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FINAL FEASIBILITY STUDY FOR OPERABLE UNIT 21 (OU 21) SITE 46 (FORMER BUILDING 72) NAS PENSACOLA FL

9/1/2010

TETRA TECH

Comprehensive **L**ong-term **E**nvironmental **A**ction **N**avy

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Feasibility Study for Operable Unit 21 Site 46 – Former Building 72

Naval Air Station Pensacola Pensacola, Florida

Contract Task Order 0079

September 2010

NAVFAC
Naval Facilities Engineering Command
NAVFAC SOUTHEAST

NAS Jacksonville
Jacksonville, Florida 32212-0030

TETRA TECH NUS, Inc.

FEASIBILITY STUDY
FOR
OPERABLE UNIT 21
SITE 46 - FORMER BUILDING 72

NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

COMPREHENSIVE LONG-TERM
ENVIRONMENTAL ACTION NAVY (CLEAN) CONTRACT

Submitted to:
Naval Facilities Engineering Command Southeast
NAS Jacksonville
Jacksonville, Florida 32212-0030

Submitted by:
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CONTRACT NUMBER N62467-04-D-0055
CONTRACT TASK ORDER 0079

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PREPARED UNDER THE SUPERVISION OF:	APPROVED FOR SUBMITTAL BY:
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CERTIFICATION OF TECHNICAL
DATA CONFORMITY

The Contractor, Tetra Tech NUS, Inc., hereby certifies that, to the best of its knowledge and belief, the technical data delivered herewith under Contract No. N62467-04-D-0055 are complete and accurate and comply with all requirements of this contract.

DATE: September 24, 2010

COMPANY CERTIFICATION AUTHORIZATION NUMBER: 7988
Tetra Tech NUS, Inc.
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NAME AND TITLE OF CERTIFYING OFFICIAL ____________________________

Gerald Walker, P.G.
Task Order Manager

This document, the *Feasibility Study for Operable Unit 21 Site 46 – Former Building 72*, for Naval Air Station Pensacola, located in Pensacola, Florida, has been prepared under the direction of a Florida registered professional engineer. The work and professional opinions rendered in this report were conducted or developed in accordance with commonly accepted procedures consistent with applicable standards of practice. This document was prepared for Naval Air Station Pensacola, Pensacola, Florida and should not be construed to apply to any other site.

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ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
AS	Air sparge
bls	Below land surface
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
cfm	Cubic feet per minute
CLEAN	Comprehensive Long-Term Environmental Action Navy
COC	Contaminant of concern
cPAH	Carcinogenic polynuclear aromatic hydrocarbon
CSF	Cancer Slope Factor
CTL	Cleanup Target Levels
CTO	Contract Task Order
CVOC	Chlorinated volatile organic compound
CWA	Clean Water Act
DCA	Dichloroethane
DCE	cis-1,2-dichloroethene
DO	Dissolved oxygen
EC	Engineering Control
F.A.C.	Florida Administrative Code
FDEP	Florida Department of Environmental Protection
fpd	feet per day
FS	Feasibility Study
ft^2	Square foot (feet)
GAC	Granular activated carbon
GCTL	Groundwater Cleanup Target Level
gpd	gallons per day
GHG	Greenhouse gas
GRA	General Response Action
HHRA	Human health risk assessment
HI	Hazard Index
HQ	Hazard Quotient
IC	Institutional Control
ILCR	Incremental Lifetime Cancer Risk

ACRONYMS (CONTINUED)

IR	Installation Restoration
IWTP	Industrial Wastewater Treatment Plant
LDR	Land Disposal Restriction
LUC	Land use control
µg/L	Microgram(s) per liter
µg/kg	Microgram(s) per kilogram
MCL	Maximum Contaminant Level
mg/L	Milligram(s) per liter
MNA	Monitored Natural Attenuation
msl	Mean sea level
mV	Milivolt
NADSC	Natural Attenuation Default Source Concentration
NAS	Naval Air Station
NAVFAC SE	Naval Facilities Engineering Command Southeast
NEESA	Naval Energy and Environmental Support Activity
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	No Further Action
NPDES	National Pollutant Discharge Elimination System
NPW	Net present worth
O&M	Operation and maintenance
ORP	Oxidation/reduction potential
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
PCE	Tetrachloroethene
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	Remedial Investigation
ROD	Record of Decision

ACRONYMS (CONTINUED)

SARA	Superfund Amendments and Reauthorization Act
SCTL	Soil Cleanup Target Level
SDWA	Safe Drinking Water Act
SPLP	Synthetic Precipitation Leaching Procedure
STP	Sewage Treatment Plant
SVE	Soil vapor extraction
SVOC	Semi-volatile organic compound
SWMU	Solid Waste Management Unit
TAL	Target Analyte List
TBC	To Be Considered
TCA	Trichloroethane
TCE	Trichloroethene
TCL	Target Compound List
TCLP	Toxicity Characteristic Leachate Procedure
TOC	Total organic carbon
TRPH	Total recoverable petroleum hydrocarbons
TSDF	Treatment, storage, and disposal facility
Tetra Tech	Tetra Tech NUS, Inc.
USEPA	United States Environmental Protection Agency
VC	Vinyl chloride
VOC	Volatile organic compound
yd^3	Cubic yard(s)

EXECUTIVE SUMMARY

E.1 PURPOSE OF THE REPORT

The purpose of this Feasibility Study (FS) Report is to develop and evaluate options for the remediation of contaminated soil and groundwater at Operable Unit (OU) 21 Site 46 – Former Building 72, Naval Air Station (NAS) Pensacola, located in Pensacola, Florida.

E.2 SITE DESCRIPTION AND HISTORY

Site 46 is located in the southeastern portion of NAS Pensacola and includes the areas south of former Building 1 (across Radford Boulevard) and southeast of former Building 51. The site is located approximately 90 feet west of the former Building 71 footprint, where the Remedial Investigation (RI) for Installation Restoration (IR) Site 38 was conducted (EnSafe, 1998). Pensacola Bay is located immediately south of the site, and a concrete seawall separates the site from the bay.

Buildings 71 and 72, constructed in the early 1920s, were steel-framed structures with metal roofs approximately 100 feet wide by 160 feet long. Prior to 1935, these buildings were sea plane hangars used for aircraft storage and maintenance. From 1935 until the late 1970s, the buildings were used for aircraft paint stripping and painting. Both buildings were demolished in mid-1993.

An estimated 400 gallons per day (gpd) of acrylic and epoxy paint stripper and another 400 gpd of ketone were used at these buildings during paint stripping operations. Other chemicals, including phenols and trichloroethene (TCE), may have been used at the site.

In 2006, the Navy used available hurricane relief funds to complete a major soil excavation project in the area surrounding the former locations of Buildings 71 and 72. Approximately 7,200 tons of soil was removed from the area to an approximate depth of 2 feet below land surface (bls) including the Site 46 soil investigation area. The excavated areas were backfilled with clean fill material and compacted to the original grade.

In 2008, the Navy completed a facility improvement and reconstruction effort including the areas of the 2006 soil excavation and former Buildings 71 and 72. These areas, which encompass Site 46 and a portion of Site 38, were redeveloped into a recreational plaza and park with a central covered area including a gazebo and elevated stage structure. The surrounding area includes several concrete walkways and various landscaped and open grassy areas.

E.3 SUMMARY OF ENVIRONMENTAL INVESTIGATIONS

Previous investigations in the vicinity of Site 46 include an RI at the adjacent Site 38 (former Building 71). The Site 38 RI included supplemental soil and groundwater sampling in an area which is now a portion of Site 46.

The RI Report for Site 38 (the area in and around former Building 71) indicated that parameters detected above screening levels in soil included metals, semi-volatile organic compounds (SVOCs), polynuclear aromatic hydrocarbons (PAHs), pesticides, polychlorinated biphenyl (PCBs), and volatile organic compounds (VOCs). The primary area of soil contamination was centered beneath the former Building 71 footprint. Parameters detected above screening levels in groundwater included metals, SVOCs, and VOCs, consistent with the soil contamination. Much of the groundwater contamination was also centered underneath the former Building 71 footprint.

Based on the results of the supplemental sampling, several monitoring wells were installed west of Building 71, near Building 72. These monitoring wells were sampled in 1999, along with several previously-installed monitoring wells in the Building 71 area. Results from this sampling event indicated that lead in shallow groundwater increased in concentration as groundwater was collected further west across the site. Groundwater data collected during the 1999 Groundwater Sampling Event (EnSafe, 1999) indicated that lead concentrations above screening levels in shallow groundwater in the former Building 72 area was not fully delineated. The incomplete delineation prompted the Navy to designate former Building 72 as a separate IR site.

Groundwater sampling in the former Building 71 area was again conducted in 2000 to identify trends in lead concentrations. Chlorinated solvent concentrations were at or slightly above screening levels in groundwater samples from monitoring wells located between former Buildings 71 and 72. This sampling event indicated that lead concentrations were drastically reduced in shallow groundwater compared to previous sampling events; the report concluded that the attenuation in lead concentrations was naturally occurring. Under the IR program, soil and groundwater contamination in the former Building 71 area are being addressed by the remedy for Site 38, and impacts to soil and/or groundwater at Site 46 (former Building 72) are being addressed by this investigation.

The FS for Site 38 concluded that the decrease in lead concentrations was the result of natural attenuation, and that geochemical conditions within the shallow groundwater were such that natural attenuation could also be expected to reduce organic parameters. The recommended remedy for Site 38 was monitored natural attenuation, and implementation of institutional controls to restrict potential receptor exposure to site soil and groundwater.

E.4 SUMMARY OF INVESTIGATION FINDINGS

The nature and extent of contamination at Site 46 is based on exceedances of Cleanup Target Levels (CTLs), as defined by Chapter 62-777, Florida Administrative Code (F.A.C.), Tables I and II. Please note that the results of the sampling event presented in the RI (Tetra Tech NUS, Inc. (Tetra Tech), 2008), does not represent the current conditions for the uppermost 2 feet of soil. As previously stated, in 2006, soil was excavated in the area surrounding the former locations of Buildings 71 and 72, and Site 46 to an approximate depth of 2 feet bls.

Soil

Volatile Organic Compounds

TCE was detected at the location of former Building 72 at concentrations greater than the Florida Industrial Direct Exposure Soil Cleanup Target Level (SCTL) and Leachability to Groundwater SCTL. Two of the soil samples (near the northeast corner of former Building 72) collected from 0 to 6 inches bls and one sample from 0.5 to 2 feet bls contained TCE at concentrations exceeding the Florida Industrial Direct Exposure Florida SCTL. Soil samples collected from 0 to 6 inches bls, 0.5 to 2 feet bls and 2 to 4 feet bls at four locations contained TCE at concentrations exceeding the Florida Leachability to Groundwater SCTL.

Metals

The lead screening identified one surface soil sample location (46SB21) with a lead concentration greater than the residential direct exposure SCTL. This sample was collected from 0 to 6 inches bls. Lead concentrations in soil samples from three soil boring locations submitted for Synthetic Precipitation Leaching Procedure (SPLP) extraction did exceed the Florida Maximum Contaminant Level (MCL) for lead under Chapter 62-550 F.A.C. One soil sample collected from 0 to 6 inches bls and one from 6 inches to 2 feet bls contained lead at concentrations exceeding its Florida Leachability to Groundwater SCTL. Based on the results of the SPLP analysis, two soil samples collected from 2 to 4 feet bls contained lead at concentrations exceeding its site specific Florida Leachability to Groundwater SCTL.

Arsenic was detected in two soil samples collected from one location at 0 to 6 inches bls and 0.5 to 2 feet bls at concentrations equal to or greater than the Residential Direct Exposure SCTL. However, the reported arsenic concentrations were within the background range determined by the facility-wide statistical analysis of the arsenic distribution at NAS Pensacola. Therefore, the reported concentrations are not believed to be attributed to former site operations. These samples were collected from a soil boring adjacent to the area investigated for IR Site 38.

Groundwater

VOCs

TCE and vinyl chloride (VC) were the only VOCs detected at concentrations exceeding MCLs under Chapter 62-550, F.A.C. Previously installed Site 38 monitoring wells 38GS03 [11 micrograms per liter (µg/L)] and 38GS13 (17 µg/L) contained TCE at concentrations exceeding its Florida MCL. The VC concentrations in two monitoring wells (38GS03, 4 µg/L and 38GS13, 3 µg/L) were also greater than the Florida marine surface water criteria of 2.4 µg/L.

SVOCs

Naphthalene was detected in four of the groundwater samples collected at Site 46, with the concentration in one monitoring well (PEN-46-19) greater than its Florida Groundwater Cleanup Target Level (GCTL) under Chapter 62-777 F.A.C. Bis(2-ethylhexyl)phthalate was detected at a concentration greater than its Florida MCL under Chapter 62-550, F.A.C. in one field duplicate sample.

Metals

A wide range of metals were reported in groundwater samples collected at Site 46. Arsenic (PEN-46-19), cadmium (38GS05), and lead (38GS01) were each detected in one shallow monitoring well at concentrations greater than their Florida MCLs. An exceedance of the chromium GCTL was detected in one deep monitoring well (PEN-46-16). Lead was detected in one monitoring well (PEN-38GS01) at a concentration (237 µg/L) greater than the Florida MCL of 15 µg/L.

Note that Hazard Quotients (HQs) for aluminum, iron, and manganese calculated in the United States Environmental Protection Agency (USEPA) Human Health Risk Assessment (HHRA) were less than the USEPA and Florida goal of 1 for non-carcinogenic health effects.

Human Health Risk Assessment

The HHRA considered five receptor scenarios; however, maintenance workers and trespassers/recreational users are considered to be the most likely receptors at Site 46 under the current land use. The carcinogenic and non-carcinogenic risks for the hypothetical future resident exceed USEPA and Florida target risk levels and hazard indices (HIs), respectively, for the Chemicals of Concern (COCs) in soil and groundwater. In soil, the primary driver of risk is TCE; in groundwater, the primary drivers of risk are chlorinated VOCs and arsenic. For the industrial worker, concentrations of TCE in surface and subsurface soil elevate the Incremental Lifetime Cancer Risk (ILCR) above 1×10^{-6}. Risks were acceptable for the maintenance worker and the recreational/trespasser, however, the risk to the construction worker were unacceptable due to presence of aluminum in surface soil.

Based on the results of USEPA's Lead Uptake/Biokinetics Model, which assesses the potential health effects of lead levels, concentrations of lead in soil and groundwater did not result in unacceptable blood level lead concentrations in any of the evaluated receptors.

Ecological Risk Assessment

The ecological risk assessment evaluated factors that affect potential exposures such as quality of the habitat, and potential use of the site by ecological receptors. The overall level of ecological risk associated with detected contaminants is considered to be minimal. Potential risk to soil invertebrates and plants from TCE and lead at Site 46 is low. This risk is lessened by the limited area of exposed soil available to soil invertebrates and plants.

RI Results

Based on the results of the RI for Site 46 and the subsequent soil removal, an FS was conducted to develop remedial alternatives for soil with TCE from 2 to 4 feet bls that exceed the Florida Leachability to Groundwater SCTL and groundwater that contains TCE, VC, naphthalene, arsenic and cadmium at concentrations exceed state and federal groundwater quality criteria.

The COCs presented for Site 46 in section 6.8.2 of the RI (Tetra Tech, 2008) have been refined and are the presented in Section E.5 of this report. Refinement of COCs is mainly due to a reassessment of the data presented in the RI and site conditions.

E.5 REMEDIAL ACTION OBJECTIVES AND CLEANUP GOALS

Site-specific Remedial Action Objectives (RAOs) specify COCs, media of interest, exposure pathways, and cleanup goals or acceptable contaminant concentrations. To protect the public from potential current and future health risks, as well as to protect the environment, the following site-specific RAOs have been developed:

- **RAO 1:** Prevent unacceptable human health risk associated with exposure to groundwater as a result of the leaching of lead and TCE from soil at concentrations exceeding their Florida Leachability to Groundwater SCTLs.

- **RAO 2:** Prevent unacceptable human health risk associated with exposure to groundwater containing organic compounds (TCE, naphthalene and VC) and metals at concentrations exceeding their USEPA and Florida MCLs or Florida GCTLs.

A cleanup goal is the target concentration to which a COC must be reduced within a particular medium of concern to achieve RAOs. According to the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), the cleanup goals are developed based on readily available information such as chemical-specific Applicable or Relevant and Appropriate Requirements (ARARs) and anticipated future land use. Current land use at NAS Pensacola consists of aviation-related activities, various military housing, training, and support activities, and historical facilities open to the public, including the National Museum of Naval Aviation. The current non-residential (recreational) land use scenario at Site 46 will remain for the foreseeable future at NAS Pensacola. Maintenance workers and recreational users are considered to be the most likely receptors under current land use

Considering all ARARs, reasonably anticipated land use, and risk assessment calculations, the COCs for Site 46 and their cleanup goals are as follows:

Soil Cleanup Goals

The Florida Leachability to Groundwater SCTL:

- TCE: 30 micrograms per kilogram (µg/kg)
- Lead: 15 µg/l, based on the Synthetic Precipitation Leaching Procedure (SPLP)

Groundwater Cleanup Goals

Florida MCLs under Chapter 62-550, F.A.C. and GCTLs under Chapter 62-777, F.A.C. have been selected for groundwater cleanup goals because they are equal to or more stringent than the USEPA MCLs for the following COCs:

- TCE: 3 µg/L
- VC: 1 µg/L
- Naphthalene: 14 µg/L
- Arsenic: 10 µg/L
- Cadmium: 5 µg/L

The following table summarizes the estimated surface areas, volumes, and quantities of COCs for the contaminant plumes.

Designation	Depth (ft bls)	Surface Area (ft^2)	Volume to be Addressed
Contaminant Plumes			
TCE in Soil above Leaching to Groundwater SCTL	2 to 4	1600	118 yd^3
Lead in Soil above Leaching to Groundwater SCTL	2 to 4	628	47 yd^3
TCE, VC, and Metals in Groundwater above GCTLs	4 to 14	24,200	1,810,160 gal

Notes:
ft = feet
ft^2 = square feet
yd^3 = cubic yards
gal = gallons

E.6 SCREENING OF GENERAL RESPONSE ACTIONS, REMEDIATION TECHNOLOGIES, AND PROCESS OPTIONS

General Response Actions (GRAs), remediation technologies, and process options associated with these GRAs were screened for effectiveness, implementability, and cost. Remediation technologies that were determined to be ineffective or too difficult to implement were eliminated from further consideration. The following GRAs, remedial technologies, and process options were retained for Site 46 soil.

General Response Action	Remedial Technology	Process Option
No Action	None	Not applicable
Removal	Excavation and Disposal	Excavation and off-site disposal of contaminated soil

The following GRAs, remedial technologies, and process options were retained for Site 46 groundwater.

General Response Action	Remedial Technology	Process Option
No Action	None	Not applicable
Limited Action	Land Use Controls (LUCs)	Prohibiting use of groundwater as a drinking water source
	Monitoring	Periodic sampling and analysis of groundwater to track the fate of contamination
	Natural Attenuation	Monitoring groundwater to assess the reduction in concentrations of COCs through natural processes
In-Situ Treatment	Air Sparge (AS)/Soil Vapor Extraction (SVE)	Supplying of air and extraction of volatilized organic compounds

E.7 DEVELOPMENT OF REMEDIAL ALTERNATIVES

Based on the results of the screening of remediation technologies, the following remedial alternatives were developed for Site 46 soil:

- **Alternative S-1: No Action**. No action would be taken. This alternative is retained as a baseline for comparison with other alternatives.

- **Alternative S-2: Excavation and Off-site Disposal**. Excavation of approximately 165 cubic yards (yd^3) of lead and TCE contaminated subsurface soil (2 to 4 feet bls) to meet their Florida Leachability to Groundwater SCTLs ; and off-site disposal of the lead and TCE contaminated soil. Alternative 2 would achieve RAO 1 after completion of the excavation activities.

Based on the results of the screening of remediation technologies, the following remedial alternatives were developed for Site 46 groundwater:

- **Alternative G-1: No Action**. No action would be taken. This alternative is retained as a baseline for comparison with other alternatives.

- **Alternative G-2: Natural Attenuation, LUCs, and Monitoring**. Natural attenuation would consist of allowing TCE concentrations in groundwater to decrease through naturally occurring processes such as biodegradation, dilution, and dispersion. Although currently only a single groundwater sampling event has been completed at the site, Natural Attenuation is expected to be effective based on the dissolved oxygen (DO), temperature, and oxidation/reduction potential (ORP) measurements recorded during the RI. The recorded measurements along with the presence of cis-1,2-dichloroethene (DCE) and VC within the plume area are indicative of ongoing natural attenuation. LUCs would be developed to prevent unacceptable risks from exposure to contaminated groundwater. Regular site inspections would be performed to verify implementation of the LUCs. Monitoring would consist of regularly collecting and analyzing groundwater samples from 18 existing and two new monitoring wells located within and surrounding the TCE plume to assess the performance of natural attenuation. For the first 5 years, the groundwater samples would also be analyzed for natural attenuation parameters. Sampling frequency would be quarterly for the first year, semi-annually for the next 2 years, and annually thereafter. It is anticipated that alternative G-2 would achieve RAO 2 within 5 to 10 years.

- **Alternative G-3: In-Situ AS/SVE of the TCE Plume, Natural Attenuation, LUCs, and Monitoring**. This alternative would consist of installing and operating an AS/SVE system consisting of AS wells and SVE wells. Air would be delivered to the AS wells at a rate of 10 to 15 cubic feet per minute (cfm) per well. The SVE wells would extract air from the vadose zone at an approximate rate of 25 to 30 cfm per well. The AS and SVE wells would be connected to an equipment building via an underground piping network. It is anticipated that Alternative G-3 would achieve RAO 2 for TCE and VC concentrations within 2 years of system start-up. Natural attenuation, LUCs, and monitoring would be the same as described for Alternative G-2.

E.8 DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

The remedial alternatives were analyzed in accordance with seven of the nine remedy selection criteria set forth in 40 Code of Federal Regulations (CFR) Part 300.430 of the NCP and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). These seven criteria are as follows:

<u>Threshold Criteria</u>

These criteria relate directly to statutory findings that must be met by the selected remedy.

- Overall Protection of Human Health and the Environment
- Compliance with ARARs

<u>Primary Balancing Criteria</u>

These criteria are grouped together because they represent the primary criteria upon which the analysis of each alternative is based.

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

<u>Modifying Criteria:</u>

Two other criteria, State and Community Acceptance, were not evaluated in this report. They will be evaluated after regulatory and public comments are addressed and a decision on the selected remedy is made.

E.9 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

The remedial alternatives were compared to each other using the same criteria used for the detailed analysis. The following is a summary of the comparisons.

Overall Protection of Human Health and Environment

Soil

Alternative S-1 would not protect human health and the environment because taking no action would not prevent the leaching of TCE from soil to groundwater that could result in an unacceptable risk to human receptors.

Alternative S-2 would be protective of human health and the environment. The removal of lead and TCE contaminated soil to meet their Leachability to Groundwater SCTLs would prevent the leaching of lead and TCE to groundwater and reduce the potential for exposure to unacceptable levels of lead and TCE in groundwater.

Groundwater

Alternative G-1 would not protect human health and the environment because taking no action would not prevent exposure to contaminated groundwater that could result in unacceptable risk to human receptors.

The natural attenuation component of Alternative G-2 would be protective because it would eventually reduce concentrations of TCE and VC to the cleanup goals over a reasonable time frame. The LUC component of Alternative G-2 would be protective because it would prevent exposure to contaminated groundwater until the cleanup goal is met. The monitoring component of Alternative G-2 would be protective because it would assess the progress of natural attenuation and measure the potential migration of TCE and VC.

Because Alternative G-3 employs active remediation it would be more protective than Alternative G-2. The LUCs and monitoring components of this alternative would be the same as Alternative G-2 but would occur over a shorter period of time.

Compliance with ARARs

Remedial actions selected under CERCLA Section 121(d) must attain a degree of cleanup that assures protection of human health and the environment and meets ARARs. Florida SCTLs for soil and

MCLs/GCTLs for groundwater are deemed relevant and appropriate for restoration of soil and groundwater, respectively, at NAS Pensacola.

Soil

Alternative S-1 would not comply with chemical- and location-specific ARARs. Action-specific ARARs would not apply.

Alternative S-2 would comply with chemical-specific ARARs by removing lead and TCE contaminated soil at concentrations that would prevent them from leaching to groundwater at concentrations that would result in their concentrations in groundwater exceeding state and federal groundwater quality criteria.

Groundwater

Alternative G-1 would not comply with chemical- and location-specific ARARs. Action-specific ARARs would not apply.

Alternatives G-2 and G-3 would comply with chemical-specific ARARs. In the long-term, these alternatives would comply with chemical-specific ARARs such as the Florida MCLs/GCTLs as cleanup goals are attained either through active remediation and/or natural attenuation; this would be verified through monitoring.

Long-Term Effectiveness and Permanence

Soil

Alternative S-1 would not have long-term effectiveness and permanence because lead and TCE contaminated soil would remain on site and TCE would have the potential to leach to groundwater.

Alternative S-2 would be effective in the long term because, soil containing TCE at concentrations that could leach to groundwater would be removed from the site.

Groundwater

Alternative G-1 would not have long-term effectiveness and permanence because contaminated groundwater would remain on site. Because there would be no restriction of groundwater use and/or site development, human receptors could be exposed to contaminated groundwater. Because there would be no monitoring, the progress of natural attenuation would not be assessed, and there would be no warning of potential future migration of TCE.

Over time, the natural attenuation component of Alternative G-2 would effectively and permanently reduce the concentration of TCE to the cleanup goal. The LUC component of Alternative G-2 would effectively prevent exposure to contaminated groundwater until the cleanup goal has been achieved. The monitoring component of Alternative G-2 would effectively assess the progress of natural attenuation and determine if TCE and VC migration are occurring.

Alternative G-3 would be more effective than Alternative G-2, because, in addition to the natural attenuation, LUCs, and monitoring components, this alternative would also include an active treatment component that would effectively treat the areas of greatest groundwater contamination and thus accelerate the removal of remaining TCE and VC through natural attenuation.

Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment

Soil

Alternatives S-1 and S-2 would not achieve reduction of toxicity, mobility, or volume of COCs through treatment.

Groundwater

Alternative G-1 and G-2 would not achieve any reduction of toxicity, mobility, or volume of COCs through treatment. However, Alternative G-2 would eventually achieve reduction of the toxicity and volume of COCs through natural attenuation.

Alternative G-3 would achieve reductions in TCE and VC toxicity and volume through treatment. Alternative G-3 would permanently and irreversibly remove TCE and VC by treating the groundwater using an AS/SVE system. Alternative G-3 would not generate treatment residues.

Short-Term Effectiveness

Soil

Implementation of Alternative S-1 would not result in risks to site workers or adversely impact the surrounding community or environment because no remedial activities would be performed. Alternative S-1 would not achieve the RAO, and although the cleanup goal might eventually be attained through natural processes, this would not be verified.

Alternative S-2 would achieve the RAO in the short term. Dust suppression and control measures would be implemented to minimize the emission of contaminated soil particulates during excavation. Erosion control measures would minimize the potential migration of soils that may contains COCs during rainfall events.

Groundwater

Implementation of Alternative G-1 would not result in risks to site workers or adversely impact the surrounding community or environment because no remedial activities would be performed. Alternative G-1 would not achieve the RAO-2.

Implementation of Alternative G-2 would result in a slight possibility of exposing site workers to contaminated groundwater during the installation, maintenance, and sampling of new and existing monitoring wells. However, these risks of exposure would be effectively controlled by compliance with proper site-specific health and safety procedures. Implementation of Alternative G-2 would not adversely impact the surrounding community or environment. Four quarters of groundwater monitoring for natural attenuation parameters would be sufficient to predict the time required to achieve the RAO or reach the cleanup goal. It is anticipated that alternative G-2 would achieve RAO 2 within 5 to 10 years.

Implementation of Alternative G-3 would result in the possibility of exposing construction workers to contaminated groundwater during the construction of in-situ groundwater treatment systems, installation of new monitoring wells, and sampling of new and existing wells. However, these risks of exposure would be effectively controlled by wearing appropriate Personal protective equipment (PPE), if needed, and compliance with proper site-specific health and safety procedures. Implementation of Alternative G-3 would not adversely impact the surrounding community or the environment. Alternative G-3 would remove the TCE and VC plume through active remediation and natural attenuation and would achieve RAO 2 within approximately 5 years.

Implementability

Soil

Alternative S-1 would be easiest to implement because there would be no activities to conduct.

Alternative S-2 would be fairly simple to implement as qualified contractors and resources for this alternative are readily available and the site is easily accessible. Non-hazardous waste landfills for the off-site disposal of soil would be readily available, as would equipment for the excavation and treatment.

The administrative aspects of Alternative S-2 would be relatively simple to implement. Off-site transportation and disposal of the excavated soil would require the completion of administrative procedures, which could be readily accomplished.

Groundwater

Alternative G-1 would be easiest to implement because there would be no activities to conduct.

Technical implementation of the various components of Alternatives G-2 and G-3 would be relatively simple. Technical implementation of the natural attenuation, LUCs, and monitoring components of Alternative G-2 would not be difficult. The resources, equipment, and material required for the activities associated with these components are readily available. Technical implementation of Alternative G-3 would be somewhat more difficult than that of Alternative G-2 because this alternative would require installation and operation and maintenance (O&M) of a groundwater remediation system. A number of qualified contractors are available locally, and the resources, equipment, and material necessary to implement these alternatives are also readily available. For Alternative G-3, trenching and pipe placement may disturb the newly constructed recreational area walkways and landscaping.

Administrative implementation of the various components of Alternatives G-2 and G-3 would be relatively simple. Administrative implementation of the LUCs and monitoring components of Alternative G-2 would be relatively simple. The administrative implementation of Alternative G-3 would be slightly more difficult than that of Alternative G-2. In addition to the same requirements as Alternative G-2, the construction and operation of the remediation system for Alternatives G-3 would have to comply with the substantive requirements of any identified ARARs.

Cost

The capital and O&M costs and net present worth (NPW) of the soil alternatives are as follows.

Alternative	Capital	NPW of O&M	NPW
S-1	$0	$0	$0
S-2	$174,740	$0	$174,740

The capital and O&M costs and NPW of the groundwater alternatives are as follows.

Alternative	Capital	NPW of O&M	NPW
G-1	$0	$0	$0
G-2	$37,000	$227,000 (30 years)	$264,000 (30 years)
G-3	$313,000	$214,000 (5 years)	$527,000 (5 years)

A summary of the comparative analysis for soil remedial alternatives is presented in Table ES-1 and a summary of the comparative analysis for groundwater remedial alternatives is presented in Table ES-2.

TABLE ES-1

**SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES – SOIL
SITE 46 FEASIBILITY STUDY
NAS PENSACOLA
PENSACOLA, FLORIDA
PAGE 1 of 2**

Evaluation Criterion	Alternative S-1: No Action	Alternative S-2: Excavation and Disposal
Overall Protection of Human Health and Environment	Would not provide protection of human health and the environment. Because no monitoring would be performed, potential migration of COCs would not be detected.	Would be protective of human health and the environment. The removal of contaminated soil to meet Leachability to Groundwater SCTLs would protect all potential receptors from exposure to unacceptable levels of TCE.
Compliance with ARARs:		
Chemical-Specific	Would not comply	Would comply
Location-Specific	Would not comply	Would comply
Action-Specific	Not applicable	Would comply
Long-Term Effectiveness and Permanence	Would have no long-term effectiveness and permanence. Contaminant reduction or migration would not be detected because monitoring would not occur.	Would provide long-term effectiveness and permanence because, following the remedial action, the site would be protective of residential uses.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	Would not reduce toxicity, mobility, or volume of contaminants through treatment because no treatment would occur. Some reduction of the toxicity and volume of COCs might occur through natural dispersion, dilution, or other attenuation processes, but no monitoring would be performed to verify.	The volume and toxicity of TCE in soil would not be reduced via excavation.

TABLE ES-1

**SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES – SOIL
SITE 46 FEASIBILITY STUDY
NAS PENSACOLA
PENSACOLA, FLORIDA
PAGE 2 of 2**

Evaluation Criterion	Alternative S-1: No Action	Alternative S-2: Excavation and Disposal
Short-Term Effectiveness	Would not pose any risks to on-site workers or result in short-term adverse impact to the local community and the environment. Would never achieve the RAOs and, although the cleanup goal might eventually be achieved through natural attenuation, this would not be verified through monitoring.	Would be effective in the short term. Dust suppression and control measures would be implemented to minimize the emission of contaminated soil particulates during excavation. Erosion control measures would minimize the potential migration of COCs.
Implementability	Because no action would occur, Alternative S-1 would be easily implementable.	Would be easily implementable.
Costs: Capital NPW of O&M NPW	 $0 $0 $0	 $174,740 $0 $174,740

Notes:

ARARs = Applicable or Relevant and Appropriate Requirements
COCs = Contaminants of concern
LUCs = Land use controls
NPW = Net present worth
O&M = Operation and maintenance
PPE = Personal protective equipment
RAOs = Remedial Action Objectives
SCTLs = Soil Cleanup Target Levels
TCE = Trichloroethene

TABLE ES-2

**SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES – GROUNDWATER
SITE 46 FEASIBILITY STUDY
NAS PENSACOLA
PENSACOLA, FLORIDA
PAGE 1 OF 2**

EVALUATION CRITERION	ALTERNATIVE G-1: NO ACTION	ALTERNATIVE G-2: NATURAL ATTENUATION, LUCS, AND MONITORING	ALTERNATIVE G-3: IN-SITU AS/SVE, NATURAL ATTENUATION, LUCS, AND MONITORING
Overall Protection of Human Health and Environment	Would not provide protection of human health and the environment. Under the current commercial/industrial land use, there could be unacceptable risks to human health from exposure to contaminated groundwater, and this potential for unacceptable risk would increase if Site 46 is further developed. Because no monitoring would be performed, potential migration of TCE and VC would not be detected.	Would be protective of human health and the environment. Although the TCE/VC plume could expand, natural attenuation would eventually reduce the concentrations of TCE and VC to less than the GCTLs. LUCs would be protective of human health and the environment. Restricting the use of surficial aquifer groundwater would be protective of human health by preventing unacceptable risks from exposure to contaminated groundwater. Monitoring would be protective of the environment by evaluating the progress of natural attenuation and detecting potential migration of contaminated groundwater.	Would be protective of human health and the environment. By actively removing the majority of groundwater contamination, AS/SVE would prevent the expansion of the TCE/VC plume. This would ultimately eliminate risk from exposure to contaminated groundwater and provide protection to future human receptors. LUCs would be protective of human health and the environment during the remedial period until cleanup goals are met. Restricting the use of surficial aquifer groundwater would be protective of human health and the environment by avoiding unacceptable risks of exposure to contaminated soil and groundwater. Monitoring would be protective by evaluating the effectiveness of the in-situ treatment.
Compliance with ARARs:			
Chemical-Specific	Would not comply	Would eventually comply	Would comply
Location-Specific	Would not comply	Would comply	Would comply
Action-Specific	Not applicable	Would comply	Would comply
Long-Term Effectiveness and Permanence	Would have no long-term effectiveness and permanence because contaminated groundwater would remain on site. Because there would be no LUCs to restrict the use of surficial aquifer groundwater, the potential would also exist for unacceptable risk to human receptors. Because there would be no groundwater monitoring, potential off-site migration of TCE and VC would not be detected. Although TCE and VC concentrations might eventually decrease to the cleanup goal through natural attenuation, no monitoring would verify this.	Would provide long-term effectiveness and permanence. Naturally occurring processes such as biodegradation would reduce concentrations of TCE and VC to cleanup goals over the long term. Long-term monitoring would be an effective means to evaluate the progress of natural attenuation and to warn of potential future migration of contaminated groundwater.	Would provide long-term effectiveness and permanence. AS/SVE of the TCE/VC plume is expected to effectively remove the majority of groundwater contamination. LUCs would effectively prevent the use of surficial aquifer groundwater until the cleanup goal is met. Long-term monitoring would be an effective means to evaluate the progress of remediation and verify that no migration of TCE and VC is occurring.

TABLE ES-2

**SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES – GROUNDWATER
SITE 46 FEASIBILITY STUDY
NAS PENSACOLA
PENSACOLA, FLORIDA
PAGE 2 OF 2**

EVALUATION CRITERION	ALTERNATIVE G-1: NO ACTION	ALTERNATIVE G-2: NATURAL ATTENUATION, LUCS, AND MONITORING	ALTERNATIVE G-3: IN-SITU AS/SVE, NATURAL ATTENUATION, LUCS, AND MONITORING
Long-Term Effectiveness and Permanence	Would have no long-term effectiveness and permanence because contaminated groundwater would remain on site. Because there would be no LUCs to restrict the use of surficial aquifer groundwater, the potential would also exist for unacceptable risk to human receptors. Because there would be no groundwater monitoring, potential off-site migration of TCE and VC would not be detected. Although TCE and VC concentrations might eventually decrease to the cleanup goal through natural attenuation, no monitoring would verify this.	Would provide long-term effectiveness and permanence. Naturally occurring processes such as biodegradation would reduce concentrations of TCE and VC to cleanup goals over the long term. Long-term monitoring would be an effective means to evaluate the progress of natural attenuation and to warn of potential future migration of contaminated groundwater.	Would provide long-term effectiveness and permanence. AS/SVE of the TCE/VC plume is expected to effectively remove the majority of groundwater contamination. LUCs would effectively prevent the use of surficial aquifer groundwater until the cleanup goal is met. Long-term monitoring would be an effective means to evaluate the progress of remediation and verify that no migration of TCE and VC is occurring.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	Would not reduce toxicity, mobility, or volume of contaminants through treatment because no treatment would occur. Some reduction of the toxicity and volume of TCE and VC might occur through natural dispersion, dilution, or other attenuation processes, but no monitoring would be performed to verify.	The volume and toxicity of TCE and VC would eventually be reduced over time through natural attenuation processes. This alternative would not reduce the mobility of TCE and VC because no containment, removal, or treatment would be provided. No treatment residues would be generated by this alternative.	Would reduce the toxicity, mobility and volume of contaminated groundwater. AS/SVE could permanently and irreversibly remove TCE and VC from groundwater. No treatment residues would be generated by this alternative.
Short-Term Effectiveness	Would not pose any risks to on-site workers or result in short-term adverse impact to the local community and the environment. No Action would not achieve the RAOs and, although the cleanup goal might eventually be achieved through natural attenuation, this would not be verified through monitoring.	Would have minimal short-term effectiveness concerns. Exposure of workers to contamination during the maintenance and sampling of monitoring wells would be minimized by the wearing of appropriate PPE and complying with site-specific health and safety procedures. This alternative would not adversely impact the surrounding community or the environment.	Would reduce human health risks in the short term because LUCs would be implemented to prohibit groundwater use. Exposure of workers to contamination during installation of SVE and AS wells, construction and operation of the groundwater treatment systems, and groundwater sampling would be minimized by compliance with health and safety requirements including wearing of appropriate PPE and adherence to site-specific health and safety procedures. Implementation of LUCs and monitoring would not adversely impact the surrounding community or the environment.
Implementability	Because no action would occur, Alternative 1 would be readily implementable.	Would be readily implementable. Maintenance of existing monitoring wells, sampling and analysis of groundwater, and performance of regular site inspections and 5-year reviews could readily be accomplished. The resources, equipment, and materials required to implement these activities are readily available.	Would be implementable. However, trenching and pipe placement may disturb the newly constructed recreational area walkways and landscaping.
Costs:			
Capital	$0	$37,000	$313,000
NPW of O&M	$0	$227,000	$214,000
NPW	$0	$264,000	$527,000

Notes:
ARARs = Applicable or Relevant and Appropriate Requirements
AS/SVE = Air sparging/soil vapor extraction
COCs = Contaminants of concern
GCTL = Groundwater Cleanup Target Level
LUCs = Land use controls
NPW = Net present worth
O&M = Operation and maintenance
PPE = Personal Protective Equipment
RAOs = Remedial Action Objectives
TCE = Trichloroethene
VC = Vinyl Chloride

1.0 INTRODUCTION

This FS for OU 21 Site 46 – Former Building 72 at NAS Pensacola, Florida, has been prepared by Tetra Tech for Naval Facilities Engineering Command Southeast (NAVFAC SE) under the Comprehensive Long-Term Environmental Action Navy (CLEAN) Program, Contract Number N62467-04-D-0055, Contract Task Order (CTO) 0079. This FS describes the development and evaluation of remedial alternatives for contaminated soil and groundwater at Site 46. The FS was conducted to establish RAOs and cleanup goals; to screen remedial technologies; and to assemble, evaluate, and compare remedial alternatives.

THE CERCLA FS PROCESS

The development of remedial alternatives for CERCLA sites consists of developing Preliminary Remediation Goals (PRGs) and areas and volumes of contamination and then identifying applicable technologies and developing those technologies into remedial alternatives to meet the PRGs.

The first step in the FS process is to develop RAOs specifying the contaminants, media of interest, and exposure pathways leading to development of the PRGs. The PRGs are developed based on chemical-specific ARARs, when available; site-specific risk-based factors; or other available information. COCs, as identified in the RI, are those chemicals with average concentrations exceeding the PRGs and background. Once the PRGs and COCs have been determined, the areas and volumes of contamination requiring remedial action are determined.

Once RAOs and PRGs are identified, GRAs for each medium of interest are developed. GRAs typically fall into the following categories: no action, containment, excavation, extraction, treatment, disposal, or other actions, taken to satisfy the RAOs for the site.

The next step in the FS process is to identify and screen alternatives. This step considers applicable technologies for each GRA. This step eliminates technologies that are not technically feasible. Those technologies passing the screening phase are then assembled into remedial alternatives. The NCP requires that a range of alternatives be presented in the FS to the maximum practicable extent. Remedial alternatives are then described and analyzed in detail using the CERCLA evaluation criteria (see Table 1-1) described in the NCP, including:

TABLE 1-1

CRITERIA FOR DETAILED ANALYSIS OF ALTERNATIVES
OU 21, SITE 46
NAS PENSACOLA
PENSACOLA, FLORIDA

THRESHOLD CRITERIA

OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

- How Alternative Provides Human Health and Environmental Protection

COMPLIANCE WITH ARARs

- Compliance with Chemical-Specific ARARs
- Compliance with Action-Specific ARARs
- Compliance with Location-Specific ARARs
- Compliance with Other Criteria, Advisories, and Guidances

BALANCING CRITERIA

LONG-TERM EFFECTIVENESS AND PERMANENCE

- Magnitude of Residual Risk
- Adequacy and Reliability of Controls

REDUCTION OF TOXICITY, MOBILITY, AND VOLUME THROUGH TREATMENT

- Treatment Process Used and Materials Treated
- Amount of Hazardous Materials Destroyed or Treated
- Degree to Expected Reductions in Toxicity, Mobility, and Volume
- Degree to Which Treatment is Irreversible
- Type and Quantity of Residuals Remaining After Treatment

SHORT-TERM EFFECTIVENESS

- Protection of Community During Remedial Actions
- Protection of Workers During Remedial Actions
- Environmental Impacts
- Time Until Remedial Action Objectives Are Achieved

IMPLEMENTABILITY

- Ability to Construct and Operate the Technology
- Reliability of the Technology
- Ease of Undertaking Additional Remedial Actions, If Necessary
- Ability to Monitor Effective-ness of Remedy
- Ability to Obtain Approvals From Other Agencies
- Coordination With Other Agencies
- Availability of Offsite Treatment, Storage, and Disposal Services and Capacity
- Availability of Necessary Equipment, Materials, and Specialists
- Availability of Prospective Technologies

COST

- Capital Costs
- Operating and Maintenance Costs
- Present Worth Costs

MODIFYING CRITERIA

STATE ACCEPTANCE [1]

COMMUNITY ACCEPTANCE [1]

1 These criteria are assessed following regulatory and public comment on the RI/FS report and the proposed plan.
Source: Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA (USEPA, 1988).

Threshold Criteria

These criteria relate directly to statutory findings that must be met by the selected remedy.

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

Balancing Criteria

These criteria are grouped together because they represent the primary criteria upon which the analysis of each alternative is based.

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

Alternatives are evaluated against two additional factors (Modifying Criteria) after state and community participation:

Modifying Criteria

These criteria will be evaluated after regulatory and public comments are addressed and a decision on the selected remedy is made.

- State acceptance
- Community acceptance

The results of the detailed analyses are summarized in a comparative analysis. The alternatives are compared against each other using the CERCLA evaluation criteria.

These criteria are used because the Superfund Amendments and Reauthorization Act (SARA) requires them to be considered during remedy selection. Modifying criteria, including state and community acceptance, are also evaluated. State acceptance is evaluated when the state reviews and comments on the draft FS, and a proposed plan is then prepared in consideration of the State's comments. Community acceptance is evaluated based on comments received on the proposed plan during a public comment period. This evaluation is described in a responsiveness summary and will be included in the Record of Decision (ROD). Upon completion of the FS report, the Proposed Plan will be developed. The Proposed Plan will identify the preferred remedial alternative for Site 46. This document will be written in community-friendly language and will be made available for public comment. Following receipt of all public comments, responses to these comments will be developed in a responsiveness summary within the ROD. The ROD will document the chosen alternative for the site and will include the responsiveness summary as an appendix. Once the ROD is signed, the chosen remedial alternative will be implemented.

The entire FS process provides the technical information and analyses which forms the basis for a proposed remedy, and the subsequent ROD documents the selection of the remedy.

PURPOSE

The purpose of the FS report for Site 46 at NAS Pensacola is to develop remedial alternatives to address threats to human health and the environment resulting from contaminated soil and groundwater. RAOs are used to develop, screen, and evaluate potential remedial alternatives to meet the objectives.

The FS report was developed in accordance with the NCP, providing guidance for identifying applicable remedial action technologies. The FS report does not present all the possible variations and combinations of remedial actions possible, but presents distinctly different alternatives representing a range of opportunities for meeting the RAOs. It is expected these different alternatives can be adjusted during the proposed plan and decision process, and to a lesser extent during detailed design, to accomplish the RAOs in a manner similar to the initially proposed alternative. Also, the FS report does not present information on alternatives failing to meet the RAOs.

The following criteria are considered in identifying appropriate remedial action for Site 46:

- RAOs: RAOs are developed to specify the contaminants, media of interest, exposure pathways, and remedial action goals.
- Applicable Technologies: Technologies applicable for addressing contaminated media are identified and screened. Technologies are eliminated if they cannot be implemented.
- Remedial Alternatives: Technologies passing the screening phase are assembled into remedial alternatives.
- Detailed Analysis: Selected remedial alternatives are described and evaluated in accordance with seven of the nine criteria set forth in 40 CFR Part 300.430 of the NCP.

- Comparative Analysis: Remedial alternatives are compared against each other using threshold and primary balancing criteria.

1.1 SITE BACKGROUND

The following paragraphs provide background information about Site 46. Figure 1-1 provides the site location, and Figure 1-2 presents the site area and current site features.

1.1.1 Site Description and History

Site 46 is located in the southeastern portion of NAS Pensacola and includes the area south of Radford Boulevard and southeast of former Building 51 (Figure 1-2). The site is located approximately 90 feet west of the former Building 71 footprint, where the RI for IR Site 38 was conducted (EnSafe, 1998). The site is bordered by Pensacola Bay to the immediate south, and is separated from the bay by a concrete seawall.

Buildings 71 and 72, constructed in the early 1920s, were steel-framed structures with metal roofs approximately 100 feet wide by 160 feet long. Prior to 1935, these buildings were sea plane hangars used for aircraft storage and maintenance. From 1935 until the late 1970s the buildings were used for aircraft paint stripping and painting. Both buildings were demolished in mid-1993.

An estimated 400 gpd of acrylic and epoxy paint stripper and another 400 gpd of ketone were used at these buildings during paint stripping operations. Other chemicals, including phenols and TCE, may have been used at the site. A series of interconnected drainage trenches in the floors of Buildings 72 and 71 were used to collect waste solvent used in the stripping operations (EnSafe, 1998). Prior to construction of the Industrial Wastewater Treatment Plant (IWTP) in 1973, these trenches drained directly to Pensacola Bay from the southern end of each building (Naval Energy and Environmental Support Activity (NEESA), 1983). The surface water and sediments in Pensacola Bay immediately south of Buildings 71 and 72 were designated as Site 2 and investigated as a separate RI. After 1973, the trenches were connected to the IWTP sewer line south of the buildings. When the buildings were demolished, the drainage trenches inside the buildings were filled with concrete (EnSafe, 1998).

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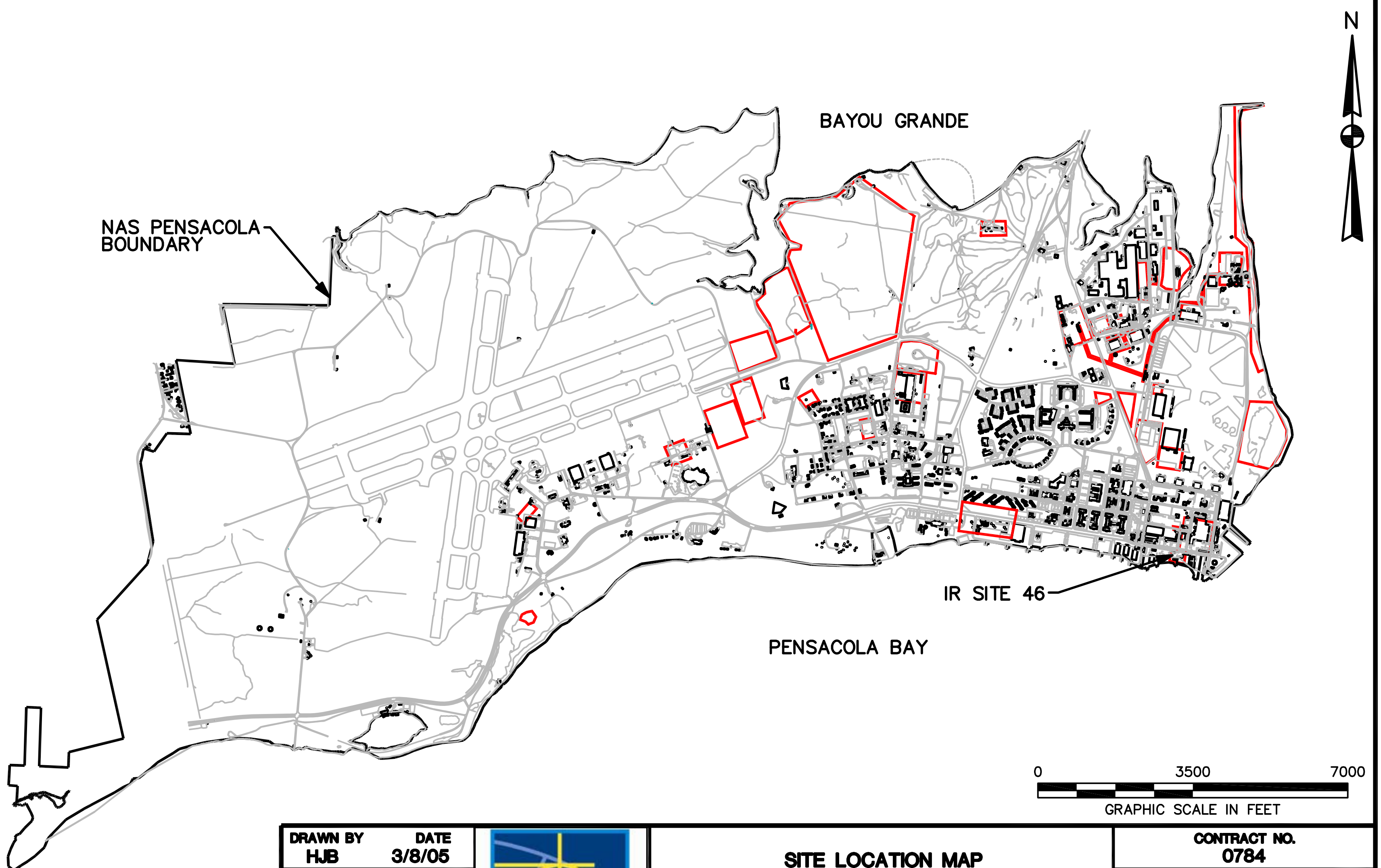

DRAWN BY HJB	DATE 3/8/05	SITE LOCATION MAP SITE 46 FEASIBILITY STUDY NAS PENSACOLA PENSACOLA, FLORIDA	CONTRACT NO. 0784	
CHECKED BY	DATE		OWNER NO. 0079	
REVISED BY	DATE		APPROVED BY	DATE
SCALE AS NOTED			DRAWING NO. FIGURE 1-1	REV. 0

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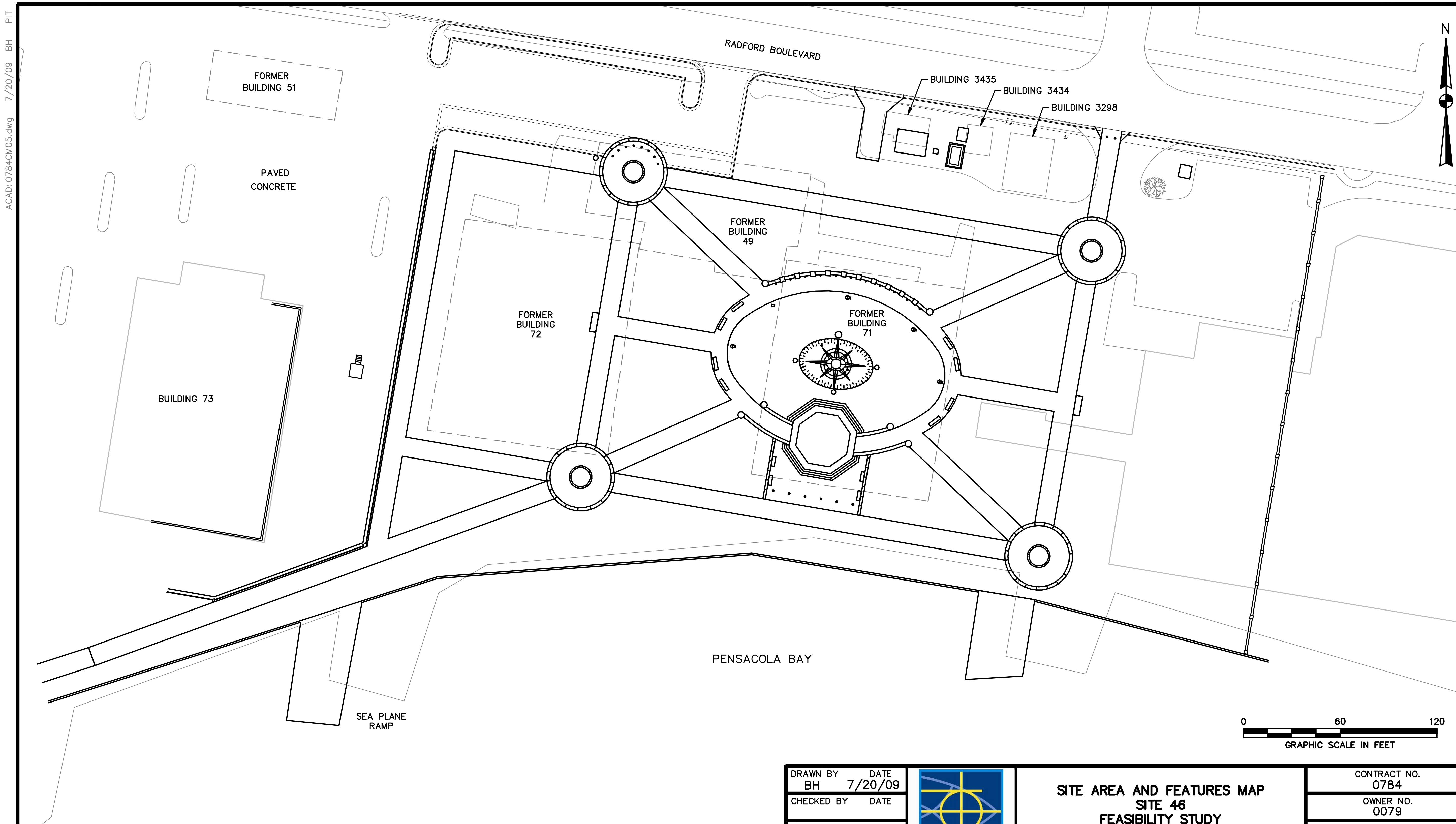

DRAWN BY BH	DATE 7/20/09	SITE AREA AND FEATURES MAP SITE 46 FEASIBILITY STUDY NAS PENSACOLA PENSACOLA, FLORIDA	CONTRACT NO. 0784
CHECKED BY	DATE		OWNER NO. 0079
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In 2006, the Navy, using available hurricane relief funds, completed a major soil excavation project in the area surrounding the former locations of Buildings 71 and 72. Approximately 7,200 tons of soil was removed from the area to an approximate depth of 2 feet bls including the Site 46 soil investigation area. The excavated areas were backfilled with clean fill material and compacted to the original grade.

In 2008, the Navy completed a significant facility improvement/reconstruction effort including the areas of the 2006 soil excavation and the former Buildings 71 and 72. These areas, which encompass Site 46 and a portion of Site 38, were redeveloped into a recreational plaza and park with a central covered area including a gazebo and elevated stage structure. The surrounding area includes several concrete walkways and various landscaped and open grassy areas (Figure 1-2).

These two major events; soil excavation in 2006 and facility improvement in 2008 removed the upper two feet of soil of Site 46 that was characterized in the RI. Therefore, the analytical results presented for soil in the RI (TtNUS, 2008) and FS do not represent the current conditions at the site. As previously stated, in 2006*, soil was excavated in the area surrounding the former locations of Buildings 71 and 72, and Site 46* to an approximate depth of 2 feet bls.

1.1.2 Site Investigations

This section summarizes previous investigations and relevant events at Site 46. Previous investigations in the vicinity of Site 46 included of an RI at the adjacent IR Site 38 (former Building 71). The Site 38 RI included supplemental soil and groundwater sampling in an area of what is now a portion of Site 46.

The investigation of Site 38 was conducted as four events:

- 1994 RI, including soil and groundwater sampling (Ensafe, 1998).
- 1998 Supplemental Groundwater Sampling Event, including installation of additional monitoring wells in the Building 72 area (Ensafe, 1999).
- 1999 Groundwater Sampling Event in the Building 71 and 72 areas, including installation of additional monitoring wells in the Building 72 area (Ensafe, 1999).
- 2000 Groundwater Sampling Event in the Building 71 area (Ensafe, 2001).

The RI Report for Site 38 (the area in and around former Building 71) indicated that parameters detected above screening levels in soil included metals, SVOCs, PAHs, pesticides, PCBs, and VOCs. The primary area of soil contamination was centered beneath the former Building 71 footprint. Parameters detected above screening levels in groundwater included metals, SVOCs, and VOCs, consistent with the soil contamination.

Much of the groundwater contamination was centered beneath the Building 71 footprint. Because of the detection of lead was detected above screening levels in groundwater west of former Building 71, supplemental groundwater sampling was conducted in 1998 to complete delineation of lead in groundwater. The results of the 1998 Supplemental Groundwater Sampling Event in the former Building 72 area indicated that lead concentrations had decreased approximately 50 percent in the Building 71 area since the RI sampling event (EnSafe, 1999). Groundwater samples from two additional monitoring wells located north of and centered on the Building 72 area contained lead concentrations exceeding screening levels.

Based on the results of this supplemental sampling (EnSafe, 1999), several new monitoring wells were installed in the Building 72 area, west of Building 71. These monitoring wells were sampled in 1999, along with several existing monitoring wells in the Building 71 area. Results from this sampling event indicated that lead in shallow groundwater in the Building 72 area had increased between the sampling events in 1998 and 1999 beneath the former building and that the greatest lead concentrations were on the west end of the site. Groundwater data collected for the 1999 Groundwater Sampling Event (EnSafe, 1999) revealed that lead contamination in shallow groundwater in the former Building 72 area was not fully delineated. Additionally, the sample from one of the shallow wells located immediately south of former Building 72 emitted a strong petroleum odor. A second confirmatory sample from this well contained methylene chloride, TCE, and naphthalene above screening levels. These results prompted the Navy to designate the former Building 72 area as a separate IR site.

Groundwater sampling in the former Building 71 area was again conducted in 2000 to identify trends in lead concentrations (EnSafe, 2001). Groundwater data collected for the 2000 Groundwater Sampling Event (EnSafe, 2001) indicated that chlorinated solvent concentrations were slightly at or above screening levels in groundwater samples collected from monitoring wells between former Buildings 71 and 72. Lead was not detected above its screening level in the groundwater samples from the former Building 71 area monitoring wells. The observed decrease in lead concentrations since the RI sampling in 1994 was attributed to sulfate-reducing conditions in the aquifer that may have caused the precipitation of dissolved lead as immobile lead sulfide.

This sampling event indicated that lead concentrations in shallow groundwater were drastically reduced compared to previous sampling events, and the report concluded that the attenuation in lead concentrations was naturally occurring (EnSafe, 2004). Under the IR program, soil and groundwater contamination in the former Building 71 area are being addressed by the remedy for Site 38, and impacts to soil and/or groundwater at Site 46 (former Building 72) are being addressed by this investigation.

Site 38 soil and groundwater sampling results were compared to the Florida SCTLs and Florida GCTLs in the Focused FS (EnSafe, 2004). Constituents that exceeded residential SCTLs in surface soil included arsenic, chromium, copper, vanadium, Arochlor-1254, benzo(a)pyrene, and dibenzo(a,h)anthracene. Constituents that exceeded the Florida Leachability to Groundwater SCTLs in surface soil included chromium, cadmium, TCE, tetrachloroethene (PCE), phenol, chloroform, 1,2-dichloroethane (DCA), 2-methylphenol, and 4-methylphenol. Constituents that exceeded the Florida Leachability to Groundwater SCTLs in subsurface soil included chromium, TCE, PCE, chloroform, 1,2-DCA, phenol, and 4-methylphenol.

Inorganic constituents exceeding GCTLs or background in shallow groundwater included aluminum, iron, lead, manganese, antimony, cadmium, chromium, and vanadium. SVOCs and PAHs exceeding GCTLs in shallow groundwater included naphthalene, bis(2-ethyhexyl)phthalate, 1,2,4-trimethylbenzene, and 1,3,5-trimethylbenzene. VOCs exceeding GCTLs in shallow groundwater included chloroethane, VC, benzene, TCE, PCE, chloroform, 1,1,1-trichloroethane (TCA), 1,1-DCA, and 1,1-dichloroethene.

The Site 38 Focused FS concluded that the decrease in lead concentrations was the result of natural attenuation, and that geochemical conditions within the shallow groundwater were such that natural attenuation could also be expected to reduce organic parameters. The recommended remedy for Site 38 was monitored natural attenuation, and implementation of institutional controls to restrict potential receptor exposure to site soil and groundwater (EnSafe, 2004).

1.1.3 Summary of Site 46 RI Findings

This section summarizes the subsurface physical characteristics, nature and extent of contamination, and contaminant fate and transport at the site based on the findings provided in the RI Report (Tetra Tech, 2008). Current surface features of the site and the site layout are discussed in Section 1.1.1. The regional geology and hydrogeology are described in the RI (Ensafe, 1994). The following is a summary of geology and hydrogeology information at Site 46 relevant to the FS.

1.1.3.1 Site Geology and Hydrogeology

The lithologies observed during drilling of Site 46 monitoring wells are typical of the undifferentiated Pleistocene marine deposits. The ground surface to 1 foot interval at most of the sampling locations showed signs of disturbance, either grading and filling or pavement construction. Below 2 feet, typical lithologies included sand ranging from white or tan to dark brown in color. Significant clay or gravel horizons were not encountered.

Groundwater in Escambia County occurs in three major aquifers: a shallow aquifer which is both artesian and nonartesian (the sand and gravel aquifer), and two deep artesian aquifers (the upper and lower limestones of the Floridan Aquifer). In the southern half of the area, the sand and gravel aquifer and the upper limestone of the Floridan Aquifer are separated by a thick section of relatively impermeable clay; however, in the northern half the sand and gravel aquifer and the upper limestone of the Floridan Aquifer are in contact with one another. The upper limestone of the Floridan Aquifer is separated from the lower limestone by a thick clay bed.

Monitoring wells installed at Site 46 are grouped by depth and subsurface well screen interval as follows:

- Shallow monitoring wells are screened from 4 to 14 feet bls
- Deep monitoring wells are screened from 32 to 50 feet bls

Groundwater elevations above mean sea level (msl) in shallow monitoring wells were measured during two separate events as follows:

- December 6, 2005 – 0.39 to 2.30 feet
- December 21, 2005 – 0.04 to 2.30 feet

Groundwater elevations in the shallow monitoring wells ranged from 0.00 to 0.40 feet lower on December 21, 2005, than the elevations measured on December 6, 2005. The magnitude of change increased in shallow wells towards the south side of the site, suggesting that tidal variations influence groundwater levels closer to Pensacola Bay. Groundwater elevations in the deep monitoring wells were 0.00 to 0.21 feet lower on December 21, 2005, compared to December 6, 2005, suggesting a weaker tidal influence on the deep interval of the surficial aquifer.

To evaluate the direction of groundwater flow in the shallow and deep zones of the surficial aquifer, the groundwater elevations from the shallow and deep monitoring wells were compiled in the RI. Interpretation of data from Site 46 indicates that overall, groundwater flow at the water table and the deep surficial aquifer interval is to the south, towards Pensacola Bay and the average horizontal gradient in both the shallow and deep intervals was 0.0035 feet/foot.

The vertical gradient is determined from the difference in groundwater elevation in adjacent shallow and deep monitoring wells and the vertical separation of the screened intervals of the monitoring wells; this is determined by the midpoint of the water column in shallow wells that bracket the water table and the midpoint of the well screen in deep wells screened below the water table. In general, the vertical gradients were upward in the area north of Radford Boulevard and in well clusters near Pensacola Bay. The vertical gradients were downward in the central part of the site around Radford Boulevard. This area has less pavement and more grassy areas; the change in vertical gradient may indicate that infiltration and recharge are more prevalent in this section of the site.

The geometric mean of the hydraulic conductivity values reported for shallow wells at Site 46 is approximately 245 feet per day (fpd). The geometric mean of the hydraulic conductivity values reported for deep wells at Site 46 is approximately 16 fpd, an order of magnitude less than the shallow wells.

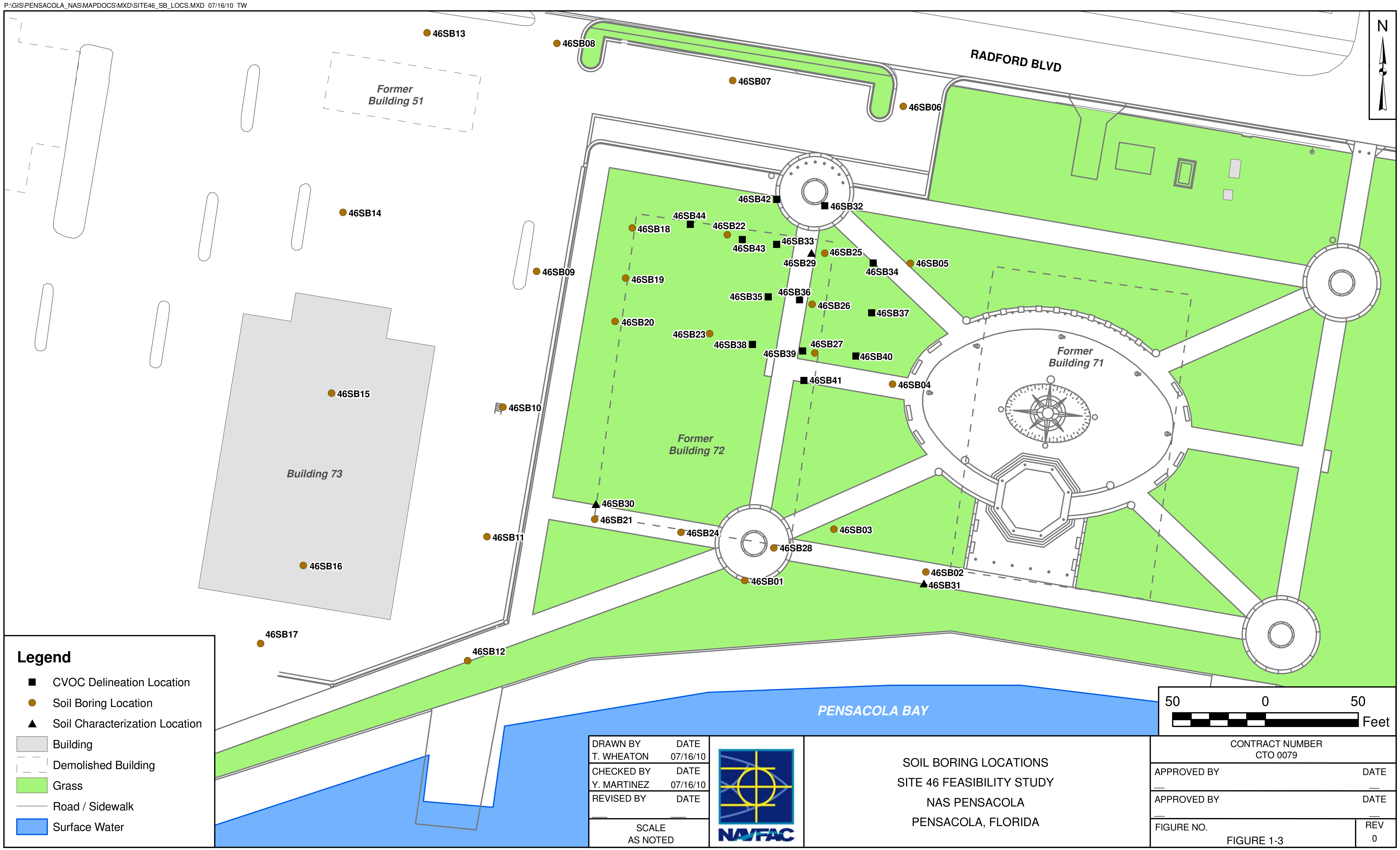
1.1.3.2 Nature and Extent of Contamination

To evaluate the nature and extent of contaminants at Site 46, the surface and subsurface soil analytical results were compared to the risk-based SCTLs established in 62-777, F.A.C. for direct exposure-residential, direct exposure-industrial, and leachability to groundwater, and the NAS Pensacola background concentrations for metals in soil (EnSafe, 1994). The SCTLs were used because they are more stringent than the comparative USEPA screening levels. The background concentrations are facility-specific background concentrations established for NAS Pensacola. Groundwater analytical results were compared to the risk-based GCTLs established in 62-777, F.A.C. The GCTLs were used because they are equal to or more stringent than the comparative USEPA MCLs. The locations of soil borings and groundwater monitoring wells are shown on Figures 1-3 and 1-4, respectively.

As defined by Chapter 62-777, F.A.C., Tables I and II, the soil and groundwater sample analytical results were compared to the following CTLs to define the nature and extent of contamination:

- Soil samples were compared to residential and Industrial Direct Exposure SCTLs and Leachability to Groundwater SCTLs.
- Groundwater samples were compared to USEPA and Florida MCLs and Florida GCTLs based on ingestion (lifetime excess cancer risk of 1×10^{-6}) and freshwater and/or marine surface water criteria, as appropriate.

In addition to these screening criteria, all media samples were compared to the NAS Pensacola background values for inorganic constituents. The results, depicting parameter-specific exceedences for soil and groundwater are described below and depicted on Figures 1-5 and 1-6, respectively. Only contaminants retained as COCs are included.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N
RADFORD BLVD
Former Building 51
Former Building 72
Former Building 71
Building 73
PENSACOLA BAY
46SB01
46SB02
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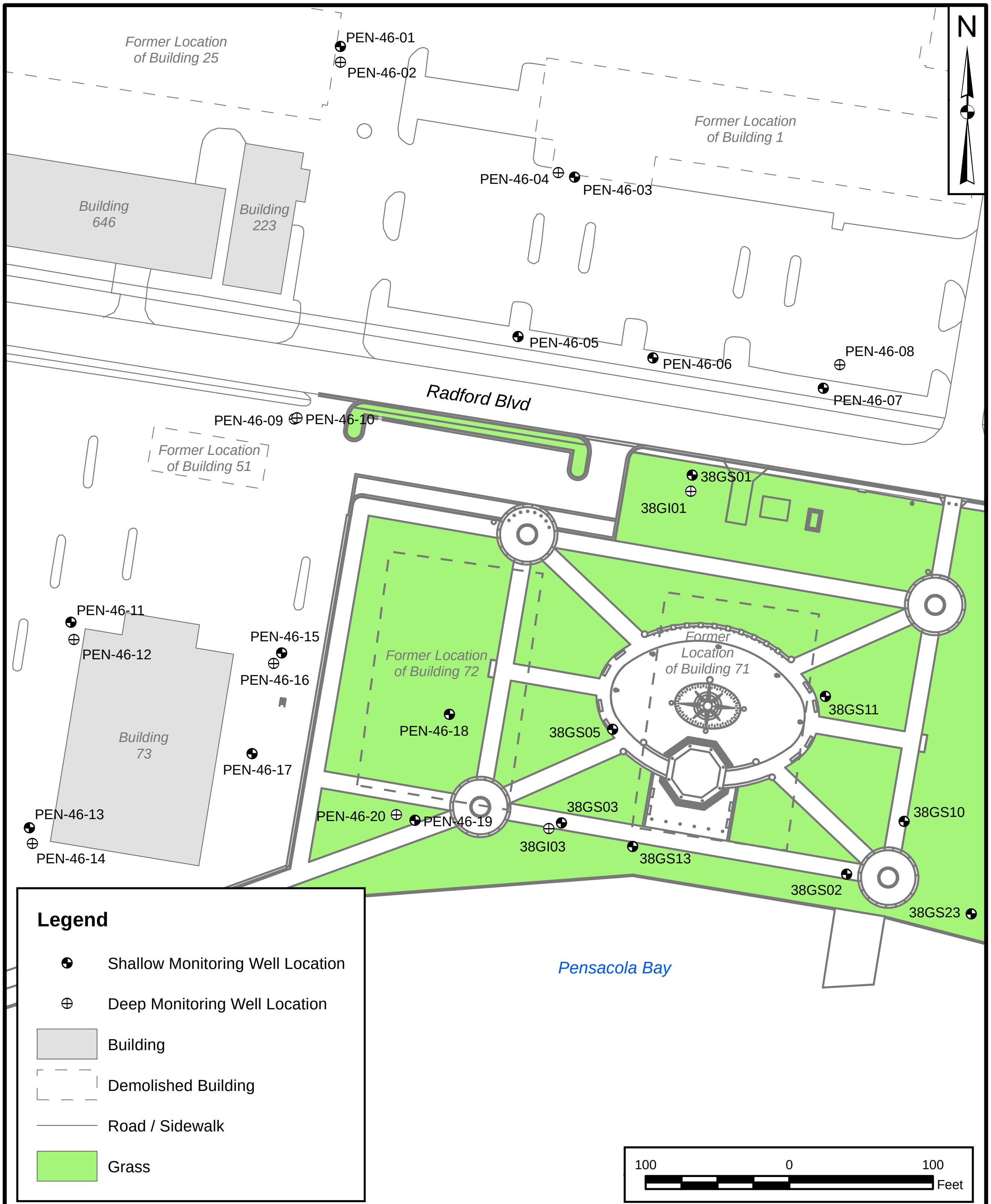
46SB44
Legend
CVOC Delineation Location
Soil Boring Location
Soil Characterization Location
Building
Demolished Building
Grass
Road / Sidewalk
Surface Water
50 0 50
Feet
DRAWN BY T. WHEATON DATE 07/16/10
CHECKED BY Y. MARTINEZ DATE 07/16/10
REVISED BY DATE
SCALE AS NOTED
NAVFAC
SOIL BORING LOCATIONS
SITE 46 FEASIBILITY STUDY
NAS PENSACOLA
PENSACOLA, FLORIDA
CONTRACT NUMBER CTO 0079
APPROVED BY DATE
APPROVED BY DATE
FIGURE NO. FIGURE 1-3
REV 0



DRAWN BY	DATE		MONITORING WELL LOCATIONS	CONTRACT NUMBER	
J. ENGLISH	07/17/09		SITE 46	CTO 0079	
CHECKED BY	DATE		FEASIBILITY STUDY	APPROVED BY	DATE
M. JAYNES	01/18/10		NAS PENSACOLA	___	___
REVISED BY	DATE		PENSACOLA, FLORIDA	APPROVED BY	DATE
___	___			___	___
SCALE		NAVFAC		FIGURE NO.	REV
AS NOTED				FIGURE 1 - 4	0

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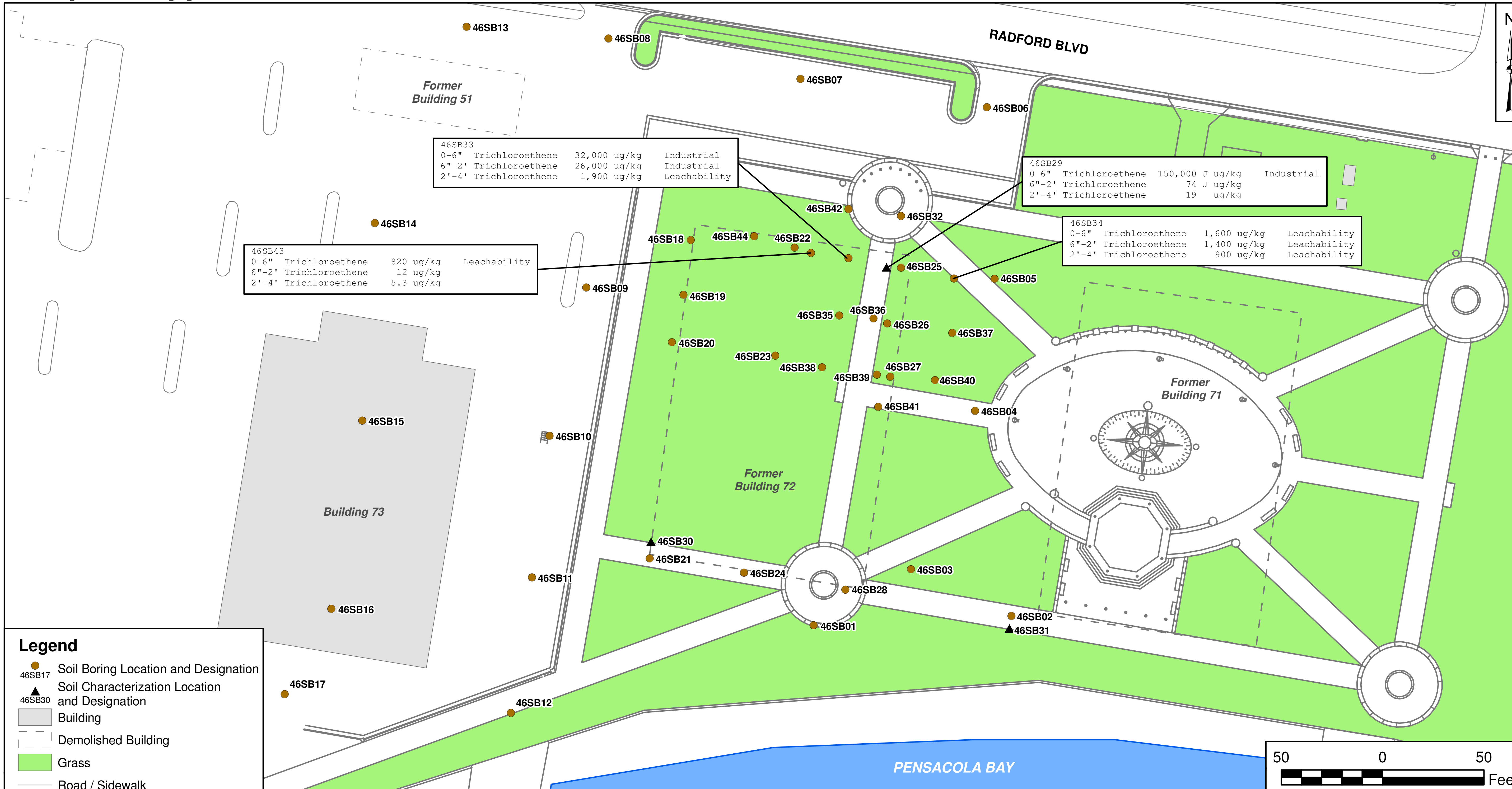
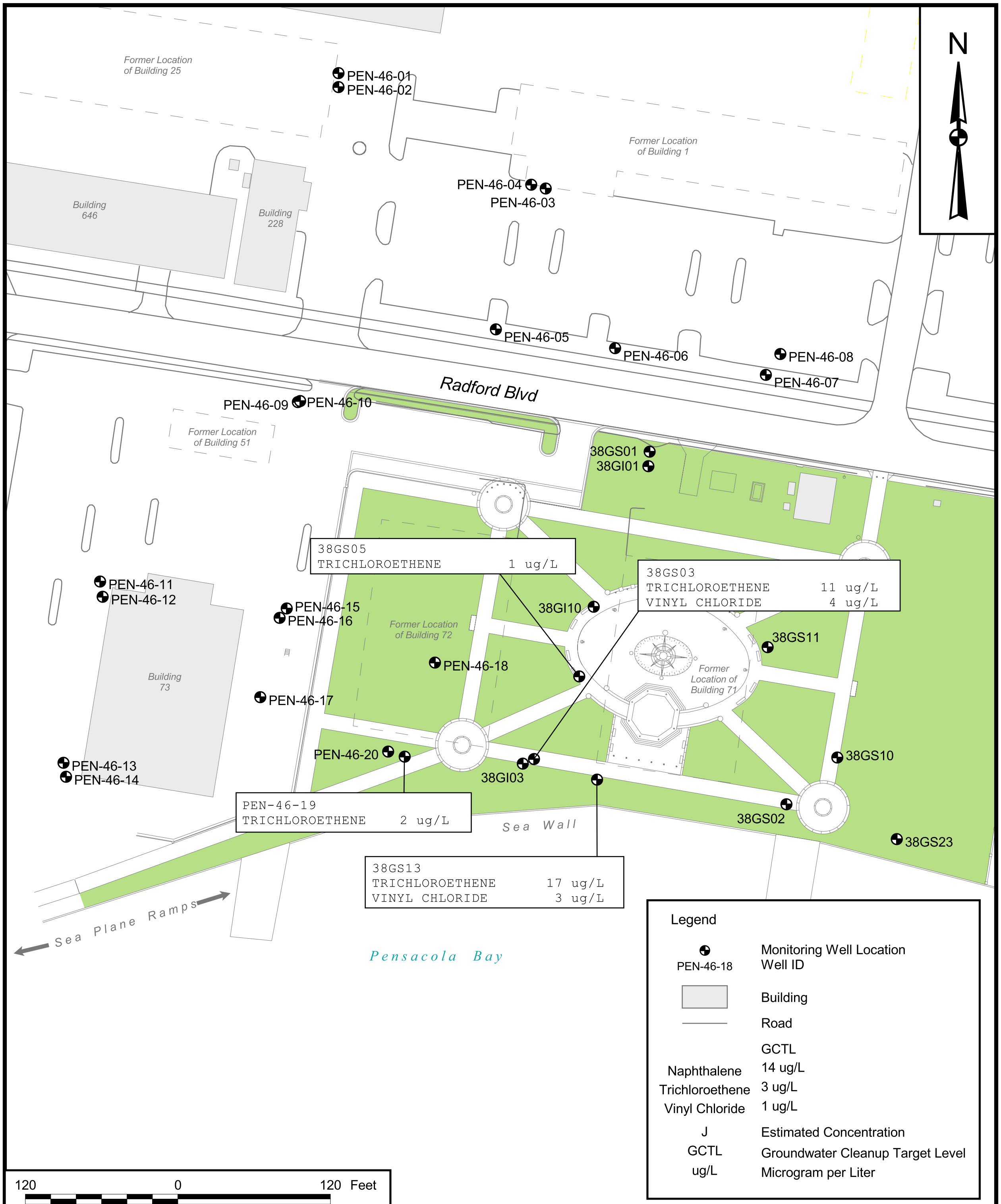


DRAWN BY	DATE
T. WHEATON	07/16/10
CHECKED BY	DATE
Y. MARTINEZ	07/16/10
REVISED BY	DATE
SCALE AS NOTED	

NAVFAC

TRICHLOROETHENE SCTL EXCEEDANCES
IN SOIL SAMPLES
SITE 46 FEASIBILITY STUDY
NAS PENSACOLA
PENSACOLA, FLORIDA

CONTRACT NUMBER CTO 0079	
APPROVED BY	DATE
APPROVED BY	DATE
FIGURE NO. FIGURE 1-5	REV 0



DRAWN BY C. SPEHAR — DATE 3/15/06	NAVFAC	CVOC EXCEEDANCES OF GCTLs IN GROUNDWATER SITE 46 FEASIBILITY STUDY NAS PENSACOLA PENSACOLA, FLORIDA	CONTRACT NUMBER CTO 0079
CHECKED BY M. JAYNES — DATE 01/18/10			APPROVED BY — DATE —
COST/SCHEDULE-AREA			APPROVED BY — DATE —
SCALE AS NOTED			DRAWING NO. FIGURE 1 - 6 — REV 0

P:\GIS\PENSACOLA_NAS\MAPDOCS\APR\SITE 46.APR SITE 46 TCE AND VC LAYOUT 01/18/10 JEE

Soil

Soil screening samples were collected from 28 locations at Site 46 for metals analysis (Figure 1-3). The samples were analyzed for lead, iron, and aluminum. Lead data were collected based on the findings of the Site 38 RI, which identified lead concentrations exceeding screening criteria in soil in the Building 72 area. Iron and aluminum data were collected to evaluate the overall level of metals in site soils and to aid in identifying locations where lead concentrations were elevated in comparison to other metals.

The characterization soil samples were collected at three soil boring locations at Site 46: 46SB03, 46SB21, and 46SB25. Three soil samples were collected from each of the boring locations at depth intervals of 0 to 6 inches, 6 inches to 2 feet, and 2 to 4 feet. The characterization samples were analyzed for target compound list (TCL) VOCs, TCL SVOCs and PAHs, TCL pesticides and PCBs, and total recoverable petroleum hydrocarbons (TRPH), and target analyte list (TAL) metals. The characterization samples were also submitted for SPLP extraction and analysis for TCL VOCs and TAL metals.

The characterization sampling identified an area at the northeast corner of the former Building 72 area (the 46SB25 and 46SB29 soil boring locations) where TCE concentrations exceeded the industrial SCTL. Thirteen additional soil borings were installed to delineate the extent of the TCE.

The lead screening identified one surface soil sample location (46SB21, collected from 0 to 6 inches bls) with a lead concentration greater than its residential direct exposure SCTL. The lead concentration in the characterization sample collected from the same interval in an adjacent soil boring (46SB30) was less than the residential direct exposure SCTL. The SPLP extract for lead in soil samples collected from three soil boring locations exceeded the state and federal MCL for lead. One soil sample collected from 0 to 6 inches bls and one soil sample collected from 6 inches to 2 feet bls contained lead in the SPLP extract at concentrations exceeding the Florida MCL for lead. Two soil samples collected from 2 to 4 feet bls contained lead in the SPLP extract at concentrations exceeding the Florida MCL for lead.

Arsenic was detected in two soil samples (collected from 0 to 6 inches bls and 6 inches to 2 feet bls) at one soil boring locations at concentrations equal to or greater than the residential SCTL. However, as reported earlier, the arsenic concentrations were within the background range determined by the facility-wide statistical analysis of arsenic and iron distribution at NAS Pensacola. Therefore, the reported concentrations are not believed to be attributed to former site operations. These samples were collected from a soil boring adjacent to the area investigated for IR Site 38.

Aluminum was reported in one soil characterization sample with a SPLP result greater than the NAS Pensacola background concentration. Aluminum was detected in the SPLP results for seven other samples at concentrations greater than the GCTL, but less than the NAS Pensacola background concentration.

TCE was detected at two soil boring locations (two samples collected from 0 to 6 inches bls and one sample from 0.5 to 2 feet bls) near the northeast corner of former Building 72 at concentrations greater than the Industrial Direct Exposure SCTL (Figure 1-5). Soil samples collected from 0 to 6 inches bls, 0.5 to 2 feet bls and 2 to 4 feet bls at four locations contained TCE at concentrations exceeding the Florida Leachability to Groundwater SCTL

Groundwater

A monitoring well network was previously installed at the site during the Site 38 investigation (Figure 1-4). Monitoring wells installed to support the Site 38 investigation are identified with 38 in the well designation. Six monitoring wells installed previously for the Site 38 investigation were included in the Site 46 groundwater program: 38GS01, 38GI01, 38GS03, 38GI03, 38GS05, and 38GS13. These wells are primarily located at the western edge of Site 38, west of former Building 71. Other Site 38 wells located in the Building 71 footprint or to the east of Building 71 were not included in the Site 46 investigation.

The RI at Site 46 included the installation of monitoring wells targeting both shallow and deep intervals, and sampling of both existing and newly-installed wells. Twelve shallow monitoring wells were installed to an approximate depth of 13 feet bls. Eight deep monitoring wells were installed to depths ranging from 44 to 50 feet bls.

Groundwater samples were collected from the existing and the newly installed monitoring wells to assess the current groundwater conditions. Sixteen shallow monitoring wells, two intermediate monitoring wells, and eight deep monitoring wells were sampled for the RI.

The groundwater samples collected during the RI were analyzed for the full list of TCL and TAL analytes, as well as TRPH. Groundwater samples were collected from 26 monitoring wells. Sixteen of the wells were shallow wells screened across the water table. Ten of the wells were deep wells, screened between 30 and 50 feet. Groundwater analytical results were compared to the risk-based GCTLs established in 62-777, F.A.C. and the NAS Pensacola background concentrations for metals in groundwater (EnSafe, 1994). The background concentrations are facility-specific background concentrations established for NAS Pensacola.

VOCs, SVOCs, and PAHs were reported in groundwater samples collected at Site 46. TCE and VC were the only VOCs detected at concentrations exceeding Florida MCLs under Chapter 62-550, F.A.C. (Figure 1-6). Previously installed Site 38 monitoring wells 38GS03 (11 μg/L) and 38GS13 (17 μg/L) were reported to contain TCE at concentrations exceeding its MCL . The VC concentrations in two monitoring wells (38GS03, 4 µg/L and 38GS13, 3 µg/L) were also greater than the marine surface water CTL of 2.4 µg/L. Naphthalene was detected in four of the groundwater samples collected at Site 46, with the concentration in one monitoring well greater than its Florida GCTL under Chapter 62-777, F.A.C. Bis(2-ethylhexyl)phthalate was detected at a concentration greater than its Florida MCL under Chapter 62-550, F.A.C. in one field duplicate sample. The well was re-sampled in May of 2006 and the bis(2-ethylhexyl)phthalate result from that sampling event was less than the laboratory detection limit. Concentrations of pesticides, PCBs, and TRPH were less than the laboratory detection limits.

A wide range of metals were detected in groundwater samples collected at Site 46. Arsenic was detected at 13.3 µg/L in a shallow monitoring well (PEN-46-19) hydraulically downgradient of Building 72 at a concentrations that exceeds its Florida MCL (10 µg/L) under Chapter 62-550, F.A.C.

Cadmium was detected at 8.9 µg/L in a shallow monitoring well (38GS05) located between Buildings 71 and 72 at a concentrations that exceeds its Florida MCL (5 µg/L) under Chapter 62-550, F.A.C.

Lead was detected in one hydraulic upgradient well monitoring well (PEN-38GS01) at a concentration greater (237 µg/L) than its state and federal MCL of 15 µg/L.

Aluminum was detected in groundwater samples from deep wells above NAS Pensacola background concentrations in only four deep wells. The highest detection of aluminum was in sample 46GW1601, which had a turbidity of 237 NTU when sampled after purging the well. Aluminum exceeded its GCTL (7,000 ug/l) under Chapter 62-785, FAC in two samples.

Iron was detected in a groundwater samples from deep wells and exceed its Florida Secondary MCL (300 µg/l), which is based on aesthetic effects such as taste and odor. Iron exceeded its health based Florida GCTL (4,200 µg/l) under Chapter 62-785, FAC, in two hydraulic sidegradient and one hydraulic downgradient well

Manganese was detected in most of the groundwater samples collected at Site 46. The manganese concentrations detected in groundwater samples from nine monitoring wells exceeded its secondary MCL under Chapter 62-550, F.A.C., but exceeded its health based GCTL under Chapter 62-785, F.A.C. at one hydraulic upgradient monitoring well location.

1.1.3.3 Potential Receptors

Site 46 has been an industrial area supporting aircraft maintenance and refurbishing for over 30 years. The contaminants at Site 46 appear to be limited to surface soil, subsurface soil, and groundwater. Migration pathways may include the following:

- Leaching of contaminants in soil into groundwater
- Migration of contaminants in groundwater in a hydraulic downgradient direction (south) from Site 64 towards Pensacola Bay
- Volatilization of TCE from soil and/or groundwater

The mobility of chemicals at Site 46 is influenced by the relatively shallow water table, potentially high rates of precipitation, and sandy soil in the area, which may allow a higher rate of infiltration than less permeable soil. The contaminants identified in soil at Site 46 (TCE and metals) generally have physical and chemical properties that result in low mobility and higher persistence in the environment.

The groundwater data at Site 46 do not provide evidence of immiscible contaminants at concentrations exceeding water solubility levels. Therefore, the migration of groundwater contaminants, for the most part, is likely governed by the movement of dissolved contaminants. Three general processes govern the migration of dissolved constituents in groundwater: advection, dispersion, and retardation.

Most of the contaminants detected in soil at Site 46 (TCE and metals) and are not expected to vaporize into the air. The TCE concentrations in groundwater are relatively low, and volatilization is not likely to occur. Air monitoring was conducted during the soil investigation due to the potential for dust/particulate exposure. Because of the sandy soil at the site, little dust is generated under normal conditions. However, there is a potential for particulate exposure in areas without grass if the soil is significantly disturbed (e.g., during excavation).

Current and potential receptors at Site 46 include the following:

- Adult and adolescent trespassers
- Maintenance workers
- Construction workers
- Occupational workers
- Future residents

1.2 RISK ASSESSMENT RESULTS

The following section summarizes soil and groundwater data in conjunction with risk assessment results to describe remedial options suitable for soil and groundwater at Site 46.

USEPA Guidance Risk Assessment

The USEPA risk assessment considered five receptors, the hypothetical future resident, the typical industrial worker, the construction worker, the maintenance worker, and the trespasser/recreational user, assuming exposure via the ingestion, dermal contact, and inhalation route of exposures. However, maintenance workers and trespassers/recreational users are considered to be the most likely receptors at Site 46 under the current land use.

The list of Chemicals of Potential Concern (COPCs) developed for the Site 46 USEPA Human Health Risk Assessment (HHRA) includes the following:

- Surface Soil – TCE, Aroclor 1260, aluminum, arsenic, iron, and lead
- Subsurface Soil – TCE, aluminum, arsenic, and iron
- Groundwater – bromodichloromethane, chlorodibromomethane, chloroform, TCE, cis-1,2-Dichloroethene (DCE), vinyl chloride, 2-methylnaphthalene, naphthalene, bis(2-ethylhexyl)phthalate, aluminum, arsenic, barium, cadmium, chromium, iron, lead, manganese, and vanadium

The ILCR for the typical industrial worker, the construction worker, the maintenance worker, and the trespasser/recreational user exposure to surface soil and subsurface soil was acceptable and within the USEPA target risk range (1 x 10^{-6} to 1 x 10^{-4}), The non-carcinogenic HI for the typical industrial worker, the maintenance worker, and the trespasser/recreational user exposure to groundwater was acceptable and less than USEPA target HI of 1. However, for the construction worker, concentrations of aluminum in surface soil elevate its HQ (3) above the USEPA target HQ of 1.

The carcinogenic (ILCR of 1 x 10^{-3}) and non-carcinogenic (HI of 60) risks for the hypothetical future resident exceed USEPA target risk range (1 x 10^{-6} to 1 x 10^{-4}); and HI, of 1, respectively, for groundwater. The primary drivers of carcinogenic risk for the hypothetical future resident use of groundwater are TCE, VC and arsenic. The primary drivers of non-carcinogenic risk for the hypothetical future resident use of groundwater are TCE, 2-methylnaphthalene, naphthalene, chromium and vanadium.

The HHRA determined that concentrations of lead in soil and groundwater do not result in unacceptable blood level lead concentrations in any of the evaluated receptors.

Florida Guidance Risk Assessment

The risk assessment conducted per Florida regulations and guidelines evaluated risks to a hypothetical future resident and a typical industrial worker using SCTLs for the residential and industrial land use scenario, respectively. Risks to a hypothetical future recreational user were evaluated using SCTLs specifically developed for this risk assessment as stipulated in the Florida regulations and guidelines.

Carcinogenic risks associated with exposure to surface soil exceed Florida's target risk level for the hypothetical future resident and industrial worker due to TCE concentrations. Carcinogenic risks associated with exposure to subsurface soil exceed Florida's target risk level for the hypothetical future resident due to TCE above the Florida SCTLs.

Carcinogenic risks exceed 1×10^{-4} for exposure to groundwater by the hypothetical future resident due to the presence of TCE and VC. This exceeds Florida's target risk level of 1×10^{-6}.

Iron and manganese were identified as COPCs for groundwater because the maximum concentrations exceeded GCTLs, which are, in effect, USEPA Secondary MCLs. Secondary MCLs are criteria based not on health effects, but on aesthetic effects such as taste and odor. Also, HQs for iron and manganese calculated in the USEPA evaluation were less than the USEPA and Florida goal of 1 (unity) for noncarcinogenic health effects.

Ecological Risk Assessment

The coastal waters of surrounding NAS Pensacola have been classified by Florida as Class III surface water, which indicates that they are used for recreation and the need to maintain a well-balanced fish and wildlife population. Potential ecological impacts of Site 46 were found to be negligible (Tetra Tech, 2008).

Refinement of COPCs

Using the data, current site conditions, and technical evaluation presented in this document, the Navy concludes that the remedial alternatives presented in this document for soil and groundwater in Site 46 are protective of human health and the environment. The following items support these conclusions:

- Soils from 0 to 2 feet bls with TCE at concentrations exceeding the Florida Industrial Direct Exposure SCTL were removed from the site (via excavation) in 2006 and 2008.

- Subsurface soil from 2 to 4 feet bls have lead and TCE at concentrations exceeding the Florida Leachability to Groundwater SCTL remains on site.

- Clean fill material (0 to 2 feet bls) was used to replace the excavated soil during the 2008 construction effort.

- Land use restrictions on the use of the shallow aquifer will prohibit direct exposure to groundwater. Therefore, the absence of exposure results in no significant risks associated with groundwater.

- Although groundwater concentrations of Naphthalene, TCE and VC at a localized source exceed their GCTLs, based on groundwater monitoring data available from Site 46 and Site 38, the plumes appear to be stable and not migrating.

- Contaminated surface water and sediment are not present at Site 46.

Based on the findings of the Site 46 RI and existing site conditions, the COPCs were further evaluated and refined for evaluation of remedial alternatives in the FS.

Soil: In the RI (Tetra Tech, 2008), as part of the HHRA, following USEPA and Florida guidance, the following COPCs were listed for surface soil: TCE, Aroclor 1260, aluminum, arsenic, iron, and lead; and subsurface soil: TCE, aluminum, arsenic, and iron. After a reevaluation of the current conditions, analyzing existing data, risk assessment and understanding the historical use of the area, the following COPCs have been eliminated for use in the evaluation of remedial alternatives as presented below:

- Aroclor 1260 was detected in a surface soil sample at 360 µg/kg and was eliminated for use in the evaluation of remedial alternatives because it was detected at concentration less than its Florida Residential Direct Exposure SCTL of 500 µg/kg.
- Aluminum was detected at concentrations ranging from 116 to 24,500 mg/kg in surface soils and 67.2 to 7,680 mg/kg in subsurface soils. The detected concentration are less than its Florida Residential Direct Exposure SCTL of 80,000 mg/kg.
- Arsenic was detected at concentrations ranging from 0.16 to 2.1 mg/kg in surface soils and 0.1 to 2.4 mg/kg in subsurface soils. Two soil samples contained arsenic at concentrations exceeding its Florida Residential Direct Exposure SCTL of 2.1 mg/kg. Statistical analysis for arsenic indicate a background range from 0.1 to 17.5 mg/kg in soils at NAS Pensacola, indicating that arsenic concentrations up to 17.5 mg/kg can be due to natural processes and not release of arsenic from site activities.

- Iron was detected at concentrations ranging from 50.6 to 13,700 mg/kg in surface soils and 32.9 to 5,390 mg/kg in subsurface soils. The detected concentrations are less than its Florida Residential Direct Exposure SCTL of 53,000 mg/kg.

Based on the above evaluation, lead and TCE were retained as COCs for subsurface soil to be evaluated in this FS.

Groundwater: In the RI (Tetra Tech, 2008), as part of the HHRA, following USEPA and Florida guidance, the following COPCs for groundwater were listed: bromodichloromethane, chlorodibromomethane, TCE, VC, bis(2-ethylhexyl)phthalate, naphthalene, aluminum, barium, cadmium, chromium, iron, lead, manganese and vanadium. However, after a reevaluation of the current conditions, analyzing existing data, risk assessment and understanding the historical use of the area, the following COPCs have been eliminated for use in the evaluation of remedial alternatives as presented below:

- Bromodichloromethane only detected in three of 29 groundwater samples and in only one sample (46GW0102, 1.6 ug/L) out of those three samples it was detected at estimated concentration slightly above risk based Florida GCTL (0.6 ug/l) (Chapter 62-777, F.A.C.). Bromodichloromethane will not be carried forward as COC.
- Chlorodibromomethane (dibromochloromethane) only exceeded in one groundwater sample, which was a duplicate, (sample 46GW1401-D, 0.6 J µg/L) at an estimated concentration slightly above Florida GCTL (0.4 µg/L) (Chapter 62-777, F.A.C.). Chlorodibromomethane was not detected (0.4 U µg/L) in the corresponding sample (46GW1401).
- Chloroform was detected at concentrations ranging from 1 to 6 J µg/L and was less than its Florida GCTL (70 µg/L) (Chapter 62-777, F.A.C.).
- cis 1,2 DCE was detected at concentrations ranging from 1 J to 18 µg/L and was less than its Florida MCL (70 µg/L) (Chapter 62-550, F.A.C.).
- 2-Methylnaphthalene was detected at concentrations ranging from 0.1 J to 11 J µg/L and was less than its Florida GCTL (28 µg/L) (Chapter 62-777, F.A.C.).
- Bis(2-ethylhexyl)phthalate was detected at a concentration (64 J µg/L) greater than Florida MCL (6 µg/L) in one field duplicate. The well was re-sampled in May 2006 and the bis(2-ethylhexyl)phthalate result from that sampling event was less than the laboratory detection limit. Therefore, Bis(2-ethylhexyl)phthalate will not be carried forward as a COC.
- Manganese was detected in groundwater samples collected from both shallow and deep monitoring wells and was identified as a COPC for groundwater because the maximum detected concentrations exceed its Florida and USEPA Secondary MCL (50 µg/l), which is based on aesthetic effects such as taste and odor. Manganese exceeded its GCTL (330 µg/l) under Chapter 62-785, FAC in one hydraulic upgradient monitoring well, however, its HQ was less than

the USEPA and Florida goal of 1 (unity) for noncarcinogenic health effects. Manganese will not be carried forward as a COC.

- Iron was detected in a groundwater samples from deep wells and it was identified as a COPC for groundwater because the maximum detected concentrations exceed its Florida and USEPA Secondary MCL (300 μg/l), which is based on aesthetic effects such as taste and odor. Iron exceeded its GCTL (4,200 μg/l) under Chapter 62-785, FAC, in two hydraulic sidegradient and one hydraulic downgradient well, however, its HQ was less than the USEPA and Florida goal of 1 (unity) for noncarcinogenic health effects. Iron will not be carried forward as a COC.
- Aluminum was detected in groundwater samples from deep wells above NAS Pensacola background concentrations in four deep wells. The highest detection of aluminum was in sample 46GW1601, which had a turbidity of 237 NTU when sampled after purging the well as indicated in relevant SOPs. Although aluminum exceeded its GCTL (7,000 ug/l) under chapter 62-785, FAC in two samples, the calculated human health risk for recreational users is below USEPA and Florida (1×10^{-6}) criteria. Aluminum will not be carried forward as a COC.
- Barium was detected (from 4.9 to 390 μg/l) at a concentration greater than NAS Pensacola background criteria (13.2 μg/l). However, it was not detected above its risk based criteria (Florida MCL of 2,000 μg/l). Barium will not be carried forward as a COC.
- Chromium was detected (244 μg/l) in a groundwater sample collected from a deep monitoring well (PEN-46-16) at a concentration above its Florida MCL(100 μg/l). The monitoring well locations is considered hydraulically sidegradient to the source area. Therefore, chromium will not be carried forward as a COC.
- Lead (23.7 μg/l) exceeded its Florida MCL, which is a treatability standard (15 ug/l) in only one shallow hydraulic upgradient well (38GS01). Additionally, lead was evaluated using the USEPA's Lead Uptake/Biokinetics Model to predict mean blood- lead levels in children based on exposure to impacted environmental media. Based on the hydraulic upgradient location and the Lead Uptake/Biokinetics Model, which assesses the potential health effects of elevated lead levels, it was determined not to be a COC.
- Vanadium was detected (from 2.6 to 377 μg/l) in groundwater samples collected from only the deep wells at concentrations exceeding its GCTL of 40 ug/l under Chapter 62-777, FAC. Vanadium was detected in one hydraulic upgradient well, two hydraulic sidegradient wells and one hydraulic downgradient well. The highest detected concentrations were in the samples collected in the hydraulic side gradient wells. Vanadium will not be carried forward as a COC.

<u>Based on the above evaluation, TCE, VC, naphthalene, arsenic and cadmium were retained as COCs for groundwater to be evaluated in this FS.</u>

1.3 DOCUMENT ORGANIZATION

This FS has been organized with the intent of meeting the general format requirements specified in the RI/FS Guidance Document (USEPA, 1988). This report contains the following five sections:

- Section 1.0, Introduction, summarizes the purpose of the report, provides site background information, summarizes findings of the RI, and provides the report outline.

- Section 2.0, Remedial Action Objectives (RAOs) and General Response Actions (GRAs), presents the RAOs, identifies ARARs and To Be Considered (TBC) criteria, develops cleanup goals and associated GRAs, and provides an estimate of matrix volumes to be remediated.

- Section 3.0, Screening of Remediation Technologies and Process Options, provides a two-tiered screening of potentially applicable remediation technologies and identifies the technologies that will be assembled into remedial alternatives.

- Section 4.0, Assembly and Detailed Analysis of Remedial Alternatives, assembles the remedial technologies retained from the Section 3.0 screening process into multiple remedial alternatives, describes these alternatives, and performs a detailed analysis of these alternatives in accordance with seven of the nine remedy selection criteria set forth in 40 CFR Part 300.430 of the NCP CERCLA criteria.

- Section 5.0, Comparative Analysis of Remedial Alternatives, compares the remedial alternatives on a criterion-by-criterion basis, for each of the seven CERCLA analysis criteria used in Section 4.0.

Appendix A contains remedial alternative cost estimates. Appendix B contains the Sustainable Remediation Evaluation.

2.0 REMEDIAL ACTION OBJECTIVES AND GENERAL RESPONSE ACTIONS

This section develops RAOs and presents cleanup goals. The regulatory requirements (i.e., ARARs) that may potentially govern remedial activities are presented in this section. In addition, this section presents the COCs identified in Section 1.0 and the conceptual pathways through which these chemicals may affect human health and the environment, and thus derives the environmental media of concern. The cleanup goals for contaminated media are developed in this section, and GRAs that may be suitable to achieve the cleanup goals are presented. Finally, this section presents estimates of the volumes of contaminated media.

2.1 REMEDIAL ACTION OBJECTIVES

The purpose of this section is to develop RAOs for Site 46 at NAS Pensacola. RAO development is an important step in the FS process. The RAOs are medium-specific goals that define the objective of conducting remedial actions to protect human health and the environment. The RAOs specify the COCs, potential exposure routes and receptors, and acceptable concentrations (i.e., cleanup goals) for the site.

The development of cleanup goals takes into consideration chemical-specific ARARs and TBCs, if any. Section 2.1.2 identifies the ARARs and TBCs, Section 2.1.3 identifies the media of concern, and Section 2.1.4 identifies the COCs retained for remediation at Site 46.

2.1.1 Statement of Remedial Action Objectives

RAOs are developed to permit consideration of a range of treatment and containment alternatives. Site-specific RAOs specify COCs, media of interest, exposure pathways, and cleanup goals or acceptable contaminant concentrations. This FS addresses soil and groundwater contamination at Site 46. To protect the public from potential current and future health risks, as well as to protect the environment, the following site-specific RAOs have been developed:

- **RAO 1:** Prevent unacceptable human health risk associated with exposure to groundwater as a result of the leaching of lead and TCE from soil at concentrations exceeding their Florida Leachability to Groundwater SCTLs.

- **RAO 2:** Prevent unacceptable human health risk associated with exposure to groundwater containing organic compounds (TCE, VC and naphthalene) and metals at concentrations exceeding their USEPA and Florida MCLs or Florida GCTLs.

2.1.2 Applicable or Relevant and Appropriate Requirements (ARARs) and To Be Considered Criteria (TBCs)

ARARs generally consist of the following:

Those substantive cleanup or control standards or environmental protection requirements, criteria, or limitations, promulgated under other Federal environmental or State environmental or facility siting laws and regulations which are either:

- Directly "Applicable" to the contaminants, proposed remedial action, location, or other circumstances found at a particular CERCLA site, or;
- Are "Relevant and Appropriate" for use at a CERCLA site because they address problems or situations sufficiently similar to those encountered at the site such that their use is well suited to the site.

To qualify, all State ARARs must be identified by the State in a timely manner and must be more stringent than the equivalent federal standard, requirement, criteria or limitation.

Per 40 CFR 300.400(g)(3), TBCs are nonpromulgated, nonenforceable guidelines or criteria that may be useful for interpreting ARARs or to determine preliminary remediation goals when ARARs do not exist for a particular contaminant. Examples of TBCs include USEPA Drinking Water Health Advisories, Reference Doses (RfDs) and Cancer Slope Factors (CSFs).

In addition, according to 40 CFR 300.430(f)(1)(i)(A), overall protection of human health and the environment and compliance with ARARs are threshold requirements that each alternative must meet to be eligible for selection.

2.1.2.1 Definitions

The NCP at 40 CFR 300.5 provides the following definitions for ARARs:

- Applicable Requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under any Federal environmental or State environmental or facility siting law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site.

- Relevant and Appropriate Requirements are cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitations promulgated under any Federal environmental or State environmental or facility siting law applicable to a hazardous substance, pollutant, contaminant, or remedial action, location, or other circumstance at a CERCLA site), that address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well suited to the particular site.

Per 40 CFR 300.400(g)(3), other advisories, criteria, or guidance are to be considered for a particular release. The TBC category consists of advisories, criteria, or guidance that were developed by USEPA, other federal agencies, or states that may be useful in developing CERCLA remedies.

Under CERCLA Section 121(d)(4), the Navy as a lead agency may waive compliance with an ARAR if one of the following conditions can be demonstrated:

- The remedial action selected is only part of a total remedial action that will attain the ARAR level or standard of control upon completion.
- Compliance with the requirement will result in greater risk to human health and the environment than other alternatives.
- Compliance with the requirement is technically impracticable from an engineering perspective.
- The remedial action selected will attain a standard of performance equivalent to that required by the ARAR through the use of another method or approach.
- With respect to a state requirement, the state has not consistently applied the ARAR in similar circumstances at other remedial actions in the state.
- Compliance with the ARAR will not provide a balance between protecting public health, welfare, and the environment at the facility with the availability of Superfund money for response at other facilities (fund-balancing). This condition only applies to Superfund-financed actions.

USEPA and the NCP have divided ARARs into three categories to facilitate identification. Chemical-specific and location-specific ARARs are identified early in the process, generally during the RI, and action-specific are normally identified during the FS in the detailed analysis of alternatives. The categories of ARARs are defined as follows:

- Chemical-Specific: Health- or risk-based numerical values or methodologies that establish concentration or discharge limits for particular contaminants. Examples include MCLs and Clean Water Act (CWA) Ambient Water Quality Criteria .

- Location-Specific: Restrict actions or contaminant concentrations in certain environmentally sensitive areas. Examples of areas regulated under various federal laws include floodplains, wetlands, and locations where endangered species or historically significant cultural resources are present.

- Action-Specific: Technology- or activity-based requirements, limitations on actions, or conditions involving special substances. Examples of action-specific ARARs include Resource Conservation and Recovery Act (RCRA) regulations for generation, characterization, and management of hazardous wastes and CWA effluent limitations and pre-treatment standards for wastewater discharges.

The following section discusses chemical- and location-specific ARARs and TBCs. Action-specific ARARs and TBCs are presented in Section 2.3 along with the discussion of GRAs.

2.1.2.2 Chemical-Specific ARARs and TBCs

Tables 2-1 and 2-2 present federal and State of Florida chemical-specific ARARs and TBCs, respectively, for Site 46. These ARARs and TBCs provide medium-specific guidance on “acceptable” or “permissible” concentrations of contaminants.

2.1.2.3 Location-Specific ARARs and TBCs

Location-specific ARARs and TBCs place restrictions on concentrations of contaminants or the conduct of activities based on the site’s particular characteristics or location. There are no location-specific ARARs or TBCs for Site 46.

2.1.2.4 Action-Specific ARARs

Action-specific ARARs are technology- or activity-based regulatory requirements or guidance that would control or restrict remedial action. Tables 2-3 and 2-4 present lists of federal and state action-specific ARARs, respectively, for Site 46.

TABLE 2-1

FEDERAL CHEMICAL-SPECIFIC ARARs AND TBCs
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

REQUIREMENT	CITATION	STATUS	SYNOPSIS	EVALUATION/ACTION TO BE TAKEN
Applicable or Relevant and Appropriate Requirements (ARARs)				
SDWA Regulations, MCLs	40 CFR Part 141.61(a) and (c) and 141.62(b)	Relevant and Appropriate	Establishes standards for potable water for specific contaminants that have been determined to adversely affect human health.	Would be used as protective levels for groundwater that is a potential drinking water source.
To Be Considered (TBCs)				
SDWA Regulations, National Secondary Drinking Water Standards (SMCLs)	40 CFR Part 143	To Be Considered	Establishes welfare-based standards for public water systems for specific contaminants or water characteristics that may affect the aesthetic qualities of drinking water.	Would be considered in establishing protective levels for groundwater that is a potential drinking water source.

Notes:
CFR = Code of Federal Regulations
MCLs = Maximum Contaminant Levels
SDWA = Safe Drinking Water Act

TABLE 2-2

STATE CHEMICAL-SPECIFIC ARARs
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

REQUIREMENT	CITATION	STATUS	SYNOPSIS	EVALUATION/ACTION TO BE TAKEN
Applicable or Relevant and Appropriate Requirements (ARARs)				
Florida Groundwater Classes, Standards, and Exemptions	Chapter 62-520.400, 520.410, and 520.420, F.A.C.	Applicable	The pertinent portions of these rules designate five classes of groundwater and specifies that Classes I and II must meet primary drinking water standards listed in Chapter 62-550 F.A.C.	This rule was used to classify groundwater and establish cleanup goals for groundwater. Groundwater at this site is considered a potential source of drinking water (Class II).
Florida Drinking Water Standards, Monitoring and Reporting	Chapter 62-550.310, 550.320, 550.515, and 550.520, F.A.C.	Relevant and Appropriate	These rules provide primary drinking water standards and MCLs and monitoring requirements for public water supply systems.	Any pertinent State primary drinking water standard(s) more stringent than federal MCLs will be used to establish groundwater cleanup goals for this site.
Florida Contaminant Cleanup Target Levels (CTLs)	Chapter 62-777.170, F.A.C. (Tables I and II)	Relevant and Appropriate	This rule provides guidance for soil, groundwater, and surface water cleanup levels that can be developed on a site-by-site basis.	These target levels for groundwater (Table II) and soil (Table II) would be used in determining cleanup goals for soil and groundwater at the site.
Florida Contaminated Site Cleanup Criteria	Chapter 62-780.650, F.A.C.	Relevant and Appropriate	This rule provides a risk-based corrective action process that is iterative and that tailors site rehabilitation tasks based on site-specific conditions and risk assessment.	These guidelines would be used in determining cleanup goals for soil and groundwater. A ILCR level of 1 x 10^{-6} and a HI of 1 or less considered in developing apportioned CTLs.

Notes:

CTL = Cleanup Target Levels
HI = Hazard Index
MCL = Maximum Contaminant Level
F.A.C. = Florida Administrative Code
ICLR = Incremental Lifetime Cancer Risk

TABLE 2-3

FEDERAL ACTION-SPECIFIC ARARs AND TBCs
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

REQUIREMENT	CITATION	STATUS	SYNOPSIS	EVALUATION/ACTION TO BE TAKEN
Applicable or Relevant and Appropriate Requirements (ARARs)				
RCRA Regulations, Identification and Listing of Hazardous Wastes	40 CFR Part 262.11 and 264.13(a)(1)	Applicable	Defines the listed and characteristic hazardous wastes subject to RCRA. Requires characterization of solid waste and additional characterization of waste determined to be hazardous.	These regulations would apply when determining whether or not a solid waste is hazardous, either by being listed or by exhibiting a hazardous characteristic, as described in the regulations.
RCRA Regulations, Use and Management of Containers	40 CFR Part 264, Subpart I	Potentially Applicable	Sets standards for the storage of containers of hazardous waste.	This requirement would apply if a remedial alternative involves the storage of a hazardous waste (i.e., contaminated soil) in containers prior to treatment or disposal.
To Be Considered (TBCs)				
Air/Superfund National Technical Guidance	USEPA Guidance: EPA/450/1-89/001-EPA/450/1-89/004	To Be Considered	This guidance describes methodologies for predicting risks due to air releases at a Superfund site.	This guidance would be considered when risks due to air releases from fugitive dust are being evaluated.

Notes:
CFR = Code of Federal Regulations
RCRA = Resource Conservation and Recovery Act
USEPA = United States Environmental Protection Agency

TABLE 2-4

**STATE ACTION-SPECIFIC ARARs
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 1 OF 2**

REQUIREMENT	CITATION	STATUS	SYNOPSIS	EVALUATION/ACTION TO BE TAKEN
Applicable or Relevant and Appropriate Requirements (ARARs)				
Florida Water Well Permitting and Construction Requirements	Chapter 62-532.500, F.A.C.	Applicable	Establishes minimum standards for location, construction, repair, and abandonment of water wells.	These requirements for construction, repair, and abandonment of monitoring and/or extraction, wells will be met.
Florida Natural Attenuation with Monitoring Regulations	Chapter 62-780.690(8)(a) through (c), F.A.C.	Relevant and Appropriate	Specifies minimum number of wells and sampling frequency for groundwater monitoring as part of a Monitored Natural Attenuation (MNA) remedy.	These requirements for implementation of groundwater monitoring as part of an MNA remedy will be met.
Florida Post-Active Remediation Monitoring Regulation	Chapter 62-780.750, F.A.C.	Potentially Relevant and Appropriate	Specifies minimum number of wells and sampling frequency for groundwater monitoring as part of post-active remediation monitoring.	The requirements of post-active remediation monitoring following implementation of the groundwater remedy will be met.
Florida Hazardous Waste - Requirements for Remedial Action	Chapter 62-730.225(3), F.A.C.	Applicable	Requires warning signs at sites suspected or confirmed to be contaminated with hazardous waste.	This requirement will be met.
Florida Solid Waste Management Facilities	Chapter 62-701.320, 701.500, 701.510 F.A.C.	Potentially Applicable	Sets the facility standards for construction, management, and monitoring of Solid Waste Management Units (SWMUs).	These requirements apply if on-site waste (or IDW) is deemed non-hazardous solid waste and needs to be stored, transported, or disposed properly.

TABLE 2-4

**STATE ACTION-SPECIFIC ARARs
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 2 OF 2**

REQUIREMENT	CITATION	STATUS	SYNOPSIS	EVALUATION/ACTION TO BE TAKEN
Florida Air Pollution Control Rules – Feb. 2008	Chapter 62-204.240,F.A.C.	Potentially Relevant and Appropriate	Establishes requirements for owners or operators of any source that emits any air pollutant. This rule also establish ambient air quality standards for sulfur dioxide, carbon monoxide, lead, and ozone.	Although this rule is directly applicable to industrial polluters, these requirements are relevant and appropriate for a remedial action that could result in release of regulated contaminants to the atmosphere.

F.A.C. = Florida Administrative Code
MNA = Monitored Natural Attenuation
SWMU = Solid Waste Management Unit

2.1.3 Media of Concern

Based on the discussion in Section 1.0 involving toxicity and risk assessment for human receptors, the media of concern at Site 46 was determined to be surface soil, subsurface soil, and groundwater. The subsurface soil of concern is less than 4 feet in depth. Ecological receptors of concern were not identified at Site 46 for exposure to soil or groundwater.

2.1.4 Chemicals of Concern

Following all risk assessment calculations, the COCs at Site 46 are lead and TCE in soil with concentrations exceeding the Florida Leachability to Groundwater SCTLs under Chapter 62-777, F.A.C., and volatile organic compounds, TCE and VC, exceeding their federal drinking water quality criteria and Florida MCLs under Chapter 62-550, F.A.C.), naphthalene exceeding its Florida GCTL under Chapter 62-777, FAC, and metals in groundwater with concentrations exceeding their USEPA and Florida MCLs.

2.2 CLEANUP GOALS

A cleanup goal is the target concentration to which a COC must be reduced within a particular medium of concern to achieve RAOs. According to the NCP, cleanup goals are developed based on readily available information such as chemical-specific ARARs and reasonably anticipated future land use. Current land use at NAS Pensacola consists of aviation-related activities at Forrest Sherman Field, various military housing, training, and support activities, and historical facilities open to the public, including the National Museum of Naval Aviation. The current non-residential (recreational) land use scenario at Site 46 will remain for the foreseeable future at NAS Pensacola.

Considering all ARARs, reasonably anticipated land use, and risk assessment calculations, the COCs for Site 46 and their cleanup goals are as follows:

2.2.1 Soil Cleanup Goals

The Florida Leachability to Groundwater SCTLs for TCE and lead:

- TCE: 30 μg/kg
- Lead 15 μg/L, based on the SPLP

2.2.2 Groundwater Cleanup Goals

The Florida MCLs and Florida GCTLs have been selected as they are equal to or more stringent than the USEPA MCLs for the following COCs:

- TCE: 3 µg/L
- VC: 1 µg/L
- Naphthalene: 14 µg/L
- Arsenic: 10 µg/L
- Cadmium: 5 µg/L

2.3 GENERAL RESPONSE ACTIONS AND ACTION-SPECIFIC ARARs

GRAs are broadly defined remedial approaches that may be used (by themselves or in combination with one or more of the others) to attain the RAOs. Action-specific ARARs are those legal requirements either directly applicable to or relevant and appropriate for the type of remedial activities to be undertaken on the site.

2.3.1 General Response Actions

GRAs describe categories of actions that could be implemented to satisfy or address a component of the RAOs for the site. Remedial action alternatives are formed using GRAs individually or in combination to meet the RAOs.

Because current and future land use will involve industrial/recreational activities, the following GRAs will be considered for soil at Site 46:

- No Action
- Removal (Excavation and Off-site Disposal)

The following GRAs will be considered for groundwater at Site 46:

- No Action
- Limited Action (LUC, Natural Attenuation and Monitoring)
- In-Situ Treatment (AS/ SVE)

2.4 ESTIMATED VOLUMES OF CONTAMINATED MEDIA

The chemical-specific volumes of soil and groundwater requiring remediation were estimated using the following medium-specific decision criteria:

Soil

- The volume of contaminated soil was determined based on the Leachability to Groundwater SCTL for lead and TCE as the soil cleanup goal (Section 2.2).

- The soil area was assumed to encompass the 1,600 feet square area at the northeast end of Building 72 from a depth of 2 to 4 feet bls and two 628 feet square areas at the southwest corner of Buildings 71 and 72. The total soil area impacted by lead and TCE above Leaching to Groundwater SCTL is 4,457 feet square.

Groundwater

- Volumetric determinations were based on groundwater analytical data from monitoring well locations that had exceedances of federal and state groundwater quality standards.

- Groundwater contaminant distributions were estimated using the observed groundwater flow direction.

- To account for dispersion, the affected groundwater was assumed to extend to a point midway between the observed exceedance by a COC of federal and state groundwater quality standards and the nearest well with a COC at a concentration below its federal and state groundwater quality standard.

- The thickness of the saturated volume of aquifer matrix used in the calculations was estimated to be 10 feet based on the lithology of the shallow aquifer.

- The porosity of the aquifer matrix was estimated to be 30 percent based on typical values for the site lithology.

2.4.1 <u>Estimated Chemical-Specific Volume of Contaminated Soil</u>

To delineate the extent of contaminants in soil at Site 46, 19 soil borings (46SB25 to 46SB43) were conducted 6 to collect soil samples for chemical analysis at a fixed base laboratory. Two of the soil samples (near the northeast corner of former Building 72) collected from 0 to 6 inches bls and one sample from 0.5 to 2 feet bls contained TCE at concentrations exceeding the Florida Industrial Direct Exposure Florida SCTL Soil sample collected from 0 to 6 inches bls, 0.5 to 2 feet bls and 2 to 4 feet bls at four locations contained TCE at concentrations exceeding the Florida Leachability to Groundwater SCTL One surface soil sample location (46SB21) contained lead at a concentration greater than the residential direct exposure SCTL. This sample was collected from 0 to 6 inches bls. Lead concentrations in soil samples from three soil boring locations submitted for SPLP extraction exceeded the Florida Level MCL for lead under Chapter 62-550 F.A.C. One soil sample collected from 0 to 6 inches bls and one from 6 inches to 2 feet bls contained lead at concentrations exceeding its Florida Leachability to Groundwater SCTL. Two soil samples collected from 2 to 4 feet bls contained lead at concentrations exceeding its Florida Leachability to Groundwater SCTL.

Based on the 2006 soil excavation and 2008 reconstruction and improvements, previous sampling data presented in RI are not representative of current conditions at the site. Therefore, taking into account that the upper two feet of soil have been excavated and replaced with clean soil, the current impacted soil area is estimated to be 80 feet by 20 feet, from a depth of 2 to 4 feet bls, extending from just west of 46SB43 and ending within the recreational walkway between Buildings 71 and 72. It is estimated that 165 cubic yards (yd^3) of soil exceed the Leachability to Groundwater SCTL for lead and TCE

2.4.2 Estimated Chemical-Specific Volume of Contaminated Groundwater

TCE, VC and naphthalene were detected in groundwater samples at concentrations exceeding Florida groundwater quality criteria. TCE was detected in groundwater samples collected from four shallow monitoring wells (38GS03, 38GS05, 38GS13, and PEN-46-19) at concentrations ranging from 1 to 17 μg/L. TCE was detected in two shallow monitoring wells (38GS03 at 11 μg/L and 38GS13 at 17 μg/L) at concentrations greater than its Florida MCL of 3 μg/L; VC was detected (38GS03 at 4 μg/L and 38GS13 at 3 μg/L) in the same shallow monitoring wells at concentrations greater than its Florida MCL of 1 μg/L. Naphthalene was detected in a groundwater sample collected from shallow monitoring well PEN-46-19 at 240 μg/L, which exceeds its Florida GCTL of 14 μg/L. Cadmium was detected in a groundwater sample collected from shallow monitoring well 38GS05 at 8.9 μg/L, which exceeds its Florida MCL of 5 μg/L. Arsenic was detected in a groundwater sample collected from shallow monitoring well PEN-46-19 at 13.3 μg/L, which exceeds its Florida MCL of 10 μg/L.

Based on the results of the groundwater characterization a plume has been identified at Site 46. The plume includes monitoring wells 38GS03, 38GS05, 38GS13, and PEN-46-19 and extends from the southwest corner of Building 72 to the sea wall, and is approximately 220 feet long and 110 feet wide. Based on an assumed plume thickness of 10 feet, the estimated volume of water impacted by the COCs is approximately 1,810,160 gallons.

3.0 SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

This section identifies, screens, and evaluates the potential technologies and process options that may be applicable to develop remedial alternatives for Site 46 at NAS Pensacola. The primary objective of this phase of the FS is to develop an appropriate range of remedial technologies and process options that will be used for developing the remedial alternatives.

The basis for technology identification and screening began in Section 2.0 with a series of discussions that included the following:

- Development of RAOs
- Identification of ARARs
- Identification of COCs
- Development of cleanup goals
- Identification of GRAs
- Estimate of volumes and areas of the media of concern

Technology screening evaluation is performed in this section with the completion of the following analytical steps:

- Identification and screening of remedial technologies and process options
- Evaluation and selection of representative process options

A variety of technologies and process options are identified under each GRA (discussed in Section 2.3.1) and screened. The selection of technologies and process options for initial screening is based on the Guidance for Conducting RI/FS under CERCLA (USEPA, 1988). The screening is first conducted at a preliminary level to focus on relevant technologies and process options. The screening is then conducted at a more detailed level based on certain evaluation criteria. Finally, process options are selected to represent the technologies that have passed the detailed evaluation and screening.

The evaluation criteria for detailed screening of technologies and process options that have been retained after the preliminary screening are effectiveness, implementability, and cost. The following are descriptions of these evaluation criteria:

- Effectiveness
  - Protection of human health and environment; reduction in toxicity, mobility, or volume; and permanence of the solution.
  - Ability of the technology to address the estimated areas or volumes of contaminated media.
  - Ability of the technology to meet the cleanup goals identified in the RAOs.
  - Technical reliability (innovative versus proven) with respect to contaminants and site conditions.

- Implementability
  - Overall technical feasibility at the site.
  - Availability of vendors, mobile units, storage and disposal services, etc.
  - Administrative feasibility.
  - Special long-term operation and maintenance (O&M) requirements.

- Cost (Qualitative)
  - Capital cost.
  - O&M costs.

Technologies and process options will be identified for Site 46 in the following sections.

3.1 PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

This section identifies and screens technologies and process options at a preliminary stage based on implementation with respect to site conditions and COCs. Tables 3-1 and 3-2 summarize the preliminary screening of technologies and process options for soil and groundwater at Site 46, respectively. The tables present the GRAs, identify the technologies and process options, and provide a brief description of each process option followed by comments regarding the results of the screening process. The technologies and process options that passed the initial screening step were retained for detailed screening in Section 3.2 and 3.4.

3.2 DETAILED SCREENING OF TREATMENT TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL

This section identifies and develops the representative process options for the soil at Site 46, through a detailed screening procedure, that will be used in the formulation of remedial alternatives to accomplish the RAOs and meet the cleanup goals identified in Section 2.0. The retained technologies are summarized in Table 3-3.

TABLE 3-1

**PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 1 OF 4**

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENT
No Action	None	Not applicable	No activities would be conducted at the site to address contamination.	Retain. No action is retained as baseline comparison with other technologies.
Containment	Surface capping	Soil cover	Use of soil cover or low-permeability barriers to minimize exposure to contaminants and migration of contaminants.	Eliminate. Application of soil layer(s) over contaminated areas to reduce exposure of human and animal receptors to site contaminants, and to prevent infiltration and provide a physical barrier.
Removal	Excavation	Excavation	Means for removal of contaminated soil by backhoe, bulldozer, loader, etc.	Retain. Excavation is considered a possibility under current site use scenario as a recreational area.
In-Situ Treatment	Thermal	Vitrification	Use of high-temperature melting to fuse inorganic contaminants into a glass matrix within vadose zone or the use of moderate temperature heating to volatilize and remove contaminants from the vadose zone.	Eliminate. Implementability concerns associated with the shallow groundwater table. Typically used for highly contaminated or radioactive materials.
In-Situ Treatment (Continued)	Thermal (Continued)	Radiofrequency heating	Use of radio-frequency energy to heat soil and cause volatilization of contaminants.	Eliminate. Limited thickness and shallow depth of contaminated soil renders this technology difficult to implement with limited, commercially available equipment.
		Electrical heating	Use of an electrical blanket or electrical heating elements within slotted pipes to volatilize contaminants.	Eliminated because of impracticability in regard to cost versus mass removal.
	Physical/	Soil flushing/ Chemical	Use of water/solvents to remove contaminants from the vadose zone by	Eliminated because of concern about migration of contaminants from soil to

TABLE 3-1

**PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 2 OF 4**

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENT
	Chemical	extraction	flushing and collecting the contaminated wastewater in the saturated zone followed by above-ground pumping and treatment.	groundwater.
		Dynamic underground stripping	Steam injection at the periphery of the contaminated area resulting in the vaporization of volatile compounds bound to soil and the movement of contaminants to a centrally located extraction well.	Eliminated because of impracticability in regard to cost versus mass removal.
		Soil vapor extraction	Use of vacuum and possibly air sparging to volatilize contaminants.	Eliminate. cVOCs are shallow and short-circuiting would limit the effectiveness of SVE.
		Chemical fixation/ Solidification	Mixing of chemical agents in the vadose zone to chemically bind, solidify, and reduce contaminant mobility.	Eliminate. Mobility of soil cVOCs is not a concern at this site. Moreover the treated material would not be suitable for revegetation.
In-Situ Treatment (Continued)	Biological	Biodegradation	Nutrients and amendments are added to surface soil to promote biodegradation.	Eliminated because TCE degrades under anaerobic conditions. Surface soil is not amenable to bioremediation of TCE.

TABLE 3-1

PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 3 OF 4

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENT
Ex-Situ Treatment	Physical/ Chemical	Soil washing/ Solvent extraction	Use of solubilization and chemical (oxidation/reduction/neutralization) processes to remove contaminants from the solid phase and convert them into more concentrated forms or less toxic forms in the liquid phase.	Eliminated because of the cost associated with low treatment volumes. This technology is more cost effective for larger contaminant plumes than that which is present at Site 46.
		Stabilization/ Solidification	Physically binds or encloses contaminants within a stabilized mass and chemically reduces the hazard potential of a waste by converting the contaminants into less soluble, mobile, or toxic forms.	Eliminated because of its limited effectiveness for the immobilization of SVOCs in contaminated soil.
	Biological	On-site landfarming	Tilling of contaminated soil and waste in layers to remove VOCs and biodegrade organics.	Eliminated because of limited availability of land for implementation.
Ex-Situ Treatment (Continued)	Thermal	Off-site incineration	Use of high temperature to destroy organic contaminants.	Eliminated because of the cost associated with low volumes. This technology is more cost effective for larger contaminant plumes than that present at Site 46.
		Low-temperature thermal desorption	Use of low to moderate temperature to volatilize contaminants and remove them from the solid phase into the gaseous phase.	Eliminated because of the cost associated with low volumes. This technology is more cost effective for larger contaminant plumes than that present at Site 46.
Disposal	Landfill	Hazardous or non-hazardous waste landfill	Disposal of excavated material at a permitted on-site or off-site landfill. Recycling can be incorporated if scrap metal is present.	Retain. Excavation has been retained as a possible option.

TABLE 3-1

PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR SOIL
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENT
		Consolidation	Excavation and placement in one location to minimize space and closure requirements.	Eliminated. Due to low volume of contaminated soil.

Notes:

COCs = Chemicals of concern
cPAH = carcinogenic polynuclear aromatic hydrocarbon
LUC = Land Use Control
PAH = Polynuclear aromatic hydrocarbon
SVE = Soil vapor extraction
SVOC = Semi-volatile organic compound
VOC = Volatile organic compound

TABLE 3-2

**PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 1 OF 5**

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENT
No Action	None	Not applicable	No activities would be conducted at the site to address contamination.	Retain. No action is retained as baseline comparison with other technologies.
Limited Action	LUCs (i.e. Institutional and Engineering Controls)	Active controls: Physical barriers/ security guards	Fencing, markers, and warning signs to restrict site access.	Retained. Restricted access would reduce risk of exposure.
		Passive controls: Restrictions on groundwater use	Administrative action such as restricting the use of groundwater as a source of drinking water.	Retain. Groundwater is currently not used as a drinking water source at Pensacola. This technology will limit all future uses of groundwater and thus limit human exposure to groundwater.
	Monitoring	Sampling and analysis	Periodic sampling and analysis of groundwater to track the spread of contamination.	Retain. This technology could effectively assess natural attenuation and/or migration of contaminants from site and evaluate the progress of active remediation.
	Natural Attenuation	Naturally occurring biodegradation and dilution	Monitoring groundwater to assess the reduction in concentrations of COCs through natural processes.	Retain. This technology may decrease concentrations of TCE over time.
Containment	Vertical Barriers	Slurry wall	Use of a low-permeability wall to restrict horizontal migration of groundwater or to redirect groundwater flow.	Eliminate. This technology would not restore groundwater quality and is used for containment only.
		Grout curtain	Pressure injection of grout to form a low-permeability perimeter wall to restrict horizontal migration of groundwater.	Eliminate. This technology would not restore groundwater quality and is used for containment only.

TABLE 3-2

PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 2 OF 5

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENT
Containment (continued)	Vertical Barriers (continued)	Sheet piling	Metal sheet piling driven into the ground to restrict horizontal migration of groundwater or to redirect groundwater flow.	Eliminate. This technology would not restore groundwater quality and would interfere with continued use of the site as an active Naval Air Station with historical facilities open to the public.
	Hydraulic Barriers	Extraction wells	Use of extraction wells and/or collection trenches to restrict horizontal migration of groundwater.	Eliminate. This technology would not restore groundwater quality.
	Horizontal Barriers	Physical barrier	Injection of bottom-sealing slurry beneath source to minimize vertical migration of groundwater.	Eliminate. The source is not migrating vertically.
Removal	Groundwater Extraction	Extraction wells	Series of conventional pumping wells used to remove contaminated groundwater.	Eliminate. This technology is considered effective for containment only.
		Collection trench	A permeable trench used to intercept and collect groundwater.	Eliminate. This technology is considered effective for containment only.
In-Situ Treatment	Biological	Aerobic	Enhancement of biodegradation of organics by addition of nutrients and oxidizers.	Eliminate. The COC is a chlorinated VOC that degrades more favorably under anaerobic conditions.
		Anaerobic	Enhancement of biodegradation of organics in an anaerobic (oxygen-deficient) environment by injection of electron-donor compounds	Eliminate, the concentrations of TCE and VC in groundwater are too low to effectively stimulate or enhance bioremediation.

TABLE 3-2

PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENT
In-Situ Treatment (Continued)	Physical/ Chemical	Air sparging/ Soil vapor extraction	Volatilization of organics by supply of air and extraction of organic compounds.	Retain. This technology is potentially effective because the aquifer predominantly consists of fine sand.
Ex-Situ Treatment	Physical	Filtration	Separation of suspended solids from water via entrapment in a bed of granular media or membrane.	Eliminate. All extraction technologies have been eliminated from consideration.
		Reverse osmosis	Use of high pressure and membranes to separate dissolved materials from water.	Eliminate. All extraction technologies have been eliminated from consideration.
		Air stripping	Contact of water with air to remove volatile organics.	Eliminate. All extraction technologies have been eliminated from consideration.
		Gas-phase granular activated carbon	Separation of volatilized contaminants from a gas stream via adsorption onto activated carbon.	Eliminate. All extraction technologies have been eliminated from consideration.
		Solvent extraction	Separation of contaminants from a solution by contact with an immiscible liquid with a higher affinity for the COCs.	Eliminate. All extraction technologies have been eliminated from consideration.
		Sedimentation	Separation of solids from water via gravity settling.	Eliminate. All extraction technologies have been eliminated from consideration.

TABLE 3-2

**PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 4 OF 5**

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENT
Ex-Situ Treatment (continued)	Chemical	Ion exchange	Process in which ions, held by electrostatic forces to charged functional groups on a resin surface, are exchanged for ions of similar charge in a water stream.	Eliminate. All extraction technologies have been eliminated from consideration.
		Electrolytic recovery	Passage of an electric current through a solution with resultant ion recovery on positive and negative electrodes.	Eliminate. All extraction technologies have been eliminated from consideration.
		Chemical precipitation	Use of reagents to convert soluble constituents into insoluble constituents.	Eliminate. All extraction technologies have been eliminated from consideration.
		Enhanced oxidation	Use of oxidizers such as ozone, hydrogen peroxide, or potassium permanganate to break down certain organic compounds.	Eliminate. All extraction technologies have been eliminated from consideration.
		Neutralization/pH adjustment	Use of acids or bases to counteract excess pH.	Eliminate. All extraction technologies have been eliminated from consideration.
Discharge/ Disposal	Surface discharge	Direct discharge (NPDES)	Discharge of treated water to surface water.	Eliminate. All extraction technologies have been eliminated from consideration.
		Indirect discharge (IWTP/STP)	Discharge of collected/treated water to a Sewage Treatment Plant (STP).	Eliminate. All extraction technologies have been eliminated from consideration.

TABLE 3-2

**PRELIMINARY SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA**

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	SCREENING COMMENT
Discharge/ Disposal (Continued)	Surface discharge (Continued)	Offsite treatment Facility	Treatment and disposal of water at an offsite treatment works.	Eliminate. All extraction technologies have been eliminated from consideration.
	Subsurface discharge	Re-injection	Use of injection wells, spray irrigation, or infiltration to discharge collected/treated groundwater underground.	Eliminate. All extraction technologies have been eliminated from consideration.

Notes:
LUC = Land Use Controls
COCs = Chemicals of concern
IWTP = Industrial Wastewater Treatment Plant
NPDES = National Pollutant Discharge Elimination System
TCE = Trichloroethene
VOC = Volatile organic compound
STP = Sewage Treatment plant

TABLE 3-3

TECHNOLOGIES AND PROCESS OPTIONS RETAINED FOR DETAILED SCREENING FOR SOIL
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION
No Action	None	Not applicable
Removal	Excavation	Excavation of contaminated soil
Disposal	Landfill	Hazardous or non-hazardous waste landfill

3.2.1 No Action

The No Action alternative consists of maintaining the current status of the site, i.e., no remedial action is taken under this response. As required under CERCLA regulations, the No Action alternative is carried through the FS to provide a baseline for comparison with other alternatives and their effectiveness in mitigating risks posed by site contaminants.

Effectiveness

A No Action alternative would not be effective in meeting the RAOs. The contaminated media are left as is without the implementation of any monitoring, LUCs, containment, removal, treatment, or other mitigation actions. Thus, this would not actively reduce the toxicity, mobility, or volume of contaminants in the soil.

Implementability

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

Cost

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

Conclusion

No action is retained because of NCP requirements, although it would not be effective.

3.2.2 Removal

The technology considered under this GRA is excavation.

3.2.2.1 Excavation

A variety of equipment, such as front-end loaders, backhoes, grade-alls, etc. could be used to perform the excavation. The type of equipment selected would take into consideration several factors such as the type of material to be removed, the load-bearing capacity of the ground surrounding the removal area, the depth and areal extent of removal, the required rate of removal, and the elevation of the groundwater table. Excavation is the technology of choice for the removal of well-consolidated material, such as soil from well-defined areas of ground with significant load-bearing capacity (i.e., greater than 1,500 pounds per square foot).

The logistics of excavation must take into account the available space for operating the equipment, loading and unloading of the excavated material, location of the site, etc. After excavation is completed, the void is filled and graded with clean fill material or treated soils.

Effectiveness

Excavation is a well-proven and effective method of removing contaminated material from a site. A properly designed excavation would remove soil with concentrations of COCs greater than cleanup levels followed by suitable use of clean soil as backfill within the excavated areas. Following excavation and backfilling, the overall site concentrations would not pose an unacceptable risk to human health or the environment.

Implementability

Excavation of subsurface soil contaminated by the COCs at concentrations exceeding their leachability to groundwater criteria at Site 46 would be implementable. Excavation equipment is readily available from multiple vendors. This technology is well proven and established in the construction/remediation industry. Prior to excavation, a utility survey would be required; the utilities would be clearly marked so that the excavation does not impact any utility. During excavation, site-specific health and safety procedures and regulations would have to be complied with to ensure that the exposure of the workers to COCs is minimized.

Cost

Cost of excavation at Site 46 on a unit volume basis would be low because of the shallow excavation depth (up to 4 feet bls) and the presence of sandy soils. Moreover, because the depth to the water table is approximately 4 feet bls, requirements for dewatering would not exist under dry weather conditions.

Conclusion

Excavation is retained in combination with other process options for the development of remedial alternatives.

3.2.3 Disposal

The technology considered under this GRA is off-site landfilling.

3.2.3.1 Off-site Landfilling

Off-site landfilling would consist of transporting the excavated soil for disposal at an off-site treatment, storage, and disposal facility (TSDF). Excavated soil characterized as non-hazardous waste under RCRA regulations could be disposed of in a RCRA Subtitle D solid waste landfill. Excavated soil characterized as hazardous waste under RCRA would have to be disposed of in a RCRA Subtitle C hazardous waste landfill. Treatment would be employed, if necessary, to meet Land Disposal Restrictions (LDRs) as required by regulations prior to land disposal.

Effectiveness

Off-site landfilling does not permanently or irreversibly reduce contaminant concentrations. Although the CERCLA preference for treatment relegates landfilling to a less preferable option, this technology can be an effective option for addressing small quantities of contaminated soil at a site. Off-site landfills are only permitted to operate if they meet certain requirements regarding design and operation governing the foundation, liner, leak detection, leachate collection and treatment, daily cover, post-closure inspections and monitoring, etc., which ensure the effectiveness of these facilities.

The requirements of a RCRA hazardous (Subtitle C) landfill are typically more stringent than those of a RCRA non-hazardous (Subtitle D) solid waste landfill. For soil failing Toxicity Characteristic Leachate Procedure (TCLP) limits, treatment (typically using chemical fixation/solidification) would be employed to meet LDRs prior to landfilling at the RCRA Subtitle C facility. Thereby, the hazardous characteristic of constituents present in the soil would be treated prior to land disposal.

Implementability

Off-site landfilling would be easily implementable. Facilities and services are available. Disposal at a RCRA Subtitle D landfill may require certain pre-treatment, mainly the removal of free liquids but, because soil would only be excavated to a depth of 4 feet, groundwater should not be present under dry weather conditions, and this requirement should be easy to meet. In addition, a waste profile would have to be prepared, indicating the contaminant concentrations and their leachability characteristic for waste disposal. Disposal of any soil with TCLP levels exceeding hazardous criteria would require pre-treatment to meet LDRs prior to landfilling. If treatment achieves Universal Treatment Standards, then disposal of the treated soil in a RCRA Subtitle D landfill would be permissible. If not, the treated soil would need to be disposed of in a RCRA Subtitle C landfill.

Cost

The cost of off-site landfilling at a RCRA Subtitle D facility would be low based on volume. The unit cost for disposal at a RCRA Subtitle C facility is typically higher than the cost for disposal at a RCRA Subtitle D facility.

Conclusion

Off-site landfilling is retained for use in combination with other process options for the development of remedial alternatives.

3.3 SELECTION OF REPRESENTATIVE PROCESS OPTIONS FOR SOIL

The following GRAs, technologies, and process options, under the GRAs as noted, were retained for the development of soil remedial alternatives:

- No Action
- Excavation and Off-site Disposal

The process options listed in Table 3-3 were retained for the formulation of alternatives.

3.4 DETAILED SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER

This section identifies and develops the representative process options for groundwater at Site 46, through a detailed screening procedure, that will be used in the formulation of remedial alternatives to accomplish the RAOs and meet the cleanup goals identified in Section 2.0. The retained technologies are summarized in Table 3-4.

3.4.1 No Action

The No Action alternative consists of maintaining the current status of the site, i.e., no remedial action is taken under this response. As required under CERCLA regulations, the No Action alternative is carried through the FS to provide a baseline for comparison with other alternatives and their effectiveness in mitigating risks posed by site contaminants.

Effectiveness

A No Action alternative would not be effective in meeting the RAOs. The contaminated media are left as is without the implementation of any monitoring, LUCs, containment, removal, treatment, or other mitigation actions. Thus, No Action would not actively reduce the toxicity, mobility, or volume of contaminants in the groundwater.

Implementability

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

Cost

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

Conclusion

No Action is retained for comparison to other options per NCP requirements.

3.4.2 Limited Action

3.4.2.1 Land Use Controls

LUCs would be developed to prevent unacceptable risks from exposure to contaminated groundwater. These LUCs would be formulated and implemented to prevent the extraction of surficial aquifer groundwater at Site 46. The following performance objectives would be incorporated into the LUC RD:

- Prohibit all uses of groundwater from the surficial aquifer underlying the site (including, but not limited to, human consumption, dewatering, irrigation, heating/cooling purposes, and industrial processes) unless prior written approval is obtained from USEPA and FDEP.

- Maintain the integrity of any existing or future monitoring or remediation system(s) unless prior written approval is obtained from USEPA and FDEP.

Effectiveness

Groundwater use restrictions would be effective in combination with plume remediation activities. These controls would minimize potential human health risks associated with exposure to contaminated groundwater.

TABLE 3-4

**TECHNOLOGIES AND PROCESS OPTIONS RETAINED FOR DETAILED SCREENING FOR GROUNDWATER
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA**

GENERAL RESPONSE ACTION	REMEDIAL TECHNOLOGY	PROCESS OPTION
No Action	None	Not applicable
Limited Action	LUCs	Restriction on all uses of groundwater
	Monitoring	Periodic sampling and analysis of groundwater to track natural attenuation
	Natural attenuation	Monitoring groundwater to assess the reduction in concentrations of COCs through natural processes
In-Situ Treatment	Air Sparging/ Soil Vapor Extraction (AS/SVE)	Supply of air and extraction of volatilized organic compounds

Note:

COC = contaminant of concern

LUCs = Land Use Controls

Implementability

LUCs would be readily implementable. NAS Pensacola will remain an active military facility in the foreseeable future. Groundwater is currently not used as a drinking water source at NAS Pensacola because of high mineralization. LUCs would assure prohibition of future use of groundwater and thus limit human exposure to groundwater at the site.

Cost

Costs for LUCs would be low.

Conclusion

LUCs are retained in combination with other process options for the development of groundwater remedial alternatives.

3.4.2.2 Monitoring

Sampling of groundwater and analysis for the soil and groundwater COCs throughout the area of the identified plume on could be used to evaluate migration of COCs and the potential for contamination of possible future on-site drinking water supplies. Groundwater monitoring would provide an effective means of evaluating the concentrations of TCE, VC, naphthalene, arsenic and cadmium in groundwater. Because lead exceeded its Florida Leachability to Groundwater SCTL, it would be included in the parameters monitored if the subsurface soils are not excavated. Monitoring could also be used to monitor potential natural attenuation or the progress of active groundwater remediation.

Effectiveness

Monitoring would not of itself reduce the toxicity, mobility, or volume of COCs in the groundwater, but it would allow the evaluation of potential off-site migration of contaminants and the expected reduction in contaminant concentrations through natural attenuation or active remediation. Periodic groundwater monitoring would serve as a warning mechanism for migration of the COCs. Monitoring would also be helpful in measuring and evaluating the effectiveness of natural attenuation and/or active remediation technologies.

Implementability

A groundwater monitoring program could be readily implemented using the existing monitoring wells at Site 46. Local and state permits would be required for additional monitoring well installation, if required.

4.0 ASSEMBLY AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES

4.1 INTRODUCTION

This section presents an evaluation of each remedial alternative with respect to the criteria of the NCP (40 CFR Part 300). These criteria 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 Part 300.430), the following nine criteria are used for the evaluation of remedial alternatives:

Threshold Criteria:

These criteria relate directly to statutory findings that must be met by the selected remedy.

- Overall Protection of Human Health and the Environment
- Compliance with ARARs

Primary Balancing Criteria:

These criteria are grouped together because they represent the primary criteria upon which the analysis of each alternative is based.

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

Modifying Criteria:

These criteria will be evaluated after regulatory and public comments are addressed and a decision on the selected remedy is being made.

- State Acceptance
- Community Acceptance

Cost

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

Conclusion

Monitoring is retained in combination with other process options for the development of groundwater remedial alternatives.

3.4.2.3 Natural Attenuation

Natural attenuation would consist of monitoring groundwater quality to determine the extent to which naturally occurring processes such as biodegradation, abiotic transformation, dispersion, and dilution would reduce concentrations of TCE in the plume. Although currently only a single groundwater sampling event has been completed at the site, Natural Attenuation is expected to be effective based on the DO, temperature, and ORP field measurements recorded during the RI along with the presence of cis-1,2-DCE and VC which are products of the natural attenuation of TCE. The field measurements and analytical results are indicative of active ongoing natural attenuation within the plume area.

New monitoring wells would be installed, if necessary, and groundwater samples from these existing and new monitoring wells would be regularly collected and analyzed for natural attenuation parameters such as ORP, DO, pH, alkalinity, temperature, conductivity, total organic carbon (TOC), ferrous and total iron, sulfur compounds (sulfides, sulfates), nitrogen compounds (nitrites, nitrates), orthophosphates, chloride, and metabolic gases (methane, ethane, ethene, and carbon dioxide).

Effectiveness

The detected TCE concentrations are relatively low, varying from 1 to 17 µg/L. Limited historical information suggests that natural attenuation may be occurring at Site 46. Initial results of water quality field parameters from the groundwater contaminated plume area indicates DO concentrations are less than 0.5 milligrams per liter (mg/L); pH values ranging from 6.81 to 7.15; and ORP values of less than 50 milivolts (mV), all which are indicative of ongoing natural attenuation. The TCE concentrations in thegroundwater samples collected from the four monitoring wells in the plume are below the Florida natural attenuation default source concentration (NADSC) criteria of 300 µg/L.

Natural attenuation could still be effective for the removal of TCE through mechanisms other than biodegradation, such as dispersion and dilution. However, such mechanisms are typically slower in reducing concentrations of TCE.

Groundwater monitoring would provide an effective means of evaluating the concentrations of TCE, VC, naphthalene, arsenic and cadmium in groundwater and of assessing the rate of decrease of the concentrations. Monitoring of indicator parameters would help to evaluate the potential effectiveness of the reductive dechlorination process.

Implementability

Natural attenuation would be easy to implement. Monitoring groundwater quality and periodically reviewing site conditions could readily be performed, and the necessary resources are available to provide these services.

Cost

Capital and O&M costs for natural attenuation would be low to moderate.

Conclusion

Natural attenuation is retained for the development of remedial alternatives because this technology could be effective in the long term and for the relatively low TCE, VC, naphthalene, arsenic and cadmium concentrations at the site.

3.4.3 In-Situ Treatment - Air Sparging/Soil Vapor Extraction (AS/SVE)

AS consists of injecting air into a contaminant plume to induce an air current through the groundwater that promotes short-term stripping of VOCs and long-term aerobic biodegradation of residual VOCs and naphthalene. Air is injected through a network of vertical wells screened at various depths within the contaminant plume. If capture and treatment of vaporized groundwater COCs or treatment of overlying soil (vadose zone) is required, an SVE system is added. In this case, a vacuum is applied through a network of vertical wells screened in the vadose zone above the contaminant plume, and the extracted vapors are collected and treated either through vapor-phase granular activated carbon (GAC) adsorption or another acceptable technology such as catalytic oxidation. Groundwater samples are regularly collected and analyzed to monitor the progress of the remedial action and, if an SVE system is used, off-gas samples are collected and analyzed to evaluate its performance, quantify mass removal, and to verify compliance with regulatory emission requirements.

Effectiveness

AS and AS/SVE are well-established technologies that could be effective for the removal of TCE and its natural attenuation degradation products (1,2-DCE and VC) by short-term stripping of VOCs and long-term aerobic biodegradation of the VOCs and naphthalene at Site 46. Because of the low concentrations of VOCs in Site 46 groundwater, it is anticipated that an SVE off-gas treatment system, such as activated carbon, would not be required. TCE and its natural attenuation degradation products (1,2-DCE and VC) would be removed primarily through volatilization.

The use of AS results in highly aerobic subsurface conditions, and a significant lag time (possibly up to 6 months) is required following application for the subsurface to readjust to anaerobic conditions if anoxic/anaerobic reductive natural attenuation is required to complete the remediation process.

Implementability

AS/SVE could be implemented at Site 46. Many qualified contractors would be available for the implementation of this technology. Installation of AS and SVE wells through concrete or asphalt surfaces at the site would have to be followed by repair with like material to match the existing conditions. Load-rated well vaults may be required in paved areas.

Cost

Capital and O&M costs for AS/SVE would be moderate.

Conclusion

AS/SVE is retained for further consideration.

3.5 SELECTION OF REPRESENTATIVE TECHNOLOGIES AND PROCESS OPTIONS FOR GROUNDWATER

The following GRAs, technologies, and process options, under the GRAs as noted, were retained for the development of groundwater remedial alternatives:

- No Action
- Limited Action: LUCs, monitoring, and natural attenuation
- In-Situ Treatment: AS/SVE

The next step is to select representative process options from each technology to assemble an adequate variety of alternatives and evaluate the alternatives in sufficient detail to aid in the final selection process. All process options listed in Table 3-4 were retained for the development of alternatives.

4.1.1.1 Overall Protection of Human Health and the Environment

Alternatives must be assessed for adequate protection of human health and the environment, in both the short and long term, from unacceptable risks posed by hazardous substances or contaminants present at the site by eliminating, reducing, or controlling exposure to levels exceeding cleanup goals. Overall protection draws on the assessments of other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

4.1.1.2 Compliance with ARARs

Alternatives must be assessed to determine whether they attain ARARs under Federal environmental laws and State environmental or facility siting laws. CERCLA Section 121(d) specifies in part that remedial actions for cleanup of hazardous substances must comply with requirements and standards under Federal or more stringent State environmental laws and regulations that are applicable or relevant and appropriate (i.e., ARARs) to the hazardous substances or particular circumstances at a site or a waiver must be obtained [see also 40 CFR 300.430(f)(1)(ii)(B)]. ARARs include only Federal and State environmental or facility siting laws/regulations and do not include occupational safety or worker protection requirements. In addition, per 40 CFR 300.405(g)(3), other advisories, criteria, or guidance may be considered in determining remedies (TBC guidance category).

4.1.1.3 Long-Term Effectiveness and Permanence

Alternatives must be assessed for the long-term effectiveness and permanence they offer, along with the degree of certainty that the alternative will prove successful. Factors that will be considered as appropriate include the following:

- Magnitude of Residual Risk - Risk posed by untreated waste or treatment residuals at the conclusion of remedial activities. The characteristics of residuals should be considered to the degree that they remain hazardous, taking into account their volume, toxicity, mobility, and propensity to bioaccumulate.

- Adequacy and Reliability of Controls - Controls such as containment systems and LUCs that are necessary to manage treatment residuals and untreated waste must be shown to be reliable. In particular, the uncertainties associated with land disposal for providing long-term protection from residuals; the assessment of the potential need to replace technical components of the alternative such as a cap, slurry wall, or treatment system; and the potential exposure pathways and risks posed if the remedial action needs replacement.

4.1.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

The degree to which the alternative employs recycling or treatment that reduces the toxicity, mobility, or volume will be assessed, including how treatment is used to address the principal threats posed by the site. Factors that will be considered, as appropriate, include the following:

- The treatment or recycling processes the alternative employs and the materials that they will treat.
- The amount of hazardous substances, pollutants, or contaminants that will be destroyed, treated, or recycled.
- The degree of expected reduction in toxicity, mobility, or volume of waste due to treatment or recycling and the specification of which reduction(s) is occurring.
- The degree to which the treatment is irreversible.
- The type and quantity of residuals that will remain following treatment, considering the persistence, toxicity, mobility, and propensity to bioaccumulate of such hazardous substances and their constituents.
- The degree to which treatment reduces the inherent hazards posed by principal threats at the site.

4.1.1.5 Short-Term Effectiveness

The short-term impacts of the alternative will be assessed considering the following:

- Short-term risks that might be posed to the community during implementation.
- Potential impacts on workers during remedial action and the effectiveness and reliability of protective measures.
- Potential environmental impacts of the remedial action and the effectiveness and reliability of mitigative measures during implementation.
- Time until protection is achieved.

4.1.1.6 Implementability

The ease or difficulty of implementing the alternatives will be assessed by considering the following types of factors, as appropriate:

- Technical feasibility, including technical difficulties and unknowns associated with the construction and operation of a technology, the reliability of the technology, ease of undertaking additional remedial actions, and the ability to monitor the effectiveness of the remedy.

- Administrative feasibility, including activities needed to coordinate with other offices and agencies, and the ability and time required to obtain any necessary approvals and permits from other agencies (for off-site actions).

- Availability of services and materials, including the availability of adequate off-site treatment capacity, storage capacity, and disposal capacity and services; the availability of necessary equipment and specialists, and provisions to ensure necessary additional resources; the availability of services and materials; and the availability of prospective technologies.

4.1.1.7 Cost

Capital costs will include both direct and indirect costs. Annual O&M costs will be provided, and a net present value of the capital and O&M costs will also be provided. Typically, the cost estimate accuracy is plus 50 percent to minus 30 percent.

4.1.1.8 State Acceptance

The state’s concerns that must be assessed include the following:

- The state’s position and key concerns related to the preferred alternative and other alternatives
- State comments on ARARs or the proposed use of waivers

These concerns cannot be evaluated until the State has reviewed and commented on the FS. These concerns will be discussed, to the extent possible, in the Proposed Plan to be issued for public comment.

4.1.1.9 Community Acceptance

This assessment consists of responses of the community to the Proposed Plan and includes determining which components of the alternatives interested persons in the community support, have reservations about, or oppose. This assessment can be conducted after comments on the Proposed Plan are received from the public.

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 the alternatives.

The remaining two of the nine criteria: State Acceptance and Community Acceptance, are considered to be modifying criteria that must be considered during remedy selection. These last two criteria can be evaluated after the FS has been reviewed by the FDEP and the Proposed Plan has been discussed at a public meeting, if required and requested, and opened to public comment. Therefore, this document addresses only seven of the nine criteria.

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 public review and comment. The preferred alternative must meet the following two criteria per CERCLA Section 121(b):

- Protection of human health and the environment
- Compliance with ARARs unless a waiver is justified

It should also meet the following criteria to the extent practicable:

- Cost effectiveness in protecting human health and environment and in complying with ARARs
- Utilization of permanent solutions and alternate treatment technologies or resource recovery technologies to the maximum extent practicable

The second step consists of the review of public comments and determination by the Navy and USEPA, in consultation with FDEP as to whether the preferred alternative continues to be the most appropriate remedial action for the site.

4.2 ASSEMBLY AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR SOIL

Based on the soil removal activities conducted in 2006 and construction activities conducted in 2008, detailed screening of technologies and process options were presented in Sections 3.2 and 3.3, and the following remedial alternatives were developed for soil at Site 46:

- Alternative S-1: No Action
- Alternative S-2: Excavation and Off-Site Disposal

Alternative S-1 was developed and analyzed to serve as a baseline for other alternatives, as required by CERCLA and the NCP. Alternative S-2 was formulated and analyzed to evaluate the adequacy of a removal action for the COCs in subsurface soils that exceed Florida leachability to groundwater criteria and their offsite disposal at a permitted landfill. A description and detailed analysis of these alternatives are presented in the following sections.

4.2.1 Alternative S-1: No Action

4.2.1.1 Description

The No Action alternative maintains the site as is. This alternative does not address the soil contamination and is retained to provide a baseline for comparison to other alternatives. There would be no reduction in toxicity, mobility, or volume of the contaminants other than what would result from natural dispersion, dilution, biodegradation, and other attenuating factors. The site would be available for unrestricted use.

4.2.1.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative S-1 would not provide protection of human health and the environment. . Lead and TCE in the subsurface soil could potentially leach to groundwater at concentrations that could contribute to the groundwater contamination that has been identified at Site 46. Because monitoring would not be performed, potential migration of COCs from soil to groundwater would not be detected.

Compliance with ARARs

Alternative S-1 would not comply with chemical-specific ARARs because no action would be taken to reduce contaminant concentrations. Compliance with location-specific ARARs would be possible, but not actively pursued. Action-specific ARARs are not applicable to this alternative.

Long-Term Effectiveness and Permanence

Alternative S-1 would have no long-term effectiveness and permanence because contaminated soil would remain on site. Because there would be no monitoring, potential off-site migration of COCs would not be detected.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative S-1 would not reduce the toxicity, mobility, or volume of contaminants through treatment because no treatment would occur.

Short-Term Effectiveness

Because no action would occur, implementation of Alternative S-1 would not pose any risks to on-site workers or result in short-term adverse impact to the local community and the environment. Alternative S-1 would never achieve the RAOs.

Implementability

Because no action would occur, Alternative S-1 would be readily implementable. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable. Implementability of administrative measures is not applicable because no such measures would be taken.

Cost

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

4.2.2 Alternative S-2: Excavation and Off-site Disposal to meet Florida Leachability to Groundwater SCTLs

4.2.2.1 Description of Alternative S-2

Alternative S-2 would involve the excavation of soil such that the concentrations of lead and TCE can meet their Florida Leachability to Groundwater SCTLs under Chapter 62-777 F.A.C. The area to be excavated to meet the SCTLs is presented on Figure 4-1.

Two components are included in this alternative as follows:

- Excavation
- Off-site Disposal

Component 1: Excavation of Soil to meet Leachability to Groundwater SCTLs

Utility clearance would be conducted in the proposed areas of excavation, at a minimum for water, communication, and electrical lines. Following the utility clearance, excavation would occur at the area of concern for TCE which is approximately 80 ft by 20 ft northeast of Building 72 to a maximum depth of 4 feet and 2 areas of concern for lead which are approximately 20 feet in diameter and 4 feet deep (Figure 4-1) for a total volume of 330 yd^3 . The top two feet of clean overburden from each area (approximately 165 yd^3) would be stored on site to be used as backfill material and the soil from 2 to 4 feet bls, a total of approximately 165 yd^3 (264 tons), would be excavated and transported off-site as contaminated soil. Dust control and appropriate health and safety measures would be implemented during the excavation and screening. Samples of soil from the side walls and bottoms of the excavated areas would be collected for confirmatory analysis of lead and TCE.

Approximately 330 yd^3 of excavated void would be filled with clean backfill and clean overburden, covered with top soil, and seeded with grass.

Component 2: Off-site Disposal

The excavated soil would be tested for TCLP characteristics. For costing purposes, it is assumed that none of the soil would exceed TCLP limits and treatment would not be required to meet land disposal

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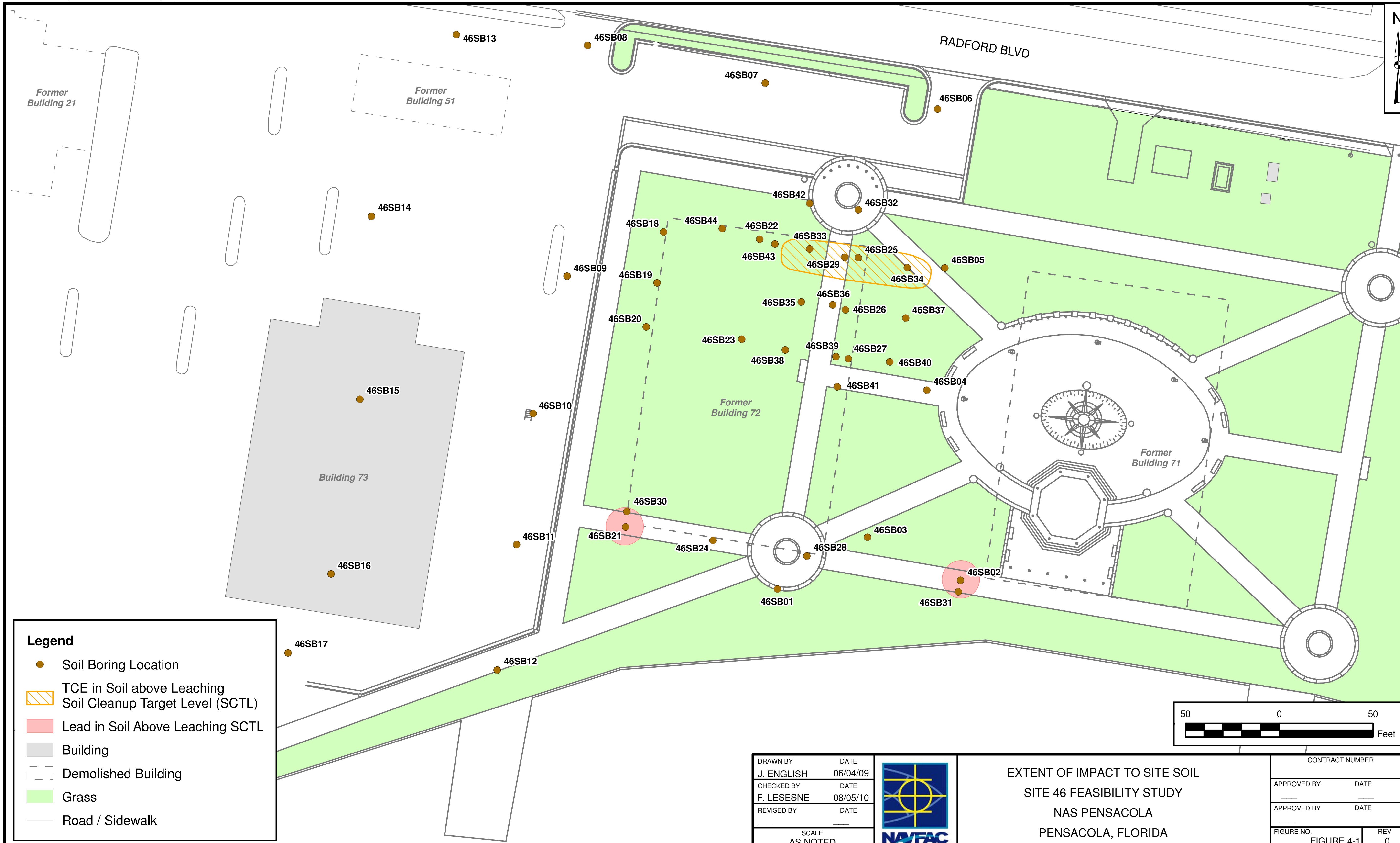

requirements at a RCRA Subtitle D facility. Approximately 165 yd^3 (264 tons), would be transported off-site for disposal.

4.2.3.2 Detailed Analysis of Alternative S-2

Overall Protection of Human Health and Environment

Alternative S-2 would be protective of human health and the environment. After excavation and removal of soil to meet the Florida Leachability to Groundwater SCTLs for lead and TCE, the site would be available for unrestricted use and unlimited exposure and the RAOs would be met.

Compliance with ARARs

Chemical-specific ARARs would be met; Alternative S-2 would reduce TCE concentrations such that the predicted risk for the hypothetical resident would no longer remain unacceptable compared to USEPA benchmarks. Also, Alternative S-2would achieve the SCTLs provided in Chapter 62-777, F.A.C..

Action-specific ARARs would be complied with, in particular, the following:

- RCRA regulations including: Identification and Listing of Hazardous Wastes and LDRs
- Florida Air Pollution Rules

Long-term Effectiveness and Permanence

Alternative S-2 would be effective in the long term because, following the remedial action, the site would be protective of residential uses and residential receptors.

Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative S-2 would not reduce toxicity, mobility, or volume of the COCs because there would not be any treatment of the soil, only off-site disposal.

Short-term Effectiveness

Alternative S-2 would be effective in the short term. Dust suppression and control measures would be implemented to minimize the emission of contaminated soil particulates during excavation. Erosion control measures would minimize the potential migration of COCs. Workers on site would be adequately protected if suitable health and safety procedures are followed. The time frame for implementation of this alternative is estimated to be approximately one month, at which time the remedy will achieve RAOs.

Implementability

Alternative S-2 is implementable. Excavation and screening equipment considered under this alternative are typical in the construction industry and are readily available from several local sources. Off-site borrow locations for clean soil can be identified.

Cost

Estimated costs for Alternative S-2 are as follows:

• Capital:	$174,740
• 30-Year NPW of O&M:	$ 0
• 30-Year NPW of Alternative S-2:	$ $174,740

The above figures have been rounded to the nearest $1,000 to reflect the preliminary nature of the estimates. A more detailed breakdown of these cost estimates is provided in Appendix A.

4.3 ASSEMBLY AND DETAILED ANALYSIS OF REMEDIAL ALTERNATIVES FOR GROUNDWATER

Based on the detailed screening of technologies and process options presented in Sections 3.2 and 3.3, the following four remedial alternatives were developed:

- Alternative G-1: No Action
- Alternative G-2: Natural Attenuation, LUCs, and Monitoring
- Alternative G-3: AS/SVE of CVOCs, Natural Attenuation, LUCs, and Monitoring

Alternative G-1 was developed and analyzed to serve as a baseline for other alternatives, as required by CERCLA and the NCP. Alternative G-2 was formulated and analyzed to evaluate the adequacy of limited action. Alternative G-3 was formulated and analyzed to evaluate active remediation of the area with the most contaminated groundwater. A description and detailed analysis of these alternatives are presented in the following sections.

4.3.1 Alternative G-1: No Action

4.3.1.1 Description

The No Action alternative maintains the site as is. This alternative does not address the groundwater contamination and is retained to provide a baseline for comparison to other alternatives. There would be no reduction in toxicity, mobility, or volume of the contaminants other than what would result from natural dispersion, dilution, biodegradation, and other attenuating factors. The site would be available for unrestricted use.

4.3.1.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative G-1 would not provide protection of human health and the environment. Under the current commercial/industrial land use, there could be unacceptable risks to human health from exposure to contaminated groundwater, and this potential for unacceptable risk would increase if Site 46 is developed further. Groundwater contamination might migrate off site and this migration would have an immediate negative impact. Because no monitoring would be performed, potential migration of TCE, VC, naphthalene, arsenic and cadmium would not be detected.

Compliance with ARARs

Alternative G-1 would not comply with chemical-specific ARARs (MCLs and GCTLs) because no action would be taken to reduce contaminant concentrations. Compliance with location-specific ARARs would be possible, but not actively pursued. Action-specific ARARs are not applicable to the alternative.

Long-Term Effectiveness and Permanence

Alternative G-1 would have no long-term effectiveness and permanence because contaminated groundwater would remain on site. Because there would be no LUCs to restrict the use of surficial aquifer groundwater, the potential would exist for unacceptable risk to develop for human receptors. Because there would be no groundwater monitoring, potential off-site migration of TCE, VC, naphthalene, arsenic and cadmium would not be detected. Although the concentration of the COCs might eventually decrease to the cleanup goals through natural attenuation, without monitoring this would not be verified.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative G-1 would not reduce toxicity, mobility, or volume of contaminants through treatment because no treatment would occur. Some reduction of the toxicity and volume of the COCs might occur through natural dispersion, dilution, or other attenuation processes, but without monitoring this could not be verified.

Short-Term Effectiveness

Because no action would occur, implementation of Alternative G-1 would not pose any risks to on-site workers or result in short-term adverse impact to the local community and the environment. Alternative G-1 would never achieve the RAOs, and though the cleanup goals might eventually be achieved through natural attenuation, this would not be verified through monitoring.

Implementability

Because no action would occur, Alternative G-1 would be readily implementable. The technical feasibility criteria, including constructability, operability, and reliability, are not applicable. Implementability of administrative measures is not applicable because no such measures would be taken.

Cost

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

4.3.2 Alternative G-2: Natural Attenuation, LUCs, and Monitoring

4.3.2.1 Description

Alternative G-2 would consist of three major components: natural attenuation, LUCs, and monitoring.

Component 1: Natural Attenuation

Natural attenuation would rely on naturally occurring processes such as biodegradation, dilution, and dispersion within the aquifer to reduce the concentrations of TCE, VC, naphthalene, arsenic and cadmium. Although only a single groundwater sampling event has been completed at the site, Natural Attenuation is expected to be effective based on the field measurements of DO, temperature, and ORP measurements. The field measurements within the plume area and the presence of DCE and VC are indicative of ongoing natural attenuation. Aquifer conditions (geochemical parameters) would be periodically monitored to ensure that concentrations of COCs are decreasing through natural processes.

Component 2: LUCs

LUCs would be developed to prevent unacceptable risks from exposure to contaminated groundwater. These LUCs would have the following performance objectives:

- Prohibit all uses of groundwater from the surficial aquifer underlying Site 46 (including, but not limited to, human consumption, dewatering, irrigation, heating/cooling purposes, and industrial processes) unless prior written approval is obtained from the Navy, USEPA, and FDEP.
- Maintain the integrity of any existing or future monitoring or remediation system(s) unless prior written approval is obtained from the Navy, USEPA, and FDEP.

The LUCs would be implemented through a LUC RD that would be prepared as a component of the overall RD. The LUCs would be maintained for as long as they are required to prevent unacceptable exposure to contaminated groundwater.

Component 3: Monitoring

Monitoring would consist of regularly collecting and analyzing groundwater samples from 18 existing and two new monitoring wells located within and surrounding the CVOC (TCE and VC) plume to assess the performance of natural attenuation. For the first five years, the performance monitoring samples would also be analyzed for natural attenuation parameters. Sampling frequency would be quarterly for the first year, semi-annually for the next two years, and annually thereafter.

Based on the current plume footprint (Figure 4-2), two new monitoring wells would be installed and designated as “sentinel” wells. If analysis of the groundwater collected from these sentinel wells indicated that the cleanup goals had been exceeded, the following step-by-step actions would be taken:

- The sentinel well(s) where the exceedance(s) was/were detected would be resampled to verify the exceedance(s).
- If the exceedance(s) is verified, hydrogeological modeling would be performed to determine a predicted expansion of the contaminant plume based on the new monitoring data.
- If the expansion of the contaminant plume predicted by the additional modeling is such that it would be of concern, contingency remedies would be developed.

4.3.2.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative G-2 would be protective of human health and the environment. Although the plume could expand, natural attenuation would be expected to eventually reduce the concentrations of TCE, VC, naphthalene and metals to less than GCTLs. If the results of monitoring, conducted as part of this alternative, indicate otherwise and expansion of the plume could have a negative environmental impact, contingency remedies would be implemented to prevent such an occurrence.

LUCs would be protective of human health and the environment. Restricting the use of surficial aquifer groundwater would be protective of human health by preventing unacceptable risks from exposure to contaminated groundwater.

Monitoring would be protective of the environment by evaluating the progress of natural attenuation and detecting potential migration of contaminated groundwater so that appropriate contingency measures could be taken, if required.

Some short-term risks would be incurred by workers during groundwater sampling. However, any potential for exposure would be minimized by the wearing of appropriate PPE and compliance with site-specific health and safety procedures.

No adverse short-term or cross-media effects are anticipated as a result of implementing this alternative.

Compliance with ARARs

Alternative G-2 would comply with location- and action-specific ARARs. In the long-term, this alternative would comply with chemical-specific ARARs such as Florida MCLs as natural processes in the aquifer reduce concentrations of TCE, VC, naphthalene, arsenic and cadmium to their respective cleanup goals; this would be verified through monitoring.

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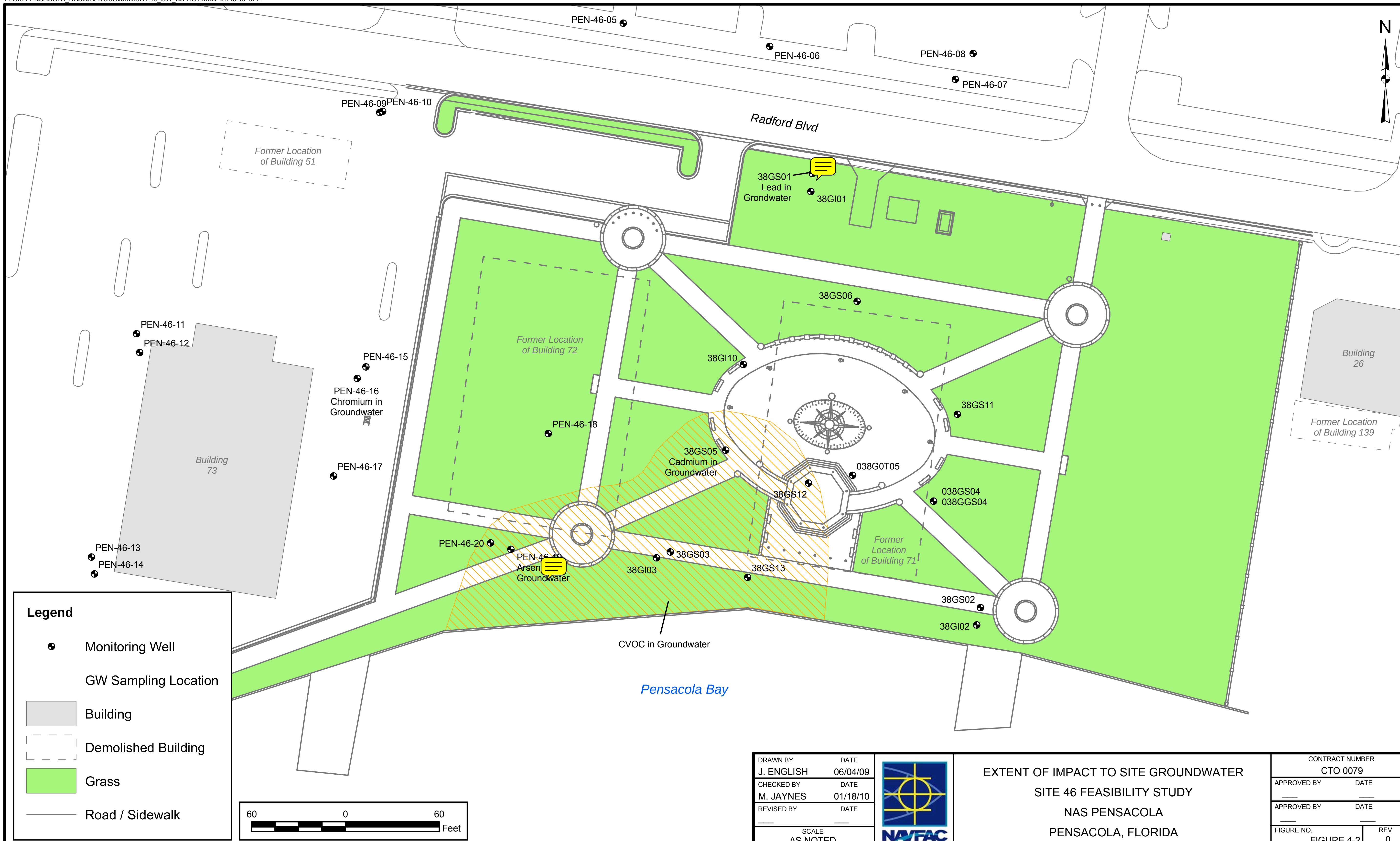

Long-Term Effectiveness and Permanence

Alternative G-2 would provide long-term effectiveness and permanence. Although no active treatment of contaminated groundwater would occur and the plume may expand, risks to human health and the environment would be monitored and controlled through LUCs.

Naturally occurring processes would reduce the COCs to their cleanup goals over time; such as by biodegradation for TCE, VC and naphthalene and adsorption to sediments for arsenic and cadmium. It could take a considerable amount of time before these processes achieve the cleanup goal; however, risk from exposure to contaminated groundwater would be addressed through LUCs, which would effectively prevent unacceptable risk from exposure until the cleanup goals are met.

Long-term monitoring would be an effective means to evaluate the progress of natural attenuation and to warn of potential future migration of contaminated groundwater. Supporting trend data are not available for the preparation of a model to predict attenuation rates for TCE and its daughter products (including VC). However, an attenuation model could be prepared after 1 year of natural attenuation sampling.

Reduction of Toxicity, Mobility, or Volume through Treatment

Although no active treatment is included in Alternative G-2, the volume and toxicity of TCE, VC, naphthalene, arsenic and cadmium would be reduced over time through natural attenuation processes. This alternative would not reduce the mobility of the COCs because no containment, removal, or treatment would be provided. Treatment residues would not be generated by this alternative.

Short-Term Effectiveness

Alternative G-2 would have minimal short-term effectiveness concerns. Exposure of workers to contamination during the maintenance and sampling of monitoring wells would be minimized by the wearing of appropriate PPE and complying with site-specific health and safety procedures. Alternative G-2 would also not adversely impact the surrounding community or the environment.

The time frame required to reach the RAO has not been predicted due to the limited field and laboratory analytical data. Four quarters of groundwater monitoring of natural attenuation parameters, TCE, VC, naphthalene, arsenic and cadmium and TCE degradation products would be used to predict the time required to reach RAO 2.

Implementability

Alternative G-2 would be readily implementable.

Maintenance of existing monitoring wells, sampling and analysis of groundwater, and performance of regular site inspections and 5-year reviews could readily be accomplished. The resources, equipment, and materials required to implement these activities are readily available.

The administrative aspects of Alternative G-2 would be relatively simple to implement. Construction permits would not be required for this alternative. Establishment of LUCs would require negotiation and agreement on the specifics of the procedures between the Navy, USEPA, FDEP, and potential future site owners who might be affected by deed restrictions.

Cost

The estimated costs for Alternative G-2 are as follows:

- Capital Cost: $37,000
- 30-Year NPW of Monitoring Costs: $227,000
- 30-Year NPW: $264,000

The above cost figures have been rounded to the nearest $1,000 to reflect the preliminary nature of these estimates. A detailed breakdown of estimated costs for this alternative is provided in Appendix A.

4.3.3 Alternative G-3: In-Situ AS/SVE, Natural Attenuation, LUCs, and Monitoring

4.3.3.1 Description

Alternative G-3 would consist of four major components: in-situ treatment of the plume via AS/SVE, natural attenuation of remaining areas within the plume, LUCs, and monitoring. The AS/SVE would initially treat the TCE, VC and naphthalene and natural attenuation processes would be used to ensure that TCE, VC, naphthalene, arsenic and cadmium meet RAO 2. Although AS/SVE is a well-established technology, its effectiveness for the treatment of the Site 46 TCE, VC and naphthalene plume could be limited due to the relatively low concentrations of theses COCs within the plume. The current TCE, VC and naphthalene concentrations are less than their NADCs, indicating that active remediation (Alternative G-3) may not be necessary.

Component 1: AS/SVE

This component would consist of installing and operating an AS/SVE system consisting of several sparge wells and SVE wells. Air would be delivered to the sparge wells via a properly sized compressor/pump and the volatilized air would be extracted from the vadose zone through the SVE wells via an appropriately sized blower. The AS and SVE wells would be connected to the equipment building via an underground piping network. Based on experience with AS/SVE systems and plumes with similar size and concentrations, it is anticipated that the AS/SVE system would operate for 1.5 to 2 years.

Component 2: Natural Attenuation

This component, to be initiated following active remediation, would be conducted as described in Component 1 of Alternative G-2.

Component 3: LUCs

This component would be identical to Component 2 of Alternative G-2.

Component 4: Monitoring

This component would be similar to Component 3 of Alternative G-2. However, aerobic parameters, such as DO would be added to the geochemical parameters. Additional monitoring would be required for the AS/SVE system, including, but not limited to flow rates, pressure, vacuum, influent vapor concentrations, and treated effluent concentrations to evaluate system performance.

4.3.3.2 Detailed Analysis

Overall Protection of Human Health and the Environment

Alternative G-3 would be protective of human health and the environment. By actively removing the majority of groundwater contamination (TCE, VC and naphthalene), AS/SVE would reduce risk from exposure to contaminated groundwater and provide protection to future human receptors.

LUCs would be protective of human health and the environment during the remedial period until cleanup goals are met. Restricting the use of surficial aquifer groundwater would be protective of human health and the environment by avoiding unacceptable risks of exposure to the Site 46 COCs in groundwater.

Monitoring would be protective of human health and the environment by evaluating the effectiveness of the in-situ treatment, measuring natural attenuation, and detecting potential migration of the COCs in groundwater.

Some short-term risks could be incurred by workers from exposure to contamination during the installation of AS/SVE system piping. However, the potential for this exposure would be minimized by the wearing of appropriate PPE and compliance with site-specific health and safety procedures. No adverse short-term or cross-media effects are anticipated as a result of implementing this alternative.

Compliance with ARARs

Alternative G-3 would eventually comply with chemical-specific ARARs through active remediation followed by monitored natural attenuation. Alternative G-3 would also comply with location- and action-specific ARARs.

Long-Term Effectiveness and Permanence

Alternative G-3 would provide long-term effectiveness and permanence. AS/SVE of the CVOC plume would be expected to effectively remove the majority of groundwater contamination by TCE, VC and naphthalene. Although AS/SVE is a well-established technology, its effectiveness for the treatment of the Site 46 plume could be limited due to the relatively low concentrations of TCE, VC and naphthalene within the plume. The current TCE, VC and naphthalene concentrations are less than their Florida NADSCs, indicating that active remediation may not be necessary.

Groundwater use restrictions would effectively prevent the use of surficial aquifer groundwater until the TCE, VC, naphthalene, arsenic and cadmium cleanup goals are met.

Long-term monitoring would be an effective means to evaluate the progress of remediation and verify that migration of COCs is not occurring.

The controls proposed in this alternative are considered reliable.

Reduction of Toxicity, Mobility, or Volume through Treatment

Alternative G-3 would reduce the toxicity, mobility and volume of TCE, VC and naphthalene in groundwater. Alternative G-3 would reduce the mobility of arsenic and cadmium but not the toxicity and volume. AS/SVE could permanently and irreversibly remove TCE, VC and naphthalene from groundwater. Arsenic and cadmium would be removed from groundwater but would be adsorbed to the aquifer sediments. Treatment residues would not be generated by this alternative.

Short-Term Effectiveness

Alternative G-3 would reduce human health risks in the short term because groundwater use restrictions would be implemented. Exposure of workers to contamination during installation of SVE and AS wells, construction and operation of the groundwater treatment system, and groundwater monitoring would be minimized by compliance with OSHA requirements including wearing of appropriate PPE and adherence to site-specific health and safety procedures. Implementation of AS/SVE system, LUCs and monitoring would not adversely impact the surrounding community or the environment. Based on experience, it is anticipated that the life cycle of the AS/SVE system will be 2 years. It is estimated that an additional 3 years of monitored natural attenuation will be required to reach the RAO.

Implementability

Alternative G-3 would be implementable. However, trenching and pipe placement around and under the Former Building 72 location may be difficult and will need to be verified during system design to better estimate the actual costs of implementation. Potential disruption to facility personnel due to noise generated from the system should be considered during equipment compound placement.

Cost

The estimated costs for Alternative G-3 are as follows:

- Capital Cost: $313,000
- 5-Year NPW of O&M Costs: $214,000
- 5-Year NPW: $527,000

A detailed breakdown of the estimated costs for this alternative is provided in Appendix A.

5.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

This section compares the analyses for each of the remedial alternatives presented in Section 4.0 of this FS. The criteria for comparison are identical to those used for the detailed analysis of individual alternatives.

5.1 COMPARISON OF REMEDIAL ALTERNATIVES BY CRITERIA

The following remedial alternatives for Site 46 are being compared in this section:

Soil

- Alternative S-1: No Action
- Alternative S-2: Excavation and Off-site Disposal

Groundwater

- Alternative G-1: No Action
- Alternative G-2: Natural Attenuation, LUCs, and Monitoring
- Alternative G-3: In-Situ AS/SVE, Natural Attenuation, LUCs, and Monitoring

The alternatives above are being compared using the following criteria:

Threshold Criteria

- Overall Protection of Human Health and the Environment
- Compliance with ARARs

Primary Balancing Criteria

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

Modifying Criteria

- State Acceptance
- Community Acceptance

5.1.1 Overall Protection of Health and Environment

Soil

Alternative S-1 would not protect human health and the environment because nothing would prevent exposure to contaminated soil that could result in unacceptable risk to human receptors. Also under this alternative, no warning of the potential future migration of TCE would be provided because no monitoring would be performed.

Alternative S-2 would be protective of human health and the environment. The removal of contaminated soil to meet Leachability to Groundwater SCTLs would protect all potential receptors from exposure to unacceptable levels of lead and TCE in groundwater.

Groundwater

Alternative G-1 would not protect human health and the environment because nothing would prevent exposure to contaminated groundwater that could result in unacceptable risk to human receptors. Also under this alternative, no warning of the potential future migration of the COCs would be provided because monitoring would not be performed.

Alternatives G-2 and G-3 would be protective of human health and the environment. The natural attenuation component of Alternative G-2 would be protective because it would eventually reduce the concentrations of TCE, VC, naphthalene, arsenic and cadmium to cleanup goals over a reasonable time frame. The LUC component of Alternative G-2 would be protective because it would prevent exposure to contaminated groundwater until cleanup goals are met. The monitoring component of Alternative G-2 would be protective because it would assess the progress of natural attenuation and warn of potential future migration of the COCs.

Alternative G-3 would be more protective than Alternative G-2, because, in addition to the same natural attenuation, LUCs, and monitoring components, this alternative would also include an active treatment component (AS/SVE) that would accelerate the removal of TCE, VC and naphthalene.

5.1.2 Compliance with ARARs

Soil

Alternative S-1 would not comply with Action-, chemical- and location-specific ARARs
Alternative S-2 would comply with chemical-specific ARARs by removal of soils containing lead and TCE at concentrations greater than their Leachability to Groundwater SCTLs under Chapter 62-777, F.A.C.

Groundwater

Alternative G-1 would not comply with chemical- and location-specific ARARs. Action-specific ARARs would not apply to this alternative.

Alternatives G-2 and G-3 would comply with location- and action-specific ARARs.

Alternatives G-2 and G-3 would not immediately comply with chemical-specific ARARs, but these alternatives would eventually achieve compliance when the cleanup goals for the COCs are achieved through active remediation and/or natural attenuation.

5.1.3 Long-Term Effectiveness and Permanence

Soil

Alternative S-1 would not have long-term effectiveness and permanence. Because lead and TCE could continue to leach to groundwater at concentrations that result in these COCs exceeding their Florida groundwater quality criteria.

Alternative S-2 would be effective in the long term because, lead and TCE would not leach to groundwater at concentrations that result in these COCs exceeding their Florida groundwater quality criteria.

Groundwater

Alternative G-1 would not have long-term effectiveness and permanence. Because there would be no restriction of groundwater use and/or site development, human receptors could be exposed to contaminated groundwater.
Alternatives G-2 and G-3 would provide long-term effectiveness and permanence. Over time, the natural attenuation component of Alternative G-2 would effectively and permanently reduce the concentration of

TCE, VC, naphthalene, arsenic and cadmium to cleanup goals. The LUC component of Alternative G-2 would effectively prevent exposure to contaminated groundwater until cleanup goals are achieved. The monitoring component of Alternative G-2 would effectively assess the progress of natural attenuation and verify that migration of the COCs is not occurring.

Alternative G-3 would be more effective than Alternative G-2, because, in addition to the natural attenuation, LUCs, and monitoring components, this alternative would also include an active treatment component that would effectively accelerate the removal of TCE, VC and naphthalene.

5.1.4 Reduction of Toxicity, Mobility, or Volume through Treatment

Soil

Alternative S-1 would not achieve reduction of toxicity, mobility, or volume of TCE through treatment.
Alternative S-2 would not reduce toxicity, mobility, or volume of TCE through treatment because there would not be any treatment of the soil, only off-site disposal.

Groundwater

Alternative G-1 would not achieve any reduction of toxicity, mobility, or volume of COCs (through treatment because no action would be conducted.
Alternative G-2 would eventually achieve reduction of toxicity and volume of TCE, VC and naphthalene through natural attenuation. Alternative G-2 would eventually achieve reduction of mobility of arsenic and cadmium through natural attenuation.

Alternative G-3 would achieve reductions in the toxicity, mobility and volume of TCE, VC and naphthalene through treatment. Alternative G-3 would permanently and irreversibly remove TCE, VC and naphthalene from the groundwater through AS/SVE. Alternative G-3 would achieve reductions in the toxicity, mobility and volume of arsenic and cadmium through treatment. Alternative G-3 would not generate treatment residues.

5.1.5 Short-Term Effectiveness

Soil

Implementation of Alternative S-1 would not result in risks to site workers or adversely impact the surrounding community or environment because no remedial activities would be performed. Alternative

S-1 would not achieve the RAOs, and although the cleanup goals might eventually be attained through natural processes, this would not be verified.

Alternative S-2 would have minimal site risks in the short term and those can be controlled. Dust suppression and control measures would be implemented to minimize the emission of contaminated soil particulates during excavation. Erosion control measures would minimize the potential migration of COCs off-site. On site workers would be adequately protected by following suitable health and safety procedures.

Groundwater

Implementation of Alternative G-1 would not result in risks to site workers or adversely impact the surrounding community or environment because no remedial activities would be performed.
Implementation of Alternative G-2 would result in a slight possibility of exposing site workers to contaminated groundwater during the installation, maintenance, and sampling of new and existing monitoring wells. However, these risks of exposure would be effectively controlled by wearing appropriate PPE and compliance with proper site-specific health and safety procedures. Implementation of Alternative G-2 would not adversely impact the surrounding community or environment. The time frame required to reach the RAO has not been predicted due to limited trend data. Following four quarters of groundwater monitoring for natural attenuation parameters and the COCs, data would be available to estimate the time required to reach the RAO.

Implementation of Alternative G-3 would result in a significant possibility of exposing construction workers to contaminated groundwater during the construction of in-situ groundwater treatment systems, installation of new monitoring wells, and sampling of new and existing wells. However, as for Alternative G-2, these risks of exposure would be effectively controlled by wearing appropriate PPE and compliance with proper site-specific health and safety procedures. Implementation of Alternative G-3 would not adversely impact the surrounding community or the environment. It is estimated that Alternative G-3 would remove the TCE plume through active remediation and natural attenuation within approximately 5 years.

5.1.6 Implementability

Soil

Alternative S-1 would be easiest to implement because there would be no activities to implement.

Alternative option S-2 is easily implementable. Excavation and field screening equipment for the COCs considered under this alternative are typical in the construction industry and are readily available. Off-site borrow locations for clean soil can be easily identified.

Groundwater

Alternative G-1 would be easiest to implement because there would be no activities to implement.

Technical implementation of Alternative G-2 would be relatively simple. The technical implementation of the natural attenuation, LUCs, and monitoring components of Alternative G-2 would not be difficult. The resources, equipment, and material required for the activities associated with these components are readily available.

The technical implementation of Alternative G-3 would be somewhat more difficult than that of Alternative G-2 because this alternative would require the installation and operation and maintenance of a groundwater remediation system. A number of qualified contractors are available locally, and the resources, equipment, and materials necessary to implement either of these alternatives are also readily available.

Administrative implementation of the LUCs and monitoring components of Alternative G-2 would be relatively simple. The administrative implementation of Alternative G-3 would be slightly more difficult than that of Alternative G-2. In addition to the same requirements as Alternative G-2, the construction and operation of the remediation system for Alternative G-3 would have to comply with the substantive requirements of any identified ARARs.

5.1.7 Cost

The capital and O&M costs and NPW of the soil alternatives are as follows:

Alternative	Capital	NPW of O&M	NPW
S-1	$0	$0	$0
			$156,937
S-2	$160,300	$0	$174,740

The capital and O&M costs and NPW of the groundwater alternatives are as follows:

Alternative	Capital	NPW of O&M	NPW
G-1	$0	$0	$0
G-2	$37,000	$227,000 (30 years)	$264,000 (30 years)
G-3	$313,000	$214,000 (5 years)	$527,000 (5 years)

Detailed cost estimates for all alternatives are provided in Appendix A.

In addition to the seven CERCLA criteria evaluated above, a Sustainable Remediation Evaluation was also conducted for all soil and groundwater remedial alternatives at Site 46 (Appendix B). The purpose of the Sustainable Remediation Evaluation is to assess the sustainability of the proposed remedial alternatives using the metrics of greenhouse gas (GHG) emissions and energy usage. Although not required by the CERCLA process, the results of the Sustainable Remediation Evaluation are intended to provide additional information for consideration with the CERCLA remedy selection criteria described in the Feasibility Study and to enhance the understanding of the net environmental benefit of the selected remedy.

5.2 SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

Tables 5-1 and 5-2 summarize the comparative analysis of the soil and groundwater remedial alternatives, respectively.

TABLE 5-1

**SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES - SOIL
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 1 OF 3**

Evaluation Criterion	Alternative S-1: No Action	Alternative S-2: Excavation and Disposal
Overall Protection of Human Health and Environment	Would not provide protection of human health and the environment. Because no monitoring would be performed, potential migration of COCs would not be detected.	Would be protective of human health and the environment. The removal of contaminated soil to meet Leachability SCTLs would protect all potential receptors from exposure to unacceptable levels of TCE.
Compliance with ARARs:		
Chemical-Specific	Would not comply	Would comply
Location-Specific	Would not comply	Would comply
Action-Specific	Not applicable	Would comply
Long-Term Effectiveness and Permanence	Would have no long-term effectiveness and permanence. Contaminant reduction or migration would not be detected because monitoring would not occur.	Would provide long-term effectiveness and permanence because, following the remedial action, the site would be protective of residential uses.

TABLE 5-1

SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES - SOIL
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Evaluation Criterion	Alternative S-1: No Action	Alternative S-2: Excavation and Disposal
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	Would not reduce toxicity, mobility, or volume of contaminants through treatment because no treatment would occur. Some reduction of the toxicity and volume of COCs might occur through natural dispersion, dilution, or other attenuation processes, but no monitoring would be performed to verify.	The volume and toxicity of TCE in soil would not be reduced via excavation and there would be no treatment of soil.
Short-Term Effectiveness	Would not pose any risks to on-site workers or result in short-term adverse impact to the local community and the environment. Would never achieve the RAOs and, although the cleanup goal may eventually be achieved through natural attenuation, this would not be verified through monitoring.	Would be effective in the short term. Dust suppression and control measures would be implemented to minimize the emission of contaminated soil particulates during excavation. Erosion control measures would minimize the potential migration of COCs.
Implementability	Because no action would occur, Alternative 1 would be easily implementable.	Would be easily implementable.

TABLE 5-1

**SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES - SOIL
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 3 OF 3**

Evaluation Criterion	Alternative S-1: No Action	Alternative S-2: Excavation and Disposal
Costs:		
Capital	$0	$160,300
NPW of O&M	$0	$0
NPW	$0	$160,300
State Acceptance	**FDEP, has reviewed and commented on the Draft FS for Site 46. FDEP final approval and subsequent acceptance to the Final FS is pending.**	
Community Acceptance	**The information concerning community acceptance will be addressed following the public comment period for the Proposed Plan for Site 46.**	

Notes:
ARARs = Applicable or Relevant and Appropriate Requirements
COCs = Chemicals of concern
NPW = Net present worth
O&M = Operation and maintenance
PPE = Personal protective equipment
RAOs = Remedial Action Objectives
SCTLs = Soil Cleanup Target Levels
TSDF = Treatment Storage and Disposal Facility

TABLE 5-2

**SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES - GROUNDWATER
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 1 OF 3**

Evaluation Criterion	Alternative G-1: No Action	Alternative G-2: Natural Attenuation, LUCs, and Monitoring	Alternative G-3: In-Situ AS/SVE, Natural Attenuation, LUCs, and Monitoring
Overall Protection of Human Health and Environment	Would not provide protection of human health and the environment. Under the current commercial/industrial land use, there could be unacceptable risks to human health from exposure to contaminated groundwater, and this potential for unacceptable risk would increase if Site 46 is further developed. Because no monitoring would be performed, potential migration of TCE and VC would not be detected.	Would be protective of human health and the environment. Although the TCE/VC plume could expand, natural attenuation would eventually reduce the concentrations of CVOCs (TCE and VC) and metals to less than the GCTLs. LUCs would be protective of human health and the environment. Restricting the use of surficial aquifer groundwater would be protective of human health by preventing unacceptable risks from exposure to contaminated groundwater. Monitoring would be protective of the environment by evaluating the progress of natural attenuation and detecting potential migration of contaminated groundwater.	Would be protective of human health and the environment. By actively removing the majority of groundwater contamination, AS/SVE would prevent the expansion of the CVOC (TCE and VC) plume. This would ultimately eliminate risk from exposure to contaminated groundwater and provide protection to future human receptors. LUCs would be protective of human health and the environment during the remedial period until cleanup goals are met. Restricting the use of surficial aquifer groundwater would be protective of human health and the environment by avoiding unacceptable risks of exposure to contaminated soil and groundwater. Monitoring would be protective by evaluating the effectiveness of the in-situ treatment.
Compliance with ARARs:			
Chemical-Specific	Would not comply	Would eventually comply	Would eventually comply
Location-Specific	Would not comply	Would comply	Would comply
Action-Specific	Not applicable	Would comply	Would comply
Long-Term Effectiveness and Permanence	Would have no long-term effectiveness and permanence because contaminated groundwater would remain on site. Because there would be no LUCs to restrict the use of surficial aquifer groundwater, the potential would also exist for unacceptable risk to human receptors. Because there would be no groundwater monitoring, potential off-site migration of TCE and VC would not be detected. Although TCE and VC concentrations may eventually decrease to the cleanup goal through natural attenuation, no monitoring would verify this.	Would provide long-term effectiveness and permanence. Naturally occurring processes such as biodegradation would reduce concentrations of CVOCs (TCE and VC) and metals to cleanup goals over the long term. Long-term monitoring would be an effective means to evaluate the progress of natural attenuation and to warn of potential future migration of contaminated groundwater.	Would provide long-term effectiveness and permanence. AS/SVE of the CVOC (TCE and VC) plume is expected to effectively remove the majority of groundwater contamination. LUCs would effectively prevent the use of surficial aquifer groundwater until cleanup goals are met. Long-term monitoring would be an effective means to evaluate the progress of remediation and verify that no migrations of CVOCs (TCE and VC) are occurring.

TABLE 5-2

**SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES - GROUNDWATER
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 2 OF 3**

Evaluation Criterion	Alternative G-1: No Action	Alternative G-2: Natural Attenuation, LUCs, and Monitoring	Alternative G-3: In-Situ AS/SVE, Natural Attenuation, LUCs, and Monitoring
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	Would not reduce toxicity, mobility, or volume of contaminants through treatment because no treatment would occur. Some reduction of the toxicity and volume of TCE and VC may occur through natural dispersion, dilution, or other attenuation processes, but no monitoring would be performed to verify.	The volume and toxicity of TCE and VC would eventually be reduced over time through natural attenuation processes. This alternative would not reduce the mobility of CVOCs (TCE and VC) or metals because no containment, removal, or treatment would be provided. No treatment residues would be generated by this alternative.	Would reduce the toxicity, mobility and volume of contaminated groundwater. AS/SVE could permanently and irreversibly remove TCE and VC from groundwater. No treatment residues would be generated by this alternative.
Short-Term Effectiveness	Would not pose any risks to on-site workers or result in short-term adverse impact to the local community and the environment. No Action would not achieve the RAOs and, although the cleanup goal may eventually be achieved through natural attenuation, this would not be verified through monitoring.	Would have minimal short-term effectiveness concerns. Exposure of workers to contamination during the maintenance and sampling of monitoring wells would be minimized by the wearing of appropriate PPE and complying with site-specific health and safety procedures. This alternative would not adversely impact the surrounding community or the environment.	Would reduce human health risks in the short term because LUCs would be implemented to prohibit groundwater use. Exposure of workers to contamination during installation of SVE and AS wells, construction and operation of the groundwater treatment system, and groundwater sampling would be minimized by compliance with health and safety requirements including wearing of appropriate PPE and adherence to site-specific health and safety procedures. Implementation of LUCs and monitoring would not adversely impact the surrounding community or the environment.
Implementability	Because no action would occur, Alternative 1 would be readily implementable.	Would be readily implementable. Maintenance of existing monitoring wells, sampling and analysis of groundwater, and performance of regular site inspections and 5-year reviews could readily be accomplished. The resources, equipment, and materials required to implement these activities are readily available.	Would be implementable. However, trenching and pipe placement may disturb the newly constructed recreational area walkways and landscaping.
Costs: Capital NPW of O&M NPW	 $0 $0 $0	 $37,000 $227,000 $264,000	 $313,000 $214,000 $527,000

TABLE 5-2

**SUMMARY OF COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES - GROUNDWATER
SITE 46 FEASIBILITY STUDY
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
PAGE 3 OF 3**

Evaluation Criterion	Alternative G-1: No Action	Alternative G-2: Natural Attenuation, LUCs, and Monitoring	Alternative G-3: In-Situ AS/SVE, Natural Attenuation, LUCs, and Monitoring
State Acceptance	**FDEP, has reviewed and commented on the Draft FS for Site 46. FDEP final approval and subsequent acceptance to the Final FS is pending**		
Community Acceptance	**The information concerning community acceptance will be addressed following the public comment period for the Proposed Plan for Site 46.**		

Notes:
ARARs= Applicable or Relevant and Appropriate Requirements
NPW = Net present worth
TCE = Trichloroethene
AS/SVE Air sparge/soil vapor extraction
O&M = Operation and maintenance
COCs = Chemicals of concern
PPE = Personal Protective Equipment
cPAH = Carcinogenic polynuclear aromatic hydrocarbons
RAOs = Remedial Action Objectives
LUCs = Land use controls

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APPENDIX A

REMEDIAL ALTERNATIVE COST ESTIMATES

NAS Pensacola
Pensacola, Florida
Site 46
Groundwater Alternative G-2: Natural Attenuation, Institutional Controls, and Groundwater Monitoring
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
PROJECT PLANNING & DOCUMENTS											
Prepare LUC RD Documents	200	hr			$35.00		$0	$0	$7,000	$0	$7,000
Groundwater Monitoring Plan	180	hr			$35.00		$0	$0	$6,300	$0	$6,300
MOBILIZATION/DEMOBILIZATION AND FIELD SUPPORT											
Drill Rig Mob/Demob	1	ls	$2,000.00				$2,000	$0	$0	$0	$2,000
Supervision & Oversight (2p * 5 days/week)	1	wk			$2,500.00		$0	$0	$2,500	$0	$2,500
DECONTAMINATION											
Decontamination Trailer	1	wk				$720.00	$0	$0	$0	$720	$720
Pressure Washer	1	wk				$400.00	$0	$0	$0	$400	$400
Equipment Decon Pad	1	ls		$500.00	$450.00	$155.00	$0	$500	$450	$155	$1,105
Decon Water Storage Tank, 1,000 gallon	1	mo				$450.00	$0	$0	$0	$450	$450
Clean Water Storage Tank, 500 gallon	0	mo				$250.00	$0	$0	$0	$0	$0
Disposal of Decon Waste (liquid & solid)	1	ls	$900.00				$900	$0	$0	$0	$900
Monitoring Wells											
Install Monitoring Wells	30	vlf	$27.00				$810	$0	$0	$0	$810
Well Vaults, 18" round	2	ea		$70.00	$380.00	$70.00	$0	$140	$760	$140	$1,040
. **Subtotal**							$3,710	$640	$17,010	$1,865	$23,225
Overhead on Labor Cost @ 30%									$5,103		$5,103
G & A on Labor Cost @ 10%									$1,701		$1,701
G & A on Material Cost @ 10%								$64			$64
G & A on Equipment Cost @ 10%										$187	$187
G & A on Subcontract Cost @ 10%							$371				$371
Tax on Materials and Equipment Cost @ 6%								$38		$112	$150
Total Direct Cost							$4,081	$742	$23,814	$2,163	$30,801
Indirects on Total Direct Cost @ 0%											$0
Profit on Total Direct Cost @ 10%											$3,080
Subtotal											$33,881
Health & Safety Monitoring @ 0%											$0
Total Field Cost											$33,881
Contingency on Total Field Costs @ 10%											$3,388
Engineering on Total Field Cost @ 0%											$0
TOTAL CAPITAL COST											**$37,269**

NAS Pensacola
Pensacola, Florida
Site 46
Groundwater Alternative G-2: Natural Attenuation, Institutional Controls, and Groundwater Monitoring
Annual Cost

Item	Item Cost year 1	Item Cost years 2 to 3	Item Cost years 4 to 5	Item Cost years 6 to 10	Notes
Site Inspection: Visit	$1,482	$1,482	$1,482	$1,482	One-day visit to verify LUC RD
Site Inspection: Report	$800	$800	$800	$800	
Sampling	$30,000	$15,000	$7,500	$6,000	Labor and supplies to collect samples from wells using a crew of two.
Analysis/Water	$24,000	$12,000	$6,000	$4,500	Analyze groundwater samples from 20 wells for TCE & natural attenuation parameters in years 1 through 10. Collect samples quarterly in year 1, twice in years 2 &3, and once a year for years 4 through 10. Natural Attenuation sampling discintinues after year 5.
Report	$16,000	$8,000	$4,000	$3,000	Document sampling events and results
Subtotal	$72,282	$37,282	$19,782	$15,782	
Contingency @ 10%	$7,228	$3,728	$1,978	$1,578	
TOTAL	**$79,510**	**$41,010**	**$21,760**	**$17,360**	

NAS Pensacola
Pensacola, Florida
Site 46
Groundwater Alternative G-2: Natural Attenuation, Institutional Controls, and Groundwater Monitoring
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$37,269		$37,269	1.000	$37,269
1		$79,510	$79,510	0.935	$74,342
2		$41,010	$41,010	0.873	$35,802
3		$41,010	$41,010	0.816	$33,464
4		$21,760	$21,760	0.763	$16,603
5		$21,760	$21,760	0.713	$15,515
6		$17,360	$17,360	0.666	$11,562
7		$17,360	$17,360	0.623	$10,815
8		$17,360	$17,360	0.582	$10,104
9		$17,360	$17,360	0.544	$9,444
10		$17,360	$17,360	0.508	$8,819
11				0.475	$0
12				0.444	$0
13				0.415	$0
14				0.388	$0
15				0.362	$0
16				0.339	$0
17				0.317	$0
18				0.296	$0
19				0.277	$0
20				0.258	$0
21				0.242	$0
22				0.226	$0
23				0.211	$0
24				0.197	$0
25				0.184	$0
26				0.172	$0
27				0.161	$0
28				0.150	$0
29				0.141	$0
30				0.131	$0
				TOTAL PRESENT WORTH	**$263,739**

NAS Pensacola
Pensacola, Florida
Site 46
Groundwater Alternative G-3 - Air Sparge/SVE, Monitoring
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost
PROJECT DOCUMENTS/INSTITUTIONAL CONTROLS											
Prepare Documents & Plans including Permits	280	hr			$30.00		$0	$0	$8,400	$0	$8,400
AS/SVE Pilot Study (self-perform)	100	hr			$30.00		$0	$0	$3,000	$0	$3,000
AS/SVE Pilot Study Equipment	1	ls				$15,000.00	$0	$0	$0	$15,000	$15,000
MOBILIZATION/DEMOBILIZATION AND FIELD SUPPORT											
Office Trailer	2	mo				$374.00	$0	$0	$0	$748	$748
Field Office Support	2	mo		$153.00			$0	$306	$0	$0	$306
Utility Connection/Disconnection (phone/electric)	1	ls	$500.00				$500	$0	$0	$0	$500
Construction Survey	1	ls	$1,500.00				$1,500	$0	$0	$0	$1,500
Drill Rig Mob/Demob	1	ls	$1,500.00				$1,500	$0	$0	$0	$1,500
Site Utilities	2	mo		$1,000.00			$0	$2,000	$0	$0	$2,000
Supervision & Oversight (2p * 5 days/week)	3	mwk			$2,500.00		$0	$0	$7,500	$0	$7,500
DECONTAMINATION											
Decontamination Trailer	1	mo				$2,883.00	$0	$0	$0	$2,883	$2,883
Pressure Washer	1	mo				$1,282.00	$0	$0	$0	$1,282	$1,282
Equipment Decon Pad	1	ls		$500.00	$450.00	$155.00	$0	$500	$450	$155	$1,105
Decon Water Storage Tank, 1,000 gallon	1	mo				$450.00	$0	$0	$0	$450	$450
Clean Water Storage Tank, 500 gallon	1	mo				$250.00	$0	$0	$0	$250	$250
Disposal of Decon Waste (liquid & solid)	1	mo	$900.00				$900	$0	$0	$0	$900
IN-SITU SOIL TREATMENT - SVE											
Install Soil Vapor Extraction Wells	80	vlf	$27.00				$2,160	$0	$0	$0	$2,160
Install ASWells	320	vlf	$27.00				$8,640	$0	$0	$0	$8,640
AS/SVE Vaults, 2" by 2' concrete	20	ea		$271.00	$380.00	$70.00	$0	$5,420	$7,600	$1,400	$14,420
2" PVC Pipe, including trenching	200	ft		$5.00	$4.54	$7.32	$0	$1,000	$908	$1,464	$3,372
Valves, Fittings, and Gauges	1	ls				$5,000.00	$0	$0	$0	$5,000	$5,000
AS/SVE Blower	2	ea		$7,500.00	$180.00		$0	$15,000	$360	$0	$15,360
Control Panel	1	ea		$5,000.00	$500.00		$0	$5,000	$500	$0	$5,500
SVE Moisture Separator, 50 gal	1	ea		$1,000.00	$180.00		$0	$1,000	$180	$0	$1,180
MISCELLANEOUS EQUIPMENT & MATERIALS											
Pre-Engineered Building, 10' by 10'	100	sf	$112.20				$11,220	$0	$0	$0	$11,220
Pavement Repair, asphalt, 4" thick, 900 ft by 2 ft	140	sy	$32.92				$4,609	$0	$0	$0	$4,609
Transport/Dispose IDW Drums Off Site	30	drum	$150.00				$4,500	$0	$0	$0	$4,500
ELECTRICAL											
Electrical	1	ls		$5,418.28	$3,026.80		$0	$5,418	$3,027	$0	$8,445
START-UP											
Start-up Cost	1	ls		$4,000.00	$4,000.00		$0	$4,000	$4,000	$0	$8,000
Subtotal							$35,529	$39,644	$35,925	$28,632	$139,730
Shipping cost on materials 15%								$5,947			$5,947
Taxes on materials, equipment, & subcontracts 6.25%							$2,221	$2,478		$1,790	$6,488
Subtotal							$37,749	$48,069	$35,925	$30,422	$152,164

NAS Pensacola
Pensacola, Florida
Site 46
Groundwater Alternative G-3 - Air Sparge/SVE, Monitoring
Capital Cost

Item	Quantity	Unit	Unit Cost Subcontract	Unit Cost Material	Unit Cost Labor	Unit Cost Equipment	Total Cost Subcontract	Total Cost Material	Total Cost Labor	Total Cost Equipment	Total Direct Cost
Overhead on Labor Cost @ 30%									$10,777		$10,777
G & A on Labor Cost @ 10%									$3,592		$3,592
G & A on Material Cost @ 10%								$4,807			$4,807
G & A on Subcontract Cost @ 10%							$3,775				$3,775
G & A on Equipment Cost @ 10%										$3,042	$3,042
Total Direct Cost							$41,524	$52,876	$50,295	$33,464	$178,158
Indirects on Total Direct Cost @ 25%											$44,540
Profit on Total Direct Cost @ 10%											$17,816
Total Field Cost											$240,514
Contingency on Total Field Cost @ 20%											$48,103
Engineering on Total Field Cost @ 10%											$24,051
TOTAL COST											**$312,668**

NAS Pensacola
Pensacola, Florida
Operation and Maintenance Costs per Year

Item	Qty	Unit	Unit Cost	Subtotal Cost	Notes
Energy - Electric	100,000	kWh	$0.08	$8,000	
Equipment Maintenance	1	ls	$2,781.60	$2,782	5% of Installation Cost
GAC - (Service Based) - Unit	1	ea	$3,000.00	$3,000	
GAC - (Service Based) - Monthly Fee	1	ea	$750.00	$750	
Labor, Mobilization/Demobilization, Per Diem, Supplies	15	wk	$800.00	$12,000	1 visit/wk for 1st month, monthly thereafter
Quarterly Reports	4	ea	$4,000.00	$16,000	
			COST	$42,532	

NAS Pensacola
Pensacola, Florida
Annual Sampling Cost

Item	Cost Year 1	Cost Year 2	Cost Year 3-5	Notes
Site Inspection	$3,650	$3,650		
Sampling & Analysis Air (1)(2)	$1,700	$3,400		SVE off gas
GW Sampling - MNA	$24,000	$12,000	$6,000	Labor and supplies to collect samples from wells using a crew of two.
MNA Sampling Analysis/Water	$24,000	$12,000	$6,000	Analyze groundwater samples from 20 wells for TCE & natural attenuation parameters in years 1 through 5. Collect samples quarterly in year 1, twice in years 2 &3, and once a year for years 4 and 5.
Reporting	$8,000	$8,000	$8,000	Reports: Presentation and evaluation of results, conclusions and recommendations.
TOTALS	$61,350	$39,050	$20,000	

(1) Year 1 = 3 months weekly, 3 months monthly, 6 months quarterly

(2) Year 2 - Quarterly before and after GAC

NAS Pensacola
Pensacola, Florida
Site 46
Groundwater Alternative G-3 - Air Sparge/SVE, Monitoring
Present Worth Analysis

Year	Capital Cost	Annual Cost	Total Year Cost	Annual Discount Rate at 7%	Present Worth
0	$312,668		$312,668	1.000	$312,668
1		$103,882	$103,882	0.935	$97,129
2		$81,582	$81,582	0.873	$71,221
3		$20,000	$20,000	0.816	$16,320
4		$20,000	$20,000	0.763	$15,260
5		$20,000	$20,000	0.713	$14,260

TOTAL PRESENT WORTH **$526,858**

NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
SITE 46
SOIL ALTERNATIVE S-2: EXCAVATION AND OFFSITE DISPOSAL
PRESENT WORTH ANALYSIS

Year	Capital Cost	Operation and Maintenance Cost	Annual Cost	Total Yearly Cost	Present-Worth Factor (i = 6%)	Present Worth
0	$160,300			$160,300	1.000	$160,300
1		$0	$0	$0	0.943	$0
2		$0	$0	$0	0.890	$0
3		$0	$0	$0	0.840	$0
4		$0	$0	$0	0.792	$0
5		$0	$0	$0	0.747	$0
6		$0	$0	$0	0.705	$0
7		$0	$0	$0	0.665	$0
8		$0	$0	$0	0.627	$0
9		$0	$0	$0	0.592	$0
10		$0	$0	$0	0.558	$0
11		$0	$0	$0	0.527	$0
12		$0	$0	$0	0.497	$0
13		$0	$0	$0	0.469	$0
14		$0	$0	$0	0.442	$0
15		$0	$0	$0	0.417	$0
16		$0	$0	$0	0.394	$0
17		$0	$0	$0	0.371	$0
18		$0	$0	$0	0.350	$0
19		$0	$0	$0	0.331	$0
20		$0	$0	$0	0.312	$0
21		$0	$0	$0	0.294	$0
22		$0	$0	$0	0.278	$0
23		$0	$0	$0	0.262	$0
24		$0	$0	$0	0.247	$0
25		$0	$0	$0	0.233	$0
26		$0	$0	$0	0.220	$0
27		$0	$0	$0	0.207	$0
28		$0	$0	$0	0.196	$0
29		$0	$0	$0	0.185	$0
30		$0	$0	$0	0.174	$0
					TOTAL PRESENT WORTH	**$160,300**

NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
SITE 46
SOIL ALTERNATIVE S-2: EXCAVATION AND OFFSITE DISPOSAL
ANNUAL COSTS

Cost Item	Quantity	Unit	Unit Cost	Labor Overhead[a]	Total Cost
1 FIVE YEAR SITE REVIEWS (FOR 30 YEAR PERIOD)					
1.1 Site Review Meeting (2-persons for 2-days)					
Project Manager	0	hr	$40.12	$40.12	$0
Staff Engineer	0	hr	$26.44	$26.44	$0
ODCs (travel, etc.)	0	ls	$400.00		$0
1.2 Five Year Review Report					
Project Manager	0	hr	$40.12	$40.12	$0
Staff Engineer	0	hr	$26.44	$26.44	$0
ODCs (photocopies, telephone, etc.)	0	ls	$250.00		$0
Subtotal Five Year Review Cost					$0
G&A and Profit @ 15%					$0
Subtotal					$0
Contingency @ 10%					$0.00
Total Five Year Review Cost					**$0**
2 LAND USE CONTROL MONITORING (FOR 30 YEAR PERIOD)					
2.1 Quarterly Site Inspections					
Project Manager (2 hrs for each Inspection)	0	hr	$40.12	$40.12	$0
Staff Engineer	0	hr	$26.44	$26.44	$0
2.2 Annual Review and Report					
Project Manager	0	hr	$40.12	$40.12	$0
Staff Engineer	0	hr	$26.44	$26.44	$0
ODCs (photocopies, telephone, etc.)	0	ls	$250.00		$0
2.3 Sign/Fence Maintenance	0	ls	$50.00		$0
Subtotal Land Use Control Monitoring					$0
G&A and Profit @ 15%					$0
Subtotal					$0
Contingency @ 10%					$0.00
Total Land Use Control Monitoring Cost					**$0**

[a] Overhead on professional labor @ 100%

NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
SITE 46
SOIL ALTERNATIVE S-2: EXCAVATION AND OFFSITE DISPOSAL
CAPITAL COSTS

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											
1.1 Prepare Remedial Design/Work Plan	120	hr			$33.79		$0	$0	$4,055	$0	$4,055
1.2 Project Scheduling and Procurement	40	hr			$33.79		$0	$0	$1,352	$0	$1,352
2 MOBILIZATION/DEMOBILIZATION											
2.1 Equipment Mob/Demob (Exc., Loader, & Dozier)	2	ea			$200.00	$250.00	$0	$0	$400	$500	$900
2.2 Mobilize/Demobilize Personnel (3-persons)	2	ea		$375.00	$300.00		$0	$750	$600	$0	$1,350
2.3 Portable Toilet	1	mo	$74.18				$74	$0	$0	$0	$74
2.4 Storage Trailer (28' x 10')	1	mo	$98.33				$98	$0	$0	$0	$98
2.5 Office Trailer (32' x 8')	1	mo	$221.49				$221	$0	$0	$0	$221
2.6 Site Utilities	1	mo	$1,500.00				$1,500	$0	$0	$0	$1,500
3 DECONTAMINATION											
3.1 Temporary Decon Pad	1	ls		$450.00	$400.00	$155.00	$0	$450	$400	$155	$1,005
3.2 Decon Water Disposal	8	drum	$125.00				$1,000	$0	$0	$0	$1,000
3.3 Decon Water Storage Drums	8	ea		$45.00			$0	$360	$0	$0	$360
3.4 PPE (3 p * 5 days * 4 Weeks)	60	m-day		$30.00			$0	$1,800	$0	$0	$1,800
3.5 Decontaminate Equipment (Pressure Washer)	8	ea			$134.45	$50.00	$0	$0	$1,076	$400	$1,476
4 SITE PREPARATION											
4.1 Erosion Control Fencing	1500	lf		$0.23	$1.17		$0	$345	$1,755	$0	$2,100
4.2 Collect/Analyze Delineation Samples (TPH & others)	5	ea	$200.00	$10.00	$23.52		$1,000	$50	$118	$0	$1,168
4.3 Construction Surveys (2-man crew)	3	day	$648.36				$1,945	$0	$0	$0	$1,945
4.4 Utility Location and Site Delineation/Layout	8	hrs			$33.23		$0	$0	$266	$0	$266
4.5 Concrete Demolition/Removal (6" reinforced)	30	cy	$45.58				$1,367	$0	$0	$0	$1,367
4.6 Concrete Debris Disposal	30	cy	$20.70				$621	$0	$0	$0	$621
5 EXCAVATION/BACKFILL											
5.1 Excavate/Load Contaminated Soil (2.0 cy Hyd. Exc.)	20	day			$350.00	$1,200.00	$0	$0	$7,000	$24,000	$31,000
5.2 Standby, Crawler Mounted 2.0 CY Hydraulic Excavator	50	hrs				$37.54	$0	$0	$0	$1,877	$1,877
5.3 Wheel Loader, 3 cy	20	day			$350.00	$520.00	$0	$0	$7,000	$10,400	$17,400
5.4 Standby, Wheel Loader, 3 cy	25	hrs				$14.07	$0	$0	$0	$352	$352
5.5 Health & Safety Monitoring with OVA during Excavation	20	day			$188.16	$100.00	$0	$0	$3,763	$2,000	$5,763
5.6 Collect/Analyze Confirmatory Samples	5	ea	$200.00	$10.00	$23.52		$1,000	$50	$118	$0	$1,168
5.7 Excavate Clean Overburden (0-2) and Contaminated Soil	330	cy		$7.82	$0.85	$1.81	$0	$2,582	$281	$598	$3,460
5.8 Backfill with On-Site Overburden	165	cy		$0.00	$2.02	$0.76	$0	$0	$333	$125	$459
5.9 Backfill with Clean Material	165	cy		$6.28	$2.02	$0.76	$0	$1,037	$333	$125	$1,495
5.10 UST Removal	0	ea		$340.72	$485.04	$1,638.12	$0	$0	$0	$0	$0
6 OFF-SITE TRANSPORTATION/DISPOSAL											
6.1 Waste Profile	2	ls	$750.00				$1,500	$0	$0	$0	$1,500
6.2 Transport and Dispose of Soil (Non-haz.) in Landfill	264	ton	$45.00				$11,884	$0	$0	$0	$11,884
6.3 Prepare Shipment Manifests	10	hrs			$33.23		$0	$0	$332	$0	$332
7 SITE RESTORATION											
7.1 Concrete on Grade (6")	900	sf	$3.60				$3,240	$0	$0	$0	$3,240
7.1 Sod or Seed Disturbed Area	1150	sf	$7.50				$8,625	$0	$0	$0	$8,625
8 LAND USE CONTROLS											
8.1 Site Survey (2-man crew)	0	days	$648.36				$0	$0	$0	$0	$0
8.2 Prepare Land Use Plan	0	hours			$33.79		$0	$0	$0	$0	$0
8.3 Modify Master Plan and Prepare Deed Restrictions	0	hours			$33.79		$0	$0	$0	$0	$0
Subtotal Direct Capital Costs less Subcontract								$7,423	$29,181	$40,532	$77,136

NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA
SITE 46
SOIL ALTERNATIVE S-2: EXCAVATION AND OFFSITE DISPOSAL
CAPITAL COSTS

Cost Item	Quantity	Unit	Unit Cost				Extended Cost				Subtotal
			Subcontract	Material	Labor	Equipment	Subcontract	Material	Labor	Equipment	
Local Area Adjustment								84%	84%	84%	
								$6,235	$24,512	$34,047	$64,794
Overhead on Labor Cost @ 30%									$7,354		$7,354
G & A on Labor Cost @ 10%									$2,451		$2,451
G & A on Material Cost @ 10%								$624			$624
Total Direct Capital Cost								$6,859	$34,317	$34,047	$75,223
Indirects on Total Direct Labor Cost @ 75%									$25,738		$25,738
Profit on Total Direct Cost @ 10%											$7,522
Subtotal											$108,483
Health & Safety Monitoring @ 3%		(Includes Subcontractor cost)									$4,277
Total Field Cost											**$112,760**
Subtotal Subcontractor Cost							$34,077				$34,077
G & A on Subcontract Cost @ 10%							$3,408				$3,408
Profit on Subcontractor Cost @ 5%											$1,704
Subcontractor Cost											**$39,188**
Contingency on Total Field and Subcontractor Costs @ 10%											**$15,195**
Engineering on Total Field and Subcontractor Costs @ 5%											**$7,597**
TOTAL Capital COST											**$174,740**

APPENDIX B

SUSTAINABLE REMEDIATION EVALUATION

APPENDIX B

Sustainability Evaluation of Remedial Alternatives for Site 46 Feasibility Study

Naval Air Station Pensacola

Pensacola, Florida

September 2010

1.0 OBJECTIVE

The Sustainable Remediation Evaluation (SRE) of Remedial Alternatives, including references, is provided as an appendix to the Feasibility Study (FS) for Site 46, Naval Air Station (NAS) Pensacola in Pensacola, Florida. The purpose of the SRE is to assess the sustainability of the proposed remedial alternatives using the metrics of greenhouse gas (GHG) and criteria pollutant emissions, energy usage, water consumption, and worker risk. The Naval Facilities Engineering Command (NAVFAC) SiteWise (Version 1-0) Tool for Green and Sustainable Remediation developed by Battelle was utilized for the SRE. The results of the SRE are intended to provide additional information for consideration with the CERCLA remedy selection criteria described in the FS and to enhance the understanding of the net environmental benefit of the selected remedy.

2.0 SUSTAINABILITY EVALUATION POLICY BACKGROUND

Department of Defense (DOD) and Navy policies require continual optimization of remedies in every phase from remedy selection through site closeout. 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 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 Navy issued an updated Navy Guidance for "Optimizing Remedy Evaluation, Selection, and Design" (Battelle, 2010), which includes sustainability evaluations as part of the traditional Navy optimization review process for remedy selection, design, and remedial action operation. On August 10, 2010, NAVFAC issued Navy policy requiring SiteWise to be used on all Feasibility Studies (FS) performed on ER sites to evaluate the sustainability of remediation alternatives. As such, this sustainability evaluation of remedial alternatives is being performed to estimate the environmental footprint associated with each alternative in the interest of increasing the sustainability of remedial action at NAS Pensacola, Site 46.

3.0 SUSTAINABILITY EVALUATION FRAMEWORK

Separate sustainability evaluations were performed for soil media Alternatives (S-2) and groundwater media Alternatives (G-2 and G-3), which considered life-cycle metrics for GHG emissions, criteria pollutant emissions, energy consumption, water usage, and collateral risk. The no action Alternatives (Alternatives S-1 and G-1) were not evaluated, as hypothetically no direct emissions or consumption occur as part of implementation of the no action alternatives.

In summary, life-cycle metrics were analyzed for the following remedial alternatives, which are described in further detail within the Site 46 Feasibility Study:

Soil Alternatives

- Alternative S-2: Excavation and Offsite Disposal

Groundwater Alternatives:

- Alternative G-2: Natural Attenuation, Institutional Controls, and Groundwater Monitoring
- Alternative G-3: Air Sparge/Soil Vapor Extraction (AS/SVE) and Groundwater Monitoring

Life cycle impacts were calculated for energy consumption, emissions of greenhouse gases (GHGs) [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, energy consumption, and worker safety. Calculation of these metrics was divided into three modules for this evaluation – remedial action construction, remedial action operations, and long term monitoring. Cost estimates from the Feasibility Study and design calculations from each alternative were used as a basis for quantities and related assumptions. Emission factor, energy consumption, and water usage data were correlated to material quantities, equipment, transportation distances, and installation time frames to calculate life-cycle emissions, energy consumption, water usage, and worker safety within the SiteWise tool. Default SiteWise emission, energy usage, water consumption, and worker fatality and accident risk factors were utilized.

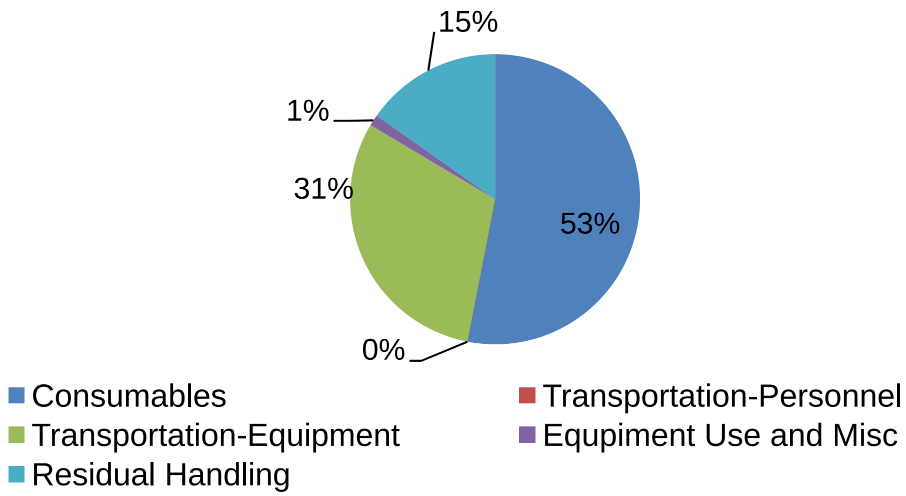
4.0 SUSTAINABLE REMEDIATION EVALUATION RESULTS (SOIL ALTERNATIVES)

The inputs and quantitative results of the sustainability evaluation performed for the Site 46 soil remedial Alternative S-2 is attached within this appendix. The following sections summarize the results of the evaluation.

4.1. Greenhouse Gas Emissions

Emissions of CO_2, CH_4, and N_2O were normalized within SiteWise to CO_2 equivalents (CO_2e), which is a cumulative method of weighing GHG emissions relative to global warming potential. Analysis of CO_2e emissions for Alternative S-2 is summarized in Figure 1. The CO_2e emission for Alternative S-2 was estimated at 14 tonnes. CO_2e emissions for Alternative S-2 were largely attributed to concrete material manufacture for site restoration (7.5 tonnes, 53% of total CO_2e emission). Secondary to concrete manufacture, transportation of heavy equipment, concrete, backfill, and sod resulted in 31% of the total CO_2e emission at 4.3 tonnes.

Figure 1 GHG Emissions



4.2. Criteria Pollutant Emissions

Criteria pollutant emissions for NO_x, SO_x, and PM_{10} were estimated for Alternative S-2 using SiteWise. Results from the evaluation of NO_x, SO_x, and PM_{10} are summarized as follows. The quantity of Alternative S-2 emission of criteria pollutants for NO_x, SO_x, and PM_{10} were 0.008 tonnes, 0.002 tonnes, and 0.001 tonnes, respectively. Criteria pollutant emissions for Alternative S-2 was primarily associated with transportation of heavy equipment and materials (concrete, backfill, and sod) and contributed to approximately 57% of the total criteria pollutant emissions. Residual handling (disposal) and heavy equipment operation resulted in 28% and 15% of the total criteria pollutant emissions, respectively. The distribution of criteria pollutants amongst remedial components are summarized in Figures 2, 3, and 4.

Figure 2 NOx Emissions

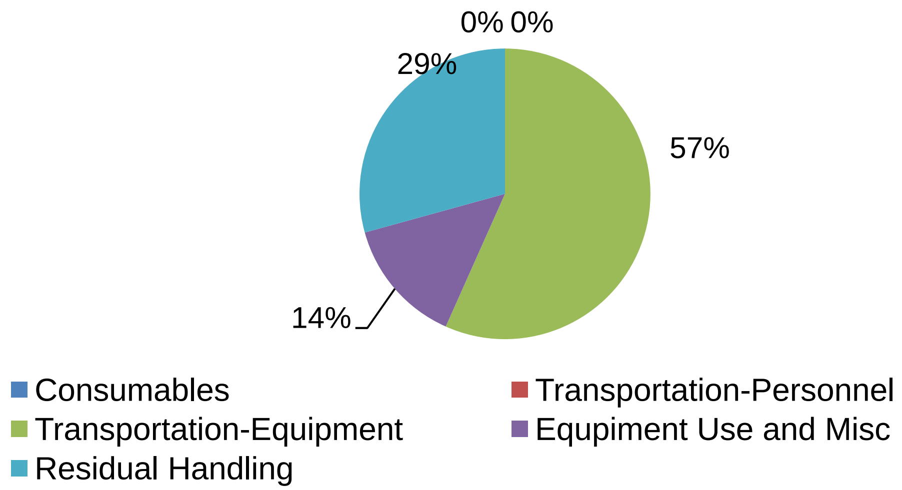


Figure 3 SOx Emissions

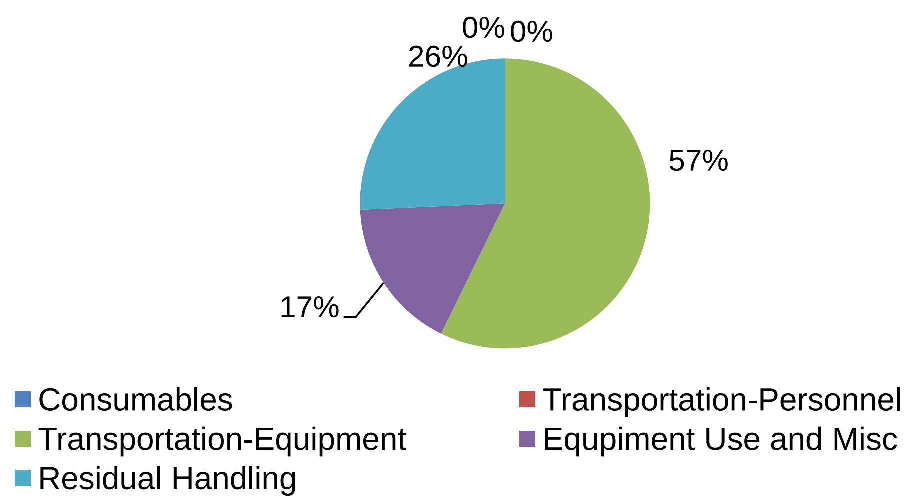
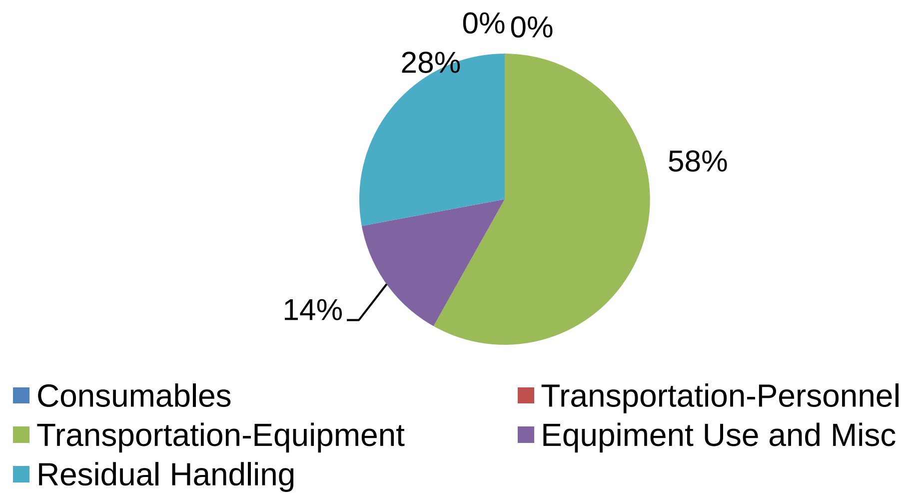


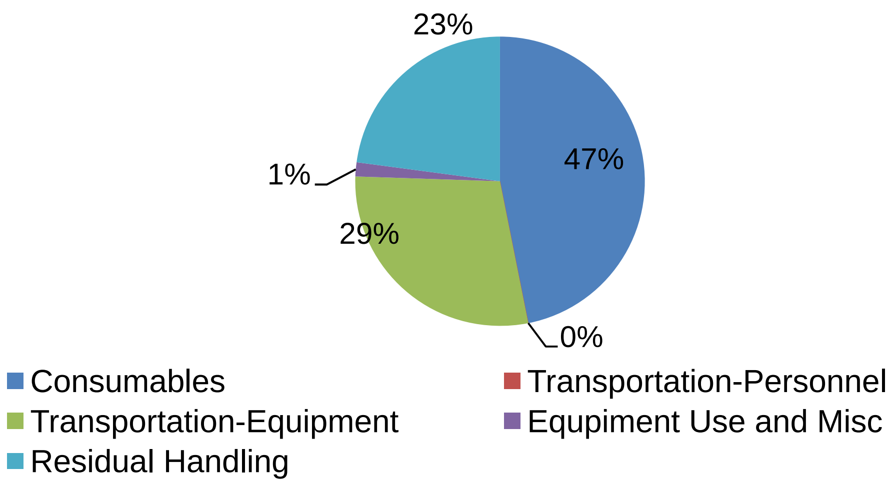
Figure 4 PM10 Emissions



4.3. Energy Consumption

Implementation of Alternative S-2 would result in an estimated energy demand of 158 million British Thermal Units (MMBTUs). Energy demand for Alternative S-2 was largely attributed to concrete and backfill production, the highest of all components at 87 MMBTUs (47%). Secondary drivers of energy demand were equipment transportation (29%) and residual handling (23%). Figure 5 summarizes the distribution of energy usage associated with Alternative S-2.

Figure 5 Energy Consumption



4.4. Water Usage

Minimal water usage is associated with Alternative S-2 (mainly decontamination water), provided excavation dewatering is not required.

4.5. Collateral Risk

Collateral risk for transportation, construction, and heavy equipment handling and operation, and production of materials associated with remedial activities was evaluated for worker njury and fatality risk. Overall, the fatality and injury risk calculated by SiteWise is driven by personnel and equipment transportation as shown on Figures 6 and 7.

Figure 6 Accident Risk - Fatality

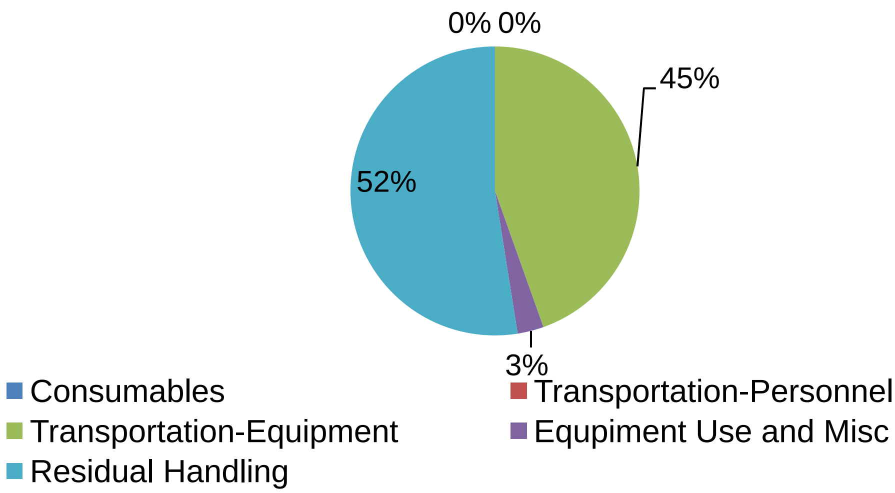
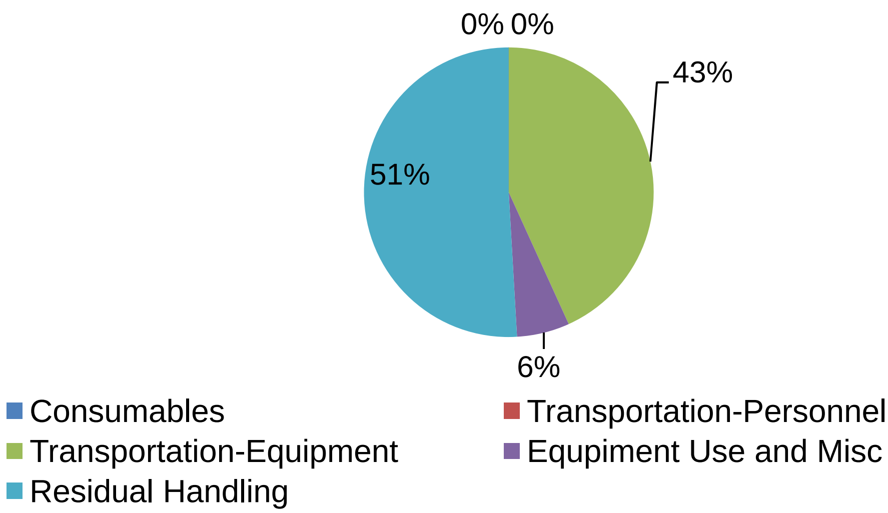


Figure 7 Accident Risk - Injury



4.6. Cost of Remedy Alternatives

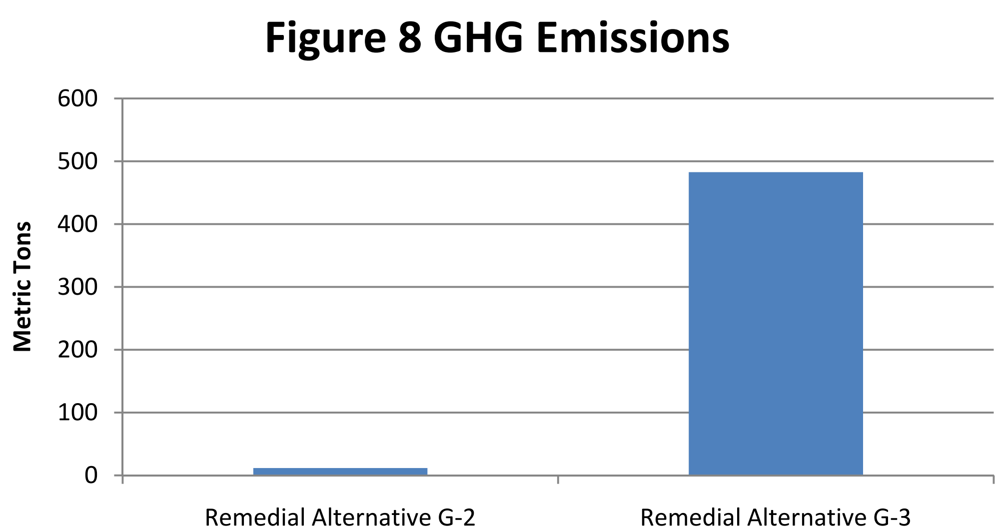
The estimated life-cycle cost estimated in the Feasibility Study for Alternative S-2, represented as 30-year net-present worth (NPW) is $175,000.

5.0 SUSTAINABLE REMEDIATION EVALUATION RESULTS (GROUNDWATER)

The inputs and quantitative results of the sustainability evaluation performed for Site 46 groundwater remedial alternatives are attached within this appendix. The following sections summarize the results of the evaluation.

5.1. Greenhouse Gas Emissions

Emissions of CO_2, CH_4, and N_2O were normalized to CO_2e relative to global warming potential. Analysis of CO_2e emissions for each alternative is summarized in Figure 8. Alternative G-3 contained the highest CO_2e emissions (483 tonnes), largely due to emissions from electrical demand from operating the two assumed 30 horsepower AS/SVE blowers (439 tonnes). Alternative G-2 CO_2e emissions (12 tonnes) largely result from personnel transportation (10 tonnes) requirements during long term monitoring and institutional control activities.



5.2. Criteria Pollutant Emissions

Criteria pollutant emissions for NO_x, SO_x, and PM_{10} were estimated for Alternatives G-2 and G-3. Results from the evaluation of NO_x, SO_x, and PM_{10} are summarized in Figures 9, 10, and 11, respectively. Of the alternatives, the highest quantity of criteria pollutants was associated with Alternative G-3 with NO_x, SO_x, and PM_{10} emissions of 0.94 tonnes, 0.44 tonnes, and 0.002 tonnes, respectively. Similar to GHG emissions, criteria pollutant emissions for Alternatives G-3 were primarily attributed to electrical demand from operating the blowers for AS/SVE. For

Alternatives G-2 criteria pollutant emissions were driven by personnel transportation for long term monitoring and institutional control inspection components.

Figure 9 NO_x Emissions

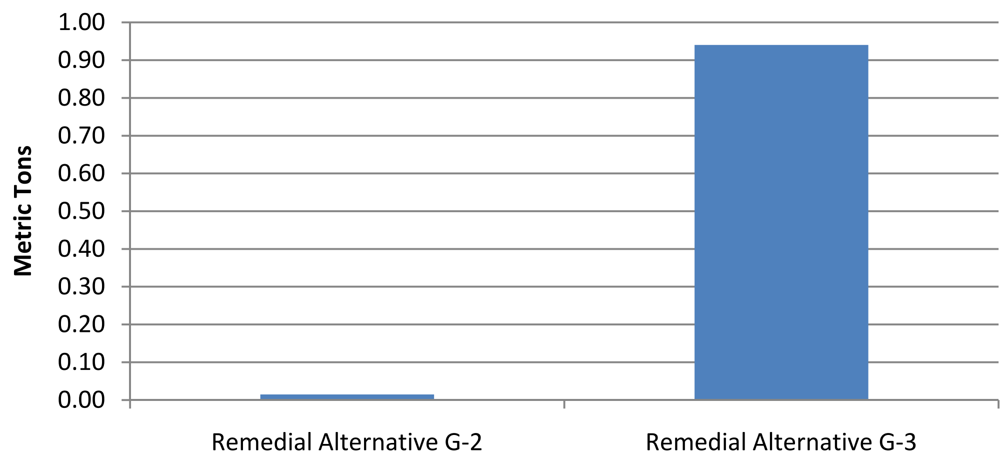
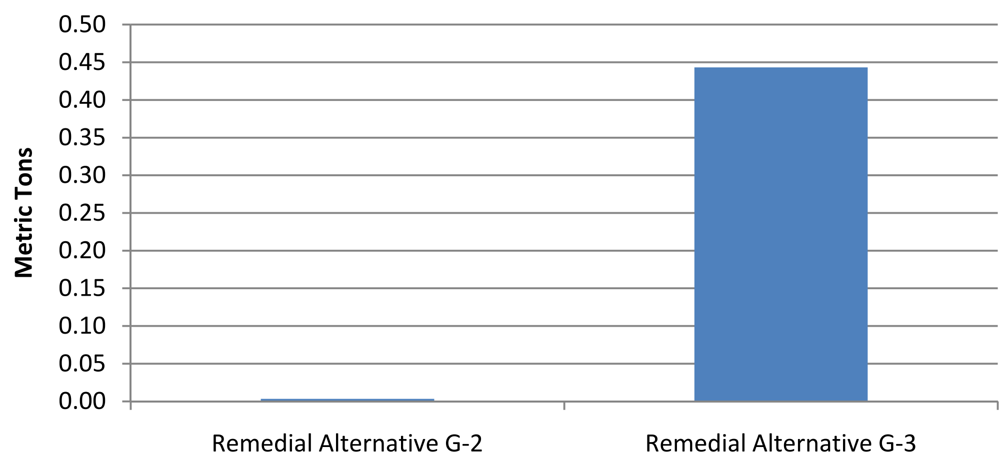
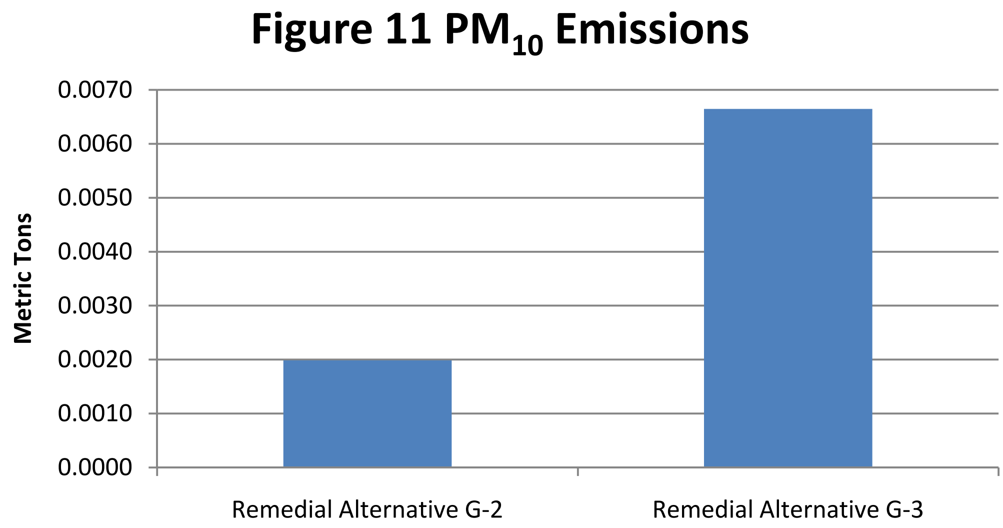


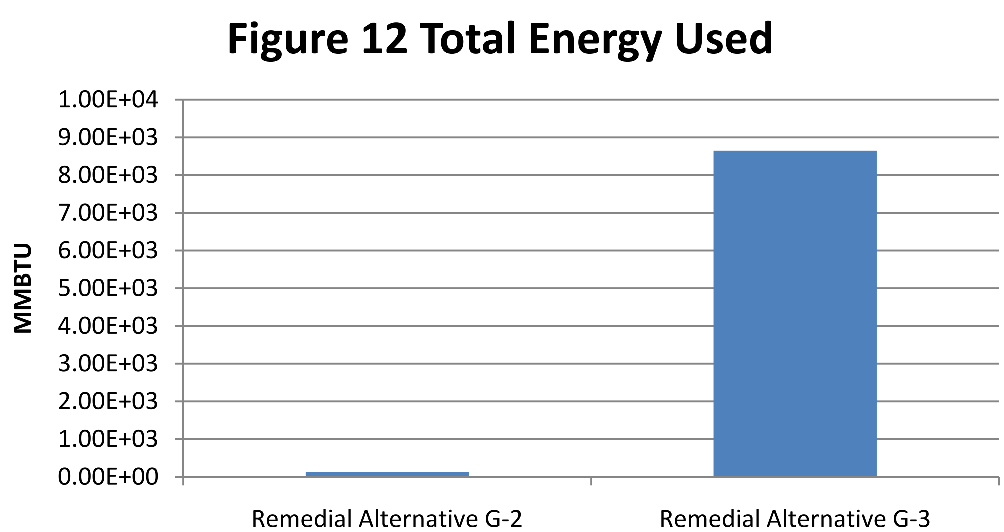
Figure 10 SO_x Emissions





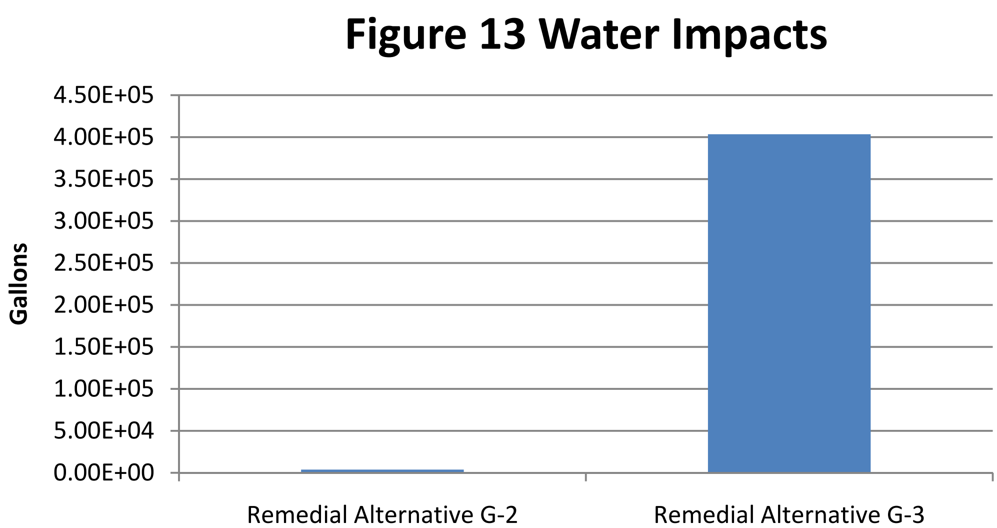
5.3. Energy Consumption

Energy demand for Alternative G-3 was the highest of the alternatives (8,649 MMBTUs) due to the energy demand associated with AS/SVE system operation. Energy demand for Alternative G-2 was driven by long term monitoring and institutional control inspection transportation. Figure 12 summarizes the energy consumption for each alternative.



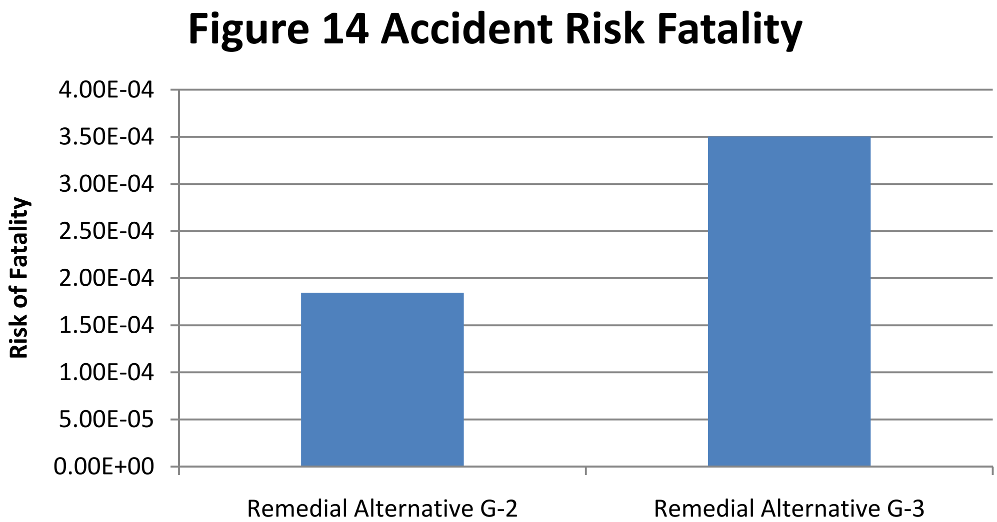
5.4. Water Usage

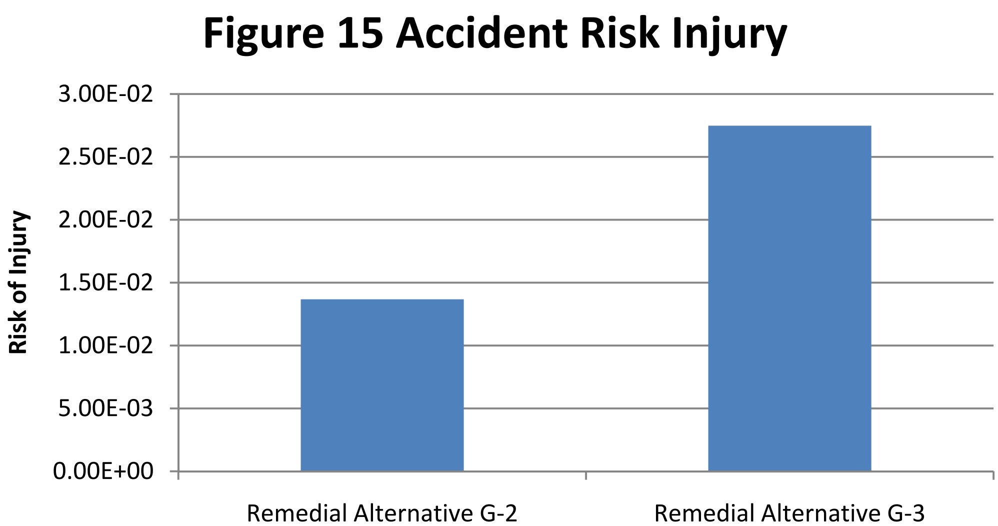
Water usage associated with electricity production for Alternative G-3 resulted in the highest water usage (403,000 gallons). There is minimal water usage associated with Alternative G-2 (investigative derived waste). Figure 13 summarizes water usage for Alternatives G-2 and G-3.



5.5. Collateral Risk

Collateral risk for transportation, construction, and heavy equipment handling and operation, and production of materials associated with remedial activities was evaluated for worker injury and fatality risk. Overall, the fatality and injury risk calculated by SiteWise for Alternatives G-2 and G-3 is driven by personnel and equipment transportation as shown on Figures 14 and 15. Alternative G-3 has a higher associated risk than Alternative G-2 due to the relatively transportation-intense aspect of remedial system operation and maintenance (O&M). The risk associated with Alternative G-2 is primarily due to the amount of personnel transportation required over the extended long term monitoring timeframe.





5.6. Cost of Remedial Alternatives

The estimated life-cycle costs estimated in the Feasibility Study, represented as 5-year NPW for Alternative G-3 and 30-year NPW for Alternative G-2, are $527,000 and 264,000, respectively. Alternative G-3 is the most expensive alternative and has the largest environmental footprint (GHG and criteria pollutant emissions, energy consumption, and water usage) of the two alternatives. However, Alternative G-3 is expected to meet Remedial Action Objectives (RAOs) in the shortest timeframe (2-years for Alternative G-3 compared to 5 to 10 years for Alternative G-2).

The estimated life-cycle costs and environmental footprints are significantly lower, but Alternative G-2 may require a longer time to meet RAOs in comparison to Alternative G-3.

6.0 CONCLUSIONS

In general, optimization of the selected remedy to decrease the energy usage and primary components of CO_2e emissions could potentially increase the net environmental benefit of remedy implementation. 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 sustainability metrics may provide additional insight into appropriate optimization. To aid in the sensitivity analysis, the primary drivers of emissions, energy consumption, and water usage for each alternative are described in the results section for soil and groundwater alternatives. Optimization of these drivers will reduce the overall environmental footprint of the selected remedy.

Specific measures identified in the evaluation that may reduce the environmental footprint of the alternatives are listed below for consideration.

- Optimize Alternative S-2 resurfacing area to reduce the energy usage and GHG and criteria pollutant emissions due to concrete material manufacture.
- Optimization of process equipment:
    - Evaluate sizing of AS/SVE blowers (pilot testing may be required);
    - Operate the AS/SVE with variable frequency drives, high efficiency motors, and/or as a pulsed operation versus continuous operation; and
    - Use remote telemetry for data collection to minimize routine O&M events, such that O&M visits are primarily dedicated to system sampling and preventative maintenance rather than normal data acquisition.
- Optimization of operation and maintenance, monitoring and institutional controls to reduce overall transportation requirements (Alternatives G-2 and G-3).
    - In the design phase, consider reducing the number of existing monitoring wells to be retained and focus on wells in area that exceeds MCLs and downgradient Alternative G-2 and G-3).
    - Continually reduce the sampling frequency and the number of sampling locations over time as warranted by monitoring results trend analysis (Alternative G-2 and primarily G-3).

ATTACHMENT

SITEWISE INPUTS AND RESULTS

- Long term monitoring through passive sampling devices, where feasible (Alternatives G-2 and G-3).
- Some reduction of the environmental footprint, particularly CO_2e emissions, could be realized for all alternatives through the possible use of hybrid vehicles and emission control measures such as alternate fuel sources (e.g., biodiesel), equipment exhaust controls (e.g., diesel oxidation catalyst and particulate filters), and equipment idle reduction (both Alternatives).

Continual optimization of the selected remedy and related monitoring plan throughout the project life-cycle (Feasibility Study, Remedial Design, Remedial Action, Remedial Action Operations, and Monitoring phases) in accordance with Navy policy and guidance will continually reduce the life-cycle environmental footprint, and potentially lifecycle costs, of the project.

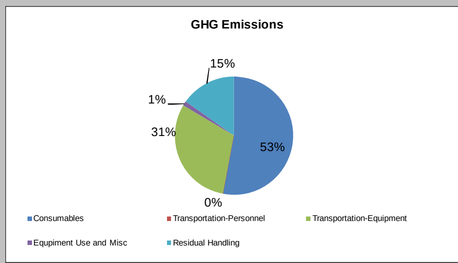
SRE SUMMARY TABLES (SOIL MEDIA)

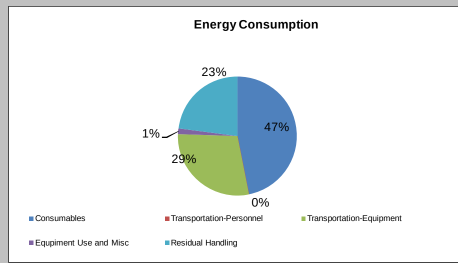
SITEWISE INPUTS

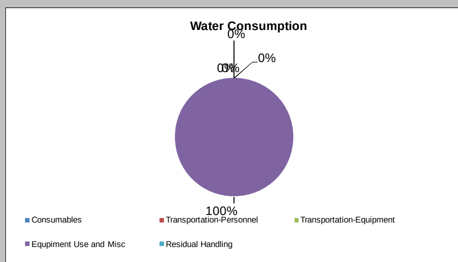
ALTERNATIVE S-2

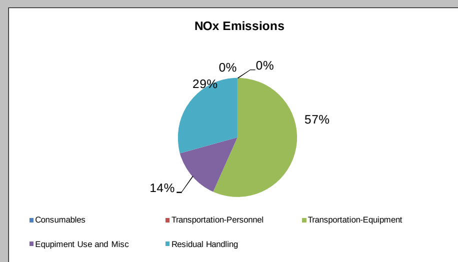
Sustainable Remediation Summary - Remedial Action Construction

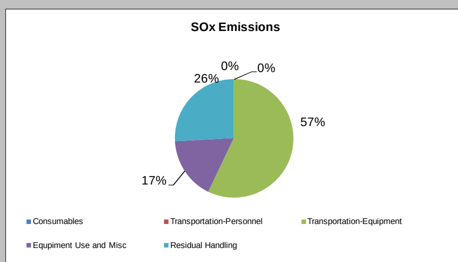
Activities	GHG Emissions	Percent Total	Total energy Used	Percent Total	Water Consumption	Percent Total	NOx emissions	Percent Total	SOx Emissions	Percent Total	PM10 Emissions	Percent Total	Accident Risk Fatality	Percent Total	Accident Risk Injury	Percent Total
	metric ton	%	MMBTU	%	gallons	%	metric ton	%	metric ton	%	metric ton	%		%		%
Consumables	7.45	53.1	8.7E+01	46.9	NA	NA	NA	-	NA	-	NA	-	NA	NA	NA	NA
Transportation-Personnel	0.00	-	0.0E+00	-	NA	NA	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Transportation-Equipment	4.28	30.5	5.3E+01	28.7	NA	NA	4.7E-03	56.7	1.0E-03	57.3	6.7E-04	58.1	5.8E-06	44.6	1.2E-03	43.2
Equipment Use and Misc	0.17	1.2	2.9E+00	1.6	3.2E+02	100.0	1.2E-03	14.0	3.1E-04	17.0	1.6E-04	13.9	3.8E-07	2.9	1.6E-04	5.9
Residual Handling	2.14	15.2	4.2E+01	22.9	NA	NA	2.4E-03	29.3	4.7E-04	25.7	3.2E-04	27.9	6.8E-06	52.5	1.4E-03	50.9
Total	14.04	100.0	1.85E+02	100.0	3.20E+02	100.0	8.30E-03	100.0	1.81E-03	100.0	1.16E-03	100.0	1.29E-05	100.0	2.78E-03	100.0

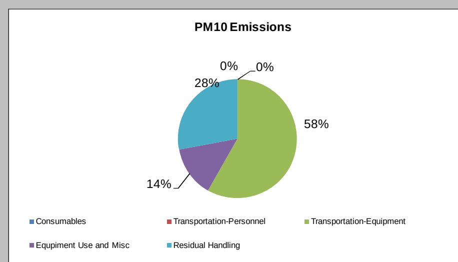


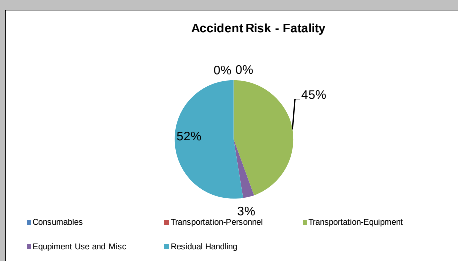


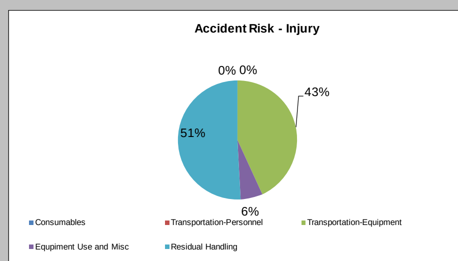












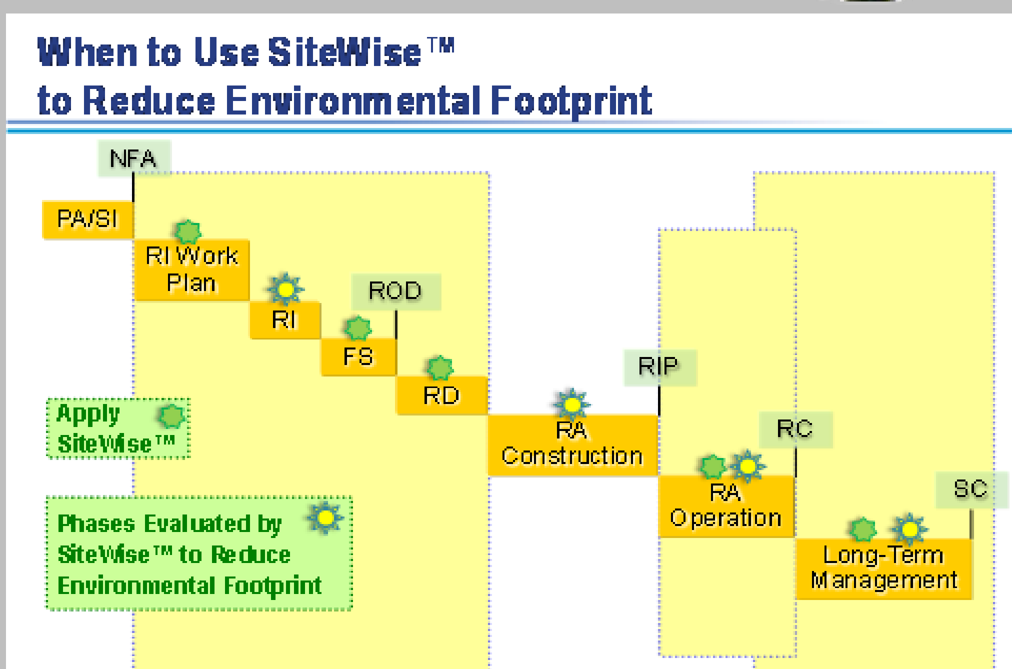
SITEWISE INPUT SUMMARY
ALTERNATIVE S-2
FEASIBILITY STUDY
SITE 46
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Alternative S-2: Excavation and Offsite Disposal

Remedial Action Construction Phase			
Materials			
Item	**Quantity**	**Units**	**Comments**
Concrete	17	CY	Concrete (900 sf x 6 in thick)
Soil	165	CY	Backfill Material (165 CY, 900 sq ft x 1 ft)
Soil	264	ton	Soil Disposal
Transportation Phase			
Item	**Quantity**	**Units**	**Comments**
On Road Truck	400	mi	Heavy Equipment Mob/Demob (100 mi/trip, 4 trips, 20 ton/trip)
Light Truck	600	mi	Site Support Crew Mob/Demob (200 mi/trip, 3 man crew)
On Road Truck	400	mi	Storage and Office Trailer Mob/Demob (100 mi/trip, 4 trips, 5 tons/trip)
Heavy Duty Truck	200	mi	Erosion Control Personnel and Materials Mob/Demob (100 mi/trip, 2 trip)
Light Truck	200	mi	Survey Crew Mob/Demob (100 mi/trip, 2 trip)
Light Truck	150	mi	Survey Crew (50 mi/d, 3d)
Light Truck	100	mi	Utility Location Delineation Mob/Demob (50 mi/trip, 2 trips)
Light Truck	1,000	mi	Site Support Crew (50 mi/d, 20 d)
Light Truck	200	mi	Decon water T&D (200 mi/trip, 1 trip)
On Road Truck	1,100	mi	Imported Fill Transportation (165 CY, 16 CY/trip, 100 mi/trip)
On Road Truck	200	mi	Construction Debris T&D (30 CY, 16 CY/trip, 20 ton, 100 mi/trip)
On Road Truck	1,400	mi	Excavated Soil T&D (264 ton, 20 ton/trip, 100 mi/trip)
On Road Truck	300	mi	Concrete Delivery (17 CY, 8 CY/Trip, 100 mi/trip)
On Road Truck	200	mi	Sod Delivery (2 trip, 100 mi/trip, 2 ton)
Heavy Duty Truck	500	mi	Sod Crew (5 dt rip, 100 mi/trip)
Construction Equipment			
Item	**Quantity**	**Units**	**Comments**
Wheel Loader, 3 CY	330 CY	CY	
Hydraulic Excavator, 2.0 CY	330 CY	CY	
Direct Water Usage			
Item	**Quantity**	**Units**	**Comments**
Decon Water	320	gal	8 drums, 40 gal/drum

SRE SUMMARY TABLES (GROUNDWATER MEDIA)

SITE INFORMATION	
Name	NAS Pensacola, Soil
Date	8/16/2010
Site	Site 46
Remedial Alternative Name	Remedial Alternative S-2



This worksheet allows the user to define material production, transportation, equipment use, and residual handling variables for the remedial alternative

Yellow cells	require the user to choose an input from a drop down menu
White cells	require the user to type in a value

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Choose well diameter (in) from drop down menu	1/2	1/2	1/2	1/2	1/2	1/2
Choose material type from drop down menu	PVC	PVC	PVC	PVC	PVC	PVC
Choose specific material schedule from drop down menu	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input number of injection points						
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Input amount of material injected at each point (pounds dry mass)						
Input number of injections per injection point						

GAC	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input weight of GAC used (lbs)						
Choose material type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC

	Site Restoration	Backfill, used as surrogate input for soil backfill material				
CONSTRUCTION MATERIALS	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6
Choose material type from drop down menu	General Concrete	Gravel	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft^2)	900	4,455				
Input depth of material (ft)	0.5	1				

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	1	1	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil

TRANSPORTATION

	Site Survey	Excavation (3 laborers +1H&S)	Site Restoration			
PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Light truck	Light truck	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	50	50	50			
Input number of trips taken	3	20	5			
Input number of travelers	2	4	3			
Input estimated vehicular fuel economy (mi/gal) (Input only if known for the vehicle selected, otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab.

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of flights taken						

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

	Equip. Mob	Concrete Truck	Backfill Delivery	Sod Restoration		
EQUIPMENT TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Gasoline	Gasoline	Gasoline
Input distance traveled (miles)	400	2,800	550	300		
Input weight of equipment transported (tons)	20	16	24	18		

EQUIPMENT TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of load (tons)						

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (mile)						
Input weight of load (tons)						

EQUIPMENT USE

	Excavation	Backfill				
EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose earthwork equipment type from drop down menu	Excavator	Loader/Backhoe	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd^3)	350	350				
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Input number of drilling locations						
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)						
Input depth of wells (ft)						
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

For each pump, select only one of the three methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose method from drop down	Method 2	Method 1	Method 1	Method 1	Method 1	Method 1

Method 1 - ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN						
Input flow rate (gpm)	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.51	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input pump horsepower (hp)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1
Equipment operating hours (hrs)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the pump selected, otherwise a default will be used by the tool)						

For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

BLOWER, COMPRESSOR, MIXER, AND OTHER EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input equipment horsepower (hp)	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0
Input equipment load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Method 2 - ELECTRICAL USAGE IS KNOWN						
Input equipment electrical usage, if known (KWh)	0	0	0	0	0	0
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Choose horsepower range from drop down menu	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6
Input operating hours (hr)						

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area to till (acre)						
Choose soil condition from drop down menu	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil
Choose soil type from drop down menu	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil
Input time available (work days)						
Input depth of tillage (in)						

CAPPING EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area (ft^2)						
Input time available (work days)						

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd^3)						
Input production rate (yd^3/hr)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the mixer selected, otherwise a default will be used by the tool)						

RESIDUAL HANDLING

	Soil Disposal	Decon Water	Construction Debris			
RESIDUE DISPOSAL/RECYCLING	**Soil Residue**	**Residual Water**	**Material Residue**	**Other Residuals**	**Other Residuals**	**Other Residuals**
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)	24	2	16			
Choose vehicle type from drop down menu	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Gasoline	Gasoline	Gasoline
Input total number of trips	11	1	1			
Input number of miles per trip	100	100	100			

LANDFILL OPERATIONS	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6
Input tons of soil or waste to be incinerated (user must input emission factors in the Look Up Table, Table 7a)						

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (scfm)						
Input time running (hours)						
Input waste gas inlet temperature (F)						
Input contaminant concentration (ppmV)						

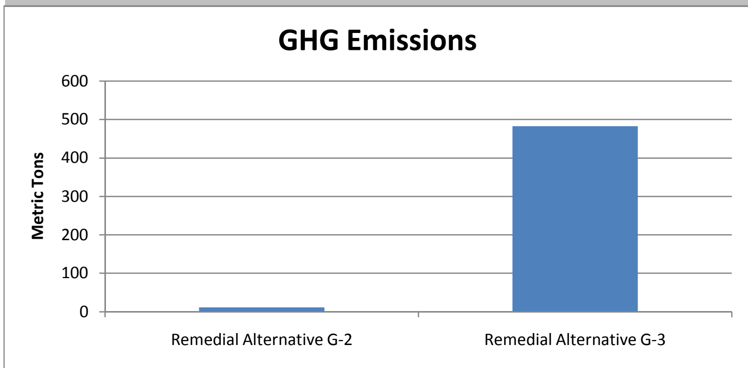
*(Electric blowers are included in the analysis)

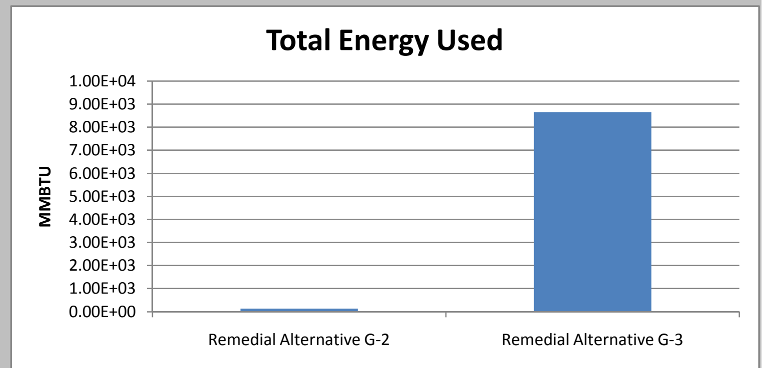
WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)	440					
Input water disposed/collected during site preparation (gal)						
Input water disposed/collected during sampling (gal)						
Input water disposed/collected during site demobilization (gal)						

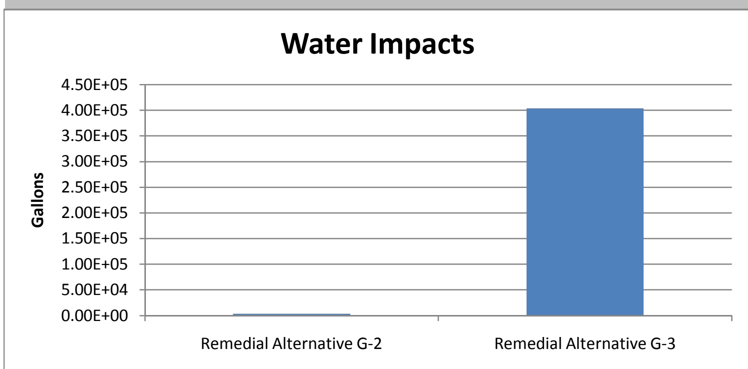
LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6
Input landfill methane emissions (metric tons)						

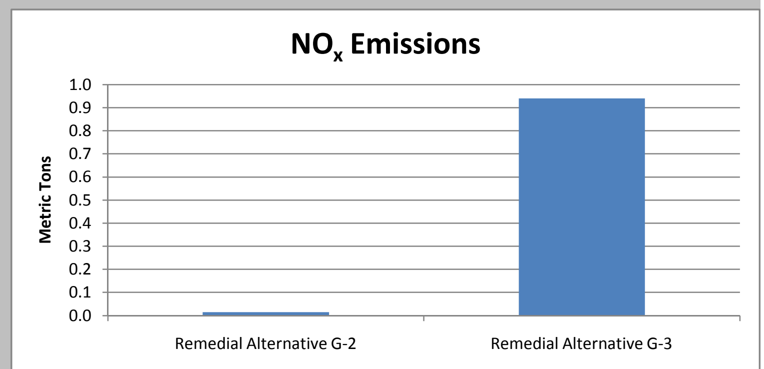
OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO_2 emission (metric ton)	
Input N_2O emission (metric ton CO_2 e)	
Input CH_4 emissions (metric ton CO_2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM_{10} emission (metric ton)	
Input fatality risk	
Input injury risk	

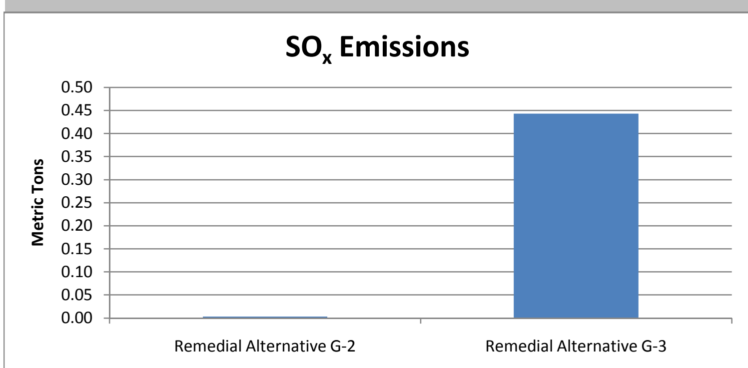
Remedial Alternatives	GHG Emissions metric ton	Total energy Used MMBTU	Water gallons	NO_x emissions metric ton	SO_x Emissions metric ton	PM_{10} Emissions metric ton	Accident Risk Fatality	Accident Risk Injury
Remedial Alternative G-2	11.60	1.34E+02	3.75E+03	0.0	0.0033	0.0020	1.84E-04	1.37E-02
Remedial Alternative G-3	482.76	8649.48	403528.66	0.9402	0.4433	0.0066	3.50E-04	2.75E-02

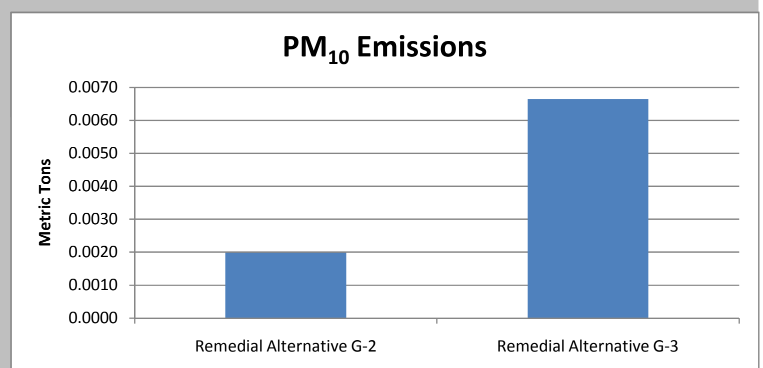


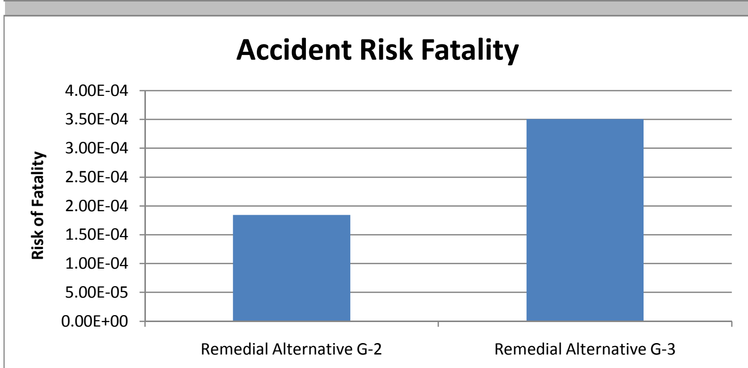


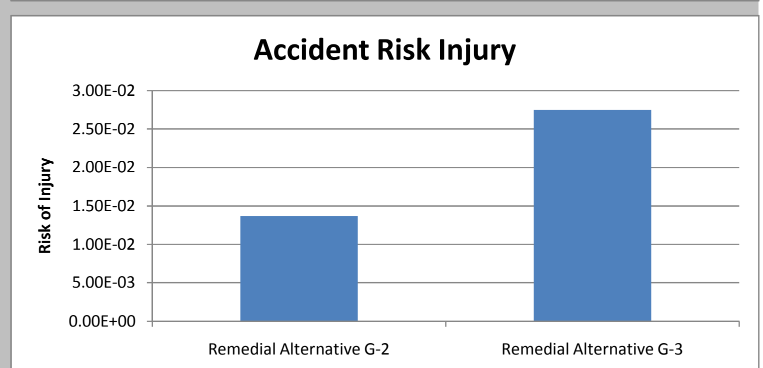






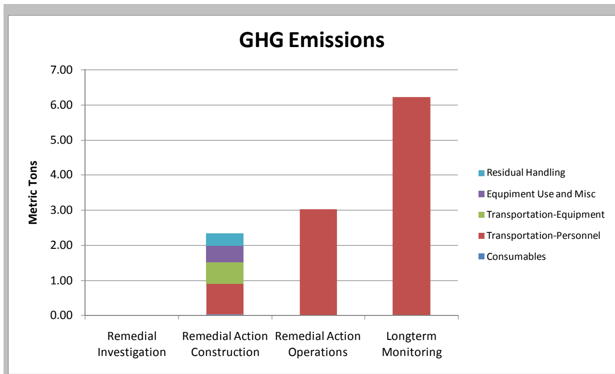


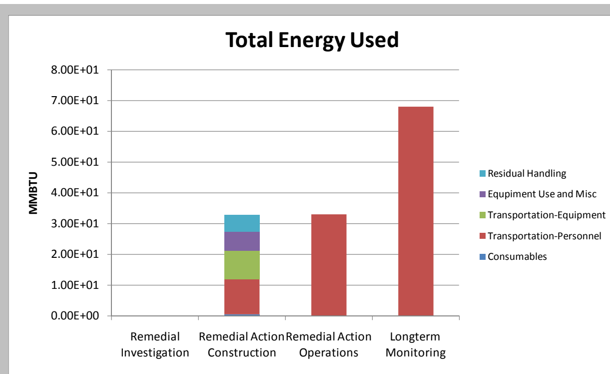


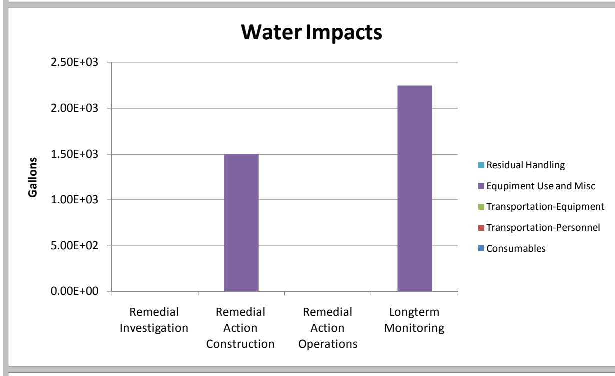


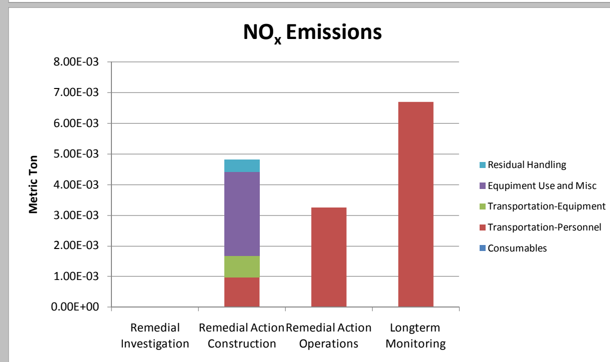
Sustainable Remediation - Environmental Footprint Summary
Remedial Alternative G-2

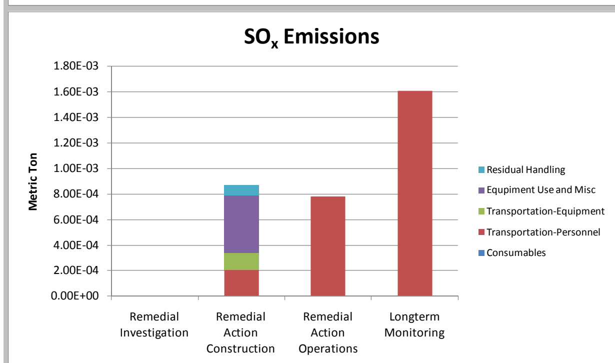
Phase	Activities	GHG Emissions metric ton	Total Energy Used MMBTU	Water Impacts gallons	NO_x Emissions metric ton	SO_x Emissions metric ton	PM_{10} Emissions metric ton	Accident Risk Fatality	Accident Risk Injury
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	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	0.03	5.9E-01	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	0.87	1.2E+01	NA	9.7E-04	2.0E-04	1.4E-04	7.7E-06	5.5E-04
	Transportation-Equipment	0.62	9.1E+00	NA	7.0E-04	1.3E-04	9.4E-05	1.1E-06	2.3E-04
	Equipment Use and Misc	0.46	6.3E+00	1.5E+03	2.7E-03	4.5E-04	2.1E-04	3.6E-07	1.6E-04
	Residual Handling	0.36	5.4E+00	NA	4.1E-04	7.8E-05	5.4E-05	1.1E-06	2.4E-04
	Sub-Total	2.34	3.29E+01	1.50E+03	4.83E-03	8.71E-04	4.92E-04	1.02E-05	1.17E-03
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	3.02	3.3E+01	NA	3.3E-03	7.8E-04	4.9E-04	3.4E-05	2.4E-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	3.02	3.31E+01	0.00E+00	3.25E-03	7.80E-04	4.88E-04	3.40E-05	2.44E-03
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	6.24	6.8E+01	NA	6.7E-03	1.6E-03	1.0E-03	1.4E-04	1.0E-02
	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	2.3E+03	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	6.24	6.82E+01	2.25E+03	6.71E-03	1.61E-03	1.01E-03	1.40E-04	1.01E-02
Total		**1.2E+01**	**1.3E+02**	**3.8E+03**	**1.5E-02**	**3.3E-03**	**2.0E-03**	**1.8E-04**	**1.4E-02**

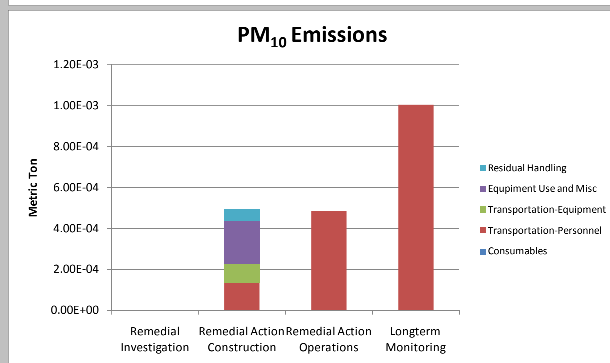

GHG Emissions
Metric Tons
0.00
1.00
2.00
3.00
4.00
5.00
6.00
7.00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

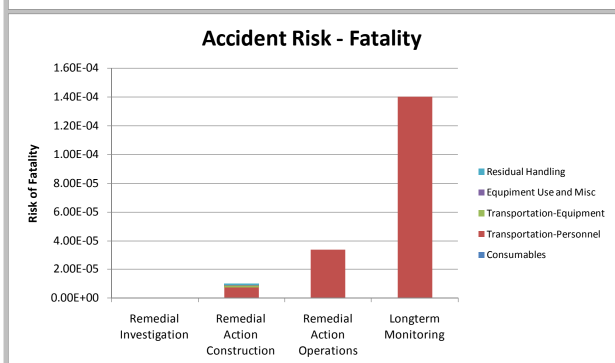

Total Energy Used
MMBTU
0.00E+00
1.00E+01
2.00E+01
3.00E+01
4.00E+01
5.00E+01
6.00E+01
7.00E+01
8.00E+01
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

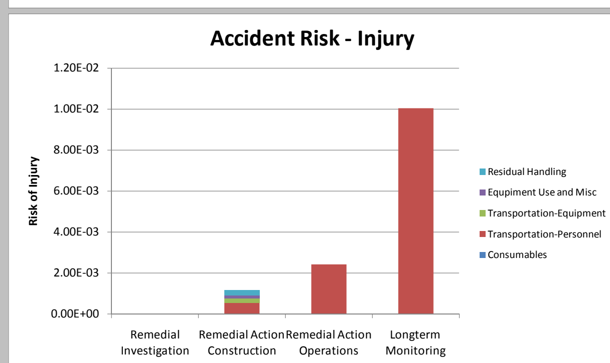

Water Impacts
Gallons
0.00E+00
5.00E+02
1.00E+03
1.50E+03
2.00E+03
2.50E+03
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NO_x Emissions
Metric Ton
0.00E+00
1.00E-03
2.00E-03
3.00E-03
4.00E-03
5.00E-03
6.00E-03
7.00E-03
8.00E-03
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


SO_x Emissions
Metric Ton
0.00E+00
2.00E-04
4.00E-04
6.00E-04
8.00E-04
1.00E-03
1.20E-03
1.40E-03
1.60E-03
1.80E-03
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
0.00E+00
2.00E-04
4.00E-04
6.00E-04
8.00E-04
1.00E-03
1.20E-03
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
0.00E+00
2.00E-05
4.00E-05
6.00E-05
8.00E-05
1.00E-04
1.20E-04
1.40E-04
1.60E-04
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

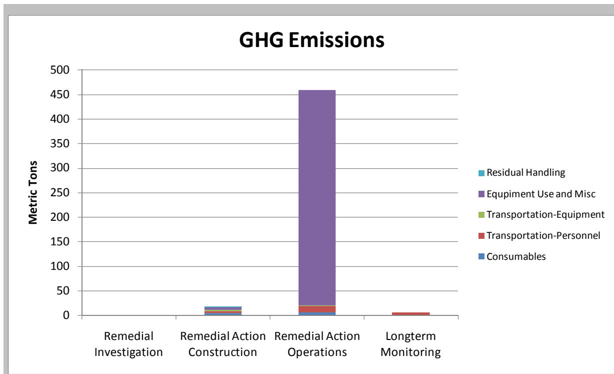

Accident Risk - Injury
Risk of Injury
0.00E+00
2.00E-03
4.00E-03
6.00E-03
8.00E-03
1.00E-02
1.20E-02
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

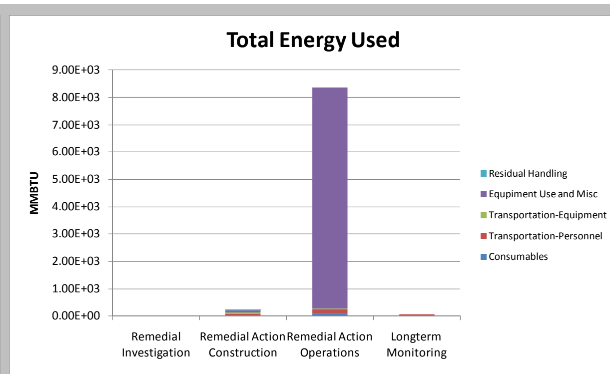
Sustainable Remediation - Environmental Footprint Summary
Remedial Alternative G-3

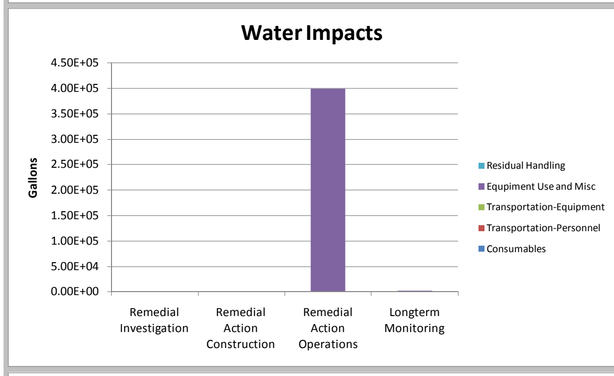
Phase	Activities	GHG Emissions (metric ton)	Total Energy Used (MMBTU)	Water Impacts (gallons)	NO_x Emissions (metric ton)	SO_x Emissions (metric ton)	PM_{10} Emissions (metric ton)	Accident Risk Fatality	Accident Risk Injury
Remedial Investigation	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	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	4.61	4.5E+01	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	4.16	4.9E+01	NA	4.5E-03	1.0E-03	6.6E-04	4.3E-05	3.1E-03
	Transportation-Equipment	3.23	4.7E+01	NA	3.7E-03	7.0E-04	4.9E-04	5.3E-06	1.1E-03
	Equipment Use and Misc	4.64	6.3E+01	1.5E+03	2.8E-02	4.5E-03	2.1E-03	3.6E-06	1.6E-03
	Residual Handling	0.12	1.9E+00	NA	1.4E-04	2.6E-05	1.8E-05	3.8E-07	7.9E-05
	Sub-Total	16.76	2.07E+02	1.50E+03	3.58E-02	6.31E-03	3.26E-03	5.22E-05	5.83E-03
Remedial Action Operations	Consumables	5.85	1.0E+02	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	13.87	1.5E+02	NA	1.5E-02	3.6E-03	2.2E-03	1.6E-04	1.1E-02
	Transportation-Equipment	0.96	1.4E+01	NA	1.1E-03	2.1E-04	1.5E-04	1.9E-06	4.0E-04
	Equipment Use and Misc	439.09	8.1E+03	4.0E+05	8.8E-01	4.3E-01	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	459.77	8.37E+03	4.00E+05	8.98E-01	4.35E-01	2.38E-03	1.58E-04	1.16E-02
Longterm Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	NA
	Transportation-Personnel	6.24	6.8E+01	NA	6.7E-03	1.6E-03	1.0E-03	1.4E-04	1.0E-02
	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	2.3E+03	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	6.24	6.82E+01	2.25E+03	6.71E-03	1.61E-03	1.01E-03	1.40E-04	1.01E-02
Total		**4.8E+02**	**8.6E+03**	**4.0E+05**	**9.4E-01**	**4.4E-01**	**6.6E-03**	**3.5E-04**	**2.7E-02**

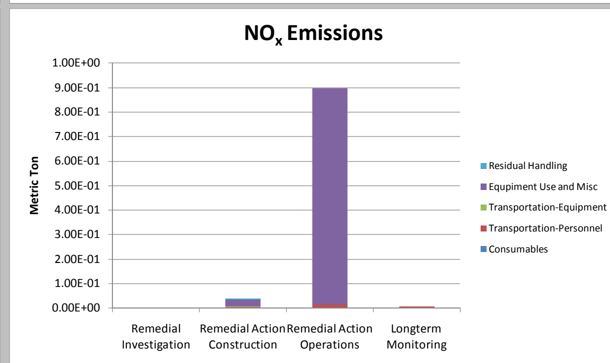
SITE WISE INPUTS

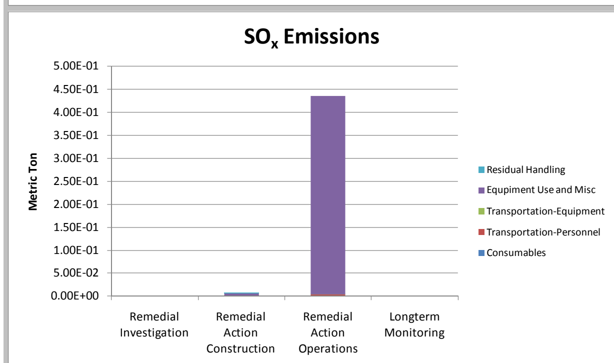
ALTERNATIVE G-2

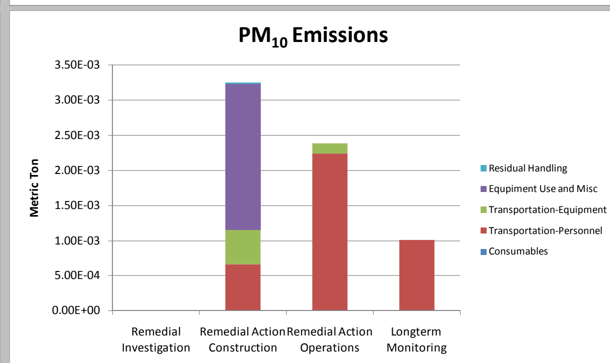

GHG Emissions
Metric Tons
500
450
400
350
300
250
200
150
100
50
0
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

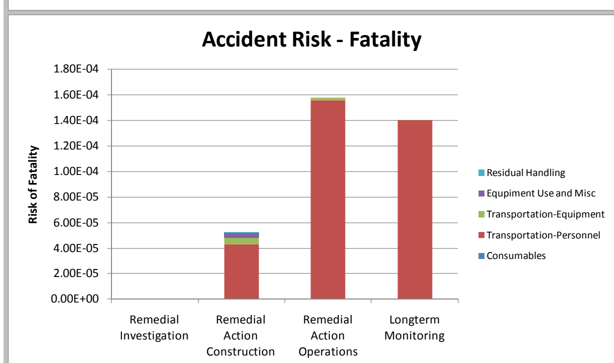

Total Energy Used
MMBTU
9.00E+03
8.00E+03
7.00E+03
6.00E+03
5.00E+03
4.00E+03
3.00E+03
2.00E+03
1.00E+03
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

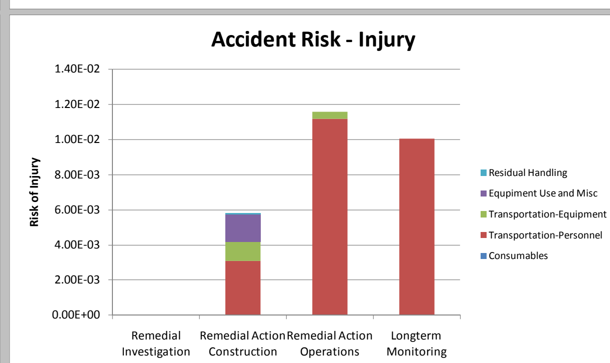

Water Impacts
Gallons
4.50E+05
4.00E+05
3.50E+05
3.00E+05
2.50E+05
2.00E+05
1.50E+05
1.00E+05
5.00E+04
0.00E+00
Remedial Investigation
Remedial Action Construction
Remedial Action Operations
Longterm Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


NO_x Emissions
Metric Ton
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


SO_x Emissions
Metric Ton
5.00E-01
4.50E-01
4.00E-01
3.50E-01
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
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
1.80E-04
1.60E-04
1.40E-04
1.20E-04
1.00E-04
8.00E-05
6.00E-05
4.00E-05
2.00E-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
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

SITEWISE INPUT SUMMARY
ALTERNATIVE G-2
FEASIBILITY STUDY
SITE 46
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Alternative G-2: Natural Attenuation, Institutional Controls, and Groundwater Monitoring

Remedial Action Construction			
Materials			
Item	**Quantity**	**Units**	**Comments**
Well Installation	30	lft	2x monitoring wells, 15 ft/well
Construction Equipment			
Item	**Quantity**	**Units**	**Comments**
Hollow Stem Auger	6	hrs	3 hrs per well, 2 wells
Transportation			
Item	**Quantity**	**Units**	**Comments**
Light Truck, MW Installation	450	mi	Site Support Crew [400 mi (mob/demob), 50 mpd onsite, 1 d]
On Road Truck	450	mi	Drill Rig [400 mi (mob/demob), 50 mpd onsite, 1 d]
Heavy Duty Truck	450	mi	Drill Rig Support Truck [400 mi (mob/demob), 50 mpd onsite, 1 d]
On Road Truck	200	mi	Decon Water Disposal (1 trip, 200 mi/trip, 4.2 ton)
Direct Water Usage			
Item	**Quantity**	**Units**	**Comments**
Decon water	1,500	gal	
Remedial Action Operations			
No Inputs			
Long Term Monitoring			
Transportation			
Item	**Quantity**	**Units**	**Comments**
Light Truck	16500	mi	LUC Inspection, Sampling, 550 mi/trip [400 mi (mob demob), 50 mpd onsite, 3 d], 15 trips, 2 travelers
Light Truck	3000	mi	Purge/Decon Water Disposal (200 mi/trip, 15 trips)
Direct Water Usage			
Item	**Quantity**	**Units**	**Comments**
Purge/Decon Water	2,250	gal	150 gal/trip, 15 trips

This worksheet allows the user to define material production, transportation, equipment use, and residual handling variables for the remedial alternative

Yellow cells	require the user to choose an input from a drop down menu
White cells	require the user to type in a value

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Choose well diameter (in) from drop down menu	1/2	1/2	1/2	1/2	1/2	1/2
Choose material type from drop down menu	PVC	PVC	PVC	PVC	PVC	PVC
Choose specific material schedule from drop down menu	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input number of injection points						
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Input amount of material injected at each point (pounds dry mass)						
Input number of injections per injection point						

GAC	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input weight of GAC used (lbs)						
Choose material type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC

CONSTRUCTION MATERIALS	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft^2)						
Input depth of material (ft)						

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	1	1	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Cars	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)						
Input number of trips taken						
Input number of travelers						
Input estimated vehicular fuel economy (mi/gal) (Input only if known for the vehicle selected, otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab.

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of flights taken						

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

EQUIPMENT TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of load (tons)						

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (mile)						
Input weight of load (tons)						

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd^3)						
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
DRILLING	**Event 1**	**Event 2**	**Event 3**	**Event 4**	**Event 5**	**Event 6**
Input number of drilling locations						
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)						
Input depth of wells (ft)						
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

For each pump, select only one of the three methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1

Method 1 - ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN						
Input flow rate (gpm)	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.51	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input pump horsepower (hp)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1
Equipment operating hours (hrs)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the pump selected, otherwise a default will be used by the tool)						

For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

BLOWER, COMPRESSOR, MIXER, AND OTHER EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input equipment horsepower (hp)	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0
Input equipment load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Method 2 - ELECTRICAL USAGE IS KNOWN						
Input equipment electrical usage, if known (KWh)	0	0	0	0	0	0
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Choose horsepower range from drop down menu	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6
Input operating hours (hr)						

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area to till (acre)						
Choose soil condition from drop down menu	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil
Choose soil type from drop down menu	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil
Input time available (work days)						
Input depth of tillage (in)						

CAPPING EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area (ft^2)						
Input time available (work days)						

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd^3)						
Input production rate (yd^3/hr)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the mixer selected, otherwise a default will be used by the tool)						

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)						
Choose vehicle type from drop down menu	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips						
Input number of miles per trip						

LANDFILL OPERATIONS	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6
Input tons of soil or waste to be incinerated (user must input emission factors in the Look Up Table, Table 7a)						

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (scfm)						
Input time running (hours)						
Input waste gas inlet temperature (F)						
Input contaminant concentration (ppmV)						

*(Electric blowers are included in the analysis)

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)						
Input water disposed/collected during site preparation (gal)						
Input water disposed/collected during sampling (gal)						
Input water disposed/collected during site demobilization (gal)						

LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6
Input landfill methane emissions (metric tons)						

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO_2 emission (metric ton)	
Input N_2O emission (metric ton CO_2 e)	
Input CH_4 emissions (metric ton CO_2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM_{10} emission (metric ton)	
Input fatality risk	
Input injury risk	

This worksheet allows the user to define material production, transportation, equipment use, and residual handling variables for the remedial alternative
Yellow cells require the user to choose an input from a drop down menu
White cells require the user to type in a value

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells	2					
Input depth of wells (ft)	15					
Choose well diameter (in) from drop down menu	2	1/2	1/2	1/2	1/2	1/2
Choose material type from drop down menu	PVC	PVC	PVC	PVC	PVC	PVC
Choose specific material schedule from drop down menu	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input number of injection points						
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Input amount of material injected at each point (pounds dry mass)						
Input number of injections per injection point						

GAC	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input weight of GAC used (lbs)						
Choose material type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC

CONSTRUCTION MATERIALS	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft^2)						
Input depth of material (ft)						

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	1	1	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Heavy Duty	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Diesel	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	450	450				
Input number of trips taken	1	1				
Input number of travelers	1	1				
Input estimated vehicular fuel economy (mi/gal) (Input only if known for the vehicle selected, otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab.

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of flights taken						

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

	Drill Rig					
EQUIPMENT TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose fuel used from drop down menu	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled (miles)	450					
Input weight of equipment transported (tons)	10					

EQUIPMENT TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of load (tons)						

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (mile)						
Input weight of load (tons)						

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd^3)						
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
DRILLING	**Event 1**	**Event 2**	**Event 3**	**Event 4**	**Event 5**	**Event 6**
Input number of drilling locations	2					
Choose drilling method from drop down menu	Hollow Stem Auger	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)	3					
Input depth of wells (ft)	15					
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

For each pump, select only one of the three methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose method from drop down	Method 2	Method 1	Method 1	Method 1	Method 1	Method 1

Method 1 - ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	0	0	0	0	0	0

Method 2 - PUMP HEAD IS KNOWN						
Input flow rate (gpm)	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.51	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1

Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input pump horsepower (hp)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85

Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1
Equipment operating hours (hrs)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the pump selected, otherwise a default will be used by the tool)						

For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

BLOWER, COMPRESSOR, MIXER, AND OTHER EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input equipment horsepower (hp)	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0
Input equipment load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Method 2 - ELECTRICAL USAGE IS KNOWN						
Input equipment electrical usage, if known (KWh)	0	0	0	0	0	0
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Choose horsepower range from drop down menu	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6
Input operating hours (hr)						

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area to till (acre)						
Choose soil condition from drop down menu	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil
Choose soil type from drop down menu	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil
Input time available (work days)						
Input depth of tillage (in)						

CAPPING EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area (ft^2)						
Input time available (work days)						

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd^3)						
Input production rate (yd^3/hr)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the mixer selected, otherwise a default will be used by the tool)						

RESIDUAL HANDLING

	Drill Cuttings	Decon Water				
RESIDUE DISPOSAL/RECYCLING	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)	1.0	4.2				
Choose vehicle type from drop down menu	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Diesel	Diesel	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips	1	1				
Input number of miles per trip	100	200				

LANDFILL OPERATIONS	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6
Input tons of soil or waste to be incinerated (user must input emission factors in the Look Up Table, Table 7a)						

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (scfm)						
Input time running (hours)						
Input waste gas inlet temperature (F)						
Input contaminant concentration (ppmV)						

*(Electric blowers are included in the analysis)

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)	1500					
Input water disposed/collected during site preparation (gal)						
Input water disposed/collected during sampling (gal)						
Input water disposed/collected during site demobilization (gal)						

LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6
Input landfill methane emissions (metric tons)						

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO_2 emission (metric ton)	
Input N_2O emission (metric ton CO_2 e)	
Input CH_4 emissions (metric ton CO_2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM_{10} emission (metric ton)	
Input fatality risk	
Input injury risk	

This worksheet allows the user to define material production, transportation, equipment use, and residual handling variables for the remedial alternative
Yellow cells require the user to choose an input from a drop down menu
White cells require the user to type in a value

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Choose well diameter (in) from drop down menu	1/2	1/2	1/2	1/2	1/2	1/2
Choose material type from drop down menu	PVC	PVC	PVC	PVC	PVC	PVC
Choose specific material schedule from drop down menu	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input number of injection points						
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Input amount of material injected at each point (pounds dry mass)						
Input number of injections per injection point						

GAC	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input weight of GAC used (lbs)						
Choose material type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC

CONSTRUCTION MATERIALS	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft^2)						
Input depth of material (ft)						

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	1	1	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil

TRANSPORTATION

	LUC Site Inspection					
PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	SUVs	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	400					
Input number of trips taken	10					
Input number of travelers	1					
Input estimated vehicular fuel economy (mi/gal) (Input only if known for the vehicle selected, otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab.

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of flights taken						

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

EQUIPMENT TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of load (tons)						

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (mile)						
Input weight of load (tons)						

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd^3)						
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Input number of drilling locations						
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)						
Input depth of wells (ft)						
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

For each pump, select only one of the three methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1

Method 1 - ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN						
Input flow rate (gpm)	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.51	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input pump horsepower (hp)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1
Equipment operating hours (hrs)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the pump selected, otherwise a default will be used by the tool)						

For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

BLOWER, COMPRESSOR, MIXER, AND OTHER EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input equipment horsepower (hp)	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0
Input equipment load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Method 2 - ELECTRICAL USAGE IS KNOWN						
Input equipment electrical usage, if known (KWh)	0	0	0	0	0	0
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Choose horsepower range from drop down menu	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6
Input operating hours (hr)						

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area to till (acre)						
Choose soil condition from drop down menu	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil
Choose soil type from drop down menu	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil
Input time available (work days)						
Input depth of tillage (in)						

CAPPING EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area (ft^2)						
Input time available (work days)						

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd^3)						
Input production rate (yd^3/hr)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the mixer selected, otherwise a default will be used by the tool)						

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)						
Choose vehicle type from drop down menu	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips						
Input number of miles per trip						

LANDFILL OPERATIONS	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6
Input tons of soil or waste to be incinerated (user must input emission factors in the Look Up Table, Table 7a)						

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (scfm)						
Input time running (hours)						
Input waste gas inlet temperature (F)						
Input contaminant concentration (ppmV)						

*(Electric blowers are included in the analysis)

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)						
Input water disposed/collected during site preparation (gal)						
Input water disposed/collected during sampling (gal)						
Input water disposed/collected during site demobilization (gal)						

LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6
Input landfill methane emissions (metric tons)						

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO_2 emission (metric ton)	
Input N_2O emission (metric ton CO_2 e)	
Input CH_4 emissions (metric ton CO_2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM_{10} emission (metric ton)	
Input fatality risk	
Input injury risk	

SITE INFORMATION	
Name	NAS Pensacola, Groundwater
Date	9/23/2010
Site	Site 46
Remedial Alternative Name	Remedial Alternative G-2

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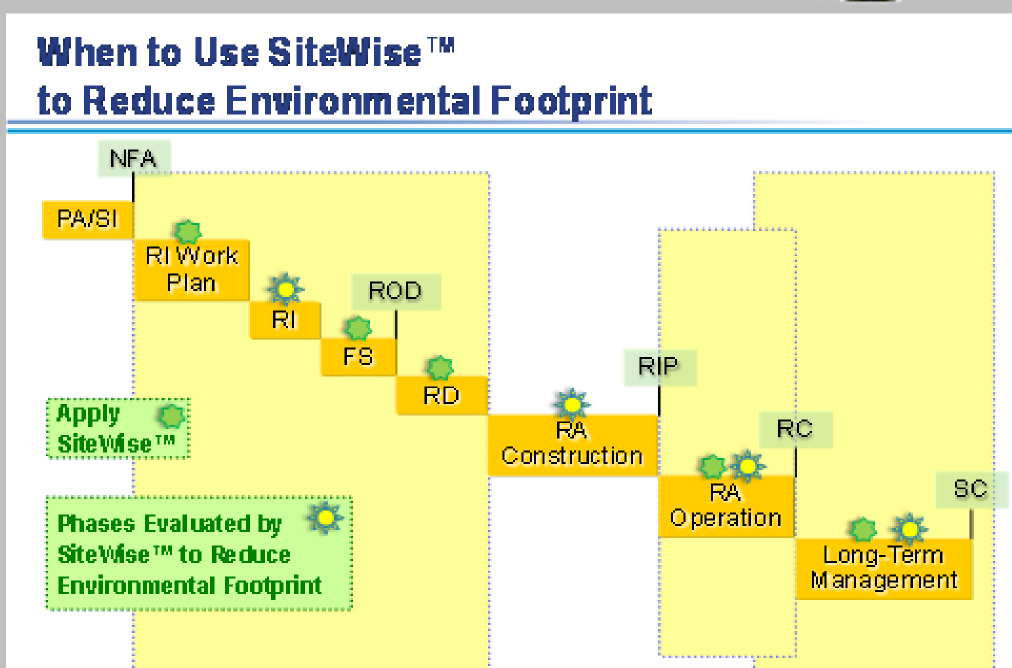

SITE WISE INPUTS

ALTERNATIVE G-3

This worksheet allows the user to define material production, transportation, equipment use, and residual handling variables for the remedial alternative

Yellow cells	require the user to choose an input from a drop down menu
White cells	require the user to type in a value

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Choose well diameter (in) from drop down menu	1/2	1/2	1/2	1/2	1/2	1/2
Choose material type from drop down menu	PVC	PVC	PVC	PVC	PVC	PVC
Choose specific material schedule from drop down menu	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input number of injection points						
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Input amount of material injected at each point (pounds dry mass)						
Input number of injections per injection point						

GAC	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input weight of GAC used (lbs)						
Choose material type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC

CONSTRUCTION MATERIALS	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft^2)						
Input depth of material (ft)						

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	1	1	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil

TRANSPORTATION

	NA Sampling					
PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	550					
Input number of trips taken	15					
Input number of travelers	2					
Input estimated vehicular fuel economy (mi/gal) (Input only if known for the vehicle selected, otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab.

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of flights taken						

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

EQUIPMENT TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of load (tons)						

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (mile)						
Input weight of load (tons)						

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd^3)						
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Input number of drilling locations						
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)						
Input depth of wells (ft)						
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

For each pump, select only one of the three methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1

Method 1 - ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN						
Input flow rate (gpm)	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.51	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input pump horsepower (hp)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1
Equipment operating hours (hrs)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the pump selected, otherwise a default will be used by the tool)						

For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

BLOWER, COMPRESSOR, MIXER, AND OTHER EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input equipment horsepower (hp)	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0
Input equipment load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Method 2 - ELECTRICAL USAGE IS KNOWN						
Input equipment electrical usage, if known (KWh)	0	0	0	0	0	0
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Choose horsepower range from drop down menu	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6
Input operating hours (hr)						

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area to till (acre)						
Choose soil condition from drop down menu	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil
Choose soil type from drop down menu	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil
Input time available (work days)						
Input depth of tillage (in)						

CAPPING EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area (ft^2)						
Input time available (work days)						

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd^3)						
Input production rate (yd^3/hr)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the mixer selected, otherwise a default will be used by the tool)						

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)						
Choose vehicle type from drop down menu	On-road truck	Heavy Duty	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips						
Input number of miles per trip						

LANDFILL OPERATIONS	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6
Input tons of soil or waste to be incinerated (user must input emission factors in the Look Up Table, Table 7a)						

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (scfm)						
Input time running (hours)						
Input waste gas inlet temperature (F)						
Input contaminant concentration (ppmV)						

*(Electric blowers are included in the analysis)

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)						
Input water disposed/collected during site preparation (gal)						
Input water disposed/collected during sampling (gal)	2250					
Input water disposed/collected during site demobilization (gal)						

LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6
Input landfill methane emissions (metric tons)						

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO_2 emission (metric ton)	
Input N_2O emission (metric ton CO_2 e)	
Input CH_4 emissions (metric ton CO_2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM_{10} emission (metric ton)	
Input fatality risk	
Input injury risk	

SITEWISE INPUT SUMMARY
ALTERNATIVE G-3
FEASIBILITY STUDY
SITE 46
NAVAL AIR STATION PENSACOLA
PENSACOLA, FLORIDA

Alternative G-3: Air Sparge/SVE, Monitoring

Remedial Action Construction			
Materials			
Item	**Quantity**	**Units**	**Comments**
Well Installation	80	lft	4x 4" SVE wells, 20 ft/well
Well Installation	320	lft	16x 2" AS wells, 20 ft/well
Concrete	16	CY	1260 sqft, 0.33 ft thick, 27 CY/CFT
Construction Equipment			
Item	**Quantity**	**Units**	**Comments**
Hollow Stem Auger	3	hrs/well	SVE 4x 4" SVE Wells
Hollow Stem Auger	3	hrs/well	AS 16x 2" AS Wells
Loader/Backhoe	16	hrs	200 lft trenching, 3 feet deep (2.2 CY)
Transportation			
Item	**Quantity**	**Units**	**Comments**
Light Truck, Well Installation	800	mi	Drilling Site Support Crew [400 mi (mob/demob), 50 mpd onsite, 8 d]
Light Truck, Installation	3,450	mi	Installation Support Crew [400 mi (mob/demob), 50 mpd onsite, 15 d, 3 man crew]
On Road Truck	800	mi	Drill Rig [400 mi (mob/demob), 50 mpd onsite, 8 d]
Heavy Duty Truck	800	mi	Drill Rig Support Truck [400 mi (mob/demob), 50 mpd onsite, 8 d]
On Road Truck	200	mi	Decon Water Disposal (1 trip, 200 mi/trip, 8 ton)
On Road Truck	200	mi	Heavy Equipment Mob/Demob (100 mi/trip, 2 trips)
On Road Truck	200	mi	Concrete Delivery (16 CY, 8 CY/trip, 100 mi/trip)
On Road Truck	1,000	mi	System Mobilization (1,000 mi/trip, 1 trip)
Direct Water Usage			
Item	**Quantity**	**Units**	**Comments**
Decon/Purge Water	2,000	gal	
Operation Phase			
Materials (O&M consumables)			
Item	**Quantity**	**Units**	**Comments**
GAC	2000	lbs	1,000 lbs/yr, 2 yrs
Transportation			
Item	**Quantity**	**Units**	**Comments**
Light Truck	10,320	mi	400 mi (mob demob), 50 mpd onsite, 1 d/month, 24 months, 1 traveler
Electrical Usage			
Item	**Quantity**	**Units**	**Comments**
SVE Blower	391,940	kwhr	30 HP, 24 hrs/d, 365 d/yr, 2 yrs
AS Blower	391,940	kwhr	30 HP, 24 hrs/d, 365 d/yr, 2 yrs
Site Monitoring Phase			
Transportation			
Item	**Quantity**	**Units**	**Comments**
Light Truck	16500	mi	LUC Inspection, Sampling, 550 mi/trip [400 mi (mob demob), 50 mpd onsite, 3 d], 15 trips, 2 travelers
Light Truck	3000	mi	Purge/Decon Water Disposal (200 mi/trip, 15 trips)
Direct Water Usage			
Item	**Quantity**	**Units**	**Comments**
Purge/Decon Water	2,250	gal	150 gal/trip, 15 trips

SITE INFORMATION	
Name	NAS Pensacola, Groundwater
Date	9/23/2010
Site	Site 46
Remedial Alternative Name	Remedial Alternative G-3

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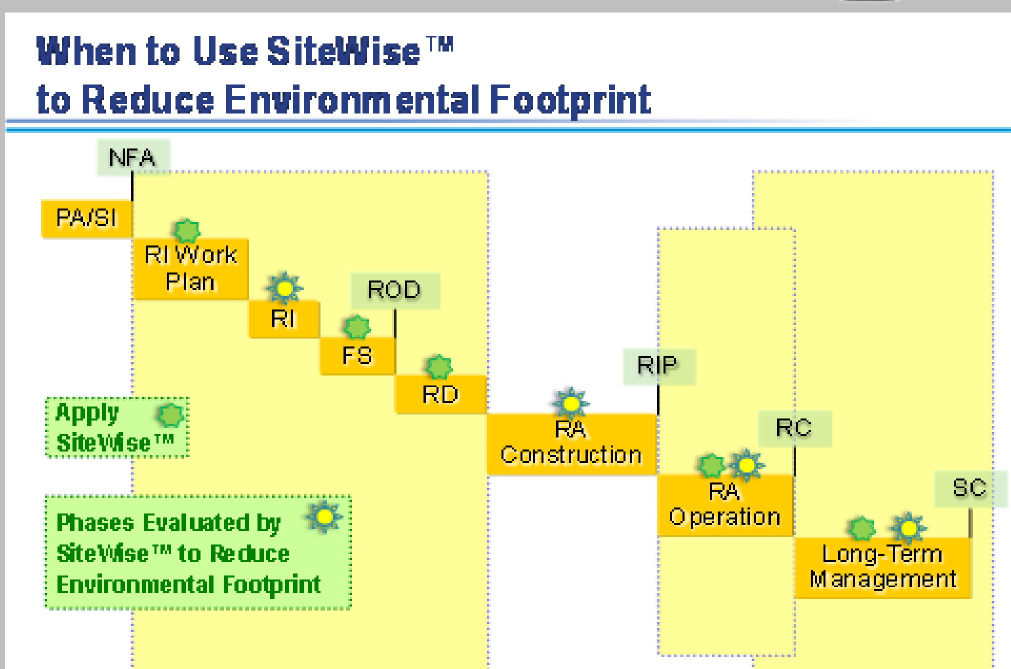

This worksheet allows the user to define material production, transportation, equipment use, and residual handling variables for the remedial alternative

Yellow cells	require the user to choose an input from a drop down menu
White cells	require the user to type in a value

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Choose well diameter (in) from drop down menu	1/2	1/2	1/2	1/2	1/2	1/2
Choose material type from drop down menu	PVC	PVC	PVC	PVC	PVC	PVC
Choose specific material schedule from drop down menu	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input number of injection points						
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Input amount of material injected at each point (pounds dry mass)						
Input number of injections per injection point						

GAC	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input weight of GAC used (lbs)						
Choose material type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC

CONSTRUCTION MATERIALS	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft^2)						
Input depth of material (ft)						

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	1	1	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Cars	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)						
Input number of trips taken						
Input number of travelers						
Input estimated vehicular fuel economy (mi/gal) (Input only if known for the vehicle selected, otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab.

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of flights taken						

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

EQUIPMENT TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of load (tons)						

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (mile)						
Input weight of load (tons)						

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd^3)						
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6
Input number of drilling locations						
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)						
Input depth of wells (ft)						
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

For each pump, select only one of the three methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1

Method 1 - ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN						
Input flow rate (gpm)	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.51	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input pump horsepower (hp)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1
Equipment operating hours (hrs)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the pump selected, otherwise a default will be used by the tool)						

For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

BLOWER, COMPRESSOR, MIXER, AND OTHER EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input equipment horsepower (hp)	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0
Input equipment load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Method 2 - ELECTRICAL USAGE IS KNOWN						
Input equipment electrical usage, if known (KWh)	0	0	0	0	0	0
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Choose horsepower range from drop down menu	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6
Input operating hours (hr)						

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area to till (acre)						
Choose soil condition from drop down menu	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil
Choose soil type from drop down menu	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil
Input time available (work days)						
Input depth of tillage (in)						

CAPPING EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area (ft^2)						
Input time available (work days)						

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd^3)						
Input production rate (yd^3/hr)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the mixer selected, otherwise a default will be used by the tool)						

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)						
Choose vehicle type from drop down menu	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips						
Input number of miles per trip						

LANDFILL OPERATIONS	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6
Input tons of soil or waste to be incinerated (user must input emission factors in the Look Up Table, Table 7a)						

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (scfm)						
Input time running (hours)						
Input waste gas inlet temperature (F)						
Input contaminant concentration (ppmV)						

*(Electric blowers are included in the analysis)

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)						
Input water disposed/collected during site preparation (gal)						
Input water disposed/collected during sampling (gal)						
Input water disposed/collected during site demobilization (gal)						

LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6
Input landfill methane emissions (metric tons)						

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO_2 emission (metric ton)	
Input N_2O emission (metric ton CO_2 e)	
Input CH_4 emissions (metric ton CO_2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM_{10} emission (metric ton)	
Input fatality risk	
Input injury risk	

This worksheet allows the user to define material production, transportation, equipment use, and residual handling variables for the remedial alternative

Yellow cells require the user to choose an input from a drop down menu

White cells require the user to type in a value

MATERIAL PRODUCTION

	SVE	AS				
WELL MATERIALS	**Well Type 1**	**Well Type 2**	**Well Type 3**	**Well Type 4**	**Well Type 5**	**Well Type 6**
Input number of wells	16	4				
Input depth of wells (ft)	20	20				
Choose well diameter (in) from drop down menu	4	2	1/2	1/2	1/2	1/2
Choose material type from drop down menu	PVC	PVC	PVC	PVC	PVC	PVC
Choose specific material schedule from drop down menu	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input number of injection points						
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Input amount of material injected at each point (pounds dry mass)						
Input number of injections per injection point						

GAC	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input weight of GAC used (lbs)						
Choose material type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC

CONSTRUCTION MATERIALS	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6
Choose material type from drop down menu	General Concrete	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft^2)	1,260					
Input depth of material (ft)	0.33					

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	1	1	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Heavy Duty	Light truck	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	800	4250				
Input number of trips taken	1	1				
Input number of travelers	1	1				
Input estimated vehicular fuel economy (mi/gal) (Input only if known for the vehicle selected, otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab.

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of flights taken						

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

	Drill Rig	Equip Mob/Demob	Concrete	System Delivery		
EQUIPMENT TRANSPORTATION - ROAD	**Trip 1**	**Trip 2**	**Trip 3**	**Trip 4**	**Trip 5**	**Trip 6**
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Diesel	Gasoline	Gasoline
Input distance traveled (miles)	800	200	200	1,000		
Input weight of equipment transported (tons)	16	20	16	10		

EQUIPMENT TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of load (tons)						

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (mile)						
Input weight of load (tons)						

EQUIPMENT USE

EARTHWORK	Trenching	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose earthwork equipment type from drop down menu	Loader/Backhoe	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd^3)	22					
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
DRILLING	**SVE Wells**	**Air Sparge Wells**	**Event 3**	**Event 4**	**Event 5**	**Event 6**
Input number of drilling locations	4	16				
Choose drilling method from drop down menu	Hollow Stem Auger	Hollow Stem Auger	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)	3	3				
Input depth of wells (ft)	20	20				
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

For each pump, select only one of the three methods to calculate energy and GHG emissions

Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose method from drop down	Method 2	Method 1	Method 1	Method 1	Method 1	Method 1

Method 1 - ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	0	0	0	0	0	0

Method 2 - PUMP HEAD IS KNOWN						
Input flow rate (gpm)	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.51	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1

Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input pump horsepower (hp)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85

Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1
Equipment operating hours (hrs)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the pump selected, otherwise a default will be used by the tool)						

For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

BLOWER, COMPRESSOR, MIXER, AND OTHER EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input equipment horsepower (hp)	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0
Input equipment load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Method 2 - ELECTRICAL USAGE IS KNOWN						
Input equipment electrical usage, if known (KWh)	0	0	0	0	0	0
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Choose horsepower range from drop down menu	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6
Input operating hours (hr)						

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area to till (acre)						
Choose soil condition from drop down menu	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil
Choose soil type from drop down menu	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil
Input time available (work days)						
Input depth of tillage (in)						

CAPPING EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area (ft^2)						
Input time available (work days)						

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd^3)						
Input production rate (yd^3/hr)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the mixer selected, otherwise a default will be used by the tool)						

RESIDUAL HANDLING

			IDW Disposal			
RESIDUE DISPOSAL/RECYCLING	**Soil Residue**	**Residual Water**	**Material Residue**	**Other Residuals**	**Other Residuals**	**Other Residuals**
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)			8			
Choose vehicle type from drop down menu	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Gasoline	Gasoline	Diesel	Gasoline	Gasoline	Gasoline
Input total number of trips			1			
Input number of miles per trip			100			

LANDFILL OPERATIONS	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6
Input tons of soil or waste to be incinerated (user must input emission factors in the Look Up Table, Table 7a)						

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (scfm)						
Input time running (hours)						
Input waste gas inlet temperature (F)						
Input contaminant concentration (ppmV)						

*(Electric blowers are included in the analysis)

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)						
Input water disposed/collected during site preparation (gal)	1500					
Input water disposed/collected during sampling (gal)						
Input water disposed/collected during site demobilization (gal)						

LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6
Input landfill methane emissions (metric tons)						

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO_2 emission (metric ton)	
Input N_2O emission (metric ton CO_2 e)	
Input CH_4 emissions (metric ton CO_2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM_{10} emission (metric ton)	
Input fatality risk	
Input injury risk	

This worksheet allows the user to define material production, transportation, equipment use, and residual handling variables for the remedial alternative

Yellow cells	require the user to choose an input from a drop down menu
White cells	require the user to type in a value

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Choose well diameter (in) from drop down menu	1/2	1/2	1/2	1/2	1/2	1/2
Choose material type from drop down menu	PVC	PVC	PVC	PVC	PVC	PVC
Choose specific material schedule from drop down menu	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input number of injection points						
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Input amount of material injected at each point (pounds dry mass)						
Input number of injections per injection point						

GAC	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input weight of GAC used (lbs)	2,000					
Choose material type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC

CONSTRUCTION MATERIALS	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft^2)						
Input depth of material (ft)						

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	1	1	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil

TRANSPORTATION

	Startup (1 week)	Weekly O&M (Month 1,2,3)	Monthly O&M			
PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Light truck	Light truck	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	750	550	550			
Input number of trips taken	1	11	21			
Input number of travelers	1	1	1			
Input estimated vehicular fuel economy (mi/gal) (Input only if known for the vehicle selected, otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab.

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of flights taken						

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

	GAC Delivery					
EQUIPMENT TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose fuel used from drop down menu	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled (miles)	800					
Input weight of equipment transported (tons)	1					

EQUIPMENT TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of load (tons)						

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (mile)						
Input weight of load (tons)						

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd^3)						
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
DRILLING	**Event 1**	**Event 2**	**Event 3**	**Event 4**	**Event 5**	**Event 6**
Input number of drilling locations						
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)						
Input depth of wells (ft)						
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

For each pump, select only one of the three methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1

Method 1 - ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	0	0	0	0	0	0

Method 2 - PUMP HEAD IS KNOWN						
Input flow rate (gpm)	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.51	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1

Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input pump horsepower (hp)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85

Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1
Equipment operating hours (hrs)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the pump selected, otherwise a default will be used by the tool)						

For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

BLOWER, COMPRESSOR, MIXER, AND OTHER EQUIPMENT	AS Blower	SVE Blower	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input equipment horsepower (hp)	30	30	0	0	0	0
Input number of equipments operating	1	1	0	0	0	0
Input operating time for each equipment (hrs)	17520	17520	0	0	0	0
Input equipment load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Method 2 - ELECTRICAL USAGE IS KNOWN						
Input equipment electrical usage, if known (KWh)	0	0	0	0	0	0
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Choose horsepower range from drop down menu	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6
Input operating hours (hr)						

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area to till (acre)						
Choose soil condition from drop down menu	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil
Choose soil type from drop down menu	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil
Input time available (work days)						
Input depth of tillage (in)						

CAPPING EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area (ft^2)						
Input time available (work days)						

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd^3)						
Input production rate (yd^3/hr)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the mixer selected, otherwise a default will be used by the tool)						

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)						
Choose vehicle type from drop down menu	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips						
Input number of miles per trip						

LANDFILL OPERATIONS	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6
Input tons of soil or waste to be incinerated (user must input emission factors in the Look Up Table, Table 7a)						

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (scfm)						
Input time running (hours)						
Input waste gas inlet temperature (F)						
Input contaminant concentration (ppmV)						

*(Electric blowers are included in the analysis)

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)						
Input water disposed/collected during site preparation (gal)						
Input water disposed/collected during sampling (gal)						
Input water disposed/collected during site demobilization (gal)						

LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6
Input landfill methane emissions (metric tons)						

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO_2 emission (metric ton)	
Input N_2O emission (metric ton CO_2 e)	
Input CH_4 emissions (metric ton CO_2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM_{10} emission (metric ton)	
Input fatality risk	
Input injury risk	

This worksheet allows the user to define material production, transportation, equipment use, and residual handling variables for the remedial alternative
Yellow cells require the user to choose an input from a drop down menu
White cells require the user to type in a value

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Choose well diameter (in) from drop down menu	1/2	1/2	1/2	1/2	1/2	1/2
Choose material type from drop down menu	PVC	PVC	PVC	PVC	PVC	PVC
Choose specific material schedule from drop down menu	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC	Schedule 40 PVC

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input number of injection points						
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide
Input amount of material injected at each point (pounds dry mass)						
Input number of injections per injection point						

GAC	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6
Input weight of GAC used (lbs)						
Choose material type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC

CONSTRUCTION MATERIALS	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft^2)						
Input depth of material (ft)						

WELL DECOMMISSIONING	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6
Input number of wells						
Input depth of wells (ft)						
Input well diameter (in)	1	1	1	1	1	1
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	Trip 1 (NA Sampling)	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	550					
Input number of trips taken	15					
Input number of travelers	2					
Input estimated vehicular fuel economy (mi/gal) (Input only if known for the vehicle selected, otherwise a default will be used by the tool)						

*For vehicle type 'Other' please enter values in Table 2b in the Look Up Table tab.

PERSONNEL TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input number of travelers						
Input number of flights taken						

PERSONNEL TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail
Input distance traveled (miles)						
Input number of trips taken						
Input number of travelers						

EQUIPMENT TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - AIR	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of equipment transported (tons)						

EQUIPMENT TRANSPORTATION - RAIL	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (miles)						
Input weight of load (tons)						

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6
Input distance traveled (mile)						
Input weight of load (tons)						

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd^3)						
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
DRILLING	**Event 1**	**Event 2**	**Event 3**	**Event 4**	**Event 5**	**Event 6**
Input number of drilling locations						
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)						
Input depth of wells (ft)						
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

For each pump, select only one of the three methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused pump columns or unused methods

PUMP OPERATION	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1

Method 1 - ELECTRICAL USAGE IS KNOWN						
Input pump electrical usage (KWh)	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN						
Input flow rate (gpm)	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Pump efficiency times motor efficiency (default already present, user override possible)	0.51	0.51	0.51	0.51	0.51	0.51
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input pump horsepower (hp)	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0
Input pump load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1	2-Stroke: 0 to 1
Equipment operating hours (hrs)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the pump selected, otherwise a default will be used by the tool)						

For each type of equipment, select only one of the methods to calculate energy and GHG emissions
Enter "0" for all user input values for unused equipment columns or unused methods

BLOWER, COMPRESSOR, MIXER, AND OTHER EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 - NAME PLATE SPECIFICATIONS ARE KNOWN						
Input equipment horsepower (hp)	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0
Input operating time for each equipment (hrs)	17520	0	0	0	0	0
Input equipment load (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Input motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85
Method 2 - ELECTRICAL USAGE IS KNOWN						
Input equipment electrical usage, if known (KWh)	0	0	0	0	0	0
Region						
Choose region from drop down menu (scroll right to see figure)	AKGD	AKGD	AKGD	AKGD	AKGD	AKGD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Choose horsepower range from drop down menu	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6	3 to 6
Input operating hours (hr)						

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area to till (acre)						
Choose soil condition from drop down menu	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil	Firm untilled soil
Choose soil type from drop down menu	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil	Clay Soil
Input time available (work days)						
Input depth of tillage (in)						

CAPPING EQUIPMENT	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input area (ft^2)						
Input time available (work days)						

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd^3)						
Input production rate (yd^3/hr)						
Input estimated fuel consumption rate (gal/hr) (Input only if known for the mixer selected, otherwise a default will be used by the tool)						

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)						
Choose vehicle type from drop down menu	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck	On-road truck
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips						
Input number of miles per trip						

LANDFILL OPERATIONS	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6
Input tons of soil or waste to be incinerated (user must input emission factors in the Look Up Table, Table 7a)						

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6
Choose oxidizer type from drop down menu	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer	Simple Thermal Oxidizer
Choose fuel type from drop down menu	natural gas	Propane	natural gas	natural gas	natural gas	natural gas
Input waste gas flow rate (scfm)						
Input time running (hours)						
Input waste gas inlet temperature (F)						
Input contaminant concentration (ppmV)						

*(Electric blowers are included in the analysis)

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6
Input water disposed/collected during treatment (gal)						
Input water disposed/collected during site preparation (gal)	2250					
Input water disposed/collected during sampling (gal)						
Input water disposed/collected during site demobilization (gal)						

LANDFILL METHANE EMISSIONS	Landfill 1	Landfill 2	Landfill 3	Landfill 4	Landfill 5	Landfill 6
Input landfill methane emissions (metric tons)						

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO_2 emission (metric ton)	
Input N_2O emission (metric ton CO_2 e)	
Input CH_4 emissions (metric ton CO_2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM_{10} emission (metric ton)	
Input fatality risk	
Input injury risk	

APPENDIX C

REPONSE TO FDEP COMMENTS

Draft Feasibility Study
Site 46 (Former Building 72)
Naval Air Station Pensacola
Pensacola, Florida

RESPONSE TO FDEP COMMENTS DATED MAY 27, 2010

Comment # 1

Comment: The list of Contaminants of Concern (COCs) for groundwater located on page ES-6 and in Section 2.2.2 on pages 2-10 and 2-11 of the FS does not match the discussion of contaminants detected in groundwater above groundwater cleanup target levels (GCTLs) on pages ES-3 and ES-4 and in Section 1.1.3.2 Nature and Extent of Contamination - Groundwater. The COCs for groundwater, and their corresponding GCTLs, that have been neglected in much of the discussion on the remedial alternatives evaluated include naphthalene, lead, chromium, aluminum, iron, manganese, sodium and vanadium. These contaminants and others are included as potential COCs for groundwater in the Remedial Investigation Report for Site 46. While there may be reasons for eliminating some of those contaminants from further consideration as COCs, the arguments have not been put forward in the report.

Response:

The FS will be revised. In summary the COCs for groundwater at Site 46 include: Trichloroethene, Vinyl Chloride, Naphthalene, Arsenic, Cadmium. A COPC Refinement Section will be added to explain the selection of COCs.

Comment # 2

Comment: The current and anticipated future use of the site is as a recreational plaza and park with a central covered including a gazebo and elevated stage. In Table 3-1 on page 3-3, for the Limited Action response, it says that current and future land use is industrial, which should be changed to recreational. It also says in Section 4.2.1.2, page 7-7, top of page, that the site is currently used for commercial/ industrial purposes.

Response:

Agreed. The land use will be described as "non-residential (recreational)" throughout the document.

Comment #3

Comment: There are conflicting statements within the report regarding how contaminated soils are to be addressed. It is stated in some parts of the report that surface soils were excavated to a depth of approximately two feet below land surface and that remaining soil contamination does not exceed residential soil cleanup target levels but that some subsurface soil remains with TCE concentrations that exceed the Department's SCTL for leachability to groundwater. Based on this, remedial action objective RAO 1 stated in Sections E.5 and 2.1.1 is appropriate. In other parts of the report, specifically in Sections E.6, E.7, 3.2.2.1 and 4.2.2.1, the application of land use controls (LUCs) to prohibit residential or residential-like uses as remedial alternative S-2 is discussed. If contaminated soil above residential SCTLs does not remain, the non-residential LUC remedy to prevent unacceptable risks from exposure to soil would not appear to be warranted. The conflict between either preventing leaching of contaminants from soil to groundwater or preventing unacceptable risks from exposure to contaminated soil is prevalent throughout the report.

Response:

The document was revised to better explain the recent changes and the current conditions of the site.

Draft Feasibility Study
Site 46 (Former Building 72)
Naval Air Station Pensacola
Pensacola, Florida

Response:
Text will be revised to state that based on available groundwater data for Site 46 and nearby Site 38, the plumes appear to be stable and not migrating.

Comment # 8
Comment: I cannot get Figure 4-1 to agree with Figure 1-5. Figure 4-1 has the area with TCE in soil to be addressed because of potential leaching of TCE to groundwater centered on soil boring location 46SB29, which Figure 1-5 shows that soil boring not contaminated with TCE above its leachability SCTL; and Figure 4-1 does not have soil borings 46SB33 and 46SB34 outside the TCE impacted area, while 1-5 shows both those borings as having TCE concentrations above its leachability SCTL.

Response:
Due to the recent constructions at the site, apparently the soil boring locations were incorrectly placed in some of the figures. Figures 1-3, 1-5 and 4-1 have been revised. However, it should be noted that the RI sampling data does not represent the current surface soil conditions. The upper 2 feet of soil have been replaced in Site 46 with clean fill.

Comment #9
Comment: On Figure 4-2, at monitoring well 38GSOl, please change "Grondwater" to "Groundwater". Please also show where the naphthalene GCTL exceedance was located.

Response:
Agreed, Figure 4-2 has been revised. "Groundwater" was correctly spelled and Naphthalene exceedance has been added to Figure 4-2.

Comment #10
Comment: In Section 5.1.2, on page 5-3, in the subsection on soil, it says that Alternative S-2 would comply with chemical- and action-specific ARARs. In the next sentence, where it says that Alternative S-2 "would not immediately comply with –specific ARARs", what type of ARARs are being discussed? I believe chemical-specific ARARs may fit into the sentence best.

Response:
Agreed. Text will be revised to read "chemical –specific ARAR".

Comment #11
Comment: In the discussion on the short-term effectiveness of Alternative S-2 in Sections 5.1.5 and in Table 5-1, it says that the implementation of LUCs on the site would have minimal short-term effectiveness concerns as exposure of workers to contamination would be minimized by the wearing of appropriate PPE and complying with site-specific health and safety procedures. I do not believe the implementation of LUCs on the site would require any site work. Rather, the implementation should mainly be an administrative exercise except for a requirement for regular inspections and annual reporting on the status of the LUCs on Site 46.

Response:
Agree. Implementation of land use control remedial alternative would not require any active site work. Therefore, there would be no need for PPE.