$2,585	0.830	$2,146
18		$2,585	$2,585	0.821	$2,123
19		$2,585	$2,585	0.812	$2,100
20		$27,885	$27,885	0.803	$22,405
21		$2,585	$2,585	0.795	$2,054
22		$2,585	$2,585	0.786	$2,032
23		$2,585	$2,585	0.778	$2,010
24		$2,585	$2,585	0.769	$1,988
25		$27,885	$27,885	0.761	$21,212
26		$2,585	$2,585	0.752	$1,945
27		$2,585	$2,585	0.744	$1,924
28		$2,585	$2,585	0.736	$1,903
29		$2,585	$2,585	0.728	$1,882
30		$27,885	$27,885	0.720	$20,083
				TOTAL PRESENT WORTH	**$3,859,006**

Cost Estimate - Alternative 21-2

	Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1	**PROJECT PLANNING & DOCUMENTS**											
1.1	Prepare LUC Documents	250	hr			$40.00		$0	$0	$10,000	$0	$10,000
	Subtotal							$0	$0	$10,000	$0	$10,000
	Overhead on Labor Cost @	30%								$3,000		$3,000
	G & A Cost @	10%						$0	$0	$1,000	$0	$1,000
	Tax on Materials and Equipment Cost @	6.25%							$0		$0	$0
	Total Direct Cost							$0	$0	$14,000	$0	$14,000
	Indirects on Total Direct Cost @	20%										$2,800
	Profit on Total Direct Cost @	10%										$1,400
	Subtotal											$18,200
	Health & Safety Monitoring @	0%										$0
	Total Field Cost											$18,200
	Contingency on Total Field Costs @	10%										$1,820
	Engineering on Total Field Cost @	0%										$0
	TOTAL CAPITAL COST											**$20,020**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 21 - Buildings 1517/1506 Area
Alternative 21-2: LUCs and Cover
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Annual Site Inspection & Report	$2,350		Labor and supplies for a yearly local inspection of Land Use Controls with Report
Cover Maintenance	$5,500		
Five Year Site Review		$23,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$7,850	$23,000	
Contingency @ 10%	$785	$2,300	
TOTAL	**$8,635**	**$25,300**	

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 21 - Buildings 1517/1506 Area
Alternative 21-2: LUCs and Cover
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 1.1%	Present Worth
0	$20,020		$20,020	1.000	$20,020
1		$8,635	$8,635	0.989	$8,541
2		$8,635	$8,635	0.978	$8,448
3		$8,635	$8,635	0.968	$8,356
4		$8,635	$8,635	0.957	$8,265
5		$33,935	$33,935	0.947	$32,129
6		$8,635	$8,635	0.936	$8,086
7		$8,635	$8,635	0.926	$7,998
8		$8,635	$8,635	0.916	$7,911
9		$8,635	$8,635	0.906	$7,825
10		$33,935	$33,935	0.896	$30,418
11		$8,635	$8,635	0.887	$7,656
12		$8,635	$8,635	0.877	$7,573
13		$8,635	$8,635	0.867	$7,490
14		$8,635	$8,635	0.858	$7,409
15		$33,935	$33,935	0.849	$28,799
16		$8,635	$8,635	0.839	$7,248
17		$8,635	$8,635	0.830	$7,170
18		$8,635	$8,635	0.821	$7,092
19		$8,635	$8,635	0.812	$7,014
20		$33,935	$33,935	0.803	$27,266
21		$8,635	$8,635	0.795	$6,863
22		$8,635	$8,635	0.786	$6,788
23		$8,635	$8,635	0.778	$6,714
24		$8,635	$8,635	0.769	$6,641
25		$33,935	$33,935	0.761	$25,815
26		$8,635	$8,635	0.752	$6,497
27		$8,635	$8,635	0.744	$6,427
28		$8,635	$8,635	0.736	$6,357
29		$8,635	$8,635	0.728	$6,288
30		$33,935	$33,935	0.720	$24,441
				TOTAL PRESENT WORTH	**$365,545**

Cost Estimate - Alternative 21-2A

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 21 - Buildings 1517/1506 Area
Alternative 21-2A: LUCs, Cover, and ISCO
Capital Cost

	Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1	**PROJECT PLANNING & DOCUMENTS**											
1.1	Prepare LUC Documents	250	hr			$40.00		$0	$0	$10,000	$0	$10,000
1.2	Prepare ISCO Work Plan	200	hr			$40.00		$0	$0	$8,000	$0	$8,000
2	**MOBILIZATION AND DEMOBILIZATION**											
2.1	Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
3	**FIELD SUPPORT AND SITE ACCESS**											
3.1	Office Trailer	2	mo				$340.00	$0	$0	$0	$680	$680
3.2	Field Office Equipment, Utilities, & Support	2	mo		$508.00			$0	$1,016	$0	$0	$1,016
3.3	Survey Support	2	day	$1,175.00				$2,350	$0	$0	$0	$2,350
3.4	Site Superintendent	38	day		$242.00	$480.00		$0	$9,196	$18,240	$0	$27,436
3.5	Site Health & Safety and QA/QC	38	day		$242.00	$360.00		$0	$9,196	$13,680	$0	$22,876
3.6	Underground Utility Clearance	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
4	**ISCO**											
4.1	Delineation sampling	1	ls	$23,000.00				$23,000	$0	$0	$0	$23,000
4.2	ISCO Bench/pilot test	1	ls	$7,500.00				$7,500	$0	$0	$0	$7,500
4.3	Project Design	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
4.4	Well installation	1	ls	$36,000.00				$36,000	$0	$0	$0	$36,000
4.5	Injection	1	ls	$46,000.00				$46,000	$0	$0	$0	$46,000
4.6	Reagents	1	ls	$5,600.00				$5,600	$0	$0	$0	$5,600
4.7	Mobilization/Demobilization	1	ls	$18,000.00				$18,000	$0	$0	$0	$18,000
4.8	Documentation	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
4.9	Second Injection	1	ls	$34,500.00				$34,500	$0	$0	$0	$34,500
4.10	Second Injection Reagents	1	ls	$4,200.00				$4,200	$0	$0	$0	$4,200
4.11	Second Injection Mobilization/Demobilization	1	ls	$18,000.00				$18,000	$0	$0	$0	$18,000
4.12	Performance Sampling	1	ls	$25,200.00				$25,200	$0	$0	$0	$25,200
	Subtotal							$232,350	$20,408	$49,920	$4,180	$306,858
	Overhead on Labor Cost @ 30%									$14,976		$14,976
	G & A Cost @ 10%							$23,235	$2,041	$4,992	$418	$30,686
	Tax on Materials and Equipment Cost @ 6.25%								$1,276		$261	$1,537
	Total Direct Cost							$255,585	$23,724	$69,888	$4,859	$354,057
	Indirects on Total Direct Cost @ 20%											$70,811
	Profit on Total Direct Cost @ 10%											$35,406
	Subtotal											$460,274
	Health & Safety Monitoring @ 2%											$9,205
	Total Field Cost											$469,479
	Contingency on Total Field Costs @ 10%											$46,948
	Engineering on Total Field Cost @ 8%											$37,558
	TOTAL CAPITAL COST											**$553,985**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 21 - Buildings 1517/1506 Area
Alternative 21-2A: LUCs, Cover, and ISCO
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Annual Site Inspection & Report	$2,350		Labor and supplies for a yearly local inspection of Land Use Controls with Report
Cover Maintenance	$5,500		
Five Year Site Review		$23,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$7,850	$23,000	
Contingency @ 10%	$785	$2,300	
TOTAL	**$8,635**	**$25,300**	

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 21 - Buildings 1517/1506 Area
Alternative 21-2A: LUCs, Cover, and ISCO
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 1.1%	Present Worth
0	$553,985		$553,985	1.000	$553,985
1		$8,635	$8,635	0.989	$8,541
2		$8,635	$8,635	0.978	$8,448
3		$8,635	$8,635	0.968	$8,356
4		$8,635	$8,635	0.957	$8,265
5		$33,935	$33,935	0.947	$32,129
6		$8,635	$8,635	0.936	$8,086
7		$8,635	$8,635	0.926	$7,998
8		$8,635	$8,635	0.916	$7,911
9		$8,635	$8,635	0.906	$7,825
10		$33,935	$33,935	0.896	$30,418
11		$8,635	$8,635	0.887	$7,656
12		$8,635	$8,635	0.877	$7,573
13		$8,635	$8,635	0.867	$7,490
14		$8,635	$8,635	0.858	$7,409
15		$33,935	$33,935	0.849	$28,799
16		$8,635	$8,635	0.839	$7,248
17		$8,635	$8,635	0.830	$7,170
18		$8,635	$8,635	0.821	$7,092
19		$8,635	$8,635	0.812	$7,014
20		$33,935	$33,935	0.803	$27,266
21		$8,635	$8,635	0.795	$6,863
22		$8,635	$8,635	0.786	$6,788
23		$8,635	$8,635	0.778	$6,714
24		$8,635	$8,635	0.769	$6,641
25		$33,935	$33,935	0.761	$25,815
26		$8,635	$8,635	0.752	$6,497
27		$8,635	$8,635	0.744	$6,427
28		$8,635	$8,635	0.736	$6,357
29		$8,635	$8,635	0.728	$6,288
30		$33,935	$33,935	0.720	$24,441
				TOTAL PRESENT WORTH	**$899,511**

Cost Estimate - Alternative 21-3

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 21 -Building 1517/1506 Area
Alternative 21-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and Groundwater LUCs
Capital Cost

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Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents, Plans, & LUCRD	300	hr			$40.00		$0	$0	$12,000	$0	$12,000
1.2 Completion Reports	60	hr			$40.00		$0	$0	$2,400	$0	$2,400
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.2 Equipment Mobilization/Demobilization	6	ea			$195.00	$640.00	$0	$0	$1,170	$3,840	$5,010
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Office Trailer	2	mo				$340.00	$0	$0	$0	$510	$510
3.2 Field Office Equipment, Utilities, & Support	2	mo		$508.00			$0	$762	$0	$0	$762
3.3 Storage Trailer	2	mo				$102.00	$0	$0	$0	$153	$153
3.8 Survey Support	2	day	$1,175.00				$2,350	$0	$0	$0	$2,350
3.9 Site Superintendent	52	day		$242.00	$480.00		$0	$12,584	$24,960	$0	$37,544
3.10 Site Health & Safety and QA/QC	52	day		$242.00	$360.00		$0	$12,584	$18,720	$0	$31,304
3.11 Underground Utility Clearance	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
4 DECONTAMINATION											
4.1 Decontamination Services	1	mo		$1,220.00	$2,245.00	$1,550.00	$0	$1,220	$2,245	$1,550	$5,015
4.2 Equipment Decon Pad	1	ls		$4,500.00	$3,000.00	$725.00	$0	$4,500	$3,000	$725	$8,225
4.3 Decon Water	1,000	gal		$0.20			$0	$200	$0	$0	$200
4.4 Decon Water Storage Tank, 6,000 gallon	1	mo				$813.00	$0	$0	$0	$813	$813
4.5 Disposal of Decon Waste (liquid & solid)	1	mo	$985.00				$985	$0	$0	$0	$985
5 SAMPLING											
5.1 Sampling Labor	80	hr			$36.00		$0	$0	$2,880	$0	$2,880
5.2 Sampling ODCs	1	ls		$750.00		$750.00	$0	$750	$0	$750	$1,500
5.3 DPT Rig	4	day	$1,000.00				$4,000	$0	$0	$0	$4,000
5.3 Samples - Analytical (PAHs)	84	ea	$175.00				$14,700	$0	$0	$0	$14,700
6 EXCAVATION AND DISPOSAL											
6.1 Excavator, 2.5 cy	20	day			$1,084.80	$1,652.00	$0	$0	$21,696	$33,040	$54,736
6.2 Site Labor, (3 laborers)	66	day			$448.40		$0	$0	$29,594	$0	$29,594
6.3 T & D of Excavated Soil, non-hazardous (PAHs)	4,420	ton	$65.00				$287,300	$0	$0	$0	$287,300
6.4 Waste Disposal Characterization / Analytical	5	ea	$850.00	$30.00	$50.00	$30.00	$4,250	$150	$250	$150	$4,800
7 BACKFILL AND SITE RESTORATION											
7.1 Excavator, 2.5 cy	10	day			$1,084.80	$1,800.00	$0	$0	$10,848	$18,000	$28,848
7.2 Dozer, 140 hp	10	day			$555.80	$889.00	$0	$0	$5,558	$8,890	$14,448
7.3 Site Labor, (3 laborers)	58	day			$448.40		$0	$0	$26,007	$0	$26,007
7.4 Backfill, common fill	2,317	cy		$16.07			$0	$37,234	$0	$0	$37,234
7.5 Backfill, vegetative soil	630	cy		$26.92			$0	$16,960	$0	$0	$16,960
7.6 Compactor, 125 hp	10	day			$656.40	$640.20	$0	$0	$6,564	$6,402	$12,966
7.7 Hydro Seed	41	msf	$63.50				$2,604	$0	$0	$0	$2,604
Subtotal							$320,189	$87,944	$167,893	$78,323	$654,348
Overhead on Labor Cost @ 30%									$50,368		$50,368
G & A Cost @ 10%							$32,018.85	$8,794	$16,789	$7,832	$65,435
Tax on Materials and Equipment Cost @ 6.25%								$5,496		$4,895	$10,392
Total Direct Cost							$352,207	$102,235	$235,050	$91,050	$780,542
Indirects on Total Direct Cost @ 15%											$117,081
Profit on Total Direct Cost @ 10%											$78,054
Subtotal											$975,678

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Health & Safety Monitoring @ 2%											$19,514
Total Field Cost											$995,191
Contingency on Total Field Costs @ 20%											$199,038
Engineering on Total Field Cost @ 5%											$49,760
TOTAL CAPITAL COST											**$1,243,989**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 21 -Building 1517/1506 Area
Alternative 21-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and Groundwater LUCs
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Annual Site Inspection & Report	$2,350		Labor and supplies for a yearly local inspection of Land Use Controls with Report
Five Year Site Review		$23,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$2,350	$23,000	
Contingency @ 10%	$235	$2,300	
TOTAL	**$2,585**	**$25,300**	

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 21 -Building 1517/1506 Area
Alternative 21-3: Excavation (Unrestricted Re-use), Off-Site Disposal, and Groundwater LUCs
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 1.1%	Present Worth
0	$1,243,989		$1,243,989	1.000	$1,243,989
1		$2,585	$2,585	0.989	$2,557
2		$2,585	$2,585	0.978	$2,529
3		$2,585	$2,585	0.968	$2,502
4		$2,585	$2,585	0.957	$2,474
5		$27,885	$27,885	0.947	$26,401
6		$2,585	$2,585	0.936	$2,421
7		$2,585	$2,585	0.926	$2,394
8		$2,585	$2,585	0.916	$2,368
9		$2,585	$2,585	0.906	$2,343
10		$27,885	$27,885	0.896	$24,995
11		$2,585	$2,585	0.887	$2,292
12		$2,585	$2,585	0.877	$2,267
13		$2,585	$2,585	0.867	$2,242
14		$2,585	$2,585	0.858	$2,218
15		$27,885	$27,885	0.849	$23,665
16		$2,585	$2,585	0.839	$2,170
17		$2,585	$2,585	0.830	$2,146
18		$2,585	$2,585	0.821	$2,123
19		$2,585	$2,585	0.812	$2,100
20		$27,885	$27,885	0.803	$22,405
21		$2,585	$2,585	0.795	$2,054
22		$2,585	$2,585	0.786	$2,032
23		$2,585	$2,585	0.778	$2,010
24		$2,585	$2,585	0.769	$1,988
25		$27,885	$27,885	0.761	$21,212
26		$2,585	$2,585	0.752	$1,945
27		$2,585	$2,585	0.744	$1,924
28		$2,585	$2,585	0.736	$1,903
29		$2,585	$2,585	0.728	$1,882
30		$27,885	$27,885	0.720	$20,083

TOTAL PRESENT WORTH **$1,435,636**

Cost Estimate - Alternative 21-3A

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 21 -Building 1517/1506 Area
Alternative 21-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, Groundwater LUCs, and ISCO
Capital Cost

				Unit Cost				Extended Cost			
Item	Quantity	Unit	Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	Subtotal
1 PROJECT PLANNING & DOCUMENTS											
1.1 Prepare Documents, Plans, & LUCRD	300	hr			$40.00		$0	$0	$12,000	$0	$12,000
1.2 Prepare ISCO Work Plan	200	hr			$40.00		$0	$0	$8,000	$0	$8,000
1.3 Completion Reports	60	hr			$40.00		$0	$0	$2,400	$0	$2,400
2 MOBILIZATION AND DEMOBILIZATION											
2.1 Site Support Facilities (trailers, phone, electric, etc.)	1	ls		$1,000.00		$3,500.00	$0	$1,000	$0	$3,500	$4,500
2.2 Equipment Mobilization/Demobilization	6	ea			$195.00	$640.00	$0	$0	$1,170	$3,840	$5,010
3 FIELD SUPPORT AND SITE ACCESS											
3.1 Office Trailer	3	mo				$340.00	$0	$0	$0	$1,020	$1,020
3.2 Field Office Equipment, Utilities, & Support	3	mo		$508.00			$0	$1,524	$0	$0	$1,524
3.3 Storage Trailer	3	mo				$102.00	$0	$0	$0	$306	$306
3.8 Survey Support	2	day	$1,175.00				$2,350	$0	$0	$0	$2,350
3.9 Site Superintendent	72	day		$242.00	$480.00		$0	$17,424	$34,560	$0	$51,984
3.10 Site Health & Safety and QA/QC	72	day		$242.00	$360.00		$0	$17,424	$25,920	$0	$43,344
3.11 Underground Utility Clearance	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
4 DECONTAMINATION											
4.1 Decontamination Services	1	mo		$1,220.00	$2,245.00	$1,550.00	$0	$1,220	$2,245	$1,550	$5,015
4.2 Equipment Decon Pad	1	ls		$4,500.00	$3,000.00	$725.00	$0	$4,500	$3,000	$725	$8,225
4.3 Decon Water	1,000	gal		$0.20			$0	$200	$0	$0	$200
4.4 Decon Water Storage Tank, 6,000 gallon	1	mo				$813.00	$0	$0	$0	$813	$813
4.5 Disposal of Decon Waste (liquid & solid)	1	mo	$985.00				$985	$0	$0	$0	$985
5 SAMPLING											
5.1 Sampling Labor	80	hr			$36.00		$0	$0	$2,880	$0	$2,880
5.2 Sampling ODCs	1	ls		$750.00		$750.00	$0	$750	$0	$750	$1,500
5.3 DPT Rig	4	day	$1,000.00				$4,000	$0	$0	$0	$4,000
5.3 Samples - Analytical (PAHs)	84	ea	$175.00				$14,700	$0	$0	$0	$14,700
6 EXCAVATION AND DISPOSAL											
6.1 Excavator, 2.5 cy	20	day			$1,084.80	$1,652.00	$0	$0	$21,696	$33,040	$54,736
6.2 Site Labor, (3 laborers)	66	day			$448.40		$0	$0	$29,594	$0	$29,594
6.3 T & D of Excavated Soil, non-hazardous (PAHs)	4,420	ton	$65.00				$287,300	$0	$0	$0	$287,300
6.4 Waste Disposal Characterization / Analytical	5	ea	$850.00	$30.00	$50.00	$30.00	$4,250	$150	$250	$150	$4,800
7 BACKFILL AND SITE RESTORATION											
7.1 Excavator, 2.5 cy	10	day			$1,084.80	$1,800.00	$0	$0	$10,848	$18,000	$28,848
7.2 Dozer, 140 hp	10	day			$555.80	$889.00	$0	$0	$5,558	$8,890	$14,448
7.3 Site Labor, (3 laborers)	58	day			$448.40		$0	$0	$26,007	$0	$26,007
7.4 Backfill, common fill	2,317	cy		$16.07			$0	$37,234	$0	$0	$37,234
7.5 Backfill, vegetative soil	630	cy		$26.92			$0	$16,960	$0	$0	$16,960
7.6 Compactor, 125 hp	10	day			$656.40	$640.20	$0	$0	$6,564	$6,402	$12,966
7.7 Hydro Seed	41	msf	$63.50				$2,604	$0	$0	$0	$2,604
8 ISCO											
8.1 Delineation sampling	1	ls	$23,000.00				$23,000	$0	$0	$0	$23,000
8.2 ISCO Bench/pilot test	1	ls	$7,500.00				$7,500	$0	$0	$0	$7,500
8.3 Project Design	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
8.4 Well installation	1	ls	$36,000.00				$36,000	$0	$0	$0	$36,000
8.5 Injection	1	ls	$46,000.00				$46,000	$0	$0	$0	$46,000
8.6 Reagents	1	ls	$5,600.00				$5,600	$0	$0	$0	$5,600
8.7 Mobilization/Demobilization	1	ls	$18,000.00				$18,000	$0	$0	$0	$18,000
8.8 Documentation	1	ls	$4,000.00				$4,000	$0	$0	$0	$4,000
8.9 Second Injection	1	ls	$34,500.00				$34,500	$0	$0	$0	$34,500
8.10 Second Injection Reagents	1	ls	$4,200.00				$4,200	$0	$0	$0	$4,200
8.11 Second Injection Mobilization/Demobilization	1	ls	$18,000.00				$18,000	$0	$0	$0	$18,000
8.12 Performance Sampling	1	ls	$25,200.00				$25,200	$0	$0	$0	$25,200
Subtotal							$546,189	$98,386	$192,693	$78,986	$916,253

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 21 -Building 1517/1506 Area
Alternative 21-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, Groundwater LUCs, and ISCO
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Extended Cost Subcontract	Extended Cost Material	Extended Cost Labor	Extended Cost Equipment	Subtotal
Overhead on Labor Cost @ 30%									$57,808		$57,808
G & A Cost @ 10%							$54,618.85	$9,839	$19,269	$7,899	$91,625
Tax on Materials and Equipment Cost @ 6.25%								$6,149		$4,937	$11,086
Total Direct Cost							$600,807	$114,373	$269,770	$91,821	$1,076,772
Indirects on Total Direct Cost @ 15%											$161,516
Profit on Total Direct Cost @ 10%											$107,677
Subtotal											$1,345,965
Health & Safety Monitoring @ 1%											$13,460
Total Field Cost											$1,359,424
Contingency on Total Field Costs @ 20%											$271,885
Engineering on Total Field Cost @ 4%											$54,377
TOTAL CAPITAL COST											**$1,685,686**

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 21 -Building 1517/1506 Area
Alternative 21-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, Groundwater LUCs, and ISCO
Annual Cost

Item	Item Cost years 1 - 30	Item Cost every 5 years	Notes
Annual Site Inspection & Report	$2,350		Labor and supplies for a yearly local inspection of Land Use Controls with Report
Five Year Site Review		$23,000	Labor and supplies to evaluate site every five years for 5-year review
SUBTOTAL	$2,350	$23,000	
Contingency @ 10%	$235	$2,300	
TOTAL	**$2,585**	**$25,300**	

NAVAL TRAINING CENTER GREAT LAKES
Great Lakes, Illinois
Site 21 -Building 1517/1506 Area
Alternative 21-3A: Excavation (Unrestricted Re-use), Off-Site Disposal, Groundwater LUCs, and ISCO
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate 1.1%	Present Worth
0	$1,685,686		$1,685,686	1.000	$1,685,686
1		$2,585	$2,585	0.989	$2,557
2		$2,585	$2,585	0.978	$2,529
3		$2,585	$2,585	0.968	$2,502
4		$2,585	$2,585	0.957	$2,474
5		$27,885	$27,885	0.947	$26,401
6		$2,585	$2,585	0.936	$2,421
7		$2,585	$2,585	0.926	$2,394
8		$2,585	$2,585	0.916	$2,368
9		$2,585	$2,585	0.906	$2,343
10		$27,885	$27,885	0.896	$24,995
11		$2,585	$2,585	0.887	$2,292
12		$2,585	$2,585	0.877	$2,267
13		$2,585	$2,585	0.867	$2,242
14		$2,585	$2,585	0.858	$2,218
15		$27,885	$27,885	0.849	$23,665
16		$2,585	$2,585	0.839	$2,170
17		$2,585	$2,585	0.830	$2,146
18		$2,585	$2,585	0.821	$2,123
19		$2,585	$2,585	0.812	$2,100
20		$27,885	$27,885	0.803	$22,405
21		$2,585	$2,585	0.795	$2,054
22		$2,585	$2,585	0.786	$2,032
23		$2,585	$2,585	0.778	$2,010
24		$2,585	$2,585	0.769	$1,988
25		$27,885	$27,885	0.761	$21,212
26		$2,585	$2,585	0.752	$1,945
27		$2,585	$2,585	0.744	$1,924
28		$2,585	$2,585	0.736	$1,903
29		$2,585	$2,585	0.728	$1,882
30		$27,885	$27,885	0.720	$20,083

TOTAL PRESENT WORTH **$1,877,333**

APPENDIX E

COC CONCENTRATION TABLES

TABLE E-5-1
COC CONCENTRATIONS IN SURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC05-SB01	NTC05-SB02	NTC05-SB03	NTC05-SB04
SAMPLE ID		NTC05-SB01-SS-0005	NTC05-SB02-SS-0005	NTC05-SB03-SS-0005	NTC05-SB04-SS-0005
SAMPLE DATE		20101217	20101217	20101214	20101217
SUBMATRIX		SS	SS	SS	SS
TOP DEPTH		0	0	0	0
BOTTOM DEPTH		0.5	0.5	0.5	0.5
METALS (MG/KG)					
ARSENIC	13	9	11	5.6	4.5
IRON	55000	**66000**	50000	16000	18000
MANGANESE	1600	420	340	420	430
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1800	48	**2000**	1500	210
BENZO(A)PYRENE	2100	50	**2800**	**2500**	320
BENZO(B)FLUORANTHENE	2100	76	**3900**	**3700**	460
BENZO(K)FLUORANTHENE	9000	31	1700	1100	230
DIBENZO(A,H)ANTHRACENE	420	13	**640**	**570**	57 J
INDENO(1,2,3-CD)PYRENE	1600	41	**2300**	**2100**	280

Shaded cells indicate concentration greater than the PRG.

Data is from RI Report.

Blank means no analysis.

TABLE E-5-1
COC CONCENTRATIONS IN SURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION SAMPLE ID SAMPLE DATE SUBMATRIX TOP DEPTH BOTTOM DEPTH	PRG	NTC05-SB05 NTC05-SB05-SS-0005 20101218 SS 0 0.5	NTC05-SB06 NTC05-SB06-SS-0005 20101218 SS 0 0.5	NTC05-SB07 NTC05-SB07-SS-0005 20101218 SS 0 0.5	NTC05-SB08 NTC05-SB08-SS-0005 20101218 SS 0 0.5
METALS (MG/KG)					
ARSENIC	13	6.4	3.2	5.2	5.7
IRON	55000	15000	9200	17000	21000
MANGANESE	1600	720	330	380	390
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1800	1800	140 U	**6100**	1100
BENZO(A)PYRENE	2100	**2700**	180	**12000**	1400
BENZO(B)FLUORANTHENE	2100	**4000**	230	**14000**	2100
BENZO(K)FLUORANTHENE	9000	1400	90	5800	750
DIBENZO(A,H)ANTHRACENE	420	**470**	36 J	**2300**	250
INDENO(1,2,3-CD)PYRENE	1600	**1900**	140	**9700**	1000

Shaded cells indicate concentration greater than the PRG.

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Blank means no analysis.

TABLE E-5-1
COC CONCENTRATIONS IN SURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION		NTC05-SB09	NTC05-SB10	NTC05-SB11	NTC05-SB12
SAMPLE ID	PRG	NTC05-SB09-SS-0005	NTC05-SB10-SS-0005	NTC05-SB11-SS-0005	NTC05-SB12-SS-0005
SAMPLE DATE		20101218	20101214	20101218	20101214
SUBMATRIX		SS	SS	SS	SS
TOP DEPTH		0	0	0	0
BOTTOM DEPTH		0.5	0.5	0.5	0.5
METALS (MG/KG)					
ARSENIC	13	12	4.6	3.9	2.5
IRON	55000	32000	12000	12000	11000
MANGANESE	1600	630	370	410	280
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1800	610	830	850 U	670 J
BENZO(A)PYRENE	2100	780	720	**4500**	1700 U
BENZO(B)FLUORANTHENE	2100	1200	1200	**4900**	1700 U
BENZO(K)FLUORANTHENE	9000	480	530	2200	340 J
DIBENZO(A,H)ANTHRACENE	420	130	150 J	**850**	1700 U
INDENO(1,2,3-CD)PYRENE	1600	530	380	**3400**	1700 U

Shaded cells indicate concentration greater than the PRG.

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Blank means no analysis.

TABLE E-5-1
COC CONCENTRATIONS IN SURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC05-SB13	NTC05-SB14	NTC05-SB15	NTC05-SB16
SAMPLE ID		NTC05-SB13-SS-0005	NTC05-SB14-SS-0005	NTC05-SB15-SS-0005	NTC05-SB16-SS-0005
SAMPLE DATE		20101219	20101214	20101219	20101218
SUBMATRIX		SS	SS	SS	SS
TOP DEPTH		0	0	0	0
BOTTOM DEPTH		0.5	0.5	0.5	0.5
METALS (MG/KG)					
ARSENIC	13	6.3	8.7	6.4 J	3.2
IRON	55000	23000	21000	25000	12000
MANGANESE	1600	490	490	610	240
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1800	10 U	77 J	50 J	870
BENZO(A)PYRENE	2100	10 U	58 J	50 J	1100
BENZO(B)FLUORANTHENE	2100	10 U	96	50 J	1800
BENZO(K)FLUORANTHENE	9000	10 U	38 J	33 J	630
DIBENZO(A,H)ANTHRACENE	420	10 U	92 U	33 J	280
INDENO(1,2,3-CD)PYRENE	1600	10 U	58 J	33 J	1000

Shaded cells indicate concentration greater than the PRG.

Data is from RI Report.

Blank means no analysis.

TABLE E-5-1
COC CONCENTRATIONS IN SURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC05-SB17	NTC05-SB18	NTC05-SB19	NTC05-SB20
SAMPLE ID		NTC05-SB17-SS-0005	NTC05-SB18-SS-0005	NTC05-SB19-SS-0005	NTC05-SB20-SS-0005
SAMPLE DATE		20101218	20101218	20101214	20101219
SUBMATRIX		SS	SS	SS	SS
TOP DEPTH		0	0	0	0
BOTTOM DEPTH		0.5	0.5	0.5	0.5
METALS (MG/KG)					
ARSENIC	13	4.1	2.7	7.1	3.1
IRON	55000	19000	7200	23000	11000
MANGANESE	1600	290	350	590	410
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1800	850	780	440	730
BENZO(A)PYRENE	2100	1700	780	690	1100
BENZO(B)FLUORANTHENE	2100	2100	940	950	1500
BENZO(K)FLUORANTHENE	9000	1000	470 J	380	620
DIBENZO(A,H)ANTHRACENE	420	370	780 U	140	260
INDENO(1,2,3-CD)PYRENE	1600	1600	470 J	500	810

Shaded cells indicate concentration greater than the PRG.

Data is from RI Report.

Blank means no analysis.

TABLE E-5-1
COC CONCENTRATIONS IN SURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC05-SB21	NTC05-SB22	NTC05-SB23	NTC05-SB24
SAMPLE ID		NTC05-SB21-SS-0005	NTC05-SB22-SS-0005	NTC05-SB23-SS-0005	NTC05-SB24-SS-0005
SAMPLE DATE		20101219	20101219	20101219	20101219
SUBMATRIX		SS	SS	SS	SS
TOP DEPTH		0	0	0	0
BOTTOM DEPTH		0.5	0.5	0.5	0.5
METALS (MG/KG)					
ARSENIC	13	3.9	5	3.3	7.9 J
IRON	55000	12000	24000	6700	26000
MANGANESE	1600	330	520	200	940
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1800	**2800**	1200	4.9	17 J
BENZO(A)PYRENE	2100	**2500**	450 J	4.2	29
BENZO(B)FLUORANTHENE	2100	**3600**	1500	9.9	33
BENZO(K)FLUORANTHENE	9000	1500	750	4.6	17 J
DIBENZO(A,H)ANTHRACENE	420	**550**	**750**	4.6	12 J
INDENO(1,2,3-CD)PYRENE	1600	**1700**	1100	8.8	46

Shaded cells indicate concentration greater than the PRG.

Data is from RI Report.

Blank means no analysis.

TABLE E-5-1
COC CONCENTRATIONS IN SURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC05-SB30		NTC05-SB31	NTC05-SB32
SAMPLE ID		NTC05-SB30-SS-0001	NTC05-SB30-SS-0001-D	NTC05-SB31-SS-0001	NTC05-SB32-SS-0001
SAMPLE DATE		20121217	20121217	20121216	20121217
SUBMATRIX		SS	SS	SS	SS
TOP DEPTH		0	0	0	0
BOTTOM DEPTH		1	1	1	1
METALS (MG/KG)					
ARSENIC	13				
IRON	55000				
MANGANESE	1600				
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1800				
BENZO(A)PYRENE	2100				
BENZO(B)FLUORANTHENE	2100				
BENZO(K)FLUORANTHENE	9000				
DIBENZO(A,H)ANTHRACENE	420				
INDENO(1,2,3-CD)PYRENE	1600				

Shaded cells indicate concentration greater than the PRG.

Data is from RI Report.

Blank means no analysis.

TABLE E-5-1
COC CONCENTRATIONS IN SURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC05-SB33	NTC05-SB34
SAMPLE ID		NTC05-SB33-SS-0001	NTC05-SB34-SS-0102
SAMPLE DATE		20121216	20121216
SUBMATRIX		SS	SS
TOP DEPTH		0	1
BOTTOM DEPTH		1	2
METALS (MG/KG)			
ARSENIC	13		
IRON	55000		
MANGANESE	1600		
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)			
BENZO(A)ANTHRACENE	1800		
BENZO(A)PYRENE	2100		
BENZO(B)FLUORANTHENE	2100		
BENZO(K)FLUORANTHENE	9000		
DIBENZO(A,H)ANTHRACENE	420		
INDENO(1,2,3-CD)PYRENE	1600		

Shaded cells indicate concentration greater than the PRG.

Data is from RI Report.

Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION		NTC05-SB01		NTC05-SB02	
SAMPLE ID		NTC05-SB01-SB-0204	NTC05-SB01-SB-0502	NTC05-SB02-SB-0204	NTC05-SB02-SB-0502
SAMPLE DATE	PRG	20101217	20101217	20101217	20101217
SUBMATRIX		SB	SB	SB	SB
TOP DEPTH		2	0.5	2	0.5
BOTTOM DEPTH		4	2	4	2
METALS (MG/KG)					
ARSENIC	13	11	8.7	6.6	4.8
MANGANESE	1600	910	900	920	590
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	1.9 U	13	2.1 U	9.1
BENZO(A)PYRENE	150	1.9 U	11	2.1 U	11
BENZO(B)FLUORANTHENE	1500	1.9 U	18	2.1 U	16
BENZO(K)FLUORANTHENE	15000	1.9 U	5.6	2.1 U	4.7
DIBENZO(A,H)ANTHRACENE	150	1.9 U	3	2.1 U	3
INDENO(1,2,3-CD)PYRENE	1500	1.9 U	8.6	2.1 U	9.1

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION		NTC05-SB03		NTC05-SB04	
SAMPLE ID		NTC05-SB03-SB-0204	NTC05-SB03-SB-0407	NTC05-SB04-SB-0204	NTC05-SB04-SB-0502
SAMPLE DATE	PRG	20101214	20101214	20101217	20101217
SUBMATRIX		SB	SB	SB	SB
TOP DEPTH		2	4	2	0.5
BOTTOM DEPTH		4	7	4	2
METALS (MG/KG)					
ARSENIC	13	3.8	8.6	4.2	5.5
MANGANESE	1600	620	640	280	360
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	54	140	52	**22000**
BENZO(A)PYRENE	150	51	**160**	61	**18000**
BENZO(B)FLUORANTHENE	1500	75	230	97	**22000**
BENZO(K)FLUORANTHENE	15000	33	68	38	11000
DIBENZO(A,H)ANTHRACENE	150	13	36	13	**3700 J**
INDENO(1,2,3-CD)PYRENE	1500	39	120	52	**12000**

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC05-SB05		NTC05-SB06	
SAMPLE ID		NTC05-SB05-SB-0204	NTC05-SB05-SB-0502	NTC05-SB06-SB-0204	NTC05-SB06-SB-0502
SAMPLE DATE		20101218	20101218	20101218	20101218
SUBMATRIX		SB	SB	SB	SB
TOP DEPTH		2	0.5	2	0.5
BOTTOM DEPTH		4	2	4	2
METALS (MG/KG)					
ARSENIC	13	8.5	6.6	9.7	4.2
MANGANESE	1600	1500	1000	890	430
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	2.7 U	**5200**	8.5	270
BENZO(A)PYRENE	150	5	**6200**	8.9	**370**
BENZO(B)FLUORANTHENE	1500	6.9	**9100**	14	510
BENZO(K)FLUORANTHENE	15000	2.7	3300	5.4	180
DIBENZO(A,H)ANTHRACENE	150	1.1 J	**1100**	1.9 J	71 J
INDENO(1,2,3-CD)PYRENE	1500	3.8	**3900**	6.2	280

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

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TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION		NTC05-SB07	
SAMPLE ID		NTC05-SB07-SB-0204	NTC05-SB07-SB-0502
SAMPLE DATE	PRG	20101218	20101218
SUBMATRIX		SB	SB
TOP DEPTH		2	0.5
BOTTOM DEPTH		4	2
METALS (MG/KG)			
ARSENIC	13	7.1	4.8
MANGANESE	1600	790	490
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)			
BENZO(A)ANTHRACENE	1500	11	140 U
BENZO(A)PYRENE	150	12	140
BENZO(B)FLUORANTHENE	1500	19	220
BENZO(K)FLUORANTHENE	15000	6.8	91 U
DIBENZO(A,H)ANTHRACENE	150	2.6	36 J
INDENO(1,2,3-CD)PYRENE	1500	9.4	130

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC05-SB08		
SAMPLE ID		NTC05-SB08-SB-0204	NTC05-SB08-SB-0502	NTC05-SB08-SB-0502-D
SAMPLE DATE		20101218	20101218	20101218
SUBMATRIX		SB	SB	SB
TOP DEPTH		2	0.5	0.5
BOTTOM DEPTH		4	2	2
METALS (MG/KG)				
ARSENIC	13	5.9	7.2	6.1
MANGANESE	1600	740	530	440
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)				
BENZO(A)ANTHRACENE	1500	**1600**	620	660
BENZO(A)PYRENE	150	**2100**	**1000**	**960**
BENZO(B)FLUORANTHENE	1500	**3000**	1500	1400
BENZO(K)FLUORANTHENE	15000	1100	590	540
DIBENZO(A,H)ANTHRACENE	150	**380**	**210**	**180**
INDENO(1,2,3-CD)PYRENE	1500	1500	750	720

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC05-SB09		NTC05-SB10	
SAMPLE ID		NTC05-SB09-SB-0204	NTC05-SB09-SB-0502	NTC05-SB10-SB-0204	NTC05-SB10-SB-0406
SAMPLE DATE		20101218	20101218	20101214	20101214
SUBMATRIX		SB	SB	SB	SB
TOP DEPTH		2	0.5	2	4
BOTTOM DEPTH		4	2	4	6
METALS (MG/KG)					
ARSENIC	13	11	7.3	11	6.2
MANGANESE	1600	**1800**	600	780	770
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	2.1 U	140 U	1.7 J	60
BENZO(A)PYRENE	150	2.1 U	150	1.3 J	79
BENZO(B)FLUORANTHENE	1500	2.1 U	260	2.2	120
BENZO(K)FLUORANTHENE	15000	2.1 U	93	0.87 J	44
DIBENZO(A,H)ANTHRACENE	150	2.1 U	62 J	0.87 J	16 J
INDENO(1,2,3-CD)PYRENE	1500	2.1 U	110	1.3 J	52

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION		NTC05-SB11		NTC05-SB12	
SAMPLE ID		**NTC05-SB11-SB-0204**	**NTC05-SB11-SB-0502**	**NTC05-SB12-SB-0204**	**NTC05-SB12-SB-0407**
SAMPLE DATE	**PRG**	**20101218**	**20101218**	**20101214**	**20101214**
SUBMATRIX		**SB**	**SB**	**SB**	**SB**
TOP DEPTH		**2**	**0.5**	**2**	**4**
BOTTOM DEPTH		**4**	**2**	**4**	**7**
METALS (MG/KG)					
ARSENIC	13	5.9	7.9	5.9	7.2
MANGANESE	1600	1100	500	780	980
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	4.1	35	12	99 U
BENZO(A)PYRENE	150	4.1	39	12	99 U
BENZO(B)FLUORANTHENE	1500	6.5	55	16	99 U
BENZO(K)FLUORANTHENE	15000	2.4	18	5.2 J	20 J
DIBENZO(A,H)ANTHRACENE	150	1.6 J	9.8	3.4 J	99 U
INDENO(1,2,3-CD)PYRENE	1500	4.1	31	6.9 J	99 U

Shaded cells indicate concentration greater than the PRG.

Data is from RI Report.

Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION		NTC05-SB13			NTC05-SB14
SAMPLE ID	PRG	NTC05-SB13-SB-0204	NTC05-SB13-SB-0502	NTC05-SB13-SB-0502-D	NTC05-SB14-SB-0204
SAMPLE DATE		20101219	20101219	20101219	20101214
SUBMATRIX		SB	SB	SB	SB
TOP DEPTH		2	0.5	0.5	2
BOTTOM DEPTH		4	2	2	4
METALS (MG/KG)					
ARSENIC	13	**16**	5.7 J	5.8 J	7.2
MANGANESE	1600	550	1300	1300	750
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	0.8 J	1.9 U	1.9 U	2.7
BENZO(A)PYRENE	150	1.9 U	1.9 U	1.9 U	8.5
BENZO(B)FLUORANTHENE	1500	1.9 U	1.9 U	1.9 U	12
BENZO(K)FLUORANTHENE	15000	1.9 U	1.9 U	1.9 U	4.9
DIBENZO(A,H)ANTHRACENE	150	1.9 U	1.9 U	1.9 U	4
INDENO(1,2,3-CD)PYRENE	1500	1.9 U	1.9 U	1.9 U	12

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC05-SB15		
SAMPLE ID		NTC05-SB15-SB-0204	NTC05-SB15-SB-0502	NTC05-SB15-SB-0502-D
SAMPLE DATE		20101219	20101219	20101219
SUBMATRIX		SB	SB	SB
TOP DEPTH		2	0.5	0.5
BOTTOM DEPTH		4	2	2
METALS (MG/KG)				
ARSENIC	13	7.2	5.7	5.9
MANGANESE	1600	970	640	790
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)				
BENZO(A)ANTHRACENE	1500	2.1 U	30	34 J
BENZO(A)PYRENE	150	2.1 U	23	84 U
BENZO(B)FLUORANTHENE	1500	2.1 U	30	84 U
BENZO(K)FLUORANTHENE	15000	2.1 U	19	17 J
DIBENZO(A,H)ANTHRACENE	150	2.1 U	6.4 J	84 U
INDENO(1,2,3-CD)PYRENE	1500	2.1 U	13	84 U

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC05-SB16	
SAMPLE ID		**NTC05-SB16-SB-0204**	**NTC05-SB16-SB-0502**
SAMPLE DATE		**20101218**	**20101218**
SUBMATRIX		**SB**	**SB**
TOP DEPTH		**2**	**0.5**
BOTTOM DEPTH		**4**	**2**
METALS (MG/KG)			
ARSENIC	13	11	6.7
MANGANESE	1600	1600	370
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)			
BENZO(A)ANTHRACENE	1500	1.7 J	19
BENZO(A)PYRENE	150	1.2 J	16
BENZO(B)FLUORANTHENE	1500	2.1	36
BENZO(K)FLUORANTHENE	15000	0.83 J	12
DIBENZO(A,H)ANTHRACENE	150	2 U	7
INDENO(1,2,3-CD)PYRENE	1500	0.83 J	15

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC05-SB17		
SAMPLE ID		NTC05-SB17-SB-0204	NTC05-SB17-SB-0502	NTC05-SB17-SB-0502-D
SAMPLE DATE		20101218	20101218	20101218
SUBMATRIX		SB	SB	SB
TOP DEPTH		2	0.5	0.5
BOTTOM DEPTH		4	2	2
METALS (MG/KG)				
ARSENIC	13	8.1	11	12
MANGANESE	1600	900	590 J	1100 J
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)				
BENZO(A)ANTHRACENE	1500	0.79 J	4 J	13 J
BENZO(A)PYRENE	150	1.6 J	8.7 J	34 J
BENZO(B)FLUORANTHENE	1500	2.4	11 J	46 J
BENZO(K)FLUORANTHENE	15000	0.79 J	4 J	19 J
DIBENZO(A,H)ANTHRACENE	150	1.9 U	3.2	8.8
INDENO(1,2,3-CD)PYRENE	1500	2	9.9 J	35 J

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC05-SB18		
SAMPLE ID		NTC05-SB18-SB-0204	NTC05-SB18-SB-0502	NTC05-SB18-SB-0502-D
SAMPLE DATE		20101218	20101218	20101218
SUBMATRIX		SB	SB	SB
TOP DEPTH		2	0.5	0.5
BOTTOM DEPTH		4	2	2
METALS (MG/KG)				
ARSENIC	13	7.9	11	12
MANGANESE	1600	1200	730	560
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)				
BENZO(A)ANTHRACENE	1500	2.1 U	0.81 J	2 U
BENZO(A)PYRENE	150	2.1 U	2.1 U	2 U
BENZO(B)FLUORANTHENE	1500	2.1 U	2.1 U	2 U
BENZO(K)FLUORANTHENE	15000	2.1 U	0.41 J	2 U
DIBENZO(A,H)ANTHRACENE	150	2.1 U	2.1 U	2 U
INDENO(1,2,3-CD)PYRENE	1500	2.1 U	2.1 U	2 U

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION		NTC05-SB19	
SAMPLE ID		**NTC05-SB19-SB-0204**	**NTC05-SB19-SB-0906**
SAMPLE DATE	**PRG**	**20101214**	**20101214**
SUBMATRIX		**SB**	**SB**
TOP DEPTH		**2**	**6**
BOTTOM DEPTH		**4**	**9**
METALS (MG/KG)			
ARSENIC	13	5	5.8
MANGANESE	1600	560	750
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)			
BENZO(A)ANTHRACENE	1500	9.7 U	9.6 U
BENZO(A)PYRENE	150	9.7 U	9.6 U
BENZO(B)FLUORANTHENE	1500	9.7 U	9.6 U
BENZO(K)FLUORANTHENE	15000	9.7 U	9.6 U
DIBENZO(A,H)ANTHRACENE	150	9.7 U	9.6 U
INDENO(1,2,3-CD)PYRENE	1500	9.7 U	9.6 U

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC05-SB20		
SAMPLE ID		**NTC05-SB20-SB-0204**	**NTC05-SB20-SB-0204-D**	**NTC05-SB20-SB-0502**
SAMPLE DATE		**20101219**	**20101219**	**20101219**
SUBMATRIX		**SB**	**SB**	**SB**
TOP DEPTH		**2**	**2**	**0.5**
BOTTOM DEPTH		**4**	**4**	**2**
METALS (MG/KG)				
ARSENIC	13	1.8 J	2.1 J	1.9
MANGANESE	1600	290	330	280
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)				
BENZO(A)ANTHRACENE	1500	1.8 U	1.8 U	11
BENZO(A)PYRENE	150	1.8 U	1.8 U	15
BENZO(B)FLUORANTHENE	1500	1.8 U	1.8 U	21
BENZO(K)FLUORANTHENE	15000	0.35 J	0.36 J	8.2
DIBENZO(A,H)ANTHRACENE	150	1.8 U	1.8 U	3.4 J
INDENO(1,2,3-CD)PYRENE	1500	1.8 U	1.8 U	11

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC05-SB21	
SAMPLE ID		NTC05-SB21-SB-0204	NTC05-SB21-SB-0502
SAMPLE DATE		20101219	20101219
SUBMATRIX		SB	SB
TOP DEPTH		2	0.5
BOTTOM DEPTH		4	2
METALS (MG/KG)			
ARSENIC	13	3.9	7.2
MANGANESE	1600	420	370
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)			
BENZO(A)ANTHRACENE	1500	2.1 U	87
BENZO(A)PYRENE	150	2.1 U	79
BENZO(B)FLUORANTHENE	1500	2.1 U	110
BENZO(K)FLUORANTHENE	15000	0.44 J	32 J
DIBENZO(A,H)ANTHRACENE	150	2.1 U	16 J
INDENO(1,2,3-CD)PYRENE	1500	2.1 U	55

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION		NTC05-SB22		
SAMPLE ID		NTC05-SB22-SB-0204	NTC05-SB22-SB-0502	NTC05-SB22-SB-0502-D
SAMPLE DATE	PRG	20101219	20101219	20101219
SUBMATRIX		SB	SB	SB
TOP DEPTH		2	0.5	0.5
BOTTOM DEPTH		4	2	2
METALS (MG/KG)				
ARSENIC	13	11	4.8	6
MANGANESE	1600	650	380	360
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)				
BENZO(A)ANTHRACENE	1500	2 U	350	340
BENZO(A)PYRENE	150	2 U	**280**	**400**
BENZO(B)FLUORANTHENE	1500	2 U	490 J	1100 J
BENZO(K)FLUORANTHENE	15000	2 U	280	320
DIBENZO(A,H)ANTHRACENE	150	2 U	**240**	**280**
INDENO(1,2,3-CD)PYRENE	1500	2 U	300	500

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION		NTC05-SB23	
SAMPLE ID		**NTC05-SB23-SB-0204**	**NTC05-SB23-SB-0502**
SAMPLE DATE	**PRG**	**20101219**	**20101219**
SUBMATRIX		**SB**	**SB**
TOP DEPTH		**2**	**0.5**
BOTTOM DEPTH		**4**	**2**
METALS (MG/KG)			
ARSENIC	13	11	3.6
MANGANESE	1600	950	220
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)			
BENZO(A)ANTHRACENE	1500	2 U	1.8 U
BENZO(A)PYRENE	150	2 U	1.8 U
BENZO(B)FLUORANTHENE	1500	2 U	1.8 U
BENZO(K)FLUORANTHENE	15000	2 U	0.37 J
DIBENZO(A,H)ANTHRACENE	150	2 U	1.8 U
INDENO(1,2,3-CD)PYRENE	1500	2 U	1.8 U

Shaded cells indicate concentration greater than the PRG.

Data is from RI Report.

Blank means no analysis.

TABLE E-5-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION		NTC05-SB24			NTC05-SB30
SAMPLE ID		NTC05-SB24-SB-0204	NTC05-SB24-SB-0502	NTC05-SB24-SB-0502-D	NTC05-SB30-SB-0506
SAMPLE DATE	PRG	20101219	20101219	20101219	20121217
SUBMATRIX		SB	SB	SB	SB
TOP DEPTH		2	0.5	0.5	5
BOTTOM DEPTH		4	2	2	6
METALS (MG/KG)					
ARSENIC	13	8.3	5.9	8.6	
MANGANESE	1600	650	880	1200	
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	0.87 J	33 J	6.1 J	
BENZO(A)PYRENE	150	2.1 U	50 J	5.2 J	
BENZO(B)FLUORANTHENE	1500	2.1 U	66 J	21 J	
BENZO(K)FLUORANTHENE	15000	0.43 J	33 J	5.2 J	
DIBENZO(A,H)ANTHRACENE	150	2.1 U	81 U	6.9	
INDENO(1,2,3-CD)PYRENE	1500	2.1 U	50 J	11 J	

Shaded cells indicate concentration greater than the PRG.

Data is from RI Report.

Blank means no analysis.

LOCATION	PRG	NTC05-SB31	NTC05-SB32	NTC05-SB33	NTC05-SB34
SAMPLE ID		NTC05-SB31-SB-0708	NTC05-SB32-SB-0405	NTC05-SB33-SB-0506	NTC05-SB34-SB-0809
SAMPLE DATE		20121216	20121217	20121216	20121216
SUBMATRIX		SB	SB	SB	SB
TOP DEPTH		7	4	5	8
BOTTOM DEPTH		8	5	6	9
METALS (MG/KG)					
ARSENIC	13				
MANGANESE	1600				
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500				
BENZO(A)PYRENE	150				
BENZO(B)FLUORANTHENE	1500				
BENZO(K)FLUORANTHENE	15000				
DIBENZO(A,H)ANTHRACENE	150				
INDENO(1,2,3-CD)PYRENE	1500				

Shaded cells indicate concentration greater than the PRG.

Data is from RI Report.

Blank means no analysis.

TABLE E-5-3
COC CONCENTRATIONS IN GROUNDWATER - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	SELECTED PRG	NTC05-MW01	NTC05-MW02		NTC05-MW03	NTC05-MW04
SAMPLE ID		NTC05-GW01	NTC05-GW02	NTC05-GW02-02	NTC05-GW03	NTC05-GW04
SAMPLE DATE		20101218	20101218	20121215	20101218	20101217
MATRIX		GW	GW	GW	GW	GW
METALS (UG/L)						
BARIUM	2000	54	57		**8100**	100
VOLATILES (UG/L)						
CARBON TETRACHLORIDE	5	0.5 U		0.5 U	0.5 U	0.5 U

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-5-3
COC CONCENTRATIONS IN GROUNDWATER - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	SELECTED PRG	NTC05-MW05			NTC05-MW06	
SAMPLE ID		**NTC05-GW05**	**NTC05-GW05-02**	**NTC05-GW05-D**	**NTC05-GW06-01**	**NTC05-GW06-01-D**
SAMPLE DATE		**20101217**	**20121215**	**20101217**	**20121217**	**20121217**
MATRIX		**GW**	**GW**	**GW**	**GW**	**GW**
METALS (UG/L)						
BARIUM	2000	250		250		
VOLATILES (UG/L)						
CARBON TETRACHLORIDE	5	**170**	**100**	**180**	0.5 U	0.5 U

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-5-3
COC CONCENTRATIONS IN GROUNDWATER - SITE 5
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	SELECTED PRG	NTC05-MW07	NTC05-MW08	NTC05-MW09
SAMPLE ID		NTC05-GW07-01	NTC05-GW08-01	NTC05-GW09-01
SAMPLE DATE		20121217	20121217	20121216
MATRIX		GW	GW	GW
METALS (UG/L)				
BARIUM	2000			
VOLATILES (UG/L)				
CARBON TETRACHLORIDE	5	0.5 U	0.5 U	0.5 U

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-9-1
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION		NTC09-SB-01-A	NTC09-SB-02-A	NTC09-SB-03-B	NTC09-SB-04-B
SAMPLE ID	PRG	NTC09SB01A-SO-0204	NTC09SB02A-SO-0406	NTC09SB03B-SO-0406	NTC09SB04B-SO-0406
SAMPLE DATE		20090923	20090923	20090922	20090922
SUBMATRIX		SB	SB	SB	SB
TOP DEPTH		2	4	4	4
BOTTOM DEPTH		4	6	6	6
METALS (MG/KG)					
ARSENIC	13	**19.8 J**	**45 J**	10.7 J	**20.9 J**
LEAD	400	106	12 J	34.2	18.1 J
MANGANESE	1600	808 J	1090 J	576 J	1010 J
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	6.1	3.9 U	91	3.9 U
BENZO(A)PYRENE	150	8.9	3.9 U	110	3.9 U
BENZO(B)FLUORANTHENE	1500	14	3.9 U	160	3.9 U
DIBENZO(A,H)ANTHRACENE	150	2.9 J	3.9 U	21	3.9 U
INDENO(1,2,3-CD)PYRENE	1500	8.5	3.9 U	100	3.9 U

Shaded cells indicate concentration
greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-9-1
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC09-SB-05-C	NTC09-SB-06-C
SAMPLE ID		NTC09SB05C-SO-0406	NTC09SB06C-SO-0204
SAMPLE DATE		20090922	20090923
SUBMATRIX		SB	SB
TOP DEPTH		4	2
BOTTOM DEPTH		6	4
METALS (MG/KG)			
ARSENIC	13	9.5 J	**34 J**
LEAD	400	20.1 J	246
MANGANESE	1600	831 J	496 J
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)			
BENZO(A)ANTHRACENE	1500	4.9	490
BENZO(A)PYRENE	150	5.5	**540**
BENZO(B)FLUORANTHENE	1500	9.4	750
DIBENZO(A,H)ANTHRACENE	150	2.7 J	81
INDENO(1,2,3-CD)PYRENE	1500	5.9	370

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-9-1
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC09-SB-07			
SAMPLE ID		NTC09SB07-SO-0204	NTC09SB07-SO-0204-	NTC09SB07-SO-0204-D	NTC09SB07-SO-1416
SAMPLE DATE		20090925	20090925	20090925	20090925
SUBMATRIX		SB	SB	SB	SB
TOP DEPTH		2	2	2	14
BOTTOM DEPTH		4	4	4	16
METALS (MG/KG)					
ARSENIC	13	**23.1**	**20.75**	**18.4**	12.8 J
LEAD	400	302	275	248	**15000**
MANGANESE	1600	909 J	726	543 J	81.4
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	150	180	210	300
BENZO(A)PYRENE	150	**520**	**550**	**580**	**270**
BENZO(B)FLUORANTHENE	1500	1100	1150	1200	350
DIBENZO(A,H)ANTHRACENE	150	**240**	**225**	**210**	43
INDENO(1,2,3-CD)PYRENE	1500	660	675	690	200

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-9-1
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC09-SB-07B		NTC09-SB-07C
SAMPLE ID		NTC09SB07B-SO-0204	NTC09SB07B-SO-0406	NTC09SB07C-SO-0204
SAMPLE DATE		20091117	20091117	20091117
SUBMATRIX		SB	SB	SB
TOP DEPTH		2	4	2
BOTTOM DEPTH		4	6	4
METALS (MG/KG)				
ARSENIC	13	5.77	**14.8**	**13.4**
LEAD	400	**767**	93.8	15.1
MANGANESE	1600	106 J	155 J	706 J
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)				
BENZO(A)ANTHRACENE	1500			
BENZO(A)PYRENE	150			
BENZO(B)FLUORANTHENE	1500			
DIBENZO(A,H)ANTHRACENE	150			
INDENO(1,2,3-CD)PYRENE	1500			

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

LOCATION	PRG	NTC09-SB-08		NTC09-SB-09	
SAMPLE ID	**PRG**	**NTC09SB08-SO-0204**	**NTC09SB08-SO-0608**	**NTC09SB09-SO-0406**	**NTC09SB09-SO-1012**
SAMPLE DATE		**20090923**	**20090923**	**20090925**	**20090925**
SUBMATRIX		**SB**	**SB**	**SB**	**SB**
TOP DEPTH		**2**	**6**	**4**	**10**
BOTTOM DEPTH		**4**	**8**	**6**	**12**
METALS (MG/KG)					
ARSENIC	13	**14 J**	11 J	12.1 J	**14.7 J**
LEAD	400	171 J	8.93 J	93.2	113
MANGANESE	1600	691 J	627 J	551	722
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	53	3.7 U	200	40
BENZO(A)PYRENE	150	66	3.7 U	**380**	47
BENZO(B)FLUORANTHENE	1500	96	3.7 U	490	73
DIBENZO(A,H)ANTHRACENE	150	11	3.7 U	55	9.8
INDENO(1,2,3-CD)PYRENE	1500	59	3.7 U	360	45

Shaded cells indicate concentration
greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-9-1
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC09-SB-10		NTC09-SB-11	
SAMPLE ID		NTC09SB10-SO-0810	NTC09SB10-SO-1012	NTC09SB11-SO-0608	NTC09SB11-SO-1416
SAMPLE DATE		20090923	20090923	20090925	20090923
SUBMATRIX		SB	SB	SB	SB
TOP DEPTH		8	10	6	14
BOTTOM DEPTH		10	12	8	16
METALS (MG/KG)					
ARSENIC	13	**115 J**	**14.4 J**	11.7 J	9.6 J
LEAD	400	**5070 J**	41.3	14.3	66.1
MANGANESE	1600	458 J	812 J	779	665 J
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	310	140	27	180
BENZO(A)PYRENE	150	**360**	**190**	52	**180**
BENZO(B)FLUORANTHENE	1500	550	240	69	260
DIBENZO(A,H)ANTHRACENE	150	71	31	11	3.8 U
INDENO(1,2,3-CD)PYRENE	1500	300	160	63	130

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-9-1
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC09-SB-12	
SAMPLE ID		NTC09SB12-SO-0810	NTC09SB12-SO-1012
SAMPLE DATE		20090923	20090923
SUBMATRIX		SB	SB
TOP DEPTH		8	10
BOTTOM DEPTH		10	12
METALS (MG/KG)			
ARSENIC	13	9.68 J	10.8 J
LEAD	400	10	12
MANGANESE	1600	587 J	785 J
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)			
BENZO(A)ANTHRACENE	1500	14	1.6 J
BENZO(A)PYRENE	150	3.8 U	3.6 U
BENZO(B)FLUORANTHENE	1500	3.8 U	3.6 U
DIBENZO(A,H)ANTHRACENE	150	3.8 U	3.6 U
INDENO(1,2,3-CD)PYRENE	1500	15	3.6 U

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-9-1
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC09-SB-14		NTC09-SB-15	
SAMPLE ID	**PRG**	**NTC09SB14-SO-0406**	**NTC09SB14-SO-0608**	**NTC09SB15-SO-0204**	**NTC09SB15-SO-1012**
SAMPLE DATE		**20090923**	**20090923**	**20090926**	**20090926**
SUBMATRIX		**SB**	**SB**	**SB**	**SB**
TOP DEPTH		**4**	**6**	**2**	**10**
BOTTOM DEPTH		**6**	**8**	**4**	**12**
METALS (MG/KG)					
ARSENIC	13	5.16 J	11.1 J	9.26	7.05
LEAD	400	10.9	11	53.4	59.3
MANGANESE	1600	497 J	565 J	544	558
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	4.2 U	4.1 U	100	78
BENZO(A)PYRENE	150	4.2 U	4.1 U	150	110
BENZO(B)FLUORANTHENE	1500	4.2 U	4.1 U	220	150
DIBENZO(A,H)ANTHRACENE	150	4.2 U	4.1 U	23	3.8 U
INDENO(1,2,3-CD)PYRENE	1500	4.2 U	4.1 U	130	100

Shaded cells indicate concentration
greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-9-1
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION		NTC09-SB-16		NTC09-SB-17	
SAMPLE ID	**PRG**	**NTC09SB16-SO-0204**	**NTC09SB16-SO-1012**	**NTC09SB17-SO-0406**	**NTC09SB17-SO-1012**
SAMPLE DATE		**20090925**	**20090925**	**20090925**	**20090925**
SUBMATRIX		**SB**	**SB**	**SB**	**SB**
TOP DEPTH		**2**	**10**	**4**	**10**
BOTTOM DEPTH		**4**	**12**	**6**	**12**
METALS (MG/KG)					
ARSENIC	13	**16.3**	7.26 J	7.48	7.98
LEAD	400	19.5	12.1	12.8	16.9
MANGANESE	1600	785	805	684	756
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	5.3	3.8 U	52	4.3
BENZO(A)PYRENE	150	6.4	3.8 U	87	3.5 J
BENZO(B)FLUORANTHENE	1500	11	3.8 U	120	6.3
DIBENZO(A,H)ANTHRACENE	150	4.2 U	3.8 U	13	4 U
INDENO(1,2,3-CD)PYRENE	1500	7.3	3.8 U	84	3.9 J

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-9-1
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC09-SB-18	
SAMPLE ID		NTC09SB18-SO-0204	NTC09SB18-SO-1012
SAMPLE DATE		20090925	20090925
SUBMATRIX		SB	SB
TOP DEPTH		2	10
BOTTOM DEPTH		4	12
METALS (MG/KG)			
ARSENIC	13	5.85	8.97
LEAD	400	23.4	42
MANGANESE	1600	299	592
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)			
BENZO(A)ANTHRACENE	1500	160	270
BENZO(A)PYRENE	150	**180**	**370**
BENZO(B)FLUORANTHENE	1500	270	520
DIBENZO(A,H)ANTHRACENE	150	28	51
INDENO(1,2,3-CD)PYRENE	1500	170	300

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-9-1
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC09-SB-19	
SAMPLE ID		NTC09SB19-SO-0204	NTC09SB19-SO-0810
SAMPLE DATE		20090925	20090925
SUBMATRIX		SB	SB
TOP DEPTH		2	8
BOTTOM DEPTH		4	10
METALS (MG/KG)			
ARSENIC	13	10.1	8.26
LEAD	400	35.3	10.6
MANGANESE	1600	716	421
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)			
BENZO(A)ANTHRACENE	1500	18	3.8 U
BENZO(A)PYRENE	150	27	3.8 U
BENZO(B)FLUORANTHENE	1500	40	3.8 U
DIBENZO(A,H)ANTHRACENE	150	4.4	3.8 U
INDENO(1,2,3-CD)PYRENE	1500	24	3.8 U

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

LOCATION		NTC09-SB-20			
SAMPLE ID	**PRG**	**NTC09SB20-SO-0204**	**NTC09SB20-SO-0810**	**NTC09SB20-SO-0810-**	**NTC09SB20-SO-0810-D**
SAMPLE DATE		**20090925**	**20090925**	**20090925**	**20090925**
SUBMATRIX		**SB**	**SB**	**SB**	**SB**
TOP DEPTH		**2**	**8**	**8**	**8**
BOTTOM DEPTH		**4**	**10**	**10**	**10**
METALS (MG/KG)					
ARSENIC	13	10.5	6.47	8.285	10.1 J
LEAD	400	31.7	23.2 J	49.55	75.9 J
MANGANESE	1600	744	533	630.5	728
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	73	210 J	122.5	35 J
BENZO(A)PYRENE	150	91	**230 J**	137.5	45 J
BENZO(B)FLUORANTHENE	1500	160	340 J	211	82 J
DIBENZO(A,H)ANTHRACENE	150	16	29 J	18.2	7.4 J
INDENO(1,2,3-CD)PYRENE	1500	90	190 J	115.5	41 J

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

LOCATION	PRG	NTC09-SB-21	
SAMPLE ID		NTC09SB21-SO-0204	NTC09SB21-SO-0608
SAMPLE DATE		20090925	20090925
SUBMATRIX		SB	SB
TOP DEPTH		2	6
BOTTOM DEPTH		4	8
METALS (MG/KG)			
ARSENIC	13	8.61	10.9
LEAD	400	22.6	11.6
MANGANESE	1600	931	508
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)			
BENZO(A)ANTHRACENE	1500	3.8 U	3.9 U
BENZO(A)PYRENE	150	3.8 U	3.9 U
BENZO(B)FLUORANTHENE	1500	3.8 U	3.9 U
DIBENZO(A,H)ANTHRACENE	150	3.8 U	3.9 U
INDENO(1,2,3-CD)PYRENE	1500	3.8 U	3.9 U

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-9-2
COC CONCENTRATIONS IN GROUNDWATER - SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	SELECTED PRG	NTC09-MW01	NTC09-MW02		NTC09-MW03	NTC09-MW04	NTC09-MW05
SAMPLE ID		NTC09MW0101	NTC09-GW02-02	NTC09MW0201	NTC09MW0301	NTC09MW0401	NTC09MW0501
SAMPLE DATE		20091113	20121215	20091113	20091115	20091113	20091115
MATRIX		GW	GW	GW	GW	GW	GW
METALS (UG/L)							
ARSENIC	10	1.31		1.14	2.16	2.43	0.75 U
LEAD	7.5	2.5 U		1.88 U	1.88 U	**14.9**	0.375 U

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-9-2
COC CONCENTRATIONS IN GROUNDWATER - SITE 9
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	SELECTED PRG	NTC09-MW06	NTC09-MW07			NTC09-MW08
SAMPLE ID		NTC09MW0601	NTC09MW0701	NTC09MW0701-	NTC09MW0701-	NTC09MW0801
SAMPLE DATE		20091113	20091115	20091115	20091115	20091115
MATRIX		GW	GW	GW	GW	GW
METALS (UG/L)						
ARSENIC	10	**13.4**	1.14	0.945	0.75	1.4
LEAD	7.5	1.88 U	1.88 U	1.88 U	1.88 U	1.88 U

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-21-1
COC CONCENTRATIONS IN SURFACE SOIL - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC21-SB-01	NTC21-SB-02	NTC21-SB-03	NTC21-SB-04
SAMPLE ID		NTC21SB01-SO-0102	NTC21SB02-SO-0001	NTC21SB03-SO-0001	NTC21SB04-SO-0001
SAMPLE DATE		20090928	20090928	20090928	20090927
SUBMATRIX		SS	SS	SS	SS
TOP DEPTH		1	0	0	0
BOTTOM DEPTH		2	1	1	1
METALS (MG/KG)					
ARSENIC	13	**21.1**	11.1	9.93	**13.4 J**
IRON	55000	48600 J	24100 J	23300 J	26000 J
LEAD	400	29.6 J	57.3 J	106 J	43 J
POLYNUCLEAR AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1800	**4800**	240	1100 J	380
BENZO(A)PYRENE	2100	**4200**	360	**2400 J**	3.6 U
BENZO(B)FLUORANTHENE	2100	**6600**	540	**3500 J**	870
BENZO(K)FLUORANTHENE	9000	2500	120	2000	820
CHRYSENE	88000	5900	270	1300 J	340
DIBENZO(A,H)ANTHRACENE	420	**1100**	89 J	**900 J**	3.6 U
INDENO(1,2,3-CD)PYRENE	1600	**3300**	420 J	3.5 UJ	3.6 U

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

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TABLE E-21-1
COC CONCENTRATIONS IN SURFACE SOIL - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC21-SB-05			NTC21-SB-06
SAMPLE ID		NTC21SB05-SO-0001	NTC21SB05-SO-0001-	NTC21SB05-SO-0001-D	NTC21SB06-SO-0001
SAMPLE DATE		20090928	20090928	20090928	20090927
SUBMATRIX		SS	SS	SS	SS
TOP DEPTH		0	0	0	0
BOTTOM DEPTH		1	1	1	1
METALS (MG/KG)					
ARSENIC	13	6.05	6.55	7.05 J	7.93 J
IRON	55000	18200 J	15050	11900 J	18500 J
LEAD	400	42.2 J	33.5	24.8 J	25.9 J
POLYNUCLEAR AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1800	250 J	270	290	4 U
BENZO(A)PYRENE	2100	390 J	415	440	4 U
BENZO(B)FLUORANTHENE	2100	480 J	405	330	720
BENZO(K)FLUORANTHENE	9000	300 J	335	370	690
CHRYSENE	88000	280 J	340	400 J	4 U
DIBENZO(A,H)ANTHRACENE	420	78 J	40.05	4.2 UJ	4 U
INDENO(1,2,3-CD)PYRENE	1600	330 J	320	310	4 U

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

8/21/2013 2:57:34 PM

TABLE E-21-1
COC CONCENTRATIONS IN SURFACE SOIL - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC21-SB-07	NTC21-SB-08
SAMPLE ID	**PRG**	**NTC21SB07-SO-0001**	**NTC21SB08-SO-0001**
SAMPLE DATE		**20090927**	**20090928**
SUBMATRIX		**SS**	**SS**
TOP DEPTH		**0**	**0**
BOTTOM DEPTH		**1**	**1**
METALS (MG/KG)			
ARSENIC	13	7.46 J	9.53
IRON	55000	18900 J	18400 J
LEAD	400	81.5 J	65.3
POLYNUCLEAR AROMATIC HYDROCARBONS (UG/KG)			
BENZO(A)ANTHRACENE	1800	**4200**	520 J
BENZO(A)PYRENE	2100	**3200**	830 J
BENZO(B)FLUORANTHENE	2100	**4400**	1200 J
BENZO(K)FLUORANTHENE	9000	1700	560 J
CHRYSENE	88000	4600	660 J
DIBENZO(A,H)ANTHRACENE	420	3.6 U	140 J
INDENO(1,2,3-CD)PYRENE	1600	**2100**	630 J

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

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TABLE E-21-1
COC CONCENTRATIONS IN SURFACE SOIL - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION		NTC21-SB-09			NTC21-SB-10
SAMPLE ID	PRG	NTC21SB09-SO-0001	NTC21SB09-SO-0001-	NTC21SB09-SO-0001-D	NTC21SB10-SO-0001
SAMPLE DATE		20090926	20090926	20090926	20090926
SUBMATRIX		SS	SS	SS	SS
TOP DEPTH		0	0	0	0
BOTTOM DEPTH		1	1	1	1
METALS (MG/KG)					
ARSENIC	13	8.14	6.46	4.78	11.9
IRON	55000	23400 J	17300	11200 J	35000 J
LEAD	400	167 J	127.5	88 J	**428**
POLYNUCLEAR AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1800	250 J	280	310 J	390
BENZO(A)PYRENE	2100	460 J	560	660 J	690
BENZO(B)FLUORANTHENE	2100	670 J	765	860 J	970
BENZO(K)FLUORANTHENE	9000	290 J	365	440 J	260
CHRYSENE	88000	320 J	385	450 J	390
DIBENZO(A,H)ANTHRACENE	420	81 J	95.5	110 J	150
INDENO(1,2,3-CD)PYRENE	1600	400 J	440	480 J	630

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-21-1
COC CONCENTRATIONS IN SURFACE SOIL - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC21-SB-11	NTC21-SB-12	NTC21-SB-13	NTC21-SB-14
SAMPLE ID		NTC21SB11-SO-0001	NTC21SB12-SO-0001	NTC21SB13-SO-0001	NTC21SB14-SO-0001
SAMPLE DATE		20090926	20090926	20090927	20090927
SUBMATRIX		SS	SS	SS	SS
TOP DEPTH		0	0	0	0
BOTTOM DEPTH		1	1	1	1
METALS (MG/KG)					
ARSENIC	13	5.6	12.9	10.7 J	**48.4 J**
IRON	55000	15000 J	25800 J	52200 J	47000 J
LEAD	400	118	51.3	**407 J**	67.2 J
POLYNUCLEAR AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1800	1600 J	400	4.3 U	280
BENZO(A)PYRENE	2100	**2900 J**	430	4.3 U	860 J
BENZO(B)FLUORANTHENE	2100	**4100 J**	740	4.3 U	4.1 UJ
BENZO(K)FLUORANTHENE	9000	1600 J	220	4.3 U	4.1 UJ
CHRYSENE	88000	1900 J	470	4.3 UJ	410 J
DIBENZO(A,H)ANTHRACENE	420	**470 J**	66	4.3 U	4.1 UJ
INDENO(1,2,3-CD)PYRENE	1600	**2700 J**	300	4.3 U	4.1 UJ

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

8/21/2013 2:57:34 PM

TABLE E-21-1
COC CONCENTRATIONS IN SURFACE SOIL - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC21-SB-15	NTC21-SB-16	NTC21-SB-17	NTC21-SB-18
SAMPLE ID		NTC21SB15-SO-0001	NTC21SB16-SO-0001	NTC21SB17-SO-0001	NTC21SB18-SO-0001
SAMPLE DATE		20090927	20090927	20090926	20090926
SUBMATRIX		SS	SS	SS	SS
TOP DEPTH		0	0	0	0
BOTTOM DEPTH		1	1	1	1
METALS (MG/KG)					
ARSENIC	13	**48.3 J**	4.86 J	8.23	7.73
IRON	55000	**69500 J**	17300 J	27200 J	23500 J
LEAD	400	31.7 J	29.2 J	29.2	27.2
POLYNUCLEAR AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1800	200 J	110	350	140
BENZO(A)PYRENE	2100	4 UJ	3.7 U	600	200
BENZO(B)FLUORANTHENE	2100	550 J	290	940	310
BENZO(K)FLUORANTHENE	9000	540 J	270	320	110
CHRYSENE	88000	250 J	130 J	480	190
DIBENZO(A,H)ANTHRACENE	420	4 UJ	3.7 U	100	44
INDENO(1,2,3-CD)PYRENE	1600	4 UJ	150	510	200

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-21-1
COC CONCENTRATIONS IN SURFACE SOIL - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC21-SB-19	NTC21-SB-20	NTC21-SB-21	NTC21-SB-22
SAMPLE ID		NTC21SB19-SO-0001	NTC21SB20-SO-0001	NTC21SB21-SO-0001	NTC21SB22-SO-0001
SAMPLE DATE		20090927	20090926	20090926	20090927
SUBMATRIX		SS	SS	SS	SS
TOP DEPTH		0	0	0	0
BOTTOM DEPTH		1	1	1	1
METALS (MG/KG)					
ARSENIC	13	5.95 J	3.12	4.87	6.96 J
IRON	55000	18500 J	6660 J	16400 J	15300 J
LEAD	400	60.3 J	16.7	124	215 J
POLYNUCLEAR AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1800	150	200 J	**22000 J**	320
BENZO(A)PYRENE	2100	250	560 J	**38000 J**	340
BENZO(B)FLUORANTHENE	2100	440	620 J	**59000 J**	710
BENZO(K)FLUORANTHENE	9000	430	300 J	**21000 J**	680
CHRYSENE	88000	190 J	280 J	31000 J	460
DIBENZO(A,H)ANTHRACENE	420	3.6 U	3.5 UJ	**690 J**	4.1 U
INDENO(1,2,3-CD)PYRENE	1600	250	350 J	**36000 J**	350

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

8/21/2013 2:57:34 PM

TABLE E-21-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION		NTC21-SB-02		NTC21-SB-03	NTC21-
SAMPLE ID		NTC21SB02-SO-0204	NTC21SB02-SO-0406	NTC21SB03-SO-0204	NTC21SB0
SAMPLE DATE	PRG	20090928	20091113	20090928	2009
SUBMATRIX		SB	SB	SB	S
TOP DEPTH		2	4	2	4
BOTTOM DEPTH		4	6	4	6
METALS (MG/KG)					
ARSENIC	13	8.57	4.16	10.4	**14.6**
COBALT	24	3.18	2.25	4.52	15.8
IRON	55000	15000 J	6560	18600 J	30500
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	280	**2000**	**32000**	120
BENZO(A)PYRENE	150	**320**	**1200**	**27000**	5.8
BENZO(B)FLUORANTHENE	1500	450	**1600**	**41000**	230
BENZO(K)FLUORANTHENE	15000	150	620	14000	220
CHRYSENE	150000	290	2100	34000	100
DIBENZO(A,H)ANTHRACENE	150	66 J	**240**	**3300**	5.8
INDENO(1,2,3-CD)PYRENE	1500	330 J	890	**16000**	5.8

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-21-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	-SB-04	NTC21-SB-05	NTC21-SB-06	NTC21-SB-07
SAMPLE ID		4-SO-0406	NTC21SB05-SO-0204	NTC21SB06-SO-0204	NTC21SB07-SO-0204
SAMPLE DATE		0927	20090928	20090927	20090927
SUBMATRIX		B	SB	SB	SB
TOP DEPTH		4	2	2	2
BOTTOM DEPTH		6	4	4	4
METALS (MG/KG)					
ARSENIC	13	J	7.32	6.39	8.88 J
COBALT	24		8.23	3.59	6.25
IRON	55000	J	20700 J	15100 J	26600 J
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500		140 J	260	**4300**
BENZO(A)PYRENE	150	U	**210 J**	**520**	**3600**
BENZO(B)FLUORANTHENE	1500		290 J	860	**4300**
BENZO(K)FLUORANTHENE	15000		120 J	840	1700
CHRYSENE	150000		170 J	360	4900
DIBENZO(A,H)ANTHRACENE	150	U	38 J	4.4 U	3.9 U
INDENO(1,2,3-CD)PYRENE	1500	U	200 J	420	**2500**

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-21-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC21-SB-08	NTC21-SB-09	NTC21-SB-10	NTC21
SAMPLE ID		NTC21SB08-SO-0204	NTC21SB09-SO-0204	NTC21SB10-SO-0406	NTC21SB1
SAMPLE DATE		20090928	20090926	20090926	2009
SUBMATRIX		SB	SB	SB	S
TOP DEPTH		2	2	4	2
BOTTOM DEPTH		4	4	6	4
METALS (MG/KG)					
ARSENIC	13	12	7.34	9.71	6
COBALT	24	10.3	9.54	9.49	6.8
IRON	55000	27600 J	25800 J	24900 J	40100
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	430 J	81 J	16	150
BENZO(A)PYRENE	150	**740 J**	**170 J**	33	**220**
BENZO(B)FLUORANTHENE	1500	1200 J	280 J	52	380
BENZO(K)FLUORANTHENE	15000	460 J	92 J	17	88
CHRYSENE	150000	580 J	120 J	23	160
DIBENZO(A,H)ANTHRACENE	150	**160 J**	28 J	4 UJ	34
INDENO(1,2,3-CD)PYRENE	1500	690 J	160 J	28	150

Shaded cells indicate concentration greater than the PRG.
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TABLE E-21-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	-SB-11	NTC21-SB-12	NTC21-SB-13	NTC21-SB-14
SAMPLE ID		1-SO-0204	NTC21SB12-SO-0204	NTC21SB13-SO-0204	NTC21SB14-SO-0204
SAMPLE DATE		0926	20090926	20090927	20090927
SUBMATRIX		B	SB	SB	SB
TOP DEPTH		2	2	2	2
BOTTOM DEPTH		4	4	4	4
METALS (MG/KG)					
ARSENIC	13		7.09	8.73 J	9.51 J
COBALT	24		23.8	7.28	9.89
IRON	55000	J	32900 J	22900 J	34900 J
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	J	420 J	14	4.4 U
BENZO(A)PYRENE	150	J	620 J	4 U	4.4 U
BENZO(B)FLUORANTHENE	1500	J	1200 J	6.4	4.4 U
BENZO(K)FLUORANTHENE	15000	J	380 J	7.2	4.4 U
CHRYSENE	150000	J	530 J	8	4.4 U
DIBENZO(A,H)ANTHRACENE	150	J	100 J	4 U	4.4 U
INDENO(1,2,3-CD)PYRENE	1500	J	470 J	4 U	4.4 U

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-21-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION		NTC21-SB-15			NTC21
SAMPLE ID		NTC21SB15-SO-0204	NTC21SB15-SO-0204-	NTC21SB15-SO-0204-D	NTC21SB1
SAMPLE DATE	PRG	20090927	20090927	20090927	2009
SUBMATRIX		SB	SB	SB	S
TOP DEPTH		2	2	2	2
BOTTOM DEPTH		4	4	4	4
METALS (MG/KG)					
ARSENIC	13	**85 J**	**104**	**123 J**	9.1
COBALT	24	22 J	16.7	11.4 J	10.6
IRON	55000	**65800 J**	**88400**	**111000 J**	34800
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	47 J	34.5	22 J	16
BENZO(A)PYRENE	150	4.3 UJ	12.075	22 J	4.3
BENZO(B)FLUORANTHENE	1500	4.3 UJ	20.075	38 J	8.7
BENZO(K)FLUORANTHENE	15000	4.3 UJ	6.075	10 J	7.4
CHRYSENE	150000	35	33	31	7.2
DIBENZO(A,H)ANTHRACENE	150	4.3 U	4.35 U	4.4 U	4.3
INDENO(1,2,3-CD)PYRENE	1500	4.3 UJ	10.075	18 J	4.3

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Blank means no analysis.

TABLE E-21-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	-SB-16	NTC21-SB-17		NTC21-SB-18
SAMPLE ID		6-SO-0204	NTC21SB17-SO-0507	NTC21SB18-SO-0507	NTC21SB18-SO-0507-
SAMPLE DATE	PRG	0927	20090926	20090926	20090926
SUBMATRIX		B	SB	SB	SB
TOP DEPTH		2	5	5	5
BOTTOM DEPTH		4	7	7	7
METALS (MG/KG)					
ARSENIC	13	J	12.5	8.65 J	**15.925**
COBALT	24		5.71	7.93	6.785
IRON	55000	J	29400 J	21100 J	23450
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500		3.7 U	3.7 U	3.65 U
BENZO(A)PYRENE	150	U	3.7 U	3.7 U	3.65 U
BENZO(B)FLUORANTHENE	1500		3.7 U	3.7 U	3.65 U
BENZO(K)FLUORANTHENE	15000		3.7 U	3.7 U	3.65 U
CHRYSENE	150000		3.4 J	3.4 J	2.6
DIBENZO(A,H)ANTHRACENE	150	U	3.7 U	3.7 U	3.65 U
INDENO(1,2,3-CD)PYRENE	1500	U	3.7 U	3.7 U	3.65 U

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Blank means no analysis.

TABLE E-21-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG		NTC21-SB-19	NTC21-SB-20	NTC21
SAMPLE ID		NTC21SB18-SO-0507-D	NTC21SB19-SO-0204	NTC21SB20-SO-0406	NTC21SB2
SAMPLE DATE		20090926	20090927	20090926	2009
SUBMATRIX		SB	SB	SB	S
TOP DEPTH		5	2	4	[illegible]
BOTTOM DEPTH		7	4	6	[illegible]
METALS (MG/KG)					
ARSENIC	13	23.2 J	9.59 J	8.39	5.7
COBALT	24	5.64	11.3	9.18	4.85
IRON	55000	25800 J	33200 J	21200 J	14300
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)					
BENZO(A)ANTHRACENE	1500	3.6 U	150	9.4	2.5
BENZO(A)PYRENE	150	3.6 U	4 U	12	3.7
BENZO(B)FLUORANTHENE	1500	3.6 U	260	19	3.7
BENZO(K)FLUORANTHENE	15000	3.6 U	250	8.5	3.7
CHRYSENE	150000	1.8 J	140	14	8.3
DIBENZO(A,H)ANTHRACENE	150	3.6 U	4 U	2.4 J	3.7
INDENO(1,2,3-CD)PYRENE	1500	3.6 U	4 U	12	3.7

Shaded cells indicate concentration greater than the PRG.
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Blank means no analysis.

TABLE E-21-2
COC CONCENTRATIONS IN SUBSURFACE SOIL - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	-SB-21	NTC21-SB-22
SAMPLE ID		1-SO-0608	NTC21SB22-SO-0204
SAMPLE DATE		0926	20090927
SUBMATRIX		B	SB
TOP DEPTH		5	2
BOTTOM DEPTH		8	4
METALS (MG/KG)			
ARSENIC	13		5.69 J
COBALT	24		3.38
IRON	55000	J	31300 J
POLYCYCLIC AROMATIC HYDROCARBONS (UG/KG)			
BENZO(A)ANTHRACENE	1500	J	230
BENZO(A)PYRENE	150	U	**480**
BENZO(B)FLUORANTHENE	1500	U	400
BENZO(K)FLUORANTHENE	15000	U	350
CHRYSENE	150000		360
DIBENZO(A,H)ANTHRACENE	150	U	4.1 U
INDENO(1,2,3-CD)PYRENE	1500	U	340

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

TABLE E-21-3
COC CONCENTRATIONS IN GROUNDWATER - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC21MW01	NTC21MW02			NTC21MW03
SAMPLE ID		NTC21MW0101	NTC21MW0201	NTC21MW0201-AVG	NTC21MW0201-D	NTC21MW0301
SAMPLE DATE		20091117	20091116	20091116	20091116	20091116
MATRIX		GW	GW	GW	GW	GW
SEMIVOLATILES (UG/L)						
PENTACHLOROPHENOL	1	**7.8**	0.92 U	0.96 U	1 U	0.96 U

Shaded cells indicate concentration
greater than the PRG.
Data is from RI Report.
Blank means no analysis.

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TABLE E-21-3
COC CONCENTRATIONS IN GROUNDWATER - SITE 21
SITES 5, 9, AND 21 FOCUSED FEASIBILITY STUDY
NAVAL STATION GREAT LAKES
GREAT LAKES, ILLINOIS

LOCATION	PRG	NTC21MW04	NTC21MW05	NTC21MW06	
SAMPLE ID		NTC21MW0401	NTC21MW0501	NTC21-GW06	NTC21MW0601
SAMPLE DATE		20091116	20091115	20101216	20091117
MATRIX		GW	GW	GW	GW
SEMIVOLATILES (UG/L)					
PENTACHLOROPHENOL	1	0.98 U	0.92 U	0.11 U	0.98 U

Shaded cells indicate concentration greater than the PRG.
Data is from RI Report.
Blank means no analysis.

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