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March 9, 2021

VIA EMAIL AND PRIVATE CARRIER

Gary Schold, Project Manager
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Subject: Groundwater Response Action Plan Addendum Number 5—Blocks E and F Revision 1
Lockheed Martin Corporation – Middle River Complex
2323 Eastern Boulevard, Middle River, Baltimore County, Maryland

Dear Mr. Schold:

For your review, please find enclosed two hard copies with a CD of the above-referenced document. This revised document is the fifth addendum to the Groundwater Response Action Plan was developed to address contamination by 1,2,4-trichlorobenzene and other chlorinated benzenes in groundwater at Tax Blocks E and F at the Lockheed Martin Middle River Complex, 2323 Eastern Boulevard, in Middle River, Maryland. The revisions in this document (Revision 1) address comments received from the Maryland Department of the Environment on November 20, 2020.

If possible, we respectfully request to receive MDE's approval by April 9, 2021.

Please let me know if you have any questions. My office phone is (301) 548-2209.

Sincerely,

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Project Lead, Environmental Remediation

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GROUNDWATER RESPONSE ACTION PLAN ADDENDUM NUMBER 5—BLOCKS E AND F
LOCKHEED MARTIN MIDDLE RIVER COMPLEX
2323 EASTERN BOULEVARD
MIDDLE RIVER, MARYLAND

Prepared for:
Lockheed Martin Corporation

Prepared by:
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March 2021

Revision: 1

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ACRONYMS AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
bgs	below ground surface
Block(s)	Tax Block(s)
CB	chlorobenzene
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
COC	chemical(s) of concern
CSM	conceptual site model
DCB	dichlorobenzene
DHC	*Dehalococcoides*
DO	dissolved oxygen
DPT	direct-push technology
ESS	Environmental sequence stratigraphy
GAC	granular activated carbon
gpm	gallon(s) per minute
GWETS	groundwater extraction and treatment system
GWS	groundwater screening
HPT	hydraulic profiling tool
Lockheed Martin	Lockheed Martin Corporation
LGAC	liquid-phase granular activated carbon
LUC	land use control
MCL	maximum contaminant level
MDE	Maryland Department of the Environment
µg/L	microgram(s) per liter
mg/kg	milligram(s) per kilogram

mg/L	milligram(s) per liter
MNA	monitored natural attenuation
MRC	Middle River Complex
NPDES	National Pollutant Discharge Elimination System
NRWQC	national recommended water quality criteria
O&M	operation and maintenance
ORP	oxidation-reduction potential
PCB(s)	polychlorinated biphenyl(s)
POTW	publicly owned treatment works
PRB	permeable reactive barrier
qPCR	quantitative polymerase chain reaction
RAP	response action plan
RAO	response action objective
RI	remedial investigation
TCB	trichlorobenzene
Tetra Tech	Tetra Tech, Inc.
USEPA	United States Environmental Protection Agency
VGAC	vapor-phase granular activated carbon
VOC	volatile organic compound
ZVI	zero-valent iron

EXECUTIVE SUMMARY

Chlorinated benzenes (primarily 1,2,4-trichlorobenzene and chlorobenzene) associated with operations at former building operations have impacted the soil and groundwater within Tax Block E and groundwater within Tax Block F at the Middle River Complex. The primary source of chlorinated benzenes likely was transformer fluid that may have been released from equipment in former transformer rooms #2, #3, and #4 located in former Building D, within Block E. This remedial action plan describes the nature and extent of chlorinated benzenes impacting groundwater and addresses future response actions to protect public health and the environment. Two groundwater plumes, extending from Block E to Dark Head Cove, have been identified. Concentrations of 1,2,4-trichlorobenzene and chlorobenzene in groundwater have exceeded groundwater cleanup standards established by the state of Maryland for the protection of drinking water. The contamination is also found in groundwater near the downgradient surface water body, Dark Head Cove. However, chlorinated benzenes have only been detected in two surface water samples collected over 16 years of monitoring, and both detected concentrations were below human health-based and ecological criteria.

The former Building D area at Block E is undergoing remediation in 2021 to remove soil impacted with polychlorinated biphenyls (PCBs) that appear to have been released from former transformers. Chlorinated benzenes were historically added to transformer oil. Because the source of polychlorinated biphenyls and chlorinated benzenes impacts is the same, the excavation of the polychlorinated biphenyl-contaminated soil will also remove a large portion of chlorinated benzene-impacted soil. The chlorinated benzene groundwater plumes will remain, and the affected groundwater is being addressed by this response action plan (RAP).

Groundwater in Blocks E and F flows slowly toward Dark Head Cove. Groundwater modeling was performed to estimate the rates of movement and discharge of chlorinated benzenes to the cove. Modeling suggests that even without treatment, chlorinated benzenes may never reach surface water at concentrations that would pose a risk to public health or exceed site-specific swimming criteria. As they migrate, chlorinated benzenes may also be degraded by natural processes.

In order to develop a response action that is protective of human health and the environment, and to ensure effectiveness of the remedy, response action objectives (RAOs) are defined. These objectives describe cleanup goals for achieving acceptable levels of chemical constituents that no longer pose an unreasonable risk to human health or the environment. The response action objectives for chlorinated benzenes in Blocks E and F groundwater are:

1. Prevent human exposure (from dermal contact, inhalation, and ingestion) to groundwater containing site-related chemicals of concern at concentrations greater than drinking water standards (Maryland Department of the Environment [MDE] "Generic Numerical Standards for Groundwater" [MDE, 2018]).

2. Prevent discharge of groundwater with chemicals of concern that would cause an exceedance of the Maryland Department of the Environment ambient water quality criteria or risk-based swimming criteria in Dark Head Cove.

3. Prevent off-site migration to adjacent properties of site-related chemicals of concern in groundwater at concentrations greater than drinking water standards.

4. Prevent exposure of industrial workers (via vapor intrusion into buildings) to site-related volatile organic compounds (VOCs) due to groundwater vapors at levels that would pose a carcinogenic risk greater than 1×10^{-5} or a cumulative noncarcinogenic hazard index greater than 1.

Various technologies and remedial approaches to address Blocks E and F chlorinated benzene-impacted groundwater were identified and screened, and three remedial alternatives were developed for further evaluation:

- Monitored natural attenuation (MNA) and land use controls (LUCs)
- Hydraulic containment, with monitored natural attenuation and land use controls
- Aerobic permeable reactive barriers (PRBs) (biosparging), with monitored natural attenuation and land use controls.

Monitored natural attenuation means to allow natural biological, chemical, and physical processes to degrade or "attenuate" groundwater contaminant concentrations and conducting ongoing monitoring to verify that these processes are effective. Monitored natural attenuation, when the proper conditions are present, can be an effective approach to achieve site-specific remediation objectives within a reasonable timeframe, as compared to more active approaches. Data collected

thus far suggests that monitored natural attenuation would likely be an effective method for managing contaminant concentrations and confirming that remedial action objectives are achieved.

Land use controls consist of restrictions placed on land use, including any groundwater existing below a site, through a formal process whereby there is regulatory oversight and routine verification that these controls remain in place. In terms of site-specific (Blocks E and F) requirements, groundwater use for any purpose would be prohibited, and inspections would be performed to confirm these restrictions are not being violated.

The two active alternatives that were evaluated consist of hydraulic containment and permeable reactive barriers. Hydraulic containment involves using extraction wells to intercept the groundwater contamination plumes, preventing migration beyond a defined point. The extracted groundwater would be treated in the groundwater treatment system installed to address the adjacent trichloroethene plume on the eastern side of Block E. The aerobic permeable reactive barrier, also known as biosparging, relies on injecting air (oxygen) into the aquifer in columns that form a wall through which groundwater flows. Biosparging promotes biological activity, stimulating aerobic bacteria in the aquifer to degrade chlorinated benzenes to chloride, carbon dioxide, and water.

The selected alternatives were evaluated comparatively based on the following criteria:

- overall protection of human health and the environment
- compliance with applicable, relevant and appropriate regulations
- achieving response action objectives
- long-term effectiveness and permanence
- reduction of toxicity, mobility, or volume by treatment
- short-term effectiveness
- implementability
- lifecycle impacts
- cost

The results of the comparative analysis indicated that the monitored natural attenuation alternative is the recommended alternative for the chlorinated benzene plumes. This alternative protects human health and the environment, and complies with applicable, relevant, and appropriate regulations and response action objectives. No adverse impacts to surface water in Dark Head Cove have been detected during surface water sampling to date. However, because of the slow movement of the groundwater and the limited duration of samples collected to date, surface water monitoring may be required for a significant time frame in order to demonstrate remedy effectiveness. If surface water monitoring indicates that surface water criteria may be exceeded, an active remediation system such as groundwater extraction or other contingent remedy might be implemented.

Lockheed Martin Corporation is committed to its partnership with the Middle River community and to maintaining a high level of community outreach and communication as work progresses. Lockheed Martin Corporation will also provide remediation program updates to the Civic Association Leadership and, upon request, will attend virtual Civic Association meetings to provide updates and answer questions. Due to ongoing concerns regarding the COVID-19 pandemic, Lockheed Martin Corporation may not hold a Community Information Availability Session, but at a minimum will provide a public comment period before the response action begins. Lockheed Martin Corporation remains committed to two-way communication with the community to ensure that questions are answered, and issues and concerns are addressed in a timely manner.

SECTION 1
INTRODUCTION

On behalf of Lockheed Martin Corporation (Lockheed Martin), Tetra Tech, Inc., (Tetra Tech) has prepared this fifth addendum to the *Groundwater Response Action Plan* (Tetra Tech, 2012) to address contamination by 1,2,4-trichlorobenzene (1,2,4-TCB) and other chlorinated benzenes in groundwater at Tax Blocks (Blocks) E and F at the Lockheed Martin Middle River Complex (MRC), 2323 Eastern Boulevard, in Middle River, Maryland (Figures 1-1 and 1-2). 1,2,4-Trichlorobenzene and related chlorinated benzenes were used as additives in polychlorinated biphenyl (PCB) commercial mixtures. Extensive environmental sampling has been conducted in Block E to assess past releases of polychlorinated biphenyls and characterize media requiring cleanup. These studies show a relationship of the chlorinated benzenes and polychlorinated biphenyls associated with electrical transformer rooms in former Building D. The information obtained from these investigations was presented in the *Remedial Investigation Block E Soil* report (Tetra Tech, 2020a), and included limited analyses of soil and groundwater for chlorinated benzenes, performed as part of efforts to assess whether impacts from polychlorinated biphenyl were confined to soils.

Recent groundwater investigations (in 2018 and 2019) focusing on chlorinated benzenes were summarized in the *Block F Chlorobenzene Characterization Report* (Tetra Tech, 2019c) and *Groundwater Chlorobenzene Characterization Report* (Tetra Tech, 2020b). In these reports, "chlorinated benzenes" includes 1,2,4-trichlorobenzene, 1,2-dichlorobenzene (1,2-DCB), 1,4-dichlorobenzene (1,4-DCB), and chlorobenzene (CB), which are the predominant chlorinated benzenes detected at the site. Investigation results indicated that chlorinated benzenes (chiefly 1,2,4-trichlorobenzene) associated with former transformers have impacted the soil and groundwater within Blocks E and F. Chlorinated benzene groundwater plumes originate at former transformer rooms in Block E and extend downgradient into Block F.

Elevated 1,2,4-trichlorobenzene concentrations were detected in Block E groundwater and soil during previous sampling and volatile organic compound (VOC) analyses in historical, industrial-

use "source" areas. Some of these historical source areas associated with former transformer rooms from a demolished manufacturing building (Building D) are the subject of a proposed soil remedial action planned for 2021. This risk-based remedial action will remove Block E soil with elevated polychlorinated biphenyl and 1,2,4-trichlorobenzene concentrations, as well as shallow soil below former Building D (Figure 1-2) and in storm drain excavations within Block E (*Block E Soil Remedial Action Plan*; Tetra Tech, 2019a). This proposed remedial action will remove a significant portion of the highest concentrations of source-area soil with chlorinated benzene impacts near former transformer rooms in Block E.

Groundwater at Blocks E and F is currently being remediated under a response action to address elevated volatile organic compound concentrations, primarily trichloroethene (TCE), resulting from releases in the southeastern part of Block E. This response action, as detailed in the *Groundwater Response Action Plan* (Tetra Tech, 2012) and its amendments, was approved by the Maryland Department of the Environment (MDE). The 2012 groundwater response action includes using anaerobic reductive dechlorination processes to treat elevated trichloroethene concentrations in groundwater. The current groundwater response action, amended under Addendum Number 4 (Tetra Tech, 2018b), also includes hydraulic containment and *ex-situ* treatment of the downgradient plume and installation of a permeable reactive barrier (PRB) using zero valent iron in Block F. Construction of that remedial action system is ongoing (at the time this document was prepared).

The removal of 1,2,4-trichlorobenezene source material by removal of Block E soil, planned as part of the soil remedy per the *Block E Soil Remedial Action Plan* (Tetra Tech, 2019a), was considered when preparing the remedial alternatives for chlorinated benzenes in groundwater. Therefore, only the chlorinated benzene plume downgradient of the source areas is addressed in this addendum to the groundwater response action plan.

The remedial alternatives for chlorinated benzenes in Blocks E and F groundwater are presented herein as *Groundwater Response Action Plan Addendum Number 5*. The primary objectives of this document are to:

- briefly discuss previous investigation of chlorinated benzenes in Blocks E and F.
- establish response action objectives (RAOs) for chlorinated benzenes in Blocks E and F groundwater.

- provide a comprehensive list of alternatives to address chlorinated benzenes in Blocks E and F groundwater.
- provide an analysis of the alternatives and retain a resultant short list of alternatives for further consideration.
- provide conceptual design information for the short-listed alternatives.
- recommend a remedial alternative for chlorinated benzenes in Blocks E and F groundwater.
- provide a conceptual design and cost estimate for the recommended alternative.

The organization of this report is as follows:

Section 1—Introduction: Presents the background and objectives of this groundwater response action plan addendum and provides a summary of the content of the subsequent report sections.

Section 2—Previous Investigations: Briefly describes previous investigations for chlorinated benzenes in Blocks E and F, and describes the conceptual site model (CSM) for the site.

Section 3—Remedial Alternatives Evaluation: Discusses the chemicals of concern (COC), response action objectives, screening of technologies, the long and short lists of alternatives, develops three short-listed alternatives, and selects a proposed response action for chlorinated benzenes in Blocks E and F groundwater.

Section 4—Proposed Response Action: Provides details for the proposed response action, including the conceptual design, implementation sequence, performance monitoring, and shutdown criteria.

Section 5—References: Lists the references used to compile this report.

SECTION 2
PREVIOUS INVESTIGATIONS

This section describes recent (2018 and 2019) investigation results for 1,2,4-trichlorobenzene (1,2,4-TCB) and other chlorinated benzenes in Blocks E and F. Chlorinated benzenes were detected in soil and groundwater during previous investigations and were first described in the *Remedial Investigation Block E Soil* report (Tetra Tech, 2020a). Based on the results of this sampling, additional investigations were performed in 2018 and 2019 to further characterize the nature and extent of the chlorinated benzene compounds. Chlorinated benzenes include 1,2,3-TCB, 1,2,4-TCB, 1,2-dichlorobenzene (1,2-DCB), 1,3-dichlorobenzene (1,3-DCB), 1,4-dichlorobenzene (1,4-DCB), and chlorobenzene (CB).

2.1 2018 BLOCKS E AND F GROUNDWATER CHARACTERIZATION

During the remedial investigation (RI) for Block E soil, chlorinated benzenes were detected in downgradient monitoring wells at the southern boundary of Block E (Tetra Tech, 2020a). This prompted additional investigation of chlorinated benzenes to delineate sources and assess the extent of downgradient migration (Tetra Tech, 2019c). The objectives of the investigations completed in autumn 2018 for characterization of the downgradient migration of chlorinated benzenes in Block F were as follows:

- delineate the extent of 1,2,4-TCB-impacted groundwater, both vertically and horizontally
- develop improved plume cross-sections representing the concentrations and extent of chlorinated benzenes, primarily 1,2,4-TCB, extending downgradient past Block E, as well as the width of the plume perpendicular to groundwater flow direction

The Block F investigations included additional soil borings, groundwater screening within borings, and analysis of samples collected from newly installed groundwater monitoring wells. Geological conditions and lithologic data for Block F were evaluated by advancing 16 borings using a hydraulic profiling tool (HPT) via a direct-push technology (DPT) rig. Soil lithologies described in the borings are consistent with those observed at other locations through Blocks E and F.

Distinct sedimentary intervals of sand, silt, or clay were encountered, as were intervals containing various mixtures of these soil types.

The HPT borings were located downgradient of the chlorobenzene detections within Block E, and oriented along transects perpendicular to the interpreted flow direction of the groundwater plumes (Figure 2-1). This generated data to generally delineate the width and length of the plumes. Groundwater samples were then collected from discrete depths determined by lithology and onsite field gas chromatograph sampling. Figure 2-1 shows the HPT field results for chlorinated benzenes along extended transects 1, 2, and 3 in Block F.

The HPT results indicated that distinct zones of both high and low conductivity were heterogeneously distributed within the aquifer. The HPT continuous data logs, as compared to lithology, indicated zones of higher conductivity within the more permeable sandy intervals, and zones of low conductivity within the less permeable clayey intervals. Analytical sampling results indicated a correlation of greater concentrations of chlorinated benzenes in more permeable soil. Groundwater screening indicated that the concentrations of the chlorinated benzenes are discretely distributed and vary both vertically within a single boring and laterally between adjacent borings.

The higher conductivity zones were targeted for discrete groundwater sampling and field screening of chlorinated benzenes to develop a high-resolution vertical profile of the chemical distribution at each boring location. Selected groundwater intervals were sampled and field analyzed for specific chlorinated benzenes (CB, 1,2,4-TCB, 1,2-DCB, and 1,3-DCB) using a Frog 4000™ field gas chromatograph. As stated above, Figure 2-1 presents the field-screening results derived using the Frog 4000™ in 2018. For field screening quality assurance and verification purposes, twenty percent of the field-screened intervals (five groundwater samples from the vertical profile borings) were also submitted to an offsite laboratory (TestAmerica Canton, Ohio) for analysis of the chlorinated benzenes on a standard turnaround time. Figure 2-2 shows the laboratory results from these select vertical profiling groundwater samples.

Hydraulic conductivity (measured via HPT) and chemical field screening results for groundwater were used to better define the dimensions of transmissive zones where downgradient migration of groundwater is most likely to occur. To monitor migration of chlorinated benzenes downgradient of these zones, five new monitoring wells (MRC-MW134A/B, MRC-MW135A/B, and MRC-

MW136B) were installed. Figure 2-2 shows the locations and laboratory detected VOC results from the five new wells. (Note that in subsequent discussion of these wells, the prefix 'MRC-' is not used, to enhance readability.)

Following well development, the five newly installed monitoring wells in Block F were sampled for chemical parameters, natural attenuation geochemical parameters, and microbial composition. Analytes included VOCs, total metals, and polychlorinated biphenyls (PCBs). Geochemical parameters included sulfate, nitrates, total dissolved solids, bromide, iron, manganese, alkalinity, salinity, hardness (ions), and dissolved gasses (methane, ethane, and ethene). Ferrous iron was tested in the field using Hach field kits. Microbial testing for *Dehalococcoides* (DHC) bacterial species and functional genes were conducted by Microbial Insights of Knoxville, Tennessee. Detailed results from this investigation are presented in the *Block F Groundwater Chlorobenzene Characterization Report* (Tetra Tech, 2019c), and are summarized below.

Thirteen VOCs were detected in the newly installed monitoring wells in Block F, with the most notable detections at MW135B, where a 1,2,4-TCB concentration of 280 micrograms per liter (µg/L) was detected, and MW134A, where a chlorobenzene concentration of 160 *J* µg/L (estimated value below the sample quantitation limit) was detected. However, no VOCs were detected in groundwater samples collected from MW134B and MW135A (Figure 2-2).

The VOC results were compared to the federal maximum contaminant levels (MCLs) for drinking water, although the groundwater from which they were obtained is not used as a drinking water source. Two concentrations exceeded MCLs: 1,2,4-TCB (280 µg/L) exceeded the MCL of 70 µg/L at MW135B, and CB (160 *J* µg/L) exceeded the MCL of 100 µg/L at MW134A (Figure 2-2).

The DHC genes in analyzed samples from the Block F monitoring wells were either not detected, or were present only at low concentrations (i.e., at concentrations not likely to be effective at reducing chlorinated benzenes). DHC results from these new wells, along with the geochemical indicator test results, were used to evaluate the potential effectiveness of natural attenuation for inclusion as a possible groundwater response action to address chlorinated benzenes and TCB in this RAP addendum.

2.2 2019 ADDITIONAL BLOCKS E AND F GROUNDWATER CHARACTERIZATION

Data gaps and uncertainties regarding the extent of chlorinated benzenes in the subsurface were identified after the 2018 investigation, presented in the section above, was conducted, so additional site investigation was performed in the summer and autumn of 2019. These investigations included installation of eight additional monitoring wells, gamma logging, hydraulic profiling, and soil and groundwater sampling. The results of the investigation were interpreted and used to update the conceptual site model (CSM) representing the nature and extent of chlorinated benzenes in groundwater (Tetra Tech, 2020b). The following tasks were conducted in 2019:

- A natural gamma ray logging program was conducted within existing monitoring wells in Blocks E and F to acquire high resolution lithostratigraphic data. Combined with the geologic boring logs, this information was intended to define the lateral and vertical distribution of the high-conductivity zones within paleochannels, leading to a better understanding of the migration pathways for chlorinated benzenes in groundwater.
- An additional HPT investigation was conducted along two newly installed transects (Figure 2-3): transect 4, downgradient of the 1,2,4-TCB plume emanating from former transformer room 4 and transect 5, along the shore south of well MW136B, to evaluate the downgradient extent of the 1,2,4-TCB plume near Dark Head Cove and to help determine locations for additional monitoring wells.
- New monitoring wells (MRC-MW-160A/B, MW-161A/B, MW-162A/B, and MW-163A/B; see Figure 2-4) were sampled and analyzed for the same chemical and geochemical parameters as for the 2018 investigation (Section 2.1). The only exception was microbial analysis, which was not performed in 2019.

Gamma ray logging was conducted at 52 existing monitoring wells within Blocks E and F to obtain a detailed record of borehole soils stratigraphy. The gamma ray logs were used to further characterize and refine the stratigraphic interpretations related to possible preferred subsurface migration pathways. The soil types observed in the borings were combined with the gamma logs to develop environmental site stratigraphy interpretations to a precision of 1 foot and construct geologic cross-sections depicting the 1,2,4-TCB plume areas.

The HPT was used to generate conductivity data from borings located along two new transects (transects 4 and 5) located in Blocks E and F, respectively (Figure 2-3). From this, zones of higher conductivity were targeted for discrete groundwater sampling and field screening of chlorinated

benzenes to develop a high-resolution vertical profile of the chemical stratigraphy at each boring location.

Twenty-one (21) discrete groundwater samples from the DPT borings were analyzed in the laboratory for CB, 1,3-DCB, and 1,2,4-TCB to determine concentrations relative to stratigraphy for these primary chlorinated benzene ("marker") chemicals. Detected concentrations are shown in Figure 2-3. Overall, results were consistent with the HPT and field screening results from the 2018 investigation - chlorinated benzenes are discretely distributed, and detections vary both vertically and laterally.

Chlorobenzene was detected in eight of 21 samples from the DPT borings analyzed with concentrations ranging from 1.6 µg/L to 49 µg/L. Chlorobenzene was detected in Block E transect 4 samples to the west only, and was not detected at any sample collected from transect 5 in Block F further east. As shown in Figure 2-3, the highest CB concentrations were observed in transect 4, at two depth intervals within one groundwater screening boring (GWS-4D): at 6-10 feet (49 µg/L) and at 10-14 feet (14 µg/L). Therefore, new well cluster MW160A/B was placed near boring GWS-4D, near the southern boundary of Block E. MW161A/B was placed downgradient of MW160A/B inside the fence-line of Block F to further delineate the chlorobenzene plume.

The highest 1,2,4-TCB concentration (1.9 µg/L) was measured in transect 5 at boring 5B (at F-GWS-5B-20-24). This detection, along with its proximity to Dark Head Cove, prompted the installation of monitoring well cluster MW162A/B approximately 5 feet upgradient of this boring location. In Block F, 1,2,4-TCB was detected in one other groundwater screening (GWS) sample (0.43 *J* µg/L at F-GWS-5A-15-19). 1,3-DCB was detected more frequently than 1,4-TCB in four of 21 total GWS samples; concentrations ranged from 0.15 *J* µg/L to 0.64 *J* µg/L, with the maximum concentration observed at E-GWS-4D-14-18. Three of four detections were in Block E (GWS-4D), and one in Block F (GWS-5E; Figure 2-3).

To further characterize soil concentrations in the area, two soil samples were collected and analyzed for 1,2,4-TCB, 1,2-DCB, 1,3-DCB, and CB from the well installation borings (SB-MW161-28-30 and SB-MW162-2-4). However, none of these chlorinated benzenes were detected in either sample.

Nineteen VOCs were detected in laboratory analyzed samples collected from the eight monitoring wells installed during the 2019 investigation. The primary chlorinated benzenes detected were 1,2,4-TCB, CB, 1,2-DCB, and 1,4-DCB, in one or more wells (Figure 2-4). The three most notable of these detections were all at MW163A (immediately downgradient of former transformer room 3; see Figure 2-4):

- 1,2,4-TCB at 3,200 µg/L (MCL of 70 µg/L)
- 1,4-DCB at 100 µg/L (MCL of 75 µg/L)
- benzene at 10 µg/L (MCL of 5 µg/L)

Other chlorinated benzenes detected in the new wells included 1,2,3-TCB, which was likely a constituent present in the chlorinated benzene mixtures incorporated in the original transformer oil spilled or released. This compound does not readily biodegrade and is not produced through the biodegradation of 1,2,4-TCB. The 1,2,3-TCB detections were at MW163A (820 µg/L) and MW163B (4.2 µg/L). In addition, 1,3-DCB was detected at very low concentrations in well MW160A (0.18 *J* µg/L) and at well MW161A, in both the parent sample and in its duplicate (0.25 *J* µg/L and 0.22 *J* µg/L, respectively). The results of the 2019 sampling are summarized further in the *Groundwater Chlorobenzene Characterization Report* (Tetra Tech, 2020b). Biodegradation pathways are discussed in more detail in Section 2.5.3.

2.3 SURFACE WATER SAMPLING AT MRC

Groundwater at Blocks E and F eventually discharges to surface water in Dark Head Cove, which adjoins the southern boundary of Block F. Site contaminants in groundwater at the Middle River Complex (MRC) could potentially be introduced to surface water either through surface water runoff, groundwater discharge, or through groundwater infiltration into storm drains, thereby discharging to surface water through nearby outfalls. Lockheed Martin currently collects surface water samples in Dark Head Cove and Cow Pen Creek (located adjacent to the MRC and west of Dark Head Cove, Figure 1-2) to monitor for VOCs (which includes chlorinated benzene compounds) and 1,4-dioxane three times per year (April, June, and September) and to monitor for PCBs once per year. Surface water sampling locations in Dark Head Cove, the surface water body downgradient of the Blocks E and F chlorinated benzene plumes, are shown in Figure 2-5.

The following screening criteria are used for evaluating surface water COC.

- Maryland ambient water quality criteria for human health consumption-of-organisms (Code of Maryland Regulations 26.08.02.03)

- United States Environmental Protection Agency (USEPA) National Recommended Water Quality Criteria – human health criteria, consumption of organism only (USEPA, 2015)

- National Recommended Aquatic Life Criteria – freshwater, acute and chronic criteria (USEPA, 2018a)

- USEPA Region 3 Biological Technical Advisory Group marine screening-benchmarks (USEPA, 2006)

    - If no benchmarks were listed by United States Environmental Protection Agency Region 3, guidance from USEPA Region 4 and Region 5 were reviewed for additional ecological benchmarks.

- Risk-based site-specific swimming screening levels developed in 2019 for trichloroethene (TCE); *cis*-1,2-dichloroethene; 1,2,4-TCB; and 1,4-dioxane for surface water in Dark Head Cove and Cow Pen Creek adjacent to MRC. These risk-based screening values were approved by the Maryland Department of the Environment (MDE) in 2019 (Lockheed Martin, 2019a).

Chlorinated benzenes have been analyzed for in surface water samples during multiple sampling events, and at least annually since 2005. To date, only two detections of chlorinated benzene constituents, at two distinct sample locations, have occurred, both in April 2017. Specifically, 1,2,4-TCB was detected at concentrations of 0.43 *J* µg/L and 0.35 *J* µg/L on April 10, 2017, in samples collected from respective locations MRC-SW14A-S and MRCSW5B (Figure 2-6). Chlorobenzene compounds have not been detected in surface water samples collected in subsequent sampling events.

Results from the most recently completed year of triannual (2019) monitoring of Dark Head Cove (AECOM, 2020) are summarized below. Surface water monitoring results from Cow Pen Creek are not summarized herein, as Blocks E and F groundwater do not discharge directly to that creek, and stormwater is not addressed by this RAP addendum.

During each of the 2019 triannual events, 18 surface water samples were collected in Dark Head Cove at offshore locations near Outfalls 006, 007, 008, and 009, and at former Outfalls 005E and 005W (see Figure A-1 in Appendix A). Two samples were collected at each of the outfalls that discharge to the cove (i.e., Outfalls 006, 007, 008, and 009): one sample from 10 feet offshore

("A" sample) and a second sample from 50 feet offshore ("B" sample). Three sampling locations west of Outfall 008 (MRC-SW13A-S, MRC-SW15A-S, and MRC-SW16A-S) had no associated "B" sample and were collected 10 feet offshore. Four additional samples were collected west of Outfall 008 (MRC-SW11A-S, MRC-SW11B-S, MRC-SW12A-S, and MRC-SW18A-S) during the 2019 triannual events; these samples were not collected the previous year (2018). One sample was collected near each former Outfall 005E and 005W, 10 feet offshore, (5A1-S and 5A2-S), and single "B" sample (MRC-5B-S) was collected 50 feet offshore, at the midpoint between these two points.

Chlorinated benzene compounds were analyzed for but were not detected at reportable concentrations in any of the Dark Head Cove surface water samples collected in April, June, and September 2019 (AECOM, 2019a). During the April 2019 event, four 1,4-DCB detections and three 1,3-DCB detections were considered possibly biased due to laboratory blank contamination and were qualified as "*B*" (blank-related) results.

2.4 2019 GROUNDWATER SAMPLING AT MRC

Lockheed Martin collects groundwater samples at the MRC annually to monitor for VOCs, PCBs, metals, and 1,4-dioxane. The April 2019 monitoring event included the collection of samples from 74 shallow aquifer wells and 69 intermediate aquifer wells, and included wells installed in Blocks E and F to monitor chlorinated benzenes (AECOM, 2019b). Two deep wells were also sampled and analyzed for VOCs and 1,4-dioxane. The monitoring wells sampled during annual MRC groundwater monitoring are shown on Figure A-2 in Appendix A.

In 2019, exceedances of MDE cleanup standards for chlorinated benzenes were detected in shallow aquifer wells clustered in the central and southern portions of Block E, with several exceedances detected in downgradient wells in Block F. No exceedances were detected in deep wells, and exceedances were seldom detected in intermediate aquifer wells. Additional wells were being installed at the time of this annual monitoring downgradient of Block E and in Block F as part of the 2019 1,2,4-TCB study described in Section 2.2 above (MW-160A/B through MW-163A/B). Therefore, the April 2019 groundwater event at MRC did not include sampling of the recently installed wells, and the annual monitoring results were independent of the groundwater

chlorobenzene characterization (AECOM, 2019b). The results of the 2019 groundwater sampling are summarized below.

- The MDE standard of 100 µg/L for CB was exceeded in two of 13 shallow wells in which it was detected, with a maximum detected concentration of 338 µg/L at MW124A in the north, central portion of Block E. The other exceedance, in well MW134A (110 µg/L), was in Block F. CB was detected in seven intermediate aquifer wells but did not exceed the MDE standard in those wells.
- The MDE groundwater standard of 70 µg/L for 1,2,4-TCB was exceeded in eight of 12 shallow wells in which it was detected. The maximum detection was at MW127A (1,800 µg/L) in the southwestern portion of Block E. Other Block E exceedances were near well MW124A (452 µg/L) and MW43A (695 µg/L), and one exceedance was detected at SEMW-9S (90.7 µg/L) in the southeastern portion of Block F. 1,2,4-TCB was detected in three intermediate wells, but exceeded its MDE groundwater standard in only one well (273 µg/L, at MW135B) in the western portion of Block F. The concentration of 1,2,4-TCB in this well also exceeded its MDE standard in 2018.
- The MDE groundwater standard of 75 µg/L for 1,4-DCB was exceeded in three of 13 shallow wells in which it was detected, with maximum detected concentration of 338 µg/L and 155 µg/L at wells MW43 and MW124A (respectively). 1,4-DCB was also detected in six intermediate wells, with only one exceedance (105 µg/L) at well MW130B, in the southwestern portion of Block E.
- 1,3-DCB was detected in 11 shallow wells and in two intermediate wells. MDE has not established a groundwater standard for 1,3-DCB.

2.5 HYDROGEOLOGY OF BLOCKS E AND F AND THE CONCEPTUAL SITE MODEL

The conceptual site model (CSM), developed through multiple investigations, including those described above, indicates that 1,2,4-TCB and 1,2,3-TCB are chlorinated benzene source compounds likely released at the former transformer locations, and that additional chlorinated benzene compounds have subsequently been created through anaerobic reductive biodegradation of the more-readily biodegradable 1,2,4-TCB. The 1,2,4-TCB is reduced to both 1,2-DCB and 1,4-DCB through reductive dechlorination, and both can then be reduced to CB. Therefore, the initial and end stages of the degradation pathway are delineated by defining the extent of 1,2,4-TCB and CB in the site groundwater. The biodegradation of chlorinated benzenes is discussed further in Section 2.5.3.

2.5.1 Environmental Sequence Stratigraphy and Significant Change to Previous Hydrogeologic CSM

The site is underlain by the Cretaceous-age Patapsco Formation, which typically consists of medium- to coarse-grained sands interbedded with red, gray, and mottled clays. The Patapsco Formation was deposited in a fluvial-deltaic environment, and resulted in a stratigraphically complex series of interbedded gravels, sands, silts, and clays (Andreasen et al., 2013; Reinhardt, 1977).

Environmental sequence stratigraphy (ESS) is the interpretation of sedimentary deposits within the context of their depositional environments and integrates the disciplines of stratigraphy and depositional sedimentary analysis with the concept of lateral and vertical facies-changes to reconstruct the paleoenvironments of a project area and its evolution between designated time periods.

ESS identifies primary or preferred migration pathways for groundwater and dissolved-phase constituents in groundwater. In unconsolidated sedimentary deposits representative of those underlying MRC, these preferred pathways are typically comprised of coarser-grained sediments such as gravels and sands that were deposited via fluvial processes in ancient rivers and streams (referred to as "paleochannels"), which were especially prevalent within higher-energy processes that existed during eustatic lowstands (during times of lower global or regional sea level). Through ESS reconstruction of the paleoenvironment, the lateral and vertical distribution (and the presence or the lack of continuity) of these migration pathways can be predicted and mapped, and results can be used to both define the extent of contamination and evaluate potential remedial options.

The current ESS analysis has identified two hydrogeologic units underlying Blocks E and F, consisting of an upper sand-prone higher-permeability interval (hydrogeologic unit 1) and a lower clay-prone interval (hydrogeologic unit 2) that consists of a dense low-permeability clay at its top underlain by thin and discontinuous intervals of clay, silts, and fine-grained sand. The ESS analysis indicates that the boundary between the upper and lower hydrogeologic units is a significant sequence boundary, or a time of chiefly geological erosion of sediments rather than their deposition.

Figure 2-7 illustrates the geometry of the sequence boundary, which is a structure contour map of Blocks E and F constructed on the erosional surface that represents the base of hydrogeologic unit 1 and the top of hydrogeologic unit 2. The sequence boundary is a two-dimensional plane that does not have a vertical thickness. The structural interpretation for Blocks E and F indicates that:

- The paleochannel created by the much higher-energy and ancestral (to Dark Head Cove) creek that existed during the glacial lowstand is a major sand-axis, and is the primary groundwater-migration pathway in the Block E area.
- Several tributary paleochannels trend west-to-east across Block E and merge into the Dark Head Cove paleochannel running north-to-south; currently existing limited data for the area east of the Dark Head Cove channel suggests that a tributary channel(s) also extends from the east and trends westward towards the primary channel (Figure 2-7).
- The sequence boundary does not consistently occur across a straight horizontal line. It strongly "dips" to as deep as approximately 25 feet below ground surface (bgs) to the east and is present at subsurface depths as shallow as 10 feet bgs to the west. This feature indicates that the erosional actions of the paleochannels were much stronger in the eastern portions of Blocks E and F. Consequently, the thickness of both the hydrogeologic units and the individual sedimentary beds within the hydrogeologic units vary with location.

Note that the geometry of the ESS-defined sequence boundary indicates that the current practice of designating onsite monitoring wells as being screened in "A," "B," or "C" intervals is correct only due to their relative subsurface depths. Within restricted geographic areas (western portion of blocks versus eastern portion of blocks), most wells with a given letter designation likely (but not universally) monitor the same stratigraphic sequence, but this assumption is certainly not valid across the entire widths of the blocks.

Hydrogeologic unit 1 contains the surficial aquifer, which can be subdivided into the upper surficial aquifer (which includes many of the "A" zone wells) and the lower surficial aquifer (which includes many of the "B" zone wells). The ESS cross-sections presented in this report indicate that the lower surficial aquifer occurs immediately above the sequence boundary and primarily consists of spatially widespread, coarse-grained and well-sorted sedimentary deposits (e.g., a basal gravel and/or a fine- to coarse-grained sand). The upper surficial aquifer consists of laterally and vertically

discontinuous beds of clay, silt, and fine-grained sand. Within the context of the ESS interpretation, the lower surficial aquifer represents lowstand deposits formed by high-energy fluvial processes and the upper surficial aquifer represents both rising sea-level (transgressive) sediment and highstand deposits. Multiple younger sequence boundaries of lower magnitude likely exist within the upper surficial aquifer, but the thin and discontinuous nature of the beds makes the identification of these additional boundaries impossible.

Hydrogeologic unit 2 (which includes many of the "C" zone wells) underlies the sequence boundary and is interpreted to consist entirely of highstand deposits formed in low-energy environments such as estuaries, overbank deposits, tidal channels, and minor streams. The clay, silt, and fine-grained sand deposited in these environments are poorly sorted. Groundwater flow is possible through silt and fine-grained sand, but the laterally discontinuous distribution of these deposits and the low transmissivities created by both the fine-grained nature and poor hydraulic sorting of sediment greatly contributes to a much lower groundwater flux.

The vertical distribution of silts and fine-grained sands in hydrogeologic unit 2 is similarly discontinuous. To test the possibility that deeper and more continuous sand units may exist and function as a deeper aquifer/migration path for the groundwater and the contaminant plume, a deep borehole for planned monitoring well SEMW-10D was advanced at a location about 75 feet east of MW-139B within the paleochannel and at the shoreline of Dark Head Cove. The dominant lithology within hydrogeologic unit 2 is a very tough and dry, hard clay. The boring was drilled to a subsurface depth of 80 feet, which included about 25 feet of hydrogeologic unit 1 and 55 feet of hydrogeologic unit 2. The lower unit consisted only of clay with no aquifer-qualifying silts or sands present, which is consistent with the ESS interpretation. As such, no significant or continuous migration pathway exists at depth below the sequence boundary.

2.5.2 Nature and Extent

Chlorinated benzenes (primarily 1,2,4-TCB, 1,2-DCB, 1,4-DCB, and CB) apparently associated with former transformer rooms have impacted the soil and groundwater within Block E and groundwater in Block F. The principal impacts to groundwater originate in Block E and are associated with former transformer rooms 2, 3, and 4 (see Figure 2-4). The former transformer room 1 was also considered as a potential source of chemical impacts; however, it was investigated,

and similar soil and groundwater contamination were not detected at transformer room 1. Dissolved-phase CB groundwater plumes originate at these transformer locations and extend downgradient into Block F. The groundwater plumes originate within hydrogeologic unit 1 and migrate vertically downward into hydrogeologic unit 2 as they also migrate laterally downgradient through Block E and ultimately into Block F within both hydrogeologic units. The general direction of groundwater flow within hydrogeologic unit 1 (Figure 2-10) and hydrogeologic unit 2 (Figure 2-11) is to the south-southeast, towards Dark Head Cove, and is consistent with the orientation of the fluvial paleochannels defined within Blocks E and F by ESS interpretation (Figure 2-7).

The extent of 1,2,4-TCB and CB in the upper and lower hydrogeologic units are illustrated on Figures 2-10 and 2-11, and 2-12 and 2-13, respectively, as described below.

2.5.2.1 Extent of 1,2,4-Trichlorobenzene Plume in Groundwater

The lateral extent of the 1,2,4-TCB plume in the upper (unit 1) and lower (unit 2) hydrogeologic units within Blocks E and F are illustrated on Figures 2-10 and 2-11, respectively. The vertical extent of the 1,2,4-TCB plume within the blocks is illustrated in a series of hydrogeologic cross-sections included as Figures 2-14 through 2-19.

Lateral Extent of 1,2,4-TCB Plume in Hydrogeologic Unit 1

The three 1,2,4-TCB plumes associated with former transformer rooms 2, 3, and 4 originate within hydrogeologic unit 1. The plumes associated with transformer rooms 2 and 3 follow a common groundwater migration pathway and coalesce into a common plume downgradient of transformer room 3 (Figure 2-8). For the purposes of this discussion, the combined plume from former transformer rooms 2 and 3 is referred to as the "eastern plume" and the plume from transformer room 4 is referred to as the "western plume."

Monitoring wells MW123A and MW124A are located approximately 100 feet downgradient of transformer room 2 and contain 1,2,4-TCB concentrations of 77.6 µg/L and 452 µg/L, respectively; these detections indicate that former transformer room 2 is the likely source of 1,2,4-TCB in these wells. Monitoring wells MW163A and MW127A, located adjacent to and about 50 feet downgradient of transformer room 3, contain respective 1,2,4-TCB concentrations of 3,200 µg/L and 1,800 µg/L; these detections indicate that their likely source is former

transformer room 3. The sinuous nature and extent of the eastern plume is consistent with the geometry defined by the paleochannels in hydrogeologic unit 1 (Figure 2-7, Figure 2-10, and Figures 2-5 and 2-16; cross-sections B-B′ and C-C′) and indicates that the eastern plume migrates within the transmissive sand of the paleochannels.

The eastern 1,2,4-TCB plume within hydrogeologic unit 1 extends downgradient of MW139B, which is screened immediately above the sequence boundary in the lowermost section of hydrogeologic unit 1; this well is approximately 30 feet upgradient of Dark Head Cove, and contains 1,2,4-TCB at a concentration of 290 µg/L. During the April 2017 surface water sampling event in Dark Head Cove, 1,2,4-trichlorobenzene was detected at a low (estimated) concentration of 0.35*J* µg/L in a surface water sample approximately 50 feet offshore from Outfalls 05A and 05B. Other than this isolated detection, no other known detections of chlorinated benzenes have been identified in Dark Head Cove surface water or storm sewer outfall samples (AECOM, 2019b).

The western plume originates at former transformer room 4, and is identified by a 1,2,4-TCB detection of 695 µg/L at monitoring well MW43A, which is installed directly in the highest contaminated soil associated with that former transformer room. This plume extends downgradient to MW134A, where 1,2,4-TCB is detected at a concentration of 11.4 µg/L. Well MW134A is about 75 feet upgradient of Dark Head Cove, and no other monitoring wells are located between it and the cove. However, no 1,2,4-TCB (or any other chlorobenzene species) was detected in recent (2019) cove surface water or storm sewer outfall samples (AECOM, 2019b).

Lateral Extent of 1,2,4-TCB Plume in Hydrogeologic Unit 2

The horizontal extent of 1,2,4-TCB in the lower hydrogeologic unit (i.e., hydrogeologic unit 2) is illustrated in Figure 2-11. The detection of 1,2,4-TCB in MW124B indicates that the eastern plume migrates downward into hydrogeologic unit 2 within about 100 feet downgradient of its origin at transformer room 2. However, unlike the areal extent of the 1,2,4-TCB plume in hydrogeologic unit 1, the lateral distribution of 1,2,4-TCB in hydrogeologic unit 2 is less extensive and instead a downward (or deeper) migration of the plume is evident, based on the low 1,2,4-TCB concentration (9 µg/L) detected in MW163B, coupled with greater concentrations at lower depths to the south..

The downgradient extent of the eastern plume in hydrogeologic unit 2 is less than the lateral extent of the plume in hydrogeologic unit 1, as 1,2,4-TCB was detected at a concentration of only 0.44 µg/L in monitoring well MW162B. This distribution, as indicated by the overall lower concentrations of 1,2,4-TCB in the lower unit, is due to the more discontinuous nature of the aquifer sand within hydrogeologic unit 2. However there are no wells screened within hydrogeologic unit 2 that are located in the most-downgradient segment of the plume extent in hydrogeologic unit 1 (and that could absolutely confirm that the plume within unit 2 does not extend this far to the south), perhaps because the increasing depth of the sequence boundary (between the upper and lower hydrogeologic units) in the easternmost portions of Blocks E and F was prohibitive to well installation at this depth (Figure 2-16).

The western plume does not extend into the lower hydrogeologic unit 2. As discussed below, a thick section of dense clay is between the upper and lower units in this area; this clay layer likely prevents the downward migration of both groundwater and/or the associated dissolved-phase plume.

Vertical Migration and Extent of 1,2,4-TCB Plume

The cross-sections of the eastern plume (see Figures 2-15 through 2-16) confirm that 1,2,4-TCB migrates downward into hydrogeologic unit 2 at a location downgradient of former transformer room 2 and upgradient of transformer room 3. Cross-section B-B′ (Figure 2-15) obliquely crosses the east-west trending sequence boundary paleochannel. Both figures indicate that the axis of the erosional channel is near monitoring wells MW123 and MW124, where the erosive and scouring action of the former stream flowing within the paleochannel has removed all but about 2 feet of the dense clay deposited at the top of the lower unit (hydrogeologic unit 2). The hydrogeologic units are assumed to have at least some limited hydraulic communication in this area, because the clay layer there is too thin to function as an effective aquitard and permits some downward migration of the groundwater plume. Cross-section C-C′ (Figure 2-16) extends to the downgradient extent of the 1,2,4-TCB plume as detected at MW139B (290 µg/L), where it occurs in the basal sand of hydrogeologic unit 1.

The basal sand within the upper hydrogeologic unit (hydrogeologic unit 1) in the southern (downgradient) segment of the eastern cross-sections occurs at a lower elevation than the bottom

of Dark Head Cove, which likely marks the location of the primary and deepest lowstand paleochannel (and thickest accumulation of sand) south of Block F. Therefore, migration of the groundwater plume into the aquifer beneath the cove could possibly occur. However, currently available data indicate that the 1,2,4-TCB plume does not migrate across the cove to its southern shore, because the sand layer was not observed in the well logs of off-site wells installed on the opposite shoreline in this area. In addition, 1,2,4-TCB and its biodegradation products have not been detected in the groundwater monitoring wells adjacent to the southern shoreline. Although the number of wells on the southern shore cannot definitively delineate groundwater flow directions in that region, the groundwater south of Dark Head Cove likely flows north to northwestward, or into the axis of the primary Dark Head Cove paleochannel.

The cross-section of the western plume that originates near former transformer room 4 (Figure 2-14, cross-section A-A′) confirms that 1,2,4-TCB in the western plume is limited to hydrogeologic unit 1. This cross-section shows that: the separation (sequence boundary) between the upper and lower hydrogeologic units occurs at a higher elevation in the western portion of the block (and above the base of Dark Head Cove) than to the east; laterally extensive and/or deep paleochannels are absent in this area; and the dense clay deposited at the top of the lower hydrogeologic unit 2 is at least 20 feet thick.

2.5.2.2 Extent of Chlorobenzene Plume in Groundwater

The lateral extent of the chlorobenzene plume in the upper (unit 1) and lower (unit 2) hydrogeologic units within Blocks E and F are illustrated on Figures 2-12 and 2-13, respectively. The vertical extent of the chlorobenzene plume within the blocks is illustrated in a series of hydrogeologic cross-sections included as Figures 2-17 through 2-19.

Lateral Extent of CB Plume in Hydrogeologic Unit 1

The upgradient extent of the CB plume associated with former transformer room 2 is delineated in the vicinity of monitoring wells MW123A and MW124A, which contain CB concentrations of 83.6 µg/L and 338 µg/L, respectively (Figure 2-12). These CB concentrations, detected near a 1,2,4-TCB source area, appear to indicate that the biodegradation of the parent compound is occurring at a different rate in this area of Block E.

Monitoring wells MW163A and MW127A are located adjacent to and about 50 feet downgradient of transformer room 3 and contain CB concentrations of 11 µg/L and 27.2 µg/L, respectively. These CB concentrations, lower than in MW-124A just downgradient of transformer room 2, suggest that the biodegradation of 1,2,4-TCB associated with former transformer room 3 may not occur at the same rate as for transformer room 2. Alternatively, these lower concentrations might be due to either the lateral proximity of the wells (meaning that complete degradation has not yet occurred), due to the geochemical quality of the groundwater, or due to the absence of the bacterial species that biodegrades the parent compounds.

The CB concentrations detected in three hydrogeologic unit 1 wells downgradient of transformer room 3 are low: 17.3 µg/L (MW36A), 1.4 µg/L (MW135B), and 68 µg/L (MW139B). The sinuous nature and location of the plume is consistent with the paleochannel geometry within hydrogeologic unit 1 and the sequence boundary and indicates that the plume is migrating within the transmissive sand of the paleochannel. Well MW139B is about 30 feet upgradient of Dark Head Cove. Chlorobenzene has not been detected in Dark Head Cove surface water or in samples collected from storm sewer outfalls at concentrations exceeding the risk-based surface water criteria (AECOM, 2019b), suggesting there is no significant contribution of CB from groundwater to surface water.

The plume originating at former transformer room 4 (Figures 2-12 and 2-17) is identified by nearby CB detections of 79.7 µg/L (MW-113A) and 53.5 µg/L (MW-114A). A low CB concentration (4.5 µg/L) was also detected at MW-43A, adjacent to the former transformer room 4 and at the location of the highest detected 1,2,4-TCB concentration in the western plume area. This lateral distribution illustrates the progression of biodegradation over time (as defined by distance from the source) and is supported by the location of the highest chlorobenzene concentration within the transformer room 4 plume (110 µg/L) that occurs at its distal location at MW-134A, about 75 feet upgradient of Dark Head Cove and the closest monitoring point to the shoreline.

Lateral Extent of CB Plume in Hydrogeologic Unit 2

The horizontal extent of CB in hydrogeologic unit 2 is illustrated in Figure 2-13. Similar to 1,2,4-TCB, the lower chlorobenzene detection in intermediate well MW124B (124 µg/L, as compared to 338 µg/L in shallow well MW124A [Figure 2-18]) indicates that the eastern plume

migrates vertically downward into hydrogeologic unit 2 within about 100 feet downgradient of its origin near former transformer room 2.

The lateral extent of the eastern CB plume in hydrogeologic unit 2 is less than that for hydrogeologic unit 1. This pattern is similar to that observed for 1,2,4-TCB, and is likely due to the overall lower CB concentrations and the more discontinuous nature of the aquifer sand within hydrogeologic unit 2.

As with 1,2,4-TCB, the extent of the western plume within hydrogeologic unit 2 is limited (Figure 2-17). The thick section of dense clay underlying the sequence boundary in the western plume area likely retards or prevents the downward migration of groundwater and its associated dissolved-phase plume.

Vertical Migration and Extent of CB Plume

The cross-sections of the eastern plume (Figures 2-18 and 2-19 cross-sections B-B′ and C-C′) confirm that the CB plume migrates downward into hydrogeologic unit 2 near wells MW123 and MW124, downgradient of former transformer room 2). At this location, surface water flow from the former stream within the paleochannel has eroded, scoured, and removed all but about 2 feet of the dense clay deposited at the top of hydrogeologic unit 2, leaving a clay thickness unable to function as an effective aquitard, and permitting the downward migration of the groundwater plume. The CB detection (124 µg/L) at MW124B was collected within sand at the bottom of the borehole and creates some uncertainty regarding the thickness of this sand interval and the delineation of the total vertical extent of the plume. However, the CSM (as depicted by cross-sections) suggests that vertically extensive sands do not occur within the upper section of hydrogeologic unit 2.

CB is detected in the basal sand of hydrogeologic unit 1 at MW139B, located at the farthest downgradient monitoring well in cross-section C-C′. As with 1,2,4-TCB, migration of the CB groundwater plume beneath Dark Head Cove is possible because the sequence boundary is below the bottom of the cove. However, as stated earlier and referenced in prior communication to the MDE (Lockheed Martin, 2019b, respective well-log data and contaminant-concentration data from off-site wells installed across the cove and downgradient from Blocks E and F (Tetra Tech, 2007) reveal both a lack of sand in soil lithology (and an associated transport pathway) and the absence

of CB in groundwater. Although there was one isolated detection of 1,4-DCB in an off-site monitoring well in April 2019 (MRC-OF01), this chlorinated benzene was not reported as a positive detection because the result was designated with a "B" data qualifier, or not detected substantially above the level reported in the laboratory or field blanks. This suggests the detected concentration may be attributed to laboratory or blank contamination, and therefore cannot be used as a valid or reliable result, so it was not included in the reported results (AECOM, 2019b). In addition, offsite well MRC-OF01 is located furthest inland directly across Cow Pen Creek from Block G; not directly in the flow path of groundwater originating at Blocks E and F (Lockheed Martin, 2019b).

The cross-section of the western plume (Figure 2-19, cross-section C-C′) also confirms the observation that the chlorobenzene is chiefly present within hydrogeologic unit 1. The higher elevation of the sequence boundary in the western portion of the blocks, the lack of deep paleochannels in this area, and the presence of the dense clay at the top of hydrogeologic unit 2 limit the lateral distribution of chlorobenzene and prevent its vertical migration downward into hydrogeologic unit 2.

The highest concentration of CB (110 µg/L) in the plume associated with transformer room 4 occurs at its distal location (i.e., MW134A), about 75 feet upgradient of Dark Head Cove. The occurrence of the sequence boundary at an elevation above the bottom of the cove at that location indicates groundwater discharge of CB to cove surface water is possible based on potential groundwater flow patterns. As discussed earlier, however, no chlorobenzene was detected in cove surface water or in stormwater sewer outfalls in 2019 (AECOM, 2019b), indicating that this groundwater plume was not discharging to surface water at detectable concentrations.

2.5.3 Fate and Transport

The CSM indicates that 1,2,4-TCB is the source material released at the former transformer room locations, and that additional chlorinated benzenes have subsequently been created through the degradation of the 1,2,4-TCB.

1,2,4-TCB can be biologically degraded under either aerobic or anerobic conditions. Figure 2-20 depicts the biological degradation pathways for 1,2,4-TCB. Under aerobic conditions, 1,2,4-TCB,

dichlorobenzenes, and chlorobenzene are used as a primary carbon source during biodegradation by specific microorganisms. During biodegradation, these compounds are completely dechlorinated and mineralized to carbon dioxide and chloride. Chlorinated benzenes also undergo reductive dechlorination, similar to chlorinated ethenes. In the presence of specific microorganisms and an electron donor under anaerobic conditions, 1,2,4-TCB is converted in succession to 1,4-dichlorobenzene, then to chlorobenzene, and finally to benzene. Chlorobenzene is also readily degraded directly to carbon dioxide under aerobic conditions. Benzene is readily degraded to carbon dioxide and water by other microorganisms under either aerobic or anaerobic processes.

Although this suite of compounds can be degraded via both aerobic and anaerobic processes, the principal degradation products detected at the site suggest that the anaerobic pathway predominates. 1,2,4-TCB is reduced to both 1,2-DCB and 1,4-DCB, both of which are further reduced to CB followed by further degradation to chloride, carbon dioxide, and water. Therefore, the extent of the groundwater contamination caused by the 1,2,4-TCB is defined by the 1,2,4-TCB and CB.

Conceptually, the highest concentrations of 1,2,4-TCB should occur closest to the source areas (the former transformer room locations), and then decrease with increasing distance from the site as microbial processes reduce the compound via dechlorination. Conversely, the degradation products should increase with increasing distance from the source areas as they are created through the breakdown of the 1,2,4-TCB.

In the recent groundwater characterization report (Tetra Tech, 2020b), several preliminary observations can be made by well location (see Figure 2-4), including the following:

- Monitoring well MW43A is located adjacent to former transformer room 4 within the most heavily contaminated soil in this area. The sampling history of this well begins in 2005, and 1,2,4-TCB concentrations have declined since 2010, but are still higher than downgradient concentrations. The low to non-detection of breakdown compounds suggests that degradation may be occurring farther downgradient, or that the concentration of the source material in soil is declining.

- The increasing trend in the degradation products at MW113A (located about 50 feet downgradient of MW43A) supports the interpretation that biodegradation is actively occurring at downgradient locations within the plume.
- MW134A (located near the distal end of the plume, and about 350 feet downgradient of former transformer room 4) contains relatively high concentrations of CB and very low to non-detectable concentrations of the more highly chlorinated compounds, suggesting that the biodegradation process from 1,2,4-TCB to CB is complete at the distal end of the plume.

- The high concentration of 1,2,4-TCB at MW163 (located adjacent to former transformer room 3) and at downgradient wells MW127A and MW128A (located within 100 feet downgradient of the transformer), together with the lack or low level of biodegradation products in each well, suggest that the degradation process may not be occurring near the source area. Elevated 1,4-DCB concentrations in MW130B (screened in hydrogeologic unit 2, about 180 feet downgradient of the transformer), suggest that biodegradation may be occurring at that location, but as discussed earlier, these detections might also be associated with the plume originating at former transformer room 2.

There is a difference between geochemical groundwater conditions required for anaerobic reduction and the recorded or measured conditions historically detected in site groundwater. For anerobic biodegradation to occur, groundwater must have a near-neutral pH, should contain very little to no dissolved oxygen (DO), and ideally should have a strongly negative oxidation-reduction potential (ORP). Recent groundwater quality measured during the 2019 groundwater sampling event indicate that although DO concentrations are low, positive ORP values are present in site groundwater (AECOM, 2019a). Although the degradation sequence and resulting products strongly suggest anaerobic processes are occurring or have occurred historically, aerobic processes may also be acting on, or have acted on, the groundwater plumes.

SECTION 3
REMEDIAL ALTERNATIVES EVALUATION

This section describes the chlorinated benzene plume chemicals of concern (COC) and related response action objectives (RAOs). Potential remedial technologies are screened, long and short lists of alternatives are developed, short-listed alternatives are evaluated, and a recommended response action is selected.

3.1 CHEMICALS OF CONCERN

The COC addressed by this RAP are chlorobenzene (CB) and related chlorinated benzenes (1,2,4-trichlorobenzene [1,2,4-TCB], 1,2-dichlorobenzene [1,2-DCB], and 1,4-dichlorobenzene [1,4-DCB]) associated with former Block E transformer rooms 2, 3, and 4, which have impacted groundwater within Blocks E and F. Dissolved-phase groundwater plumes originating at these transformer locations have extended downgradient into Block F. The groundwater plumes originate within the hydrogeologic unit 1 and migrate within both hydrogeologic unit 1 and hydrogeologic unit 2. The extent of the 1,2,4-TCB plume detected in hydrogeologic unit 1 and hydrogeologic unit 2 are shown on Figures 2-8 and 2-9, respectively. Figures 2-10 and 2-11 show the respective extent of CB in the hydrogeologic unit 1 and hydrogeologic unit 2. However, as noted in Section 2.3, no chlorinated benzenes were detected in Dark Head Cove surface water samples at concentrations greater than the lowest (swimming) screening level.

3.2 RESPONSE ACTION OBJECTIVES

RAOs are contaminant- and medium specific-goals that define the objectives of response actions that will protect human health and the environment. The following RAOs were established in the *Groundwater Response Action Plan Addendum No. 2* (Tetra Tech, 2015) to address chlorinated hydrocarbons in groundwater at Blocks E and F and are applicable to the chlorinated benzenes in the RAP:

Remedial action objective	Description
1	Prevent human exposure (from dermal contact, inhalation, and ingestion) to groundwater containing site-related chemicals of concern at concentrations greater than drinking water standards (Maryland Department of the Environment [MDE] "Generic Numerical Standards for Groundwater").
2	Prevent discharge of groundwater with chemicals of concern that would cause an exceedance of the MDE ambient water quality criteria or risk-based swimming criteria in Dark Head Cove.
3	Prevent off-site migration to adjacent properties of site-related chemicals of concern in groundwater at concentrations greater than drinking water standards.
4	Prevent exposure of industrial workers (via vapor intrusion into buildings) to site-related volatile organic compounds (VOCs) due to groundwater vapors at levels that would pose a carcinogenic risk greater than 1×10^{-5} or a cumulative hazard index greater than 1 for noncarcinogenic VOCs.

RAOs 1, 2, and 3 are unchanged from those presented in the *Groundwater Response Action Plan Addendum 2: Response Action Objectives and Project Implementation Schedule* (Tetra Tech, 2015) except that they apply to the release of chlorinated benzenes rather than the trichloroethene addressed in the 2012 response action plan (RAP) (Tetra Tech, 2012). RAO 4 was revised from *Groundwater Response Action Plan Addendum 2* by deleting the construction trench exposure pathway which would be addressed by health and safety measures required by any excavation work. There is no RAO for source removal because that will have been addressed by the soil remedy in the areas of the chlorinated benzene sources (i.e., the former transformer rooms). While the soil removal proposed is a risk-based cleanup and is expected to result in some soil impacts being left in place around the former transformer rooms, the bulk of the contaminant mass will be removed to minimum depths of 16, 18, and 20 feet respectively in transformer rooms 2, 3, and 4.

The risk-based and ambient water quality criteria referenced in RAOs 2 and 3 are summarized below:

Parameter	Maryland Department of the Environment water quality criteria[1] (µg/L)		Swimming screening levels[2] (µg/L)	Maximum contaminant level[3] (µg/L)
	Water + organism	Organism only		
1,2,4-TCB	35	70	8	70
1,2-DCB	420	1,300	Not calculated	600
1,4-DCB	63	190	Not calculated	75
CB	130	1,600	30	100

1 – Per Code of Maryland Regulations 26.08.02.03-2

2 – Per Revised Site-Specific Surface Water Swimming Screening Levels for Contaminants in Dark Head Cove and Cow Pen Creek (Lockheed Martin, 2019a)

3 – Per 40 Code of Federal Regulations 141.61

There are no established MDE water quality criteria for aquatic life for any of the groundwater COC addressed herein. Per RAO 2, surface water results will be compared to the lower of MDE water quality criteria and swimming screening levels.

3.3 SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

An appropriate range of technologies and process options applicable for groundwater remediation of 1,2,4-TCB and other chlorinated benzenes at Blocks E and F are identified, evaluated, and screened in this section. The various technologies and process options identified and screened were based on the following criteria:

- site-specific information (RAOs, geology, hydrogeology, pumping tests in Block F, contaminant distribution, and specific risks)
- information and analysis from the *Groundwater Response Action Plan* (Tetra Tech, 2012)
- governmental authority guidance documents (e.g., *Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA* [the Comprehensive Environmental Response, Compensation, and Liability Act] [United States Environmental Protection Agency (USEPA)], 1988)

Table 3-1 summarizes the preliminary screening of technologies and process options applicable to the TCB groundwater plumes. Note that treatment of the (soil) sources of TCB and other chlorinated benzenes will be addressed by the excavations of the Block E soil remedy during 2021. Table 3-1 presents the general response actions, identifies technologies and process options, briefly describes process options, and provides screening comments. Since the RAOs are currently being met, the most important screening criterion is an ability to continue to meet the stated RAOs. There have been two detections of 1,2,4-TCB in surface water in April 2017, and the concentrations were less than the criteria in RAO 2. No 1,2,4-TCB was detected in surface water samples collected in June and September 2017 (Tetra Tech, 2018a). RAO 1 will be met by an LUC for Block F and a proposed LUC for Block E that prohibits the use of groundwater. RAO 4 is being met by current site use and activities and would be addressed by LUCs. Since no chlorinated benzenes have been detected in off-site monitoring wells at concentrations greater than MCLs, RAO 3 is being met. The relative effectiveness for different technologies and process options to maintain RAOs is also an important consideration. Associated risk factors for possible negative unintended consequences are also considered while screening remedial technologies and process options. Technologies and process options that were retained after the screening are listed in Table 3-2.

3.4 DEVELOPMENT AND ANALYSES OF ALTERNATIVES

This section includes the response action alternatives and process options retained after initial screening (Table 3-2) and describes the conceptual designs for the selected "short list" of alternatives. Key definitions, assumptions, and design considerations used to develop remedial alternatives are below.

- Reducing migration of TCB and its degradation byproducts to Dark Head Cove is the primary consideration for selecting a remedial alternative.
- Sources of 1,2,4-TCB will be removed by the subsurface soil excavations of the soil remedy; therefore, treatment alternatives will only address the downgradient portions of the plumes within Block F.
- The "eastern plume" refers to the chlorinated benzene plume originating from the vicinity of former transformer rooms 2 and 3.
- The "western plume" refers to the chlorinated benzene plume originating from the vicinity of former transformer room 4.

- 1,2,4-TCB and other chlorinated benzenes are adsorbed to silt and clay material in the saturated zone. This mass will likely act as a long-term source of dissolved contaminants in groundwater due to matrix diffusion. However, the mass flux associated with matrix diffusion is expected to be considerably lower than the current mass flux associated with the dissolved-phase plumes.

- Groundwater extraction rates for containment are based upon groundwater modeling results (see Section 3.4.2.2) and the results obtained from hydraulic testing in Block F for the trichloroethene (TCE) plume (Tetra Tech, 2018b).

- The treatment system for the TCE plume, also known as the groundwater extraction and treatment system (GWETS), has excess capacity to treat groundwater extracted from the chlorinated benzene plumes.

- The preferred method of treated groundwater disposal is conveyance to the sanitary sewer (publicly owned treatment works [POTW]), as has been done for the treatment of the TCE plume.

- Under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process, a "No Action" alternative is included as a baseline for comparing other alternatives. In this RAP, a "No Action alternative" is not included because the RAO would not be met.

3.4.1 Assembly of Remedial Alternatives

Based on the assumptions and design considerations listed above, four remedial alternatives from the retained list in Table 3-2 were assembled and evaluated, comprising the "long list" of alternatives (Table 3-3). These alternatives are as follows:

- ***Alternative 1****:* monitored natural attenuation (MNA) and land use controls (LUCs)

- ***Alternative 2:*** hydraulic containment; MNA/LUCs

- ***Alternative 3:*** anaerobic permeable reactive barriers (PRBs) using injections of electron donor such as emulsified vegetable oil; MNA/LUCs

- ***Alternative 4:*** aerobic PRBs (biosparging); MNA/LUCs

These potential remedial alternatives were first screened against the CERCLA criteria of effectiveness, implementability, and cost. Remedial alternatives would be eliminated, (a) if determined that the technologies used in the remedy would be ineffective (i.e., would not mitigate risk), (b) if the risk of unintended consequences posed by the alternative was excessive, (c) if the alternative could not be implemented using a reasonable level of effort, or (d) if the alternative was significantly more expensive than other technologies, with an equal risk-mitigation benefit. This

initial screening included consideration of RAOs, area geology and hydrogeology, contaminant type, distribution, and concentrations, the proximity of the site to surface water, and physical characteristics of the affected environmental media.

Table 3-3 includes a brief description of the "long list" of alternatives, and a summary of their advantages and disadvantages based on relative effectiveness, implementability, and cost. Retained alternatives are in bold font in the table. A summary of the criteria follows:

- ***Effectiveness***
  - the degree to which it protects human health and environment, reduces toxicity, mobility, or volume, and the permanence achieved by the solution
  - potential for the technology to address the estimated areas or volumes of contaminated media
  - potential for the technology to meet the cleanup goals identified in the RAOs
  - technical reliability with respect to contaminants and site conditions
- ***Implementability***
  - overall technical feasibility for implementation at Blocks E and F
  - availability of vendors, mobile units, storage and disposal services, etc.
  - administrative feasibility
  - special long-term maintenance and operation requirements
- ***Cost (qualitative)***
  - capital cost
  - operation and maintenance costs

Retained alternatives (Alternatives 1, 2, and 4) comprise the "short list" of alternatives ultimately established (Section 3.4.2). Based on advantages and disadvantages for each alternative (summarized in Table 3-3), the following alternative was eliminated:

- ***Alternative 3—anaerobic permeable reactive barriers (PRBs), MNA/LUCs:*** This alternative would include PRBs that promote anaerobic conditions and reductive dechlorination. The effectiveness of complete dechlorination is currently uncertain and could result in generation of DCBs and CB, thereby replacing one COC with another. Although these compounds are much less toxic than 1,2,4-TCB, nonetheless they could

also reach Dark Head Cove at unacceptable concentrations. Therefore, Alternative 3 was removed from further consideration.

Alternatives 1, 2, and 4 above were carried forward for further evaluation:

- ***Alternative 1****:* MNA and LUCs
- ***Alternative 2:*** hydraulic containment; MNA/LUCs
- ***Alternative 4:*** aerobic PRBs (biosparging); MNA/LUCs

3.4.2 Description and Analysis of the Retained Alternatives

The retained, short-listed response action alternatives are described below and summarized in Table 3-4. Each retained alternative described in this section includes the following components:

- remedy performance monitoring (specific to each remedial technology)
- for alternatives with active remediation, MNA in portions of the plume that are not directly affected by active treatment, such as edges of the plume and the downgradient-most portion of the plume.
- LUCs necessary to maintain the RAOs for Blocks E and F groundwater

Conceptual designs were developed for the three alternatives. Each was evaluated against the nine CERCLA criteria from 40 CFR Part 300.430, as well as a tenth LMC criterion: lifecycle impacts. The nine CERCLA and lifecycle evaluation criteria are described below:

- overall protection of human health and the environment
- compliance with applicable or relevant and appropriate requirements (ARARs)
- long-term effectiveness and permanence
- reduction of toxicity, mobility, or volume through treatment
- short-term effectiveness
- implementability
- lifecycle impacts
- cost
- state acceptance
- community acceptance

***Overall protection of human health and the environment*—**Alternatives must be assessed for the degree to which they adequately protect human health and the environment (in both the short- and long-term) from regulatory-based unacceptable risks posed by COC in Middle River Complex

(MRC) groundwater and adjacent surface water by eliminating, reducing, or controlling exposure to those COC. Evaluation of this criterion includes assessing the other evaluation criteria, especially long-term effectiveness and permanence, short-term effectiveness, and compliance with ARARs.

Compliance with ARARs—Alternatives must be assessed to determine whether they would attain ARARs under federal and state environmental laws. ARARs were developed and presented in the initial groundwater response action plan (RAP) (Tetra Tech, 2012) and have been revised herein (see Tables 3-5 to 3-7) to bring a few citations up to date and to eliminate ARARs that are not pertinent to the activities in this RAP. If one or more applicable regulations cannot be complied with, a waiver would have to be secured. Grounds for waivers are as follows:

- the alternative would attain a standard of performance equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method or approach
- a state requirement has not been consistently applied or the state has not demonstrated the intention to consistently apply the promulgated requirement in similar circumstances at other response actions in the state
- the ability of each alternative to meet the RAOs is also considered in this criterion

Long-term effectiveness and permanence—Alternatives must be assessed for the long-term effectiveness and the permanence they offer, along with the degree of certainty that the alternative will succeed. Other considerations include, as appropriate, the magnitude of residual risk (e.g., risks posed by untreated waste or treatment residuals) and the adequacy and reliability of controls (e.g., controls needed to manage untreated waste or treatment residuals).

Reduction of toxicity, mobility, or volume through treatment—The degree to which an alternative employs recycling or treatment that would reduce the toxicity, mobility, or volume of the waste must be assessed, including how the treatment and associated reduction would address principal site risks.

Short-term effectiveness—The short-term effects of the alternative must be assessed in consideration of the following concerns:

- short-term risks that the community may be exposed to during implementation

- potential effects to workers during the response action and the effectiveness and reliability of protective measures
- potential environmental effects of the response action and the effectiveness and reliability of mitigation measures during implementation
- time until RAOs are achieved

***Implementability*—**The ease or difficulty of implementing the alternatives must be assessed by considering technical feasibility, administrative feasibility, and availability of services and materials.

***Lifecycle impacts*—**Lifecycle impacts, including energy, water, and emissions, are evaluated qualitatively, based on the duration and intensity of field construction, duration of operation and maintenance, and waste transportation and disposal quantities. *SiteWise* is used to analyze the life cycle environmental effects of the three remedial alternatives. *SiteWise* is a spreadsheet-based tool developed by the U.S. Navy, U.S. Army Corps of Engineers, and Battelle Memorial Institute. It provides a model for assessing the environmental footprint of remedial alternatives in terms of a consistent set of metrics, including greenhouse gas emissions, particulate emissions, water use, and energy usage. The *SiteWise Analysis* information is in Appendix B.

***Cost*—**For each alternative, capital and operating cost estimates were developed to calculate a net present worth (NPW) value. Cost estimates are in Appendix C. Several assumptions used for the cost estimate are listed below:

- No additional source area response actions are required.
- The duration of Alternative 1 is based on the groundwater model (see Appendix D). The time for complete natural attenuation of the COC is estimated at more than 100 years. Per USEPA guidance for feasibility studies (USEPA, 1988), a period of 30 years was used for the NPW cost analysis.
- The duration of the active remediation associated with Alternatives 2 and 4 was based on groundwater modeling and is estimated to be more than 100 years. These durations are long because of the time it takes for the contaminants, particularly TCB, to travel from the

source area to the extraction/treatment zones. A period of 30 years was used for the NPW cost analyses per EPA guidance (USEPA, 1988).

- The GWETS installed per groundwater RAP Addendum 4 will be used in Alternative 2. Pumping rates are based on modeling with consideration of pump tests performed in the TCE plume (Tetra Tech, 2018b).

- A two-year MNA duration following active remediation is assumed for all alternatives, except for Alternative 1. Semi-annual sampling is assumed for those three years. After two years have lapsed, a Response Action Completion Report would be submitted, and any groundwater monitoring would be completed under the site-wide groundwater monitoring program.

State acceptance—Maryland Department of the Environment (MDE) will review the proposed groundwater RAP addendum and inform Lockheed Martin in writing, on or before the end of a 75-day review period, whether the addendum has been approved or rejected. This criterion is not included in this evaluation because the MDE review has not yet occurred.

Community acceptance—Lockheed Martin is committed to its partnership with the community regarding MRC environmental activities, and currently plans to present the contents of this groundwater RAP addendum to the public. Lockheed Martin will also provide remediation program updates and attend civic association meetings upon request. Input from the community will be an important consideration in selecting and implementing the MRC response action. However, because community review of the groundwater RAP addendum has not yet occurred, this criterion is not included in this evaluation.

Relative importance of criteria—Among the 10 evaluation criteria outlined above, the following are considered *threshold criteria*:

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

Threshold criteria must be satisfied for an alternative to be eligible for selection. Among the remaining criteria, the following six are considered the primary *balancing criteria*. *Balancing criteria* weigh the relative merits of alternatives regarding the following:

- long-term effectiveness and permanence
- reduction of toxicity, mobility, or volume
- short-term effectiveness
- implementability
- lifecycle impacts
- cost

The remaining two of 10 criteria (state and community acceptance) are *modifying criteria* that must be considered in selecting a response action. These last two modifying criteria can only be evaluated after MDE and the community have reviewed the proposed RAP addendum. Therefore, this groundwater RAP addendum addresses only eight of 10 evaluation criteria. The remaining two will be addressed through the groundwater RAP addendum review, comment, and approval process.

3.4.2.1 Alternative 1: MNA/LUCs

Note that treatment of the (soil) sources of the chlorinated benzenes will be addressed by the excavations of the Block E soil remedy during 2021. Therefore, this alternative would consist of MNA and LUCs and would include semiannual sampling of the monitoring wells associated with the chlorinated benzene plumes and surface water for four years with annual events thereafter subject to ongoing remedy optimization. The sampling data would be used to monitor the progress of the natural attenuation and the continued compliance with RAO 2. Groundwater and surface water samples would be analyzed for chlorinated benzenes. Groundwater samples would be analyzed for natural attenuation parameters such as dissolved oxygen (DO), pH, oxidation-reduction potential (ORP), total and dissolved iron, total and dissolved manganese, ferrous iron, alkalinity, nitrate/nitrite, sulfate, sulfide, and methane.

If data indicate chlorinated benzene concentrations in groundwater are increasing, or if the surface water COC concentrations exceed one-half of the site-specific risk-based swimming screening levels per RAO 2, an active contingency remedy, such as Alternative 2 or 4, might be required. The frequency of sampling, analytes, and specific wells that are sampled may change based on the

evaluation of the results and trends. For example, if some of the natural attenuation parameters are not detected, they would be dropped from later analyses. A baseline event would include analysis of samples from selected wells using molecular biological tools, such as quantitative polymerase chain reaction (qPCR), to evaluate the presence of bacterial populations and functional genes indicative of biological degradation.

Natural attenuation processes such as biodegradation and sorption, affect the fate and transport of contaminants in all hydrologic systems. Historical results presented in the *Groundwater Chlorobenzene Characterization Report* (Tetra Tech, 2020b) which show chlorobenzene concentrations at levels similar to 1,2,4-TCB concentrations generally confirm that the biodegradation processes have occurred and may still be occurring, but the limited volume of historical data decreases the statistical confidence of these interpreted trends. The anaerobic dechlorination degradation pathway of 1,2,4-TCB is similar to that of TCE, and progresses from TCB, to dichlorobenzenes, then to chlorobenzene, and to benzene, and finally to carbon dioxide and water. Like TCE, an electron donor (such as natural organic carbon) or manmade substances (such as spilled fuels) is needed for the anaerobic dechlorination process. Finally, microorganisms that can degrade chlorinated benzenes must also be present. Groundwater geochemical conditions measured in the site monitoring wells do not appear conducive or supportive of either aerobic or anaerobic reductive biodegradation process. For example, although dissolved oxygen was generally *not* detected in groundwater samples (typical of anaerobic conditions) collected in 2019, values for oxidation-reduction potential (ORP) were positive to highly positive (typical of aerobic conditions). In other words, although the absence of DO indicates conditions favorable to anaerobic biological degradation are present in groundwater, ORP values indicate aerobic conditions are present; the reason for this apparent discrepancy is not understood. The absence of reducing conditions limits reductive dechlorination. However, other anaerobic biological processes that consume chlorinated benzenes may be occurring.

As noted in Section 2.1, *Dehalococcoides* (DHC) genes in analyzed samples from the Block F monitoring wells were either not detected, or were present only at low concentrations (i.e., at concentrations not likely to be effective at reducing chlorinated benzenes). However, the DHC analyses were not performed on samples collected in the higher concentration portions of the plume.

The aerobic degradation pathway is expected to be available if 1,2,4-TCB and chlorobenzene reach surface water. The surface water has dissolved oxygen, and biological degradation of the COC to chloride, carbon dioxide, and water would be expected to happen quickly.

As noted, natural attenuation also includes physical processes, such as sorption. However, some of the contaminant mass desorbs back into the groundwater, but at a slower rate than it was sorbed. Sorption retains COC mass and slows the migration of contaminants through the saturated zone. As demonstrated by the groundwater model, the sorption component of natural attenuation plays a significant role in reducing the mass flux to the cove.

Elevated concentrations of 1,2,4-TCB and CB have been detected in monitoring wells near the shore of Dark Head Cove. However, these compounds were not detected in recent sampling results of cove surface water at concentrations greater than RAO 2 criteria. Therefore, the elevated groundwater COC concentrations near the shore does not appear to impact the surface water at COC concentrations greater than the RAO 2 criteria.

Groundwater modeling (Appendix D) indicates that the duration for complete natural attenuation of COC in contaminant plumes is over 100 years. The estimated mass discharge of 1,2,4-TCB over 100 years is approximately 6.2 pounds.

Alternative 1 summary—This alternative is being considered because no RAO 2 surface water screening criteria have been exceeded since surface water sampling began in 2005. LUCs have already been implemented for Block F, and LUCs will be implemented in the future in Block E after completion of the soil remedy, which will address the source of the chlorinated benzene plumes.

The main advantage of Alternative 1 is that no chlorinated benzenes have been detected in surface water samples at concentrations greater than RAO 2 criteria. Reducing the TCB mass in Block E should eventually decrease the mass flux to the downgradient area, thus reducing migration of chlorinated benzenes toward Dark Head Cove. The time it takes to demonstrate this alternative meets RAOs may be long. Alternative 1 does not contain the chlorinated benzene plumes and may not reduce the migration of chlorinated benzenes into Dark Head Cove.

3.4.2.2 Alternative 2: Hydraulic Containment, MNA/LUCs

Alternative 2 has three major components: (a) groundwater extraction, (b) *ex situ* treatment and discharge of treated groundwater and vapors, and (c) MNA and LUCs. These components are described below. Note that treatment of the (soil) sources of the chlorinated benzenes will be addressed by the excavations pursuant to the Block E soil remedy in 2021.

Component 1: groundwater collection—The groundwater collection component of this option would include groundwater recovery wells installed in Block F to hydraulically contain the plumes in hydrogeologic unit 1 (see Figures 2-12 through 2-17 for geologic cross-sections). Five wells with a combined extraction rate of 4 gallons per minute (gpm) would capture the eastern plume, and two wells with a combined extraction rate of 1 gpm would capture the western plume. Figure 3-1 shows the groundwater extraction well locations. The number and spacing of the extraction wells are based on the results of groundwater modeling and consideration of pump tests performed on the TCE plume. Groundwater modeling (Appendix D) indicates a nearly constant mass flux of 1,2,4-TCB of approximately 0.0018 pounds per year even after 100 years, so the extraction and treatment component of this alternative may need to be operated for an extended period of time, or until sampling shows that there would be no impacts to Dark Head Cove.

Component 2: ex situ treatment and discharge of treated groundwater and vapors— Groundwater from the seven recovery wells would be conveyed via underground piping to the GWETS (Tetra Tech, 2019b) at Block E (see Figure 3-1. Extracted groundwater would be pumped through a 2-inch-diameter spare pipeline to the GWETS building. A spare 2-inch pipeline beneath Chesapeake Park Plaza was installed with the GWETS, so a road cut is not needed. Treatment system components are housed in a pre-engineered steel building at the location shown on Figure 3-1. The GWETS consists of the following major components:

- shallow-tray air stripper to remove volatile organic compounds (VOCs) from groundwater
- filtration to remove suspended solids after air stripping
- liquid-phase granular activated carbon (LGAC) vessels providing a final VOC polishing step before discharge to the POTW
- vapor-phase granular activated carbon (VGAC) vessels to treat air stripper exhaust

Treated groundwater would be discharged to the sanitary sewer under a permit with Baltimore County. Discharged treated groundwater would be metered and routinely sampled to comply with the permit. Treated vapor would be discharged into the atmosphere and included in the general MRC facility air discharge permit. Treated vapors would be routinely sampled (monthly sampling is assumed) to comply with the MRC facility air discharge permit.

The GWETS was designed with extra capacity. The system was designed to treat 12 gpm. The extraction rate of the GWETS is about 5 gpm; the remaining balance of 7 gpm is sufficient to treat the volume of 5 gpm estimated for the extracted groundwater associated with the chlorinated benzene plumes.

***Component 3: MNA and LUCs*—**Low non-captured concentrations of chlorinated benzenes on the edges of the plume will be allowed to naturally attenuate. Groundwater and surface water sampling would monitor the effectiveness of the extraction, and as in Alternative 1, annual sampling would need to be conducted for an extended period of time to demonstrate effectiveness. LUCs would be implemented as described in Alternative 1.

***Alternative 2 summary*—**Alternative 2 would effectively treat groundwater and maintain the RAP RAOs with a high degree of reliability and at moderate costs. Groundwater extraction would achieve hydraulic containment of the chlorinated benzene plumes. Groundwater treatment under Alternative 2 would rely on using the existing GWETS.

One drawback of Alternative 2 would be the pumping duration potentially as long as 100 years or more required to maintain hydraulic control and prevent contaminant discharge to Dark Head Cove. Even though operation and maintenance costs for the relatively uncomplicated groundwater treatment system are expected to be low, prolonged operation of a groundwater treatment system is generally undesirable due to the long-term expenditures.

3.4.2.3 Alternative 4: Aerobic PRBs, LUCs/MNA

Alternative 4 has two major components: (a) installation of aerobic PRBs and (b) MNA and LUCs, as described below. Note that treatment of the (soil) sources of the chlorinated benzenes will be addressed by the excavations of the Block E soil remedy during 2021.

***Component 1: aerobic PRBs*—**A line of biosparge wells spaced 18 feet apart would be installed across each plume in hydrogeologic unit 1 (see Figure 3-2). Nine wells would be needed for the eastern plume, and six wells would be needed for the western plume. Compressed air would be supplied from a compressor in the GWETS building to each well at 3 standard cubic feet per minute. The compressed air would be conveyed through the two-inch-diameter spare pipeline under the road for Chesapeake Park Plaza to the biosparge wells. The wells in the eastern plume would be installed at the base of the sand layer at approximately 20 feet below ground surface (bgs). In the western plume, the wells would be installed to a depth of approximately 15 feet bgs. The uppermost five feet of soil in these areas consist of clay, so vent wells will be installed to allow air to pass through to the surface. Geologic cross-sections are shown on Figures 2-12 through 2-17.

The biosparge wells would be operated intermittently with a timer to provide air to maintain oxic conditions in the groundwater and promote aerobic biological activity to degrade chlorinated benzenes to chloride, carbon dioxide, and water. Groundwater samples would be collected upgradient and downgradient of the PRBs to monitor the effectiveness of the treatment. The duration of biosparging is assumed to be similar to hydraulic containment; the biosparging treatment would be required for potentially as long as 100 years or more.

***Component 2: MNA and LUCs*—**Low non-captured concentrations of chlorinated benzenes on the edges of the plume would be allowed to naturally attenuate. Groundwater and surface water sampling would monitor the effectiveness of the PRBs, and as in Alternative 1, monitoring would be required for an extensive period of time to demonstrate remedy effectiveness. LUCs would be implemented as described in Alternative 1.

***Alternative 4 summary*—**Alternative 4 is expected to effectively and reliably maintain the RAOs. The biosparging wells would need to be operated so long as the chlorinated benzene plumes must be contained, potentially as long as 100 years or more.

The major drawback of Alternative 4 is the long operation duration of the biosparge system. Like Alternative 2, the system would need to be operated for potentially as long as 100 years or more to maintain control of the plumes. Even though operation and maintenance costs for a sparging system are expected to be low, prolonged operation of a groundwater treatment system is generally undesirable.

Alternative 4 would be readily implementable, although some uncertainty exists regarding how efficiently chlorinated benzenes will be removed. Heterogeneity and low soil permeability may adversely affect the distribution or air and oxygen in the subsurface. In addition, a suitable population of microorganisms capable of degrading chlorinated benzenes must be established. As for Alternative 2, the proposed locations for the PRBs are available for this use.

3.5 COMPARATIVE ANALYSIS OF ALTERNATIVES AND PROPOSED ALTERNATIVE

The short-listed groundwater response action alternatives were compared qualitatively using the seven CERCLA criteria plus the eighth Lockheed Martin criterion of lifecycle impacts. As discussed above, this evaluation did not consider state acceptance or community acceptance, as these criteria will be evaluated via community input and upon MDE approval, following the submittal of the groundwater RAP addendum to MDE. Table 3-4 summarizes the qualitative analysis per CERCLA.

A comparison of the selected alternatives based on the seven CERCLA criteria and lifecycle impacts is summarized below:

- ***overall protection of human health and the environment—***All three alternatives would meet this criterion. Alternatives 2 and 4 would be protective because they both intercept the plumes. Alternative 1 is currently protective because chlorinated benzenes are not impacting surface water in Dark Head Cove at concentrations greater than the RAO 2 criteria.

- ***compliance with ARARs and meets RAOs—***All three alternatives would meet these criteria.

- ***long-term effectiveness and permanence—***Alternatives 2 and 4 would provide the highest long-term effectiveness and permanence because both alternatives intercept the plumes in hydrogeologic unit 1 completely and provide for removal and treatment of chlorinated benzenes. Alternative 1 is less effective in that no active treatment is provided. However, degradation of chlorinated benzenes by natural biological processes would be permanent.

- ***reduction of toxicity, mobility, or volume by treatment—***Alternative 2 provides reduction of volume through extraction. Alternative 4 provides reduction in toxicity and volume through treatment. Alternative 1 provides no treatment and provides reduction only through natural attenuation.

- ***short-term effectiveness—***

- Time to achieve RAOs – All alternatives would maintain RAOs 1 and 4 upon implementation of LUCs. RAOs 2 and 3 are currently being met. All alternatives could potentially require in excess of 100 years of operation or long-term monitoring to demonstrate maintaining RAO 2.
- Protection of construction workers and minimization of environmental impacts – Alternative 1 ranks highest in this category because the amount of fieldwork (specifically, groundwater and surface water sampling only) would be significantly less than the fieldwork needed for Alternatives 2 and 4 (well installation and pipeline installation). Alternative 2 has fewer potential impacts because only piping and wells need to be installed; Alternative 4 requires the installation of additional treatment equipment, in addition to wells.
- Protection of community – Alternatives 1 and 4 have smaller short-term impacts on the community. Alternative 2 has a slight impact on the community due to the truck transport of granular activated carbon (GAC) to and from the treatment plant.

- ***implementability*—**Alternative 1 generally ranks highest because it is the simplest remedy and involves only sampling and LUC implementation. Alternatives 2 and 4 are more complicated to implement, but vendors, drillers, and contractors are readily available to supply equipment and materials for these alternatives. A spare pipeline has already been installed under Chesapeake Park Plaza when the GWETS was constructed; this spare pipeline can be used to convey extracted groundwater (Alternative 2) or compressed air (Alternative 4).

- ***lifecycle impacts*—**Alternative 1 has the lowest lifecycle impacts because there are no active remediation components. The lifecycle impacts of Alternatives 2 and 4 are similar, and both are much higher than Alternative 1. Alternative 4 was higher than Alternative 2 for greenhouse gases emissions, energy use, water use, sulfur oxides emissions, and particulate matter emissions. Alternative 2 had higher nitrogen oxides emissions than Alternative 4.

- ***cost*—**Because potentially long durations are associated with all retained alternatives, a 30-year period was used for costing. Alternative 1 has the lowest cost, followed by Alternatives 4 and 2. Cost estimates and a summary of the total costs over the analysis periods are included in Appendix C.

Alternative 1 was chosen for the chlorinated benzene plumes in the qualitative analysis for several reasons. Most importantly, it protects human health and the environment, and complies with RAOs and ARARs. No adverse impacts to surface water in Dark Head Cove have been indicated during sampling to date, and the model does not predict a mass flux that would impact the cove; therefore, active remediation is not needed. In addition, LUCs would be protective of groundwater exposure. Even though Alternative 2 uses the existing GWETS in Block E2, costs would be associated with installation and operation of the extraction wells. Alternative 4 was not selected because of the uncertainties associated with the effectiveness and distribution of air in the saturated zone of the

subsurface at this site. Alternative 4 also has costs associated with installation and operation similar to Alternative 2. Thus, Alternative 1 was selected as the proposed TCB groundwater response action, based on the qualitative analyses.

SECTION 4
PROPOSED RESPONSE ACTION

This section describes the proposed response action, implementation details, sequence of implementation, and contingency measures for the chlorinated benzene plumes.

4.1 OVERVIEW OF THE CONCEPTUAL DESIGN AND IMPLEMENTATION OF THE PROPOSED RESPONSE ACTION

Sources of 1,2,4-trichlorobenzene (1,2,4-TCB) will be removed by the subsurface soil excavations of the soil remedy; therefore, the remedy will only address the dissolved portions of the groundwater plumes within Blocks E and F. The conceptual design for the proposed chlorinated benzenes groundwater response action at Blocks E and F at the Middle River Complex (MRC) under Alternative 1 entails monitored natural attenuation (MNA) and the implementation of land use controls (LUCs). Figure 4-1 is a site plan presenting the selected monitoring wells and surface water sampling locations for the proposed response action. A summary of the conceptual design for Alternative 1 is provided below. The selected monitoring wells might be revised once a more detailed design has been produced, and in response to any additional information and regulatory/stakeholder comments obtained before implementation.

The long-term monitoring work plan will be developed following approval of this groundwater response action plan (RAP) addendum. The work plan will provide the final design basis for the response actions, selected monitoring wells, sampling procedures, analytical methods, the remedy optimization process to be followed to ensure the monitoring effectively and efficiently monitors the success of the remedy, and the criteria to demonstrate when RAOs are met.

4.2 SAMPLING, ANALYSIS, AND REPORTING

Sampling would begin in 2022 after the completion of the soil remedy (Tetra Tech, 2019b) that will in part, remove the chlorinated benzenes source. Groundwater and surface water samples will be collected and evaluated to monitor the progress of the natural attenuation of 1,2,4-TCB and other chlorinated benzenes. Groundwater samples will be collected from 18 existing groundwater

monitoring wells in Blocks E and F, as shown on Figure 4-1 and as listed on Table 4-1. These locations include the former source areas and downgradient portions of the plume. Any wells needed for long-term monitoring that were abandoned during the soil excavations would be replaced after construction. Four new monitoring wells will be installed in hydrogeologic unit 1 near the shoreline. Thirteen of the wells will monitor hydrogeologic unit 1, and five wells will monitor hydrogeologic unit 2. Table 4-1 identifies the hydrogeologic unit to be monitored by each well. Surface water samples will be collected from Dark Head Cove at locations nearest to the downgradient-most point of each plume at the same locations as the current surface water sampling program, as shown generally on Figure 4-1. Samples would be collected semiannually for the first four years and annually thereafter subject to the ongoing remedy optimization presented in Section 4.4.

Monitoring wells will be purged using low flow purging techniques. During groundwater purging, water level drawdown measurements and groundwater parameters, including pH, temperature, specific conductance, dissolved oxygen (DO), oxidation-reduction potential (ORP), and turbidity will be collected. After purging, groundwater will be sampled from each well using low-flow sampling protocols.

The selected laboratory will be state certified with demonstrated ability to achieve the specified detection limits. Groundwater samples will be analyzed for 1,2,4-trichlorobenzene, 1,2-dichlorobenzene (1,2-DCB), 1,4-dichlorobenzene (1,4-DCB), and chlorobenzene to monitor the progress of the attenuation. During baseline sampling and subsequent sampling events, geochemistry will be evaluated by analyzing samples for total organic carbon, ferrous iron, total and dissolved iron, total and dissolved manganese, methane, sulfate, and alkalinity. Dissolved oxygen, oxidation-reduction potential, and pH measurements will also be used in the evaluation. The baseline event will also include samples from selected wells in the source areas and middle of the plumes to be analyzed using molecular biological tools. These results will be used to evaluate the presence of bacterial populations and functional genes that may indicate the potential for and degree of biological degradation.

The spring sampling event data will be included in the report for the facility wide annual groundwater monitoring. For the fall sampling event, a separate groundwater monitoring report

will be prepared to summarize the results of both sampling events completed that year. The report will include a summary of the field activities, data summary tables of the validated analytical results, sample location maps and analytical "tag" maps, a data validation discussion, groundwater potentiometric surface maps, and laboratory analytical reports. Results will be compared to RAO 2 criteria. Concentration trend graphs for the chlorinated benzenes will be prepared for each well for the report and will include the historical pre-remediation results as applicable. Molar concentration trend graphs will be prepared to evaluate biological degradation in wells in the portions of the plume with higher concentrations. After each event, results and trends will be evaluated to optimize the analytes, the number of wells being sampled, and frequency of analysis.

4.3 LAND USE CONTROLS

Land use controls that prohibit the use of Block F groundwater and restrict land use for uses other than industrial have already been implemented in 2017 following completion of soil remediation. Additionally, there are required notifications to the Maryland Department of the Environment (MDE) for any excavation and handling requirements for excavated materials in Block F. Land use controls for Block E have not yet been prepared or implemented but are expected to be similar and include prohibition of groundwater use, restrictions on use of the property for other than industrial purposes, and similar notifications to MDE for any excavation and handling requirements. It is anticipated that the MDE will issue land use controls, documented in a No Further Action letter, for Block E at the completion of soil remediation.

The No Further Action letter for Block F was filed in the local land records and will be transmitted to subsequent property owners as part of the deed documentation. The No Further Action letter for Block E will be filed at the completion of soil remediation. The Maryland Department of the Environment regards all land use controls as existing in perpetuity, unless the related environmental covenants are eliminated or modified by mutual consent of the stakeholders. As part of the "No Further Action" letter and supporting documentation, the Maryland Department of the Environment will require certain environmental covenants that will give certain stakeholders legal standing to enforce them.

Once implemented, we expect these land use controls will apply to the entire tax block, and not just to particular portions of the block.

4.4 REMEDY OPTIMIZATION

Chlorinated benzene surface water results to date are less than site-specific swimming criteria. Groundwater modeling results show that the migration of the chlorinated benzene plumes is quite slow. The groundwater model shows that the mass flux of 1,2,4-trichlorobenzene and chlorobenzene is also low. These results strongly suggest that there will be no adverse impacts to surface water by the plumes. However, groundwater sampling has only been performed for a few years, and trends cannot be established.

The rate of natural biological degradation is uncertain. The presence of chlorobenzene strongly suggests that biological degradation has occurred in the past and may still be occurring. Geochemical analyses of the groundwater are inconclusive.

Because the plumes will be moving for a long period of time, a long monitoring period may be necessary to verify that there are no impacts to surface water. Therefore, to reduce the duration and amount of sampling, the following approach will be used to evaluate the data within each plume. The approach is also depicted on Figure 4-2.

- The results of the surface water and groundwater samples will be tabulated, graphed, and evaluated for trends using a statistical method, such as the Mann-Kendall (MK) test. The first trend analysis will be performed after at least four sampling events have been completed.
- If, after at least eight sampling events, the concentrations in monitoring well sampling results nearest the cove are steady or trending downward (and no exceedances have occurred in the surface water samples), then RAO 2 has been demonstrated to have been met. An NFA letter for chlorinated benzenes may be requested and surface water sampling for chlorinated benzenes can be stopped.
- If contaminant concentrations in monitoring wells nearest the cove are not steady or do not trend downward (and no exceedances in the surface water samples have occurred), then continue with annual groundwater sampling.
- If the concentrations of chlorinated benzenes in groundwater samples in a given well (nearest to) the cove are less than one-half of the swimming screening criteria for two consecutive events, then sampling of that well can be stopped.

- If surface water sampling results exceed one-half of the swimming screening level, proceed to the Contingencies Measures section (Section 4.7).

4.5 SEQUENCE AND SCHEDULE OF REMEDY IMPLEMENTATION

The proposed remedy for the chlorinated benzene plumes involves monitored natural attenuation and the implementation of land use controls; no active remedial components are involved. Alternative 1 will be implemented in the sequence summarized below:

- Submit this response action plan (RAP) to Maryland Department of the Environment (Fall 2020)
- Maryland Department of the Environment review and approval (Spring 2021)
- Public review and comment (Summer 2021)
- Prepare long-term monitoring work plan (Spring 2021)
- Submit long-term monitoring work plan to Maryland Department of the Environment (Spring 2021)
- Maryland Department of the Environment approval of long-term monitoring work plan (Summer 2021)
- Monitoring wells that are part of the sampling program but were abandoned during the soil excavations will be installed after construction (early 2022)
- Baseline groundwater monitoring will be completed after the soil remedy is completed (mid 2022)
- Long-term monitoring will be performed to follow the progress of natural attenuation and verify that chlorinated benzenes are not reaching Dark Head Cove (2022 until response action objectives are met)
- When response action objectives have been met, a Response Action Completion Report will be submitted

4.6 PERMIT REQUIREMENTS AND NOTIFICATIONS

4.6.1 Permits

Lockheed Martin will meet federal, state, and local permitting requirements for the proposed groundwater response action. Permitting requirements for the proposed response action relate to groundwater sampling, as determined by a review of United States Environmental Protection

Agency, the Maryland Department of the Environment, and Baltimore County Department of Environmental Protection and Natural Resources Groundwater Management requirements. Permits that are required for the response action include:

- Maryland Department of the Environment/Baltimore County Well Construction Permits for the installation of new monitoring wells.

4.6.2 Notifications

Lockheed Martin will follow appropriate MDE notification requirements regarding previously undiscovered contamination, changes in the RAP schedule, and citations from regulators related to health and safety practices associated with implementation of the proposed response action and MDE will be promptly notified of any discharges to the environment, should they occur. MDE will be notified prior to the start of significant field activities per the final work plan and schedule.

4.7 CONTINGENCY MEASURES

Several contingency measures will be built into the design and implementation of the response action for the chlorinated benzene groundwater plumes:

- If concentrations of chlorinated benzenes are detected in the surface water at concentrations greater than one-half of the RAO 2 criteria for two consecutive events, then active treatment will be considered.
- If land use controls are not being followed, the implementation plan could be revised to increase inspections and/or expand the awareness program.

The need for contingency measures will be evaluated using data received, or when site conditions change, such as land use, development, or building construction.

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FIGURES

Figure 1-1 Site Location Map, Blocks E/F, Middle River Complex

Figure 1-2 Site Layout and Tax Blocks, Middle River Complex

Figure 2-1 Field Results for Chlorobenzene and 1,2,4-Trichlorobenzene, June 2018, Block F

Figure 2-2 Laboratory Detections for Volatile Organic Compounds, Block F

Figure 2-3 2019 Hydraulic Profiling Tool Results

Figure 2-4 2019 Monitoring Well Tag Map Volatile Organic Compounds

Figure 2-5 Surface Water Sampling Locations Dark Head Cove

Figure 2-6 Historical 1,2,4-Trichlorobenzene and Chlorobenzene Surface Water Sample Results Middle River Complex

Figure 2-7 Structure Contour Map Constructed on Sequence Boundary Surface

Figure 2-8 Groundwater Elevations in Hydrogeologic Unit 1, Blocks E and F

Figure 2-9 Groundwater Elevations in Hydrogeologic Unit 2, Blocks E and F

Figure 2-10 1,2,4-Trichlorobenzene in Hydrogeologic Unit 1

Figure 2-11 1,2,4-Trichlorobenzene in Hydrogeologic Unit 2

Figure 2-12 Chlorobenzene in Hydrogeologic Unit 1

Figure 2-13 Chlorobenzene in Hydrogeologic Unit 2

Figure 2-14 Cross Section A-A' with 2019 Groundwater 1,2,4-Trichlorobenzene Concentrations

Figure 2-15 Cross Section B-B' with 2019 Groundwater 1,2,4-Trichlorobenzene Concentrations

Figure 2-16 Cross Section C-C' with 2019 Groundwater 1,2,4-Trichlorobenzene Concentrations

Figure 2-17 Cross Section A-A' with 2019 Groundwater Chlorobenzene Concentrations

Figure 2-18 Cross Section B-B' with 2019 Groundwater Chlorobenzene Concentrations

Figure 2-19 Cross Section C-C' with 2019 Groundwater Chlorobenzene Concentrations

Figure 2-20 Simplified Degradation Pathways of Chlorinated Benzenes

Figure 3-1 Alternative 2 – Extraction and Treatment of Chlorinated Benzene Plumes

Figure 3-2 Alternative 4 – Aerobic PRB Treatment of Chlorinated Benzene Plumes

Figure 4-1 Alternative 1 – Monitored Natural Attenuation and Land Use Controls

Figure 4-2 Remedy Optimization Flow Chart



2014 aerial photograph provided by U.S. Geological Survey.

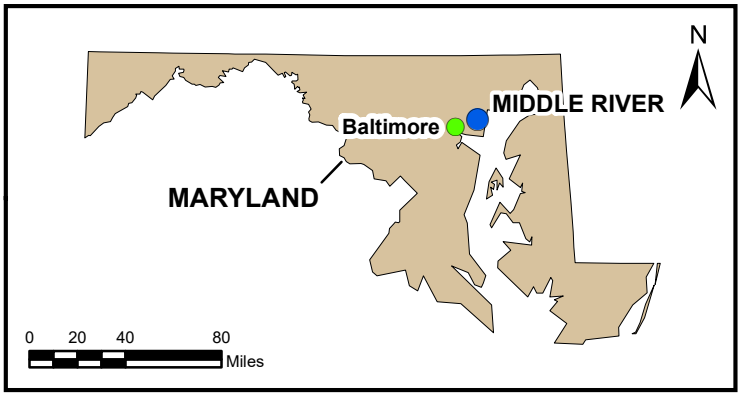

FIGURE 1-1

SITE LOCATION MAP, BLOCKS E/F
MIDDLE RIVER COMPLEX

Lockheed Martin Middle River Complex
Middle River, Maryland

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01/29/20	JEE

TETRA TECH

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BLOCK 'B'
ATHLETIC FIELD
PARKING LOT NO. 4
MIDDLE RIVER POST OFFICE
BLOCK 'A'
PARKING LOT NO. 5
BUILDING E
BLOCK 'I'
BLOCK 'A'
PARKING LOT NO. 1
ASHLEY FURNITURE
ENGINEERING RESEARCH BUILDING
MARTIN STATE AIRPORT
BLOCK 'H'
PROGRAM BUILDING
BUILDING C
BUILDING B
BUILDING A
JOHNSON AND TOWERS
PARKING LOT NO. 2
VLS BUILDING
PARKING LOT NO. 6
BLOCK 'D'
BLOCK 'D' PANHANDLE
FORMER BUILDING D
BLOCK 'E'
PARKING LOT NO. 3
BLOCK 'G'
BLOCK 'E2'
TILLEY CHEMICAL COMPANY
WATERFRONT LOT
TOTAL INDUSTRIAL GROUP
BLOCK 'F'
DARK HEAD COVE
COW PEN CREEK

FIGURE 1-2

SITE LAYOUT AND TAX BLOCKS
MIDDLE RIVER COMPLEX

LEGEND

TAX BLOCK

2014 aerial photograph provided by U.S. Geological Survey.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 225 450 Feet

N

DATE MODIFIED: 05/05/20

CREATED BY: JEE

TETRA TECH

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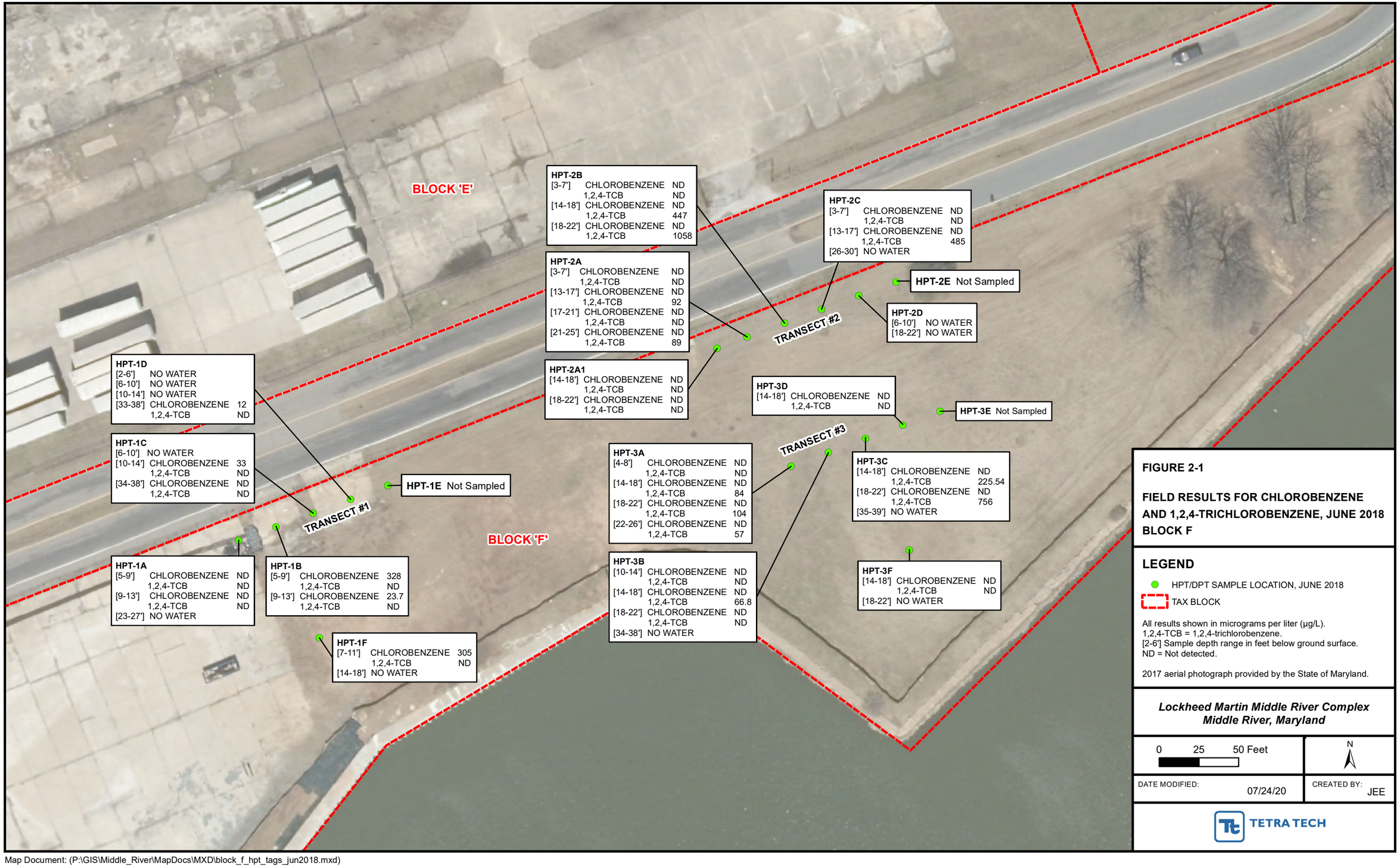

FIGURE 2-1

FIELD RESULTS FOR CHLOROBENZENE AND 1,2,4-TRICHLOROBENZENE, JUNE 2018 BLOCK F

LEGEND

- HPT/DPT SAMPLE LOCATION, JUNE 2018
- TAX BLOCK

All results shown in micrograms per liter (µg/L).
1,2,4-TCB = 1,2,4-trichlorobenzene.
[2-6'] Sample depth range in feet below ground surface.
ND = Not detected.

2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 25 50 Feet

N

DATE MODIFIED: 07/24/20

CREATED BY: JEE

TETRA TECH

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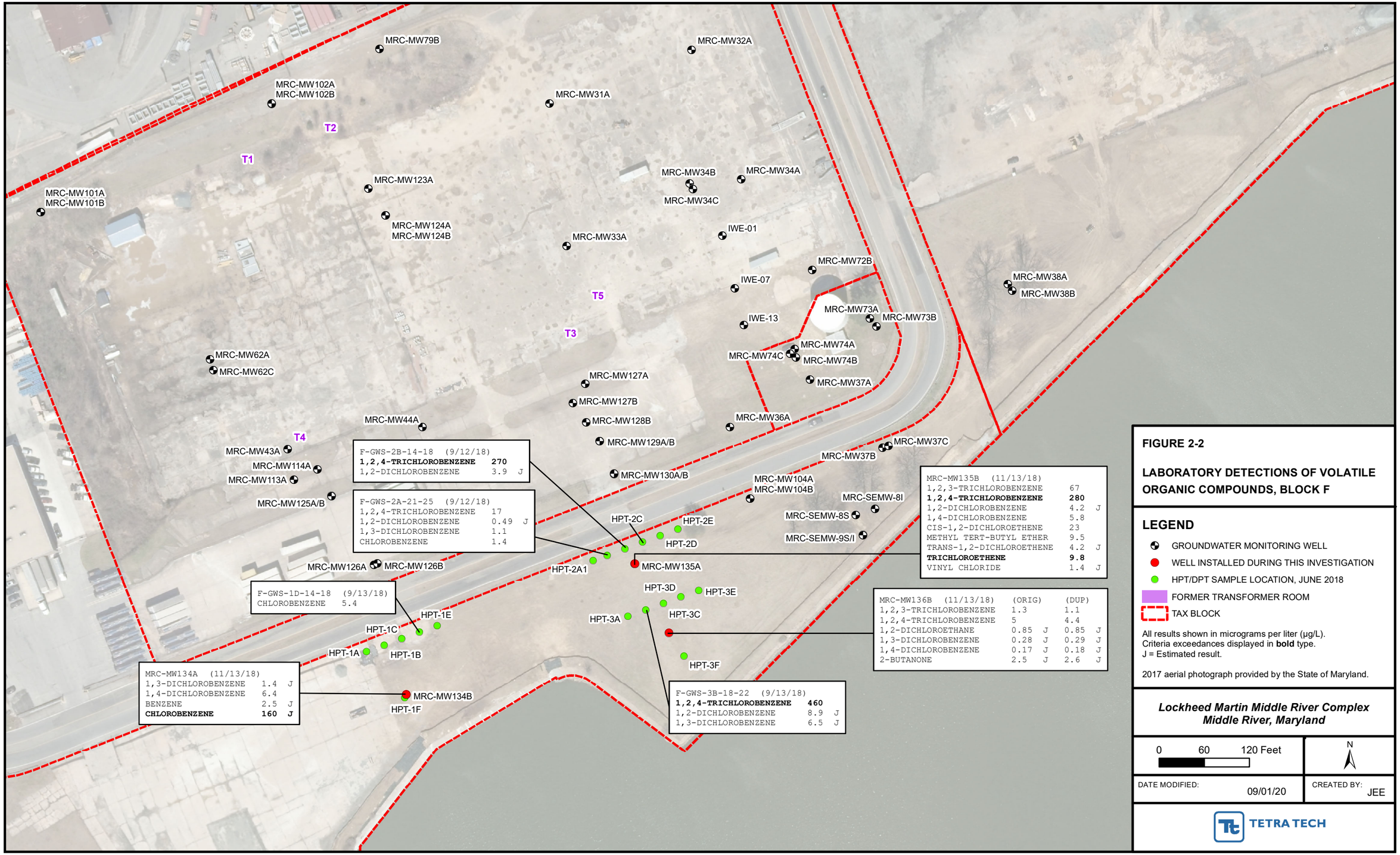

FIGURE 2-2

LABORATORY DETECTIONS OF VOLATILE ORGANIC COMPOUNDS, BLOCK F

LEGEND

- GROUNDWATER MONITORING WELL
- WELL INSTALLED DURING THIS INVESTIGATION
- HPT/DPT SAMPLE LOCATION, JUNE 2018
- FORMER TRANSFORMER ROOM
- TAX BLOCK

All results shown in micrograms per liter (µg/L).
Criteria exceedances displayed in **bold** type.
J = Estimated result.

2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 60 120 Feet

N

DATE MODIFIED: 09/01/20

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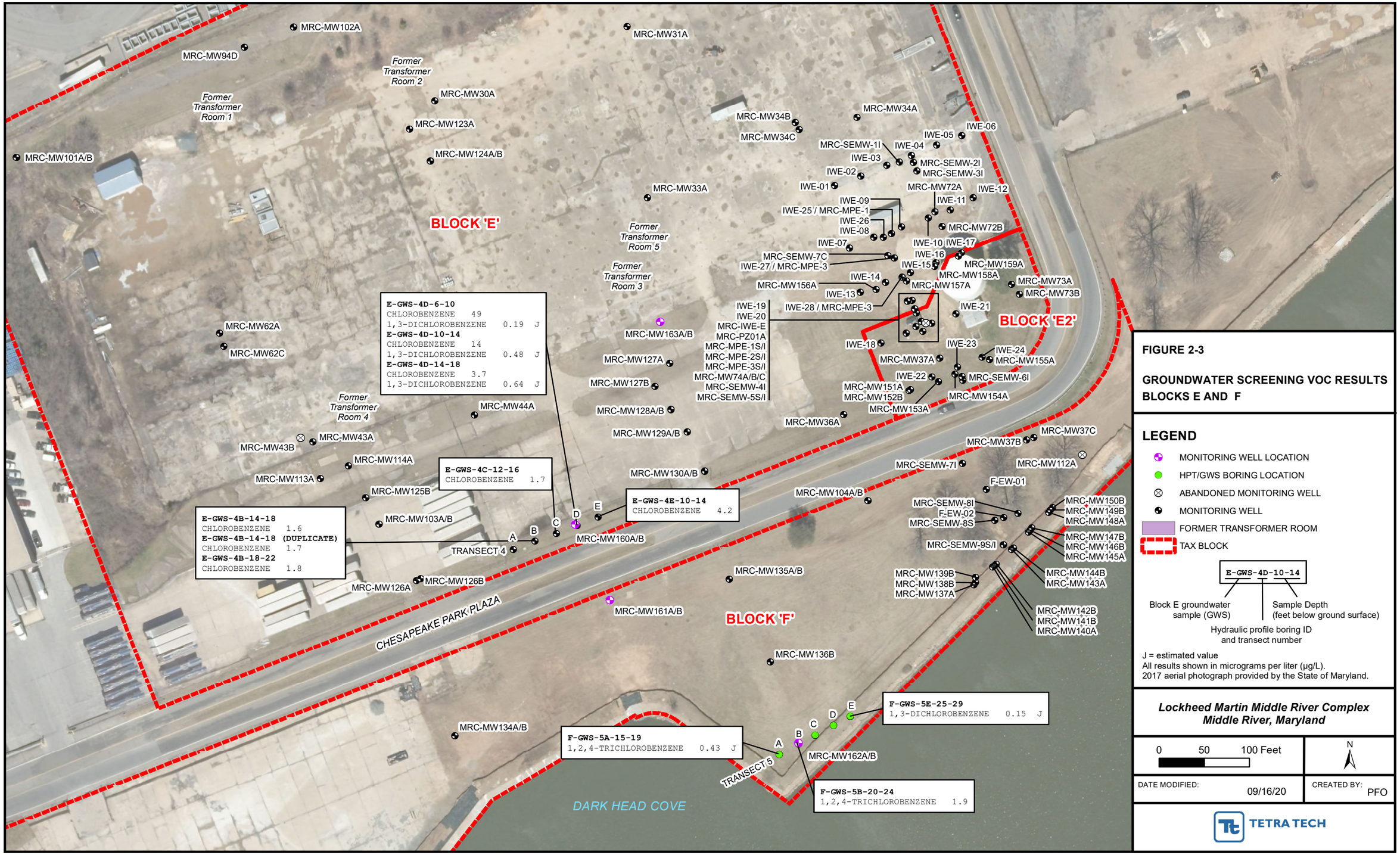


FIGURE 2-3

GROUNDWATER SCREENING VOC RESULTS BLOCKS E AND F

LEGEND

- MONITORING WELL LOCATION
- HPT/GWS BORING LOCATION
- ABANDONED MONITORING WELL
- MONITORING WELL
- FORMER TRANSFORMER ROOM
- TAX BLOCK

E-GWS-4D-10-14

Block E groundwater sample (GWS) — Sample Depth (feet below ground surface)

Hydraulic profile boring ID and transect number

J = estimated value
All results shown in micrograms per liter (µg/L).
2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 50 100 Feet

N

DATE MODIFIED: 09/16/20

CREATED BY: PFO

TETRA TECH

Map Document: (P:\GIS\Middle_River\MapDocs\MXD\blocks_ef_gw_voc_results_nov2019.mxd)
09/16/20 -- JEE

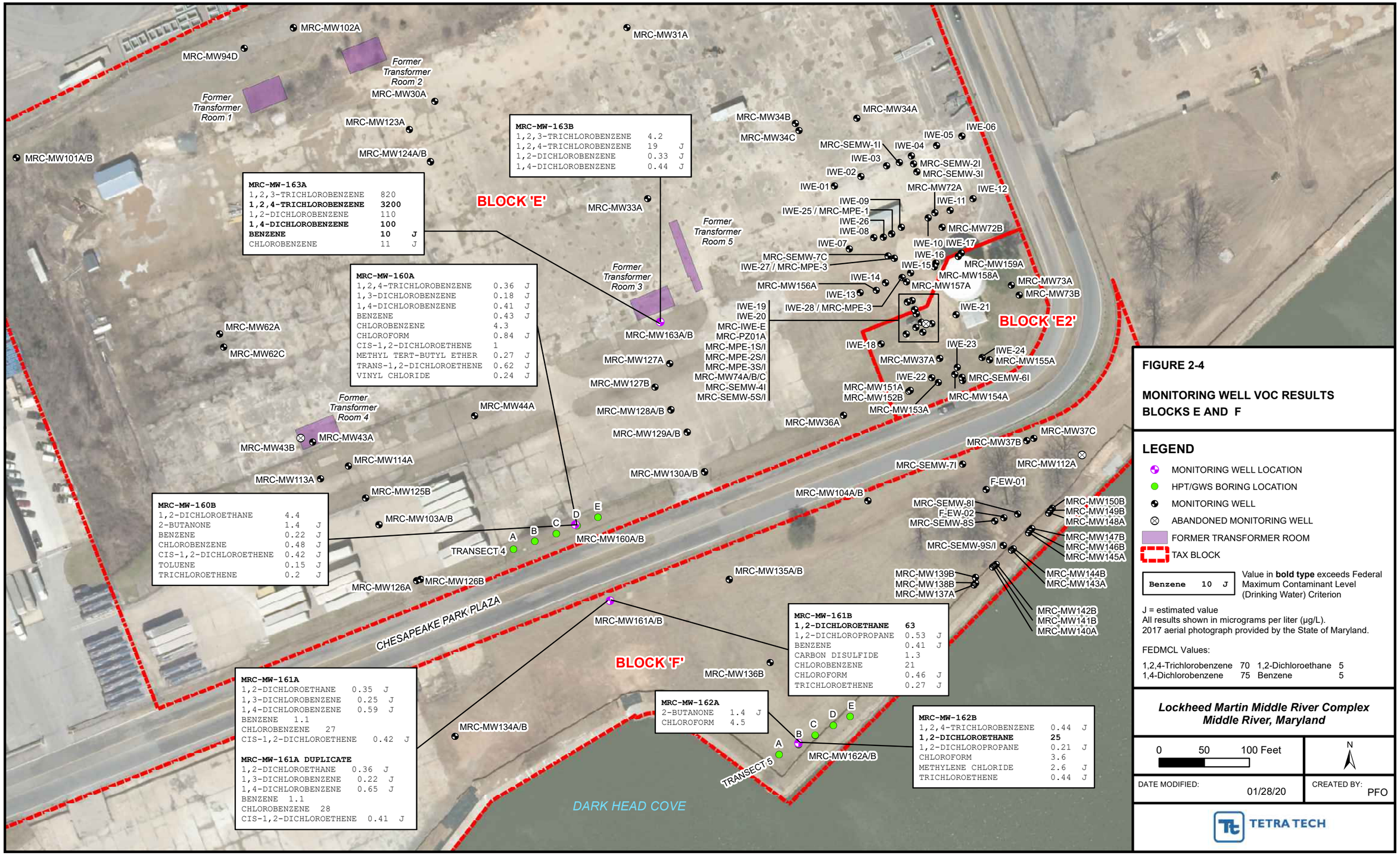


FIGURE 2-4

MONITORING WELL VOC RESULTS
BLOCKS E AND F

LEGEND

- MONITORING WELL LOCATION
- HPT/GWS BORING LOCATION
- MONITORING WELL
- ABANDONED MONITORING WELL
- FORMER TRANSFORMER ROOM
- TAX BLOCK

Benzene	10	J

Value in **bold type** exceeds Federal Maximum Contaminant Level (Drinking Water) Criterion

J = estimated value
All results shown in micrograms per liter (µg/L).
2017 aerial photograph provided by the State of Maryland.

FEDMCL Values:

1,2,4-Trichlorobenzene	70	1,2-Dichloroethane	5
1,4-Dichlorobenzene	75	Benzene	5

Lockheed Martin Middle River Complex
Middle River, Maryland

0 50 100 Feet

N

DATE MODIFIED: 01/28/20

CREATED BY: PFO

TETRA TECH

Map Document: (P:\GIS\Middle_River\MapDocs\MXD\blocks_ef_mw_voc_results_nov2019.mxd)
01/28/20 -- JEE



FIGURE 2-5

DARK HEAD COVE
SURFACE WATER SAMPLE LOCATIONS

LEGEND

- SURFACE WATER SAMPLE LOCATION
- TAX BLOCK

2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 125 250 Feet

N

DATE MODIFIED: 07/24/20

CREATED BY: JAZ

TETRA TECH

Map Document: (P:\GIS\Middle_River\MapDocs\MXD\mrc_sw_locations.mxd)
07/24/20 -- JEE

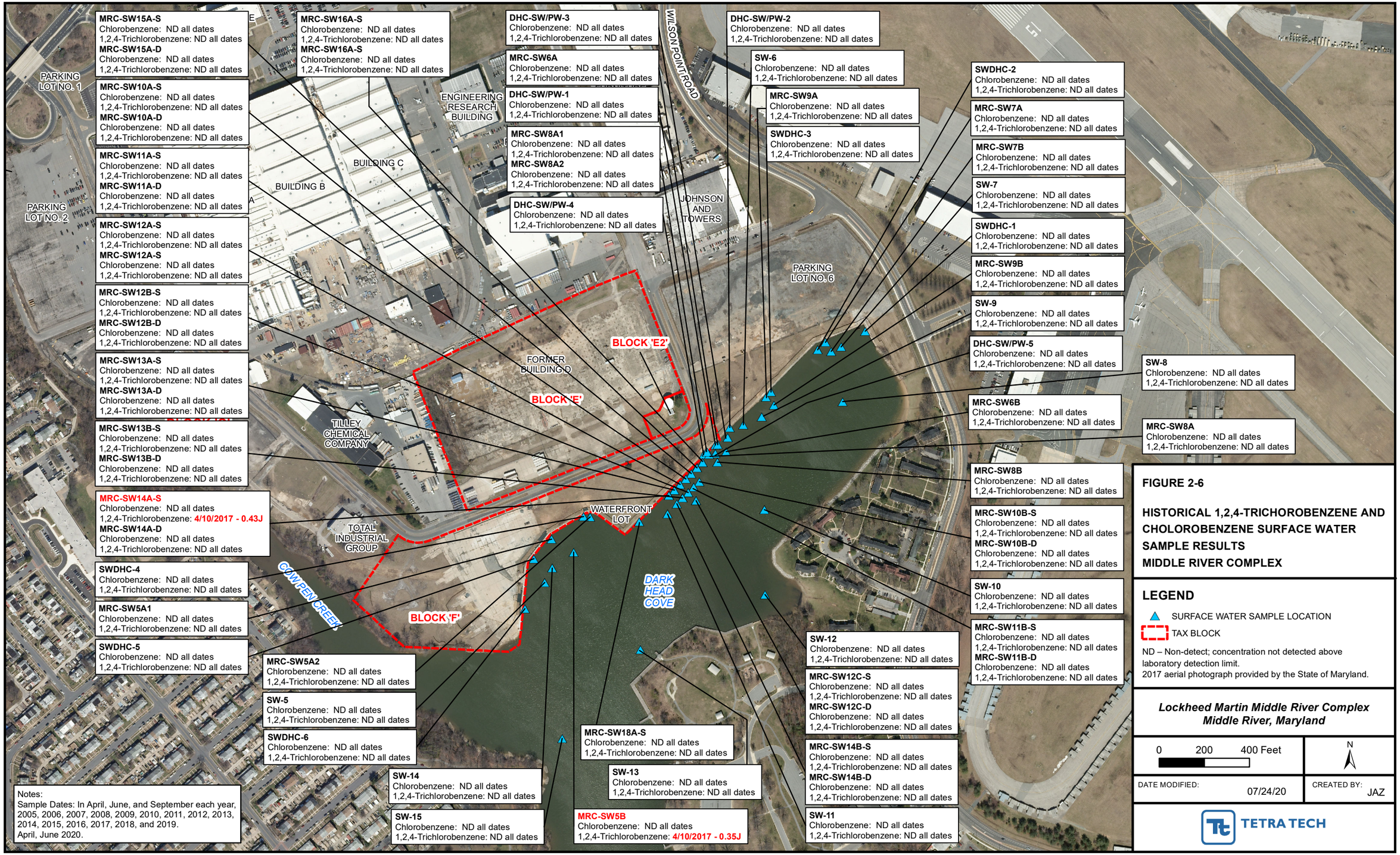


FIGURE 2-6

HISTORICAL 1,2,4-TRICHOROBENZENE AND CHOLOROBENZENE SURFACE WATER SAMPLE RESULTS MIDDLE RIVER COMPLEX

LEGEND

- SURFACE WATER SAMPLE LOCATION
- TAX BLOCK

ND – Non-detect; concentration not detected above laboratory detection limit.
2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 200 400 Feet

N

DATE MODIFIED: 07/24/20

CREATED BY: JAZ

TETRA TECH

Map Document: (P:\GIS\Middle_River\MapDocs\MXD\mrc_sw_tags_jul2020.mxd)
07/24/20 -- JEE

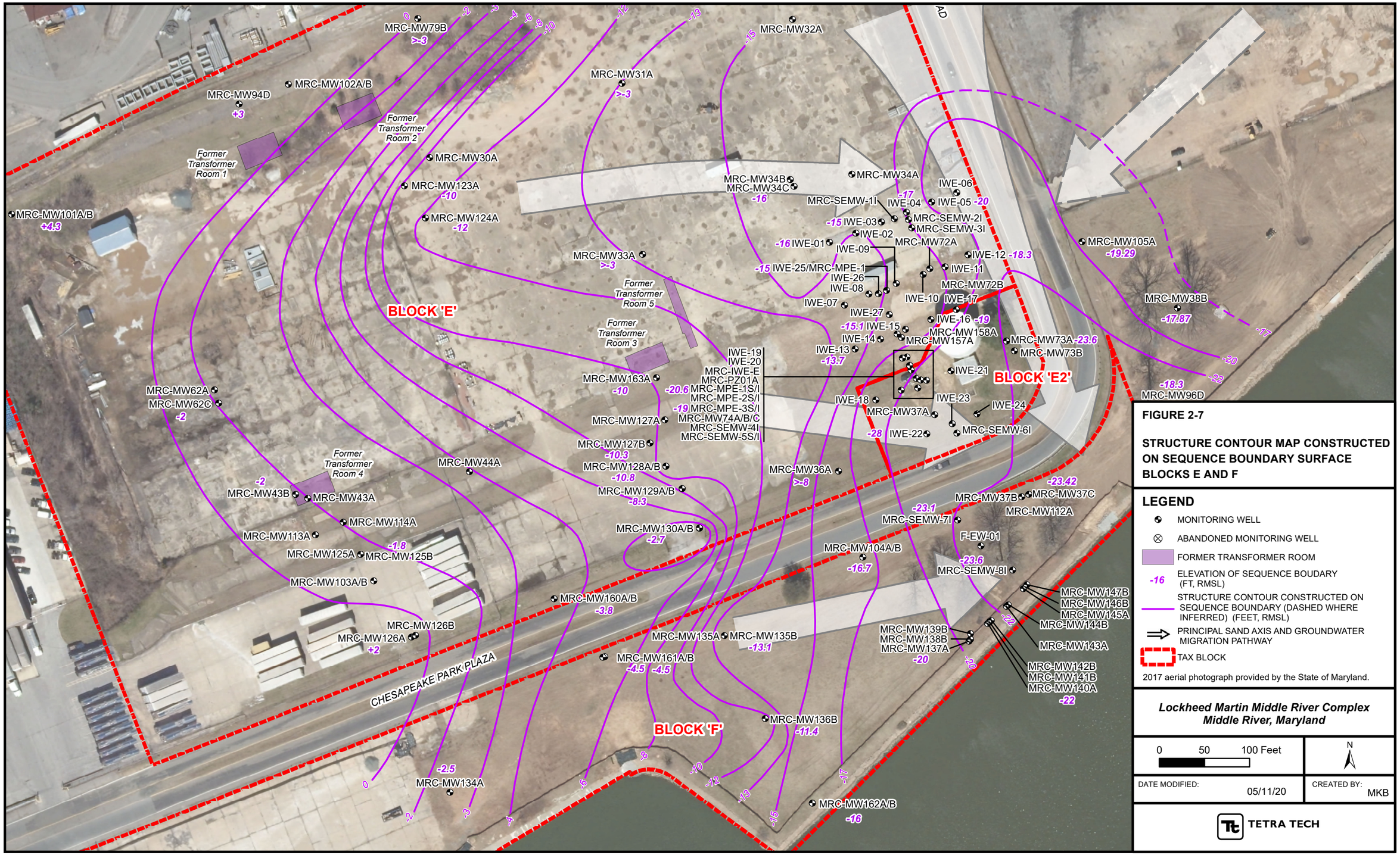


FIGURE 2-7

STRUCTURE CONTOUR MAP CONSTRUCTED ON SEQUENCE BOUNDARY SURFACE BLOCKS E AND F

LEGEND

- MONITORING WELL
- ABANDONED MONITORING WELL
- FORMER TRANSFORMER ROOM
- -16 ELEVATION OF SEQUENCE BOUDARY (FT, RMSL)
- STRUCTURE CONTOUR CONSTRUCTED ON SEQUENCE BOUNDARY (DASHED WHERE INFERRED) (FEET, RMSL)
- PRINCIPAL SAND AXIS AND GROUNDWATER MIGRATION PATHWAY
- TAX BLOCK

2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 50 100 Feet

N

DATE MODIFIED: 05/11/20

CREATED BY: MKB

TETRA TECH

Map Document: GER (K:\Patrick\GIS\Middle River\MapDocs\MXDs\blocks_ef_structure_cont_kop.mxd)
05/11/20 -- PFO



FIGURE 2-8

GROUNDWATER ELEVATIONS IN HYDROGEOLOGIC UNIT 1 BLOCKS E AND F

LEGEND

- MONITORING WELL
- ABANDONED MONITORING WELL
- PROPOSED HPT/GWS BORING LOCATION
- 5.73 GROUNDWATER ELEVATION MEASURED ON 9/19/2019 (FEET, MSL)
- GENERAL TREND OF CONTOURS IN EASTERN PORTION OF BLOCKS BASED ON PREVIOUS ROUNDS (DASHED WHERE INFERRED)
- CONTOUR LINE
- FORMER TRANSFORMER ROOM
- TAX BLOCK

2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 50 100 Feet

N

DATE MODIFIED: 02/10/20

CREATED BY: MKB

TETRA TECH

Map Document: (C:\GIS\Middle_River\MapDocs\MXD\blocks_ef_gw_hu1_kop.mxd)
02/10/20 -- MKB KoP

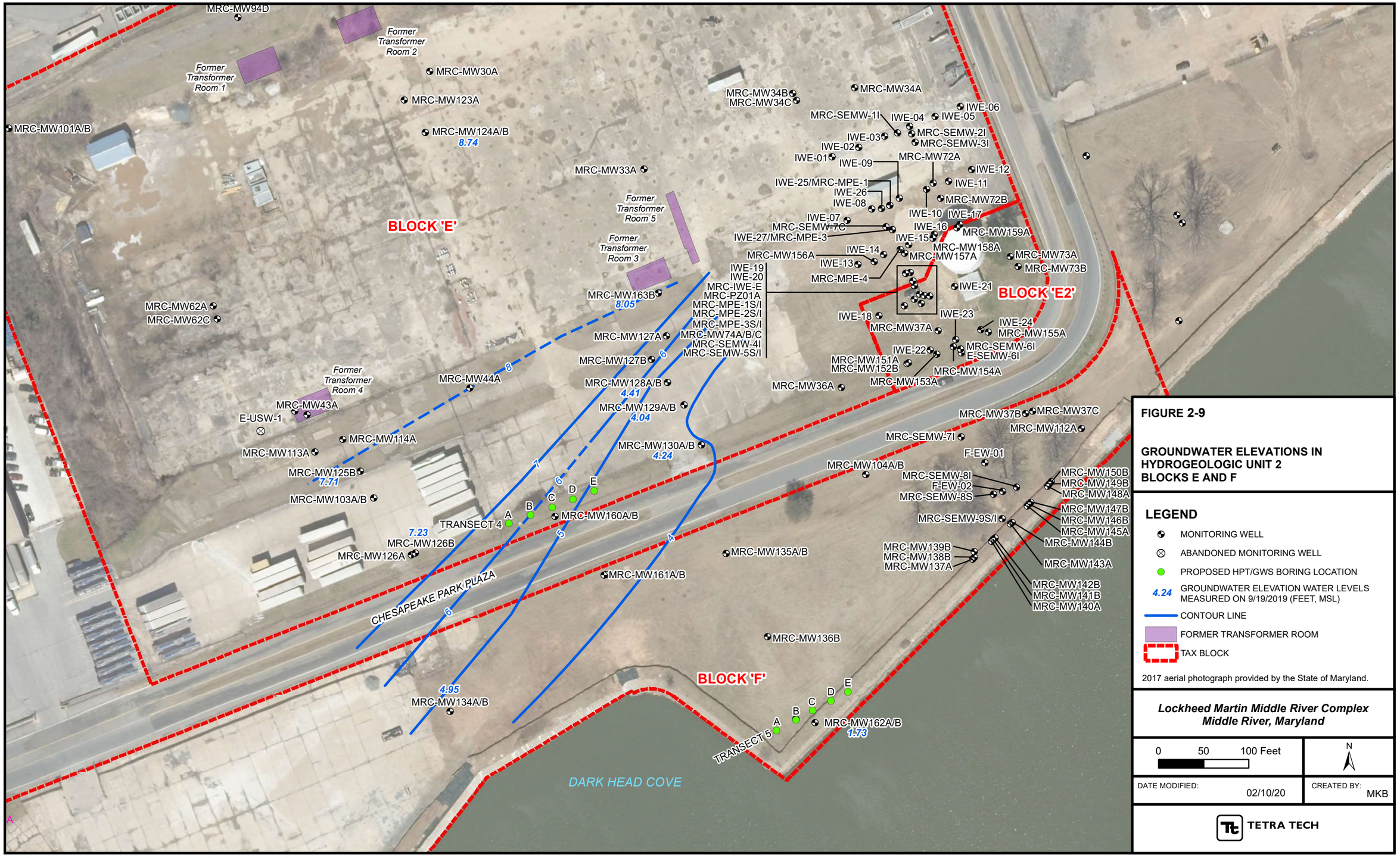


FIGURE 2-9

GROUNDWATER ELEVATIONS IN HYDROGEOLOGIC UNIT 2 BLOCKS E AND F

LEGEND

- MONITORING WELL
- ABANDONED MONITORING WELL
- PROPOSED HPT/GWS BORING LOCATION
- 4.24 GROUNDWATER ELEVATION WATER LEVELS MEASURED ON 9/19/2019 (FEET, MSL)
- CONTOUR LINE
- FORMER TRANSFORMER ROOM
- TAX BLOCK

2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 50 100 Feet

N

DATE MODIFIED: 02/10/20

CREATED BY: MKB

TETRA TECH

Map Document: (C:\GIS\Middle_River\MapDocs\MXD\blocks_ef_gw_hu2_kop.mxd)
02/10/20 -- MKB KoP

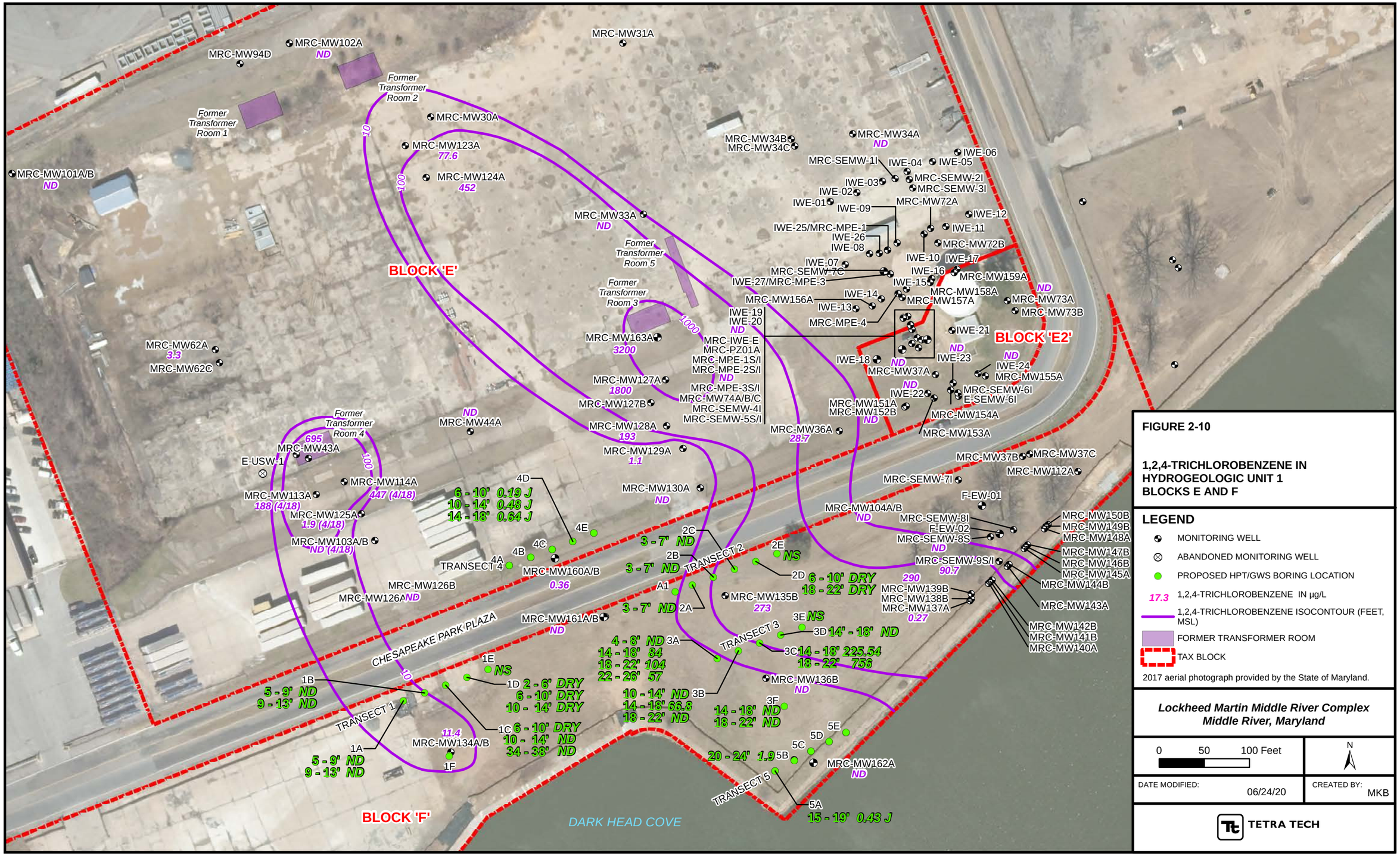


FIGURE 2-10

1,2,4-TRICHLOROBENZENE IN HYDROGEOLOGIC UNIT 1 BLOCKS E AND F

LEGEND

- MONITORING WELL
- ABANDONED MONITORING WELL
- PROPOSED HPT/GWS BORING LOCATION
- 17.3 — 1,2,4-TRICHLOROBENZENE IN µg/L
- 1,2,4-TRICHLOROBENZENE ISOCONTOUR (FEET, MSL)
- FORMER TRANSFORMER ROOM
- TAX BLOCK

2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 50 100 Feet

N

DATE MODIFIED: 06/24/20

CREATED BY: MKB

TETRA TECH

Map Document: (C:\GIS\Middle_River\MapDocs\MXD\blocks_ef_trichlorobenzene_hpt_hu1_kop.mxd)
06/24/20 -- MKB KoP

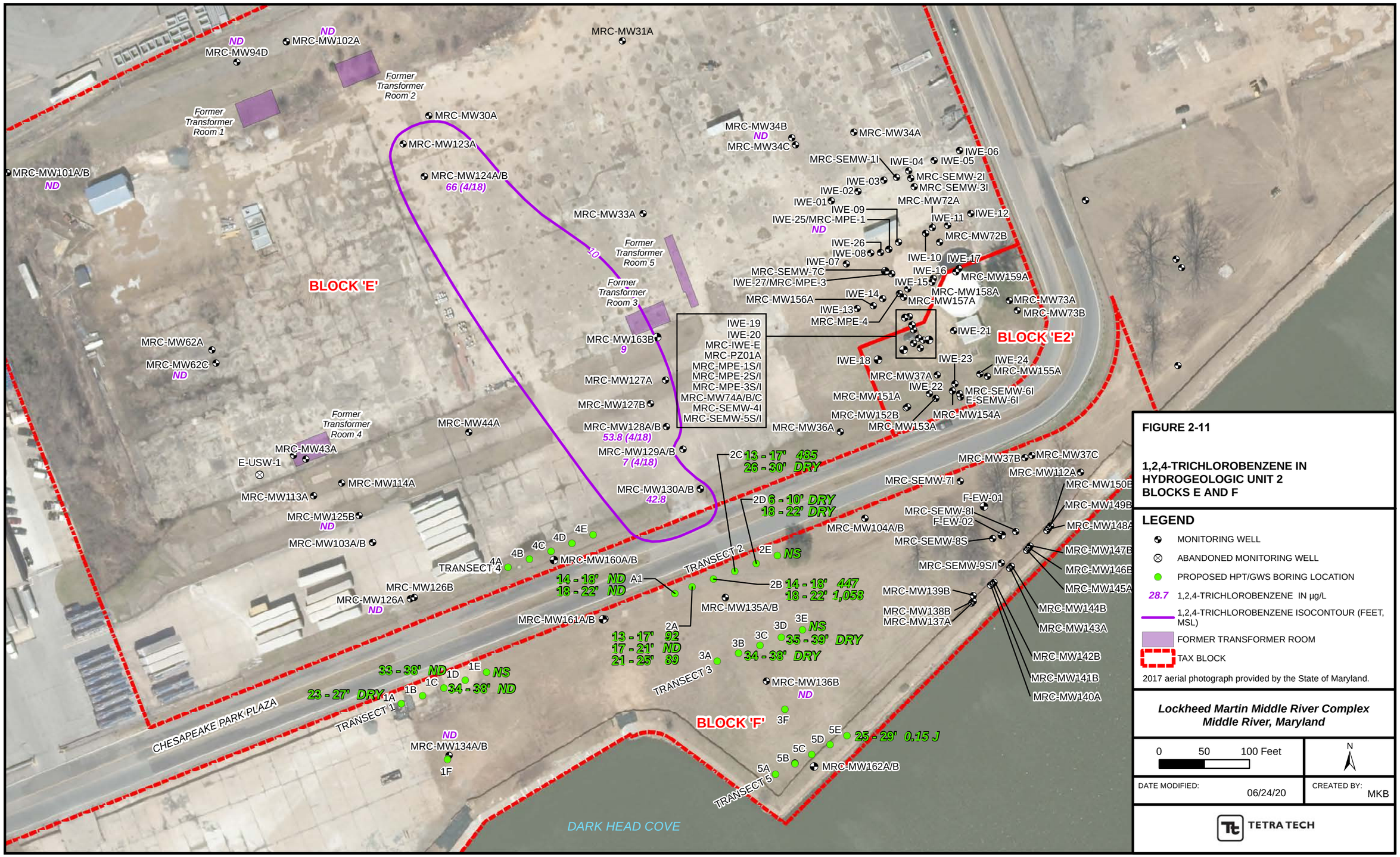


FIGURE 2-11

1,2,4-TRICHLOROBENZENE IN HYDROGEOLOGIC UNIT 2 BLOCKS E AND F

LEGEND

- MONITORING WELL
- ABANDONED MONITORING WELL
- PROPOSED HPT/GWS BORING LOCATION
- 28.7 — 1,2,4-TRICHLOROBENZENE IN µg/L
- 1,2,4-TRICHLOROBENZENE ISOCONTOUR (FEET, MSL)
- FORMER TRANSFORMER ROOM
- TAX BLOCK

2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 50 100 Feet

N

DATE MODIFIED: 06/24/20

CREATED BY: MKB

TETRA TECH

Map Document: (C:\GIS\Middle_River\MapDocs\MXD\blocks_ef_trichlorobenzene_hpt_hu2_kop.mxd)
06/24/20 -- MKB KoP

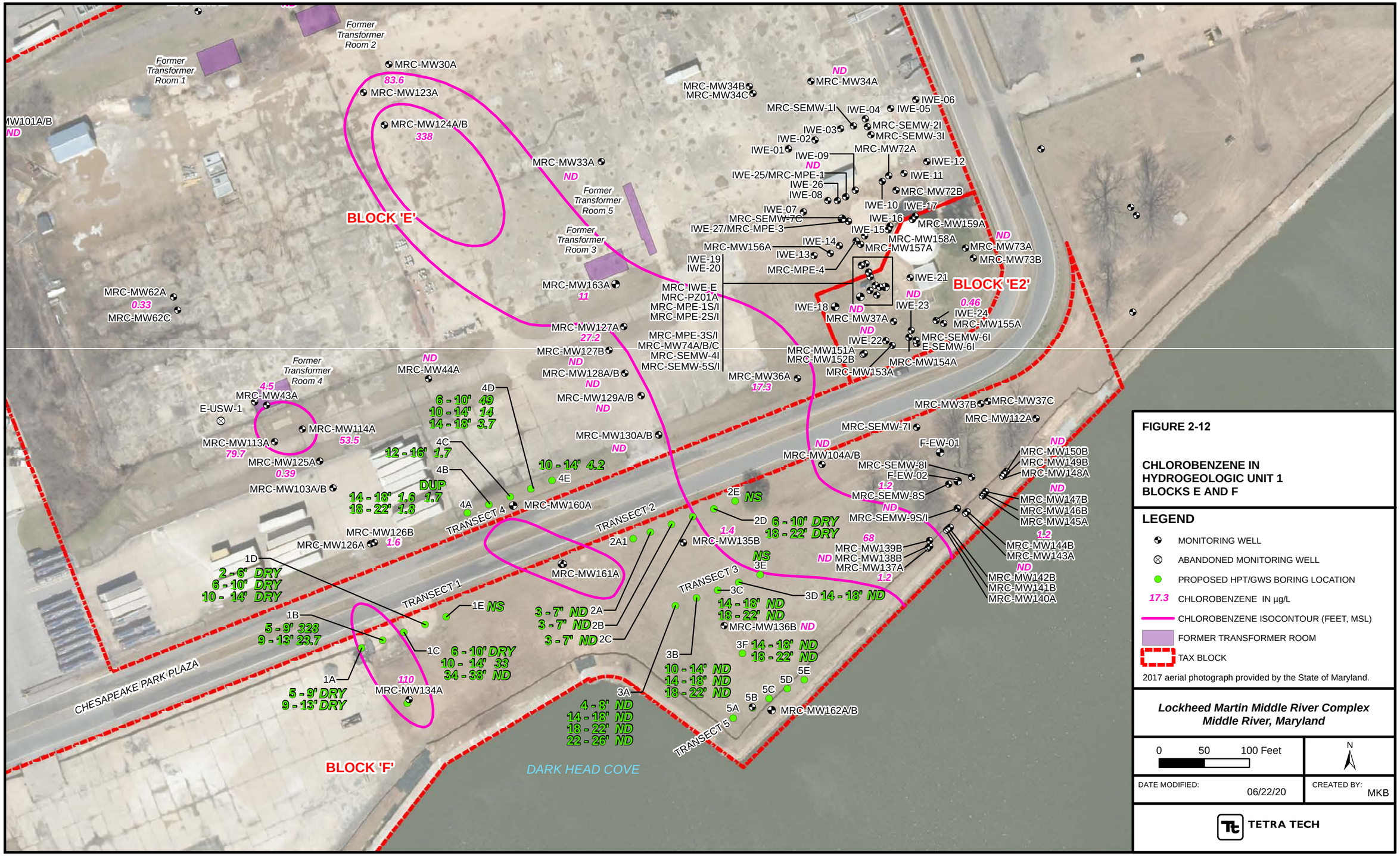


FIGURE 2-12

CHLOROBENZENE IN HYDROGEOLOGIC UNIT 1 BLOCKS E AND F

LEGEND

- MONITORING WELL
- ABANDONED MONITORING WELL
- PROPOSED HPT/GWS BORING LOCATION
- 17.3 CHLOROBENZENE IN µg/L
- CHLOROBENZENE ISOCONTOUR (FEET, MSL)
- FORMER TRANSFORMER ROOM
- TAX BLOCK

2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 50 100 Feet

N

DATE MODIFIED: 06/22/20

CREATED BY: MKB

TETRA TECH

Map Document: (C:\GIS\Middle_River\MapDocs\MXD\blocks_ef_chlorobenzene_hpt_hu1_kop.mxd)
06/22/20 -- MKB KoP

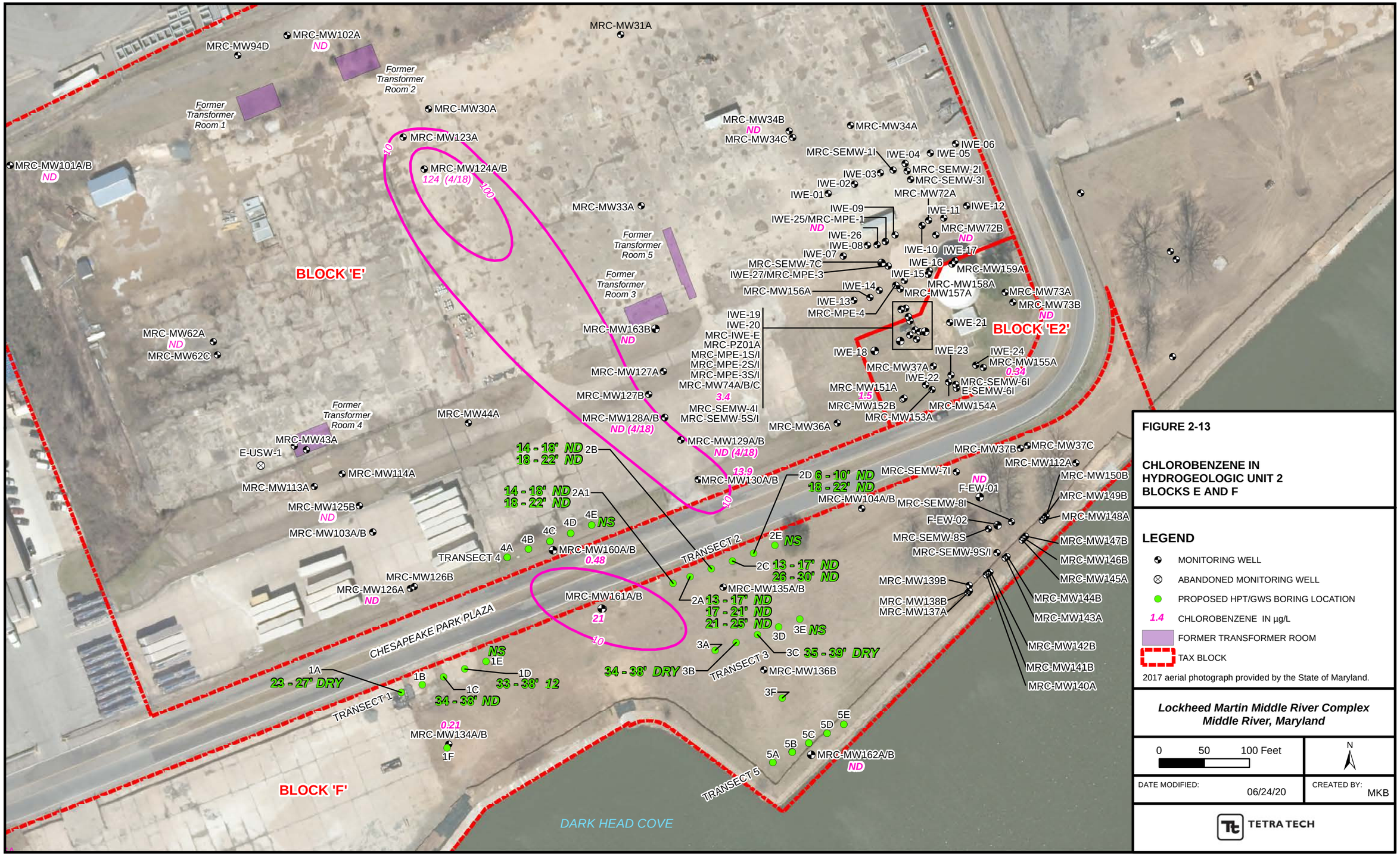


FIGURE 2-13

CHLOROBENZENE IN HYDROGEOLOGIC UNIT 2 BLOCKS E AND F

LEGEND

- MONITORING WELL
- ABANDONED MONITORING WELL
- PROPOSED HPT/GWS BORING LOCATION
- 1.4 CHLOROBENZENE IN µg/L
- FORMER TRANSFORMER ROOM
- TAX BLOCK

2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 50 100 Feet

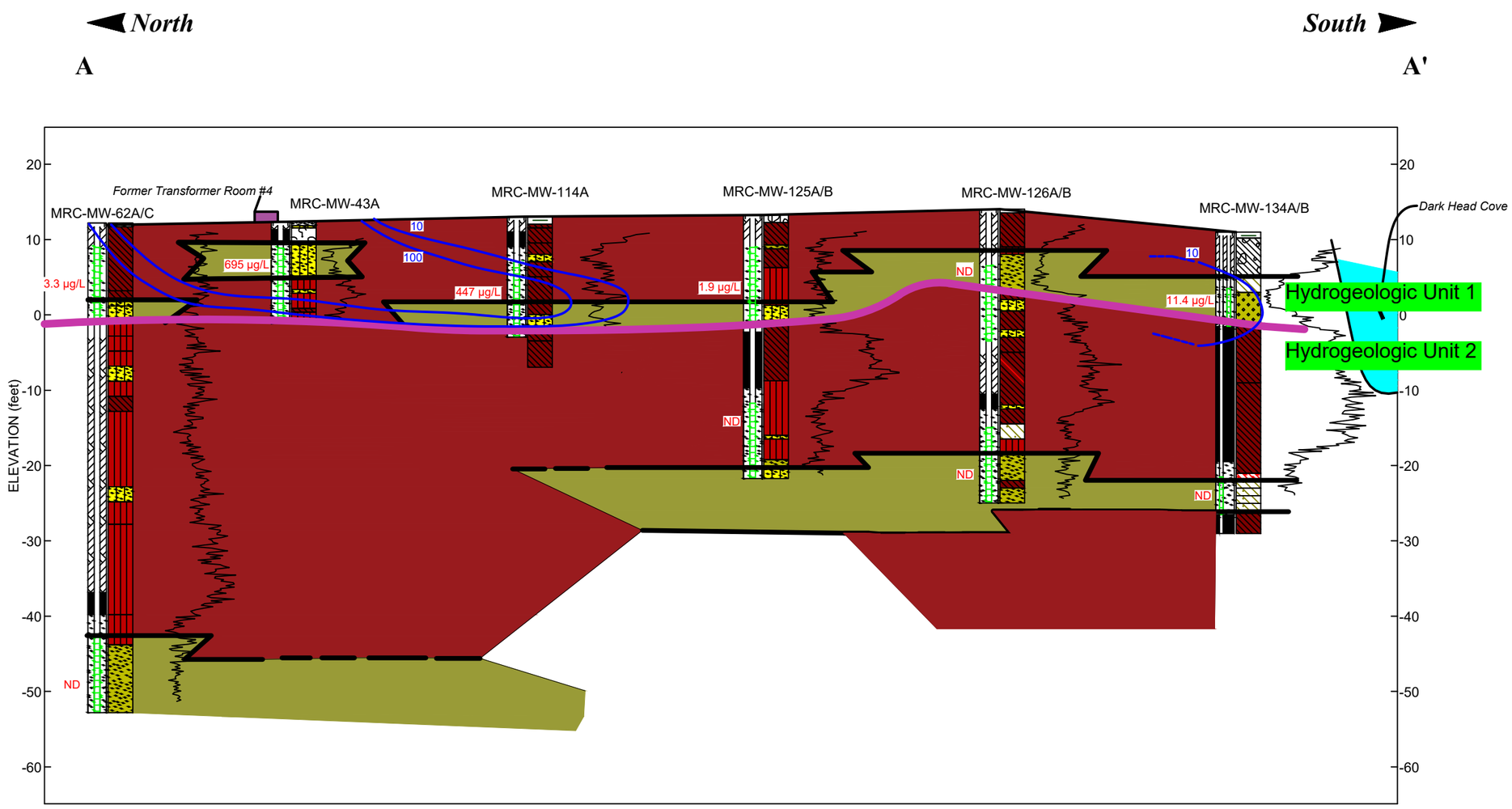
N

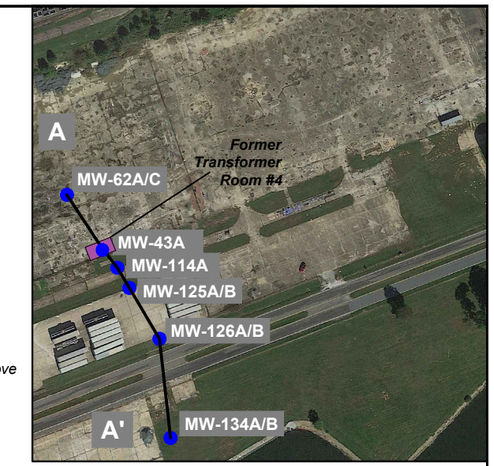
DATE MODIFIED: 06/24/20

CREATED BY: MKB

TETRA TECH

Map Document: (C:\GIS\Middle_River\MapDocs\MXD\blocks_ef_chlorobenzene_hpt_hu2_kop.mxd)
06/24/20 -- MKB KoP





Lithology Graphics

- Concrete
- USCS Low Plasticity Clay
- USCS Low Plasticity Sandy Clay
- USCS Silty Sand
- USCS Poorly-graded Sand
- USCS Clayey Sand
- NO RECOVERY
- USCS Low Plasticity Organic silt or clay
- USCS Low Plasticity Gravelly Clay
- USCS Silt
- USCS Silty Gravel
- USCS Well-graded Sand

FIGURE 2-14

CROSS SECTION A-A'
WITH 2019 GROUNDWATER
1,2,4-TRICHLOROBENZENE CONCENTRATIONS
BLOCKS E/F, MIDDLE RIVER COMPLEX

Legend

MRC-MW-43A — Borehole Number

Borehole Lithology — Well Construction

Gamma Levels (cps)
Sequence Boundary
6.44 Hydraulic Head (feet RMSL)
193 1,2,4-TCB Concentration (µg/L)
10,100 contour line

Dominantly CLAYS
Dominantly SANDS
Dominantly SILTS

Note: Analytical data collected from 2019 annual groundwater sampling, or most recent data available

Lockheed Martin Middle River Complex
Middle River, Maryland

0 57
Horizontal Scale
Vertical Exaggeration: 3.5x

N

DATE MODIFIED: 7/7/2020

CREATED BY: JM

TETRA TECH

C:\Users\josh.mullis\Desktop\ESS cross section DWGs\feb 11 final dwgs\newest figures july 2020\Figure 2-12 A-A'

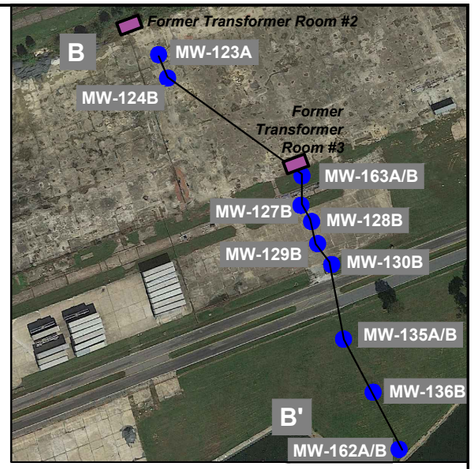
North

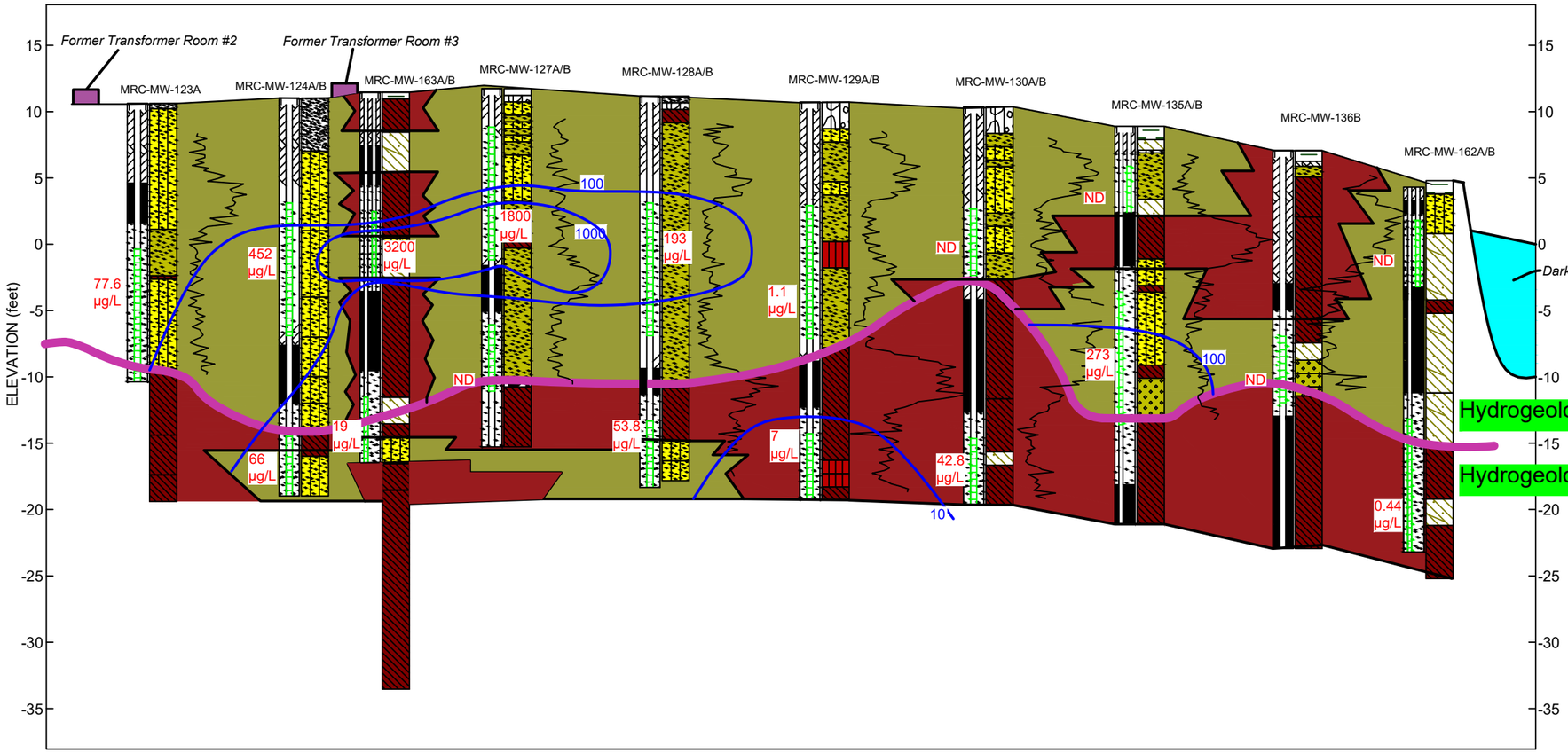
B

South

B'

N





DISTANCE ALONG PROFILE (feet)

Lithology Graphics

- Concrete
- USCS Clayey Sand
- USCS Low Plasticity Gravelly Clay
- USCS Silty Sand
- USCS Silty Gravel
- USCS Low Plasticity Organic silt or clay
- USCS Poorly-graded Sand
- USCS Well-graded Gravel
- USCS Poorly-graded Gravelly Sand
- USCS Low Plasticity Clay
- USCS Silt
- USCS Well-graded Sand

FIGURE 2-15

CROSS SECTION B-B'
WITH 2019 GROUNDWATER
1,2,4-TRICHLOROBENZENE CONCENTRATIONS
BLOCKS E/F, MIDDLE RIVER COMPLEX

Legend

MRC-MW-43A — Borehole Number

Borehole Lithology — Well Construction

- Gamma Levels (cps)
- Sequence Boundary
- 161 µg/L 1,2,4-Trichlorobenzene Concentration
- 10,100 contour line
- Dominantly CLAYS
- Dominantly SANDS
- Dominantly SILTS

Note: Analytical data collected from 2019 annual groundwater sampling, or most recent data available

Lockheed Martin Middle River Complex
Middle River, Maryland

0 — 94 Horizontal Scale
Vertical Exaggeration: 9x

N

DATE MODIFIED: 7/7/2020

CREATED BY: JM

TETRA TECH

C:\Users\josh.mullis\Desktop\ESS cross section DWGs\feb 11 final dwgs\newest figures july 2020\Figure 2-10 B-B'

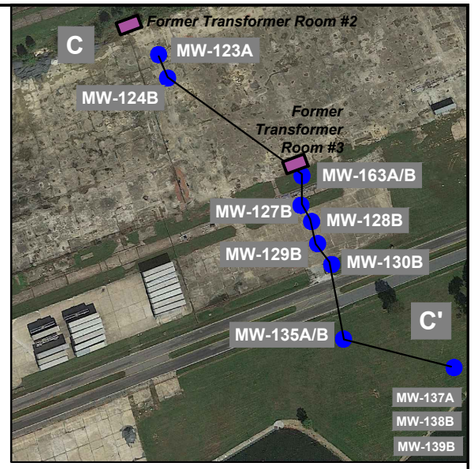
North

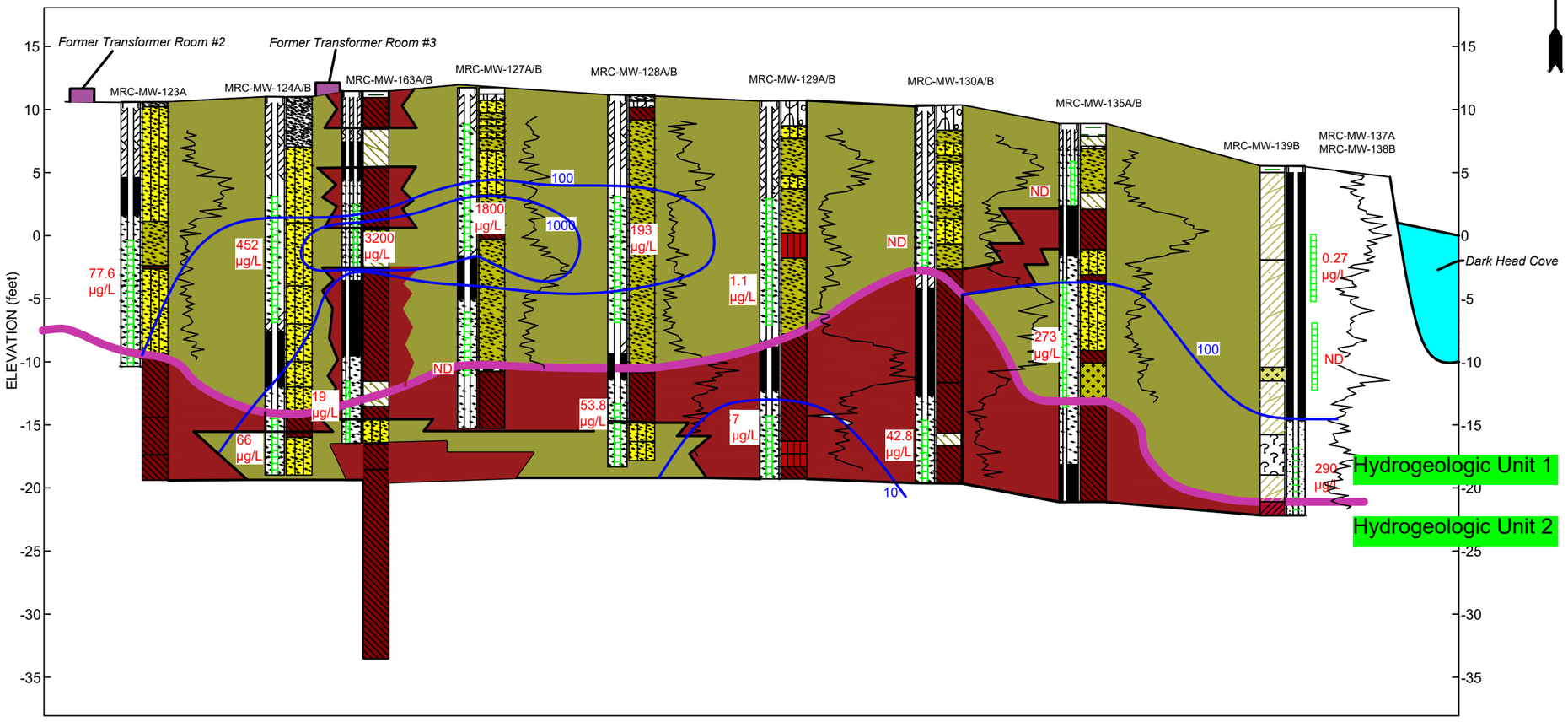
C

South

C'

N





DISTANCE ALONG PROFILE (feet)

Lithology Graphics

- Concrete
- USCS Clayey Sand
- USCS Low Plasticity Gravelly Clay
- USCS Silty Sand
- USCS Silty Gravel
- USCS Low Plasticity Organic silt or clay
- USCS Poorly-graded Sand
- USCS Well-graded Gravel
- USCS Poorly-graded Gravelly Sand
- USCS Low Plasticity Clay
- USCS Silt
- USCS Well-graded Sand

FIGURE 2-16

CROSS SECTION C-C'
WITH 2019 GROUNDWATER
1,2,4-TRICHLOROBENZENE CONCENTRATIONS
BLOCKS E/F, MIDDLE RIVER COMPLEX

Legend

MRC-MW-43A — Borehole Number

Borehole Lithology — Well Construction

- Gamma Levels (cps)
- Sequence Boundary
- 161 µg/L 1,2,4-Trichlorobenzene Concentration
- 10,100 contour line
- Dominantly CLAYS
- Dominantly SANDS
- Dominantly SILTS

Note: Analytical data collected from 2019 annual groundwater sampling, or most recent data available

Lockheed Martin Middle River Complex
Middle River, Maryland

0 — 94 Horizontal Scale
Vertical Exaggeration: 9x

N

DATE MODIFIED: 7/7/2020

CREATED BY: JM

TETRA TECH

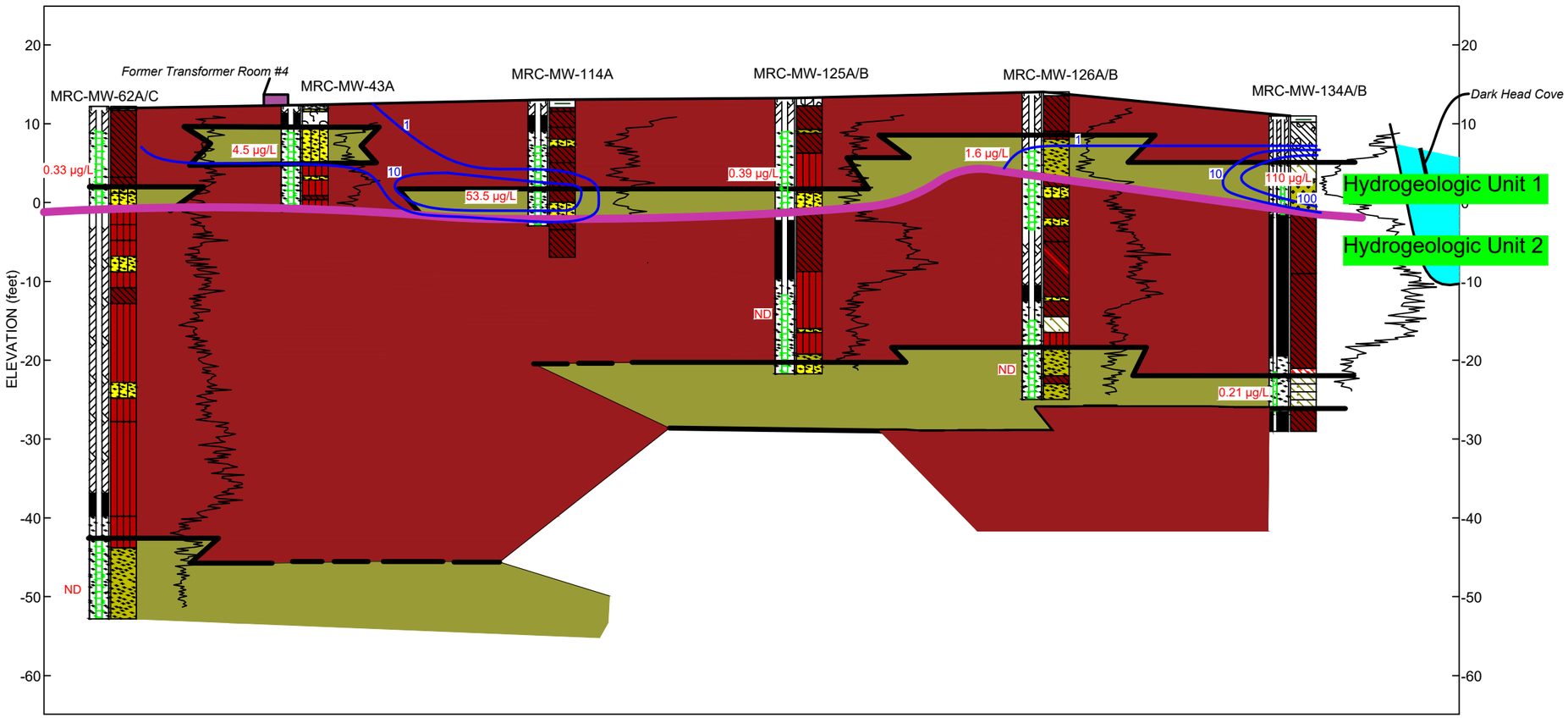
C:\Users\josh.mullis\Desktop\ESS cross section DWGs\feb 11 final dwgs\newest figures july 2020\Figure 2-11 C-C'

North

A

South

A'



DISTANCE ALONG PROFILE (feet)

Lithology Graphics

- Concrete
- USCS Low Plasticity Clay
- USCS Low Plasticity Sandy Clay
- USCS Silty Sand
- USCS Poorly-graded Sand
- USCS Clayey Sand
- NO RECOVERY
- USCS Low Plasticity Organic silt or clay
- USCS Low Plasticity Gravelly Clay
- USCS Silt
- USCS Silty Gravel
- USCS Well-graded Sand

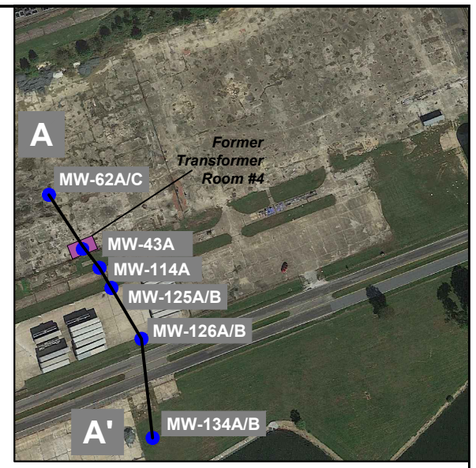


FIGURE 2-17

**CROSS SECTION A-A'
WITH 2019 GROUNDWATER
CHLOROBENZENE CONCENTRATIONS
BLOCKS E/F, MIDDLE RIVER COMPLEX**

Legend

MRC-MW-43A — Borehole Number

Borehole Lithology — Well Construction

- Gamma Levels (cps)
- Sequence Boundary
- 6.44 Hydraulic Head (feet RMSL)
- 193 Chlorobenzene Concentration (µg/L)
- 10,100 contour line
- Dominantly CLAYS
- Dominantly SANDS
- Dominantly SILTS

Note: Analytical data collected from 2019 annual groundwater sampling, or most recent data available

***Lockheed Martin Middle River Complex
Middle River, Maryland***

0 — 57 Horizontal Scale

Vertical Exaggeration: 3.5x

N

DATE MODIFIED: 7/7/2020

CREATED BY: JM

TETRA TECH

C:\Users\josh.mullis\Desktop\ESS cross section DWGs\feb 11 final dwgs\newest figures july 2020\Figure 2-15 A-A'

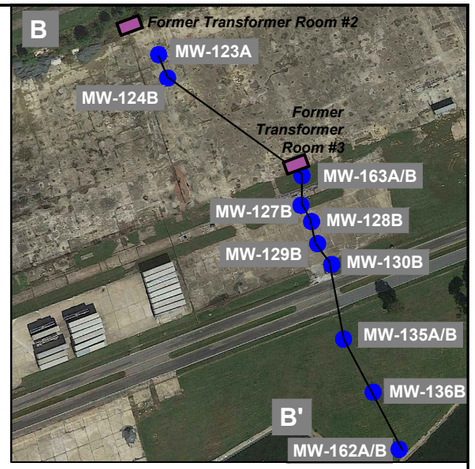
North

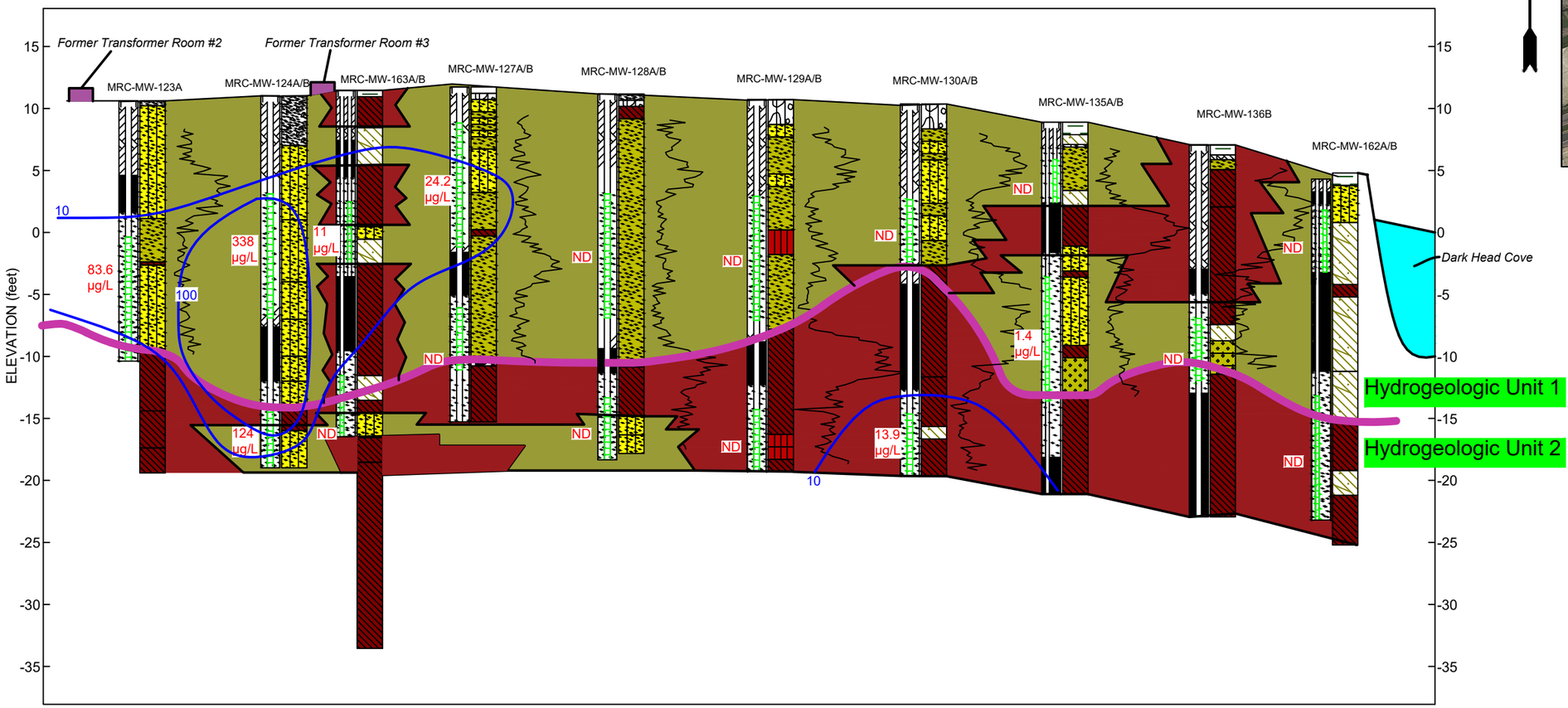
B

South

B'

N





Lithology Graphics

- Concrete
- USCS Clayey Sand
- USCS Low Plasticity Gravelly Clay
- USCS Silty Sand
- USCS Silty Gravel
- USCS Low Plasticity Organic silt or clay
- USCS Poorly-graded Sand
- USCS Well-graded Gravel
- USCS Poorly-graded Gravelly Sand
- USCS Low Plasticity Clay
- USCS Silt
- USCS Well-graded Sand

FIGURE 2-18

CROSS SECTION B-B'
WITH 2019 GROUNDWATER
CHLOROBENZENE CONCENTRATIONS
BLOCKS E/F, MIDDLE RIVER COMPLEX

Legend

MRC-MW-43A
Borehole Number
Borehole Lithology
Well Construction

- Gamma Levels (cps)
- Sequence Boundary
- 161 µg/L Chlorobenzene Concentration
- 10,100 contour line
- Dominantly CLAYS
- Dominantly SANDS
- Dominantly SILTS

Note: Analytical data collected from 2019 annual groundwater sampling, or most recent data available

Lockheed Martin Middle River Complex
Middle River, Maryland

0 94
Horizontal Scale
Vertical Exaggeration: 9x

N

DATE MODIFIED: 7/7/2020

CREATED BY: JM

TETRA TECH

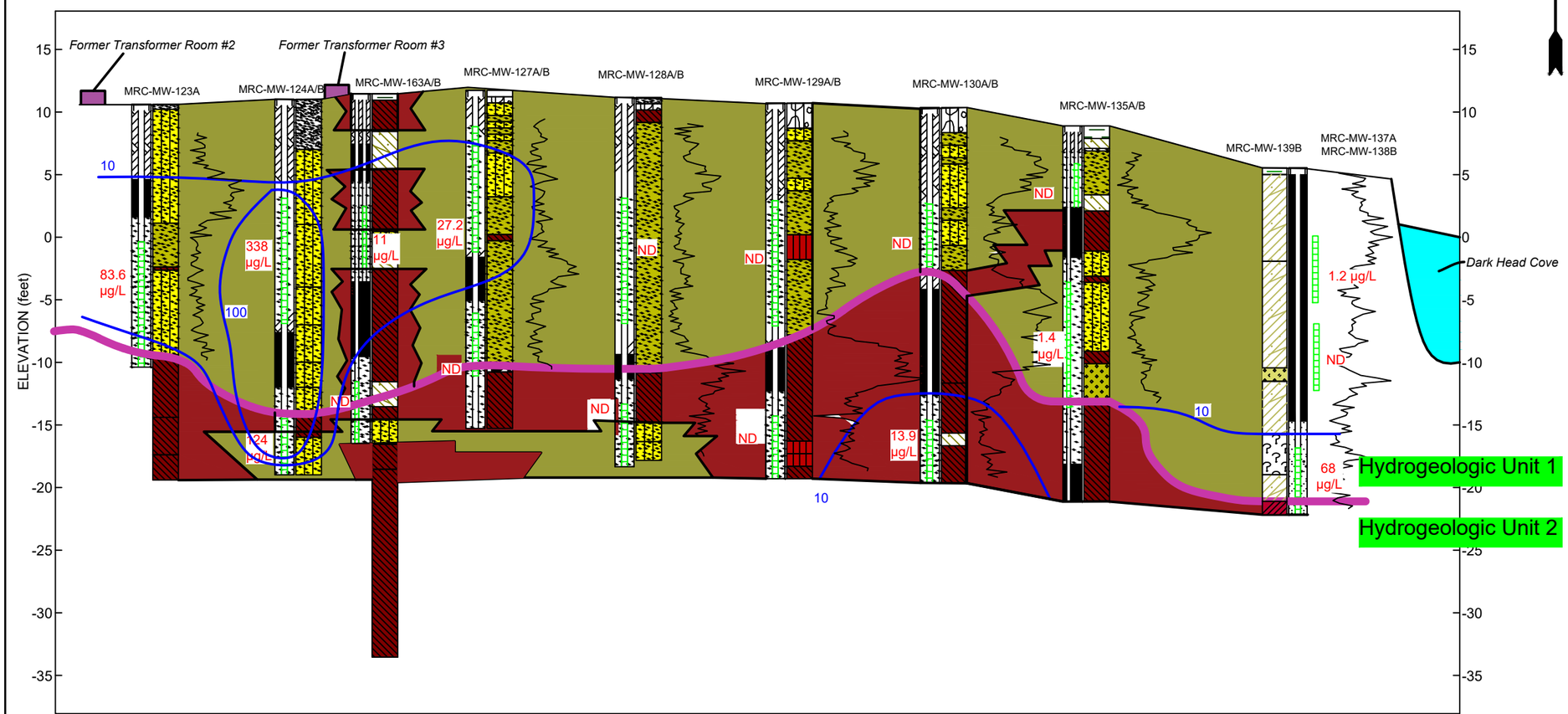
C:\Users\josh.mullis\Desktop\ESS cross section DWGs\feb 11 final dwgs\newest figures july 2020\Figure 2-13 B-B'

North

C

South

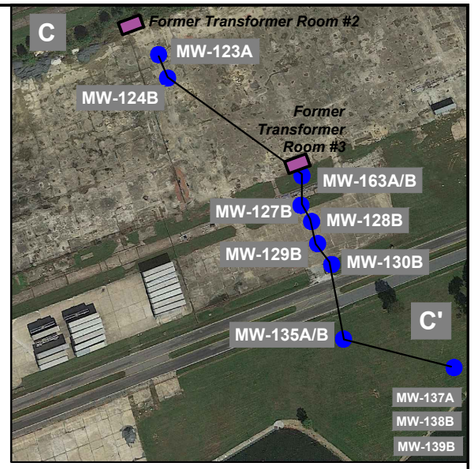
C'



DISTANCE ALONG PROFILE (feet)

Lithology Graphics

- Concrete
- USCS Clayey Sand
- USCS Low Plasticity Gravelly Clay
- USCS Silty Sand
- USCS Silty Gravel
- USCS Low Plasticity Organic silt or clay
- USCS Poorly-graded Sand
- USCS Well-graded Gravel
- USCS Poorly-graded Gravelly Sand
- USCS Low Plasticity Clay
- USCS Silt
- USCS Well-graded Sand



N

FIGURE 2-19

**CROSS SECTION C-C'
WITH 2019 GROUNDWATER
CHLOROBENZENE CONCENTRATIONS
BLOCKS E/F, MIDDLE RIVER COMPLEX**

Legend

MRC-MW-43A — Borehole Number

Borehole Lithology — Well Construction

- Gamma Levels (cps)
- Sequence Boundary
- 161 µg/L 1,2,4-Trichlorobenzene Concentration
- 10,100 contour line
- Dominantly CLAYS
- Dominantly SANDS
- Dominantly SILTS

Note: Analytical data collected from 2019 annual groundwater sampling, or most recent data available

Lockheed Martin Middle River Complex
Middle River, Maryland

0 — 94
Horizontal Scale
Vertical Exaggeration: 9x

N

DATE MODIFIED: 7/7/2020

CREATED BY: JM

TETRA TECH

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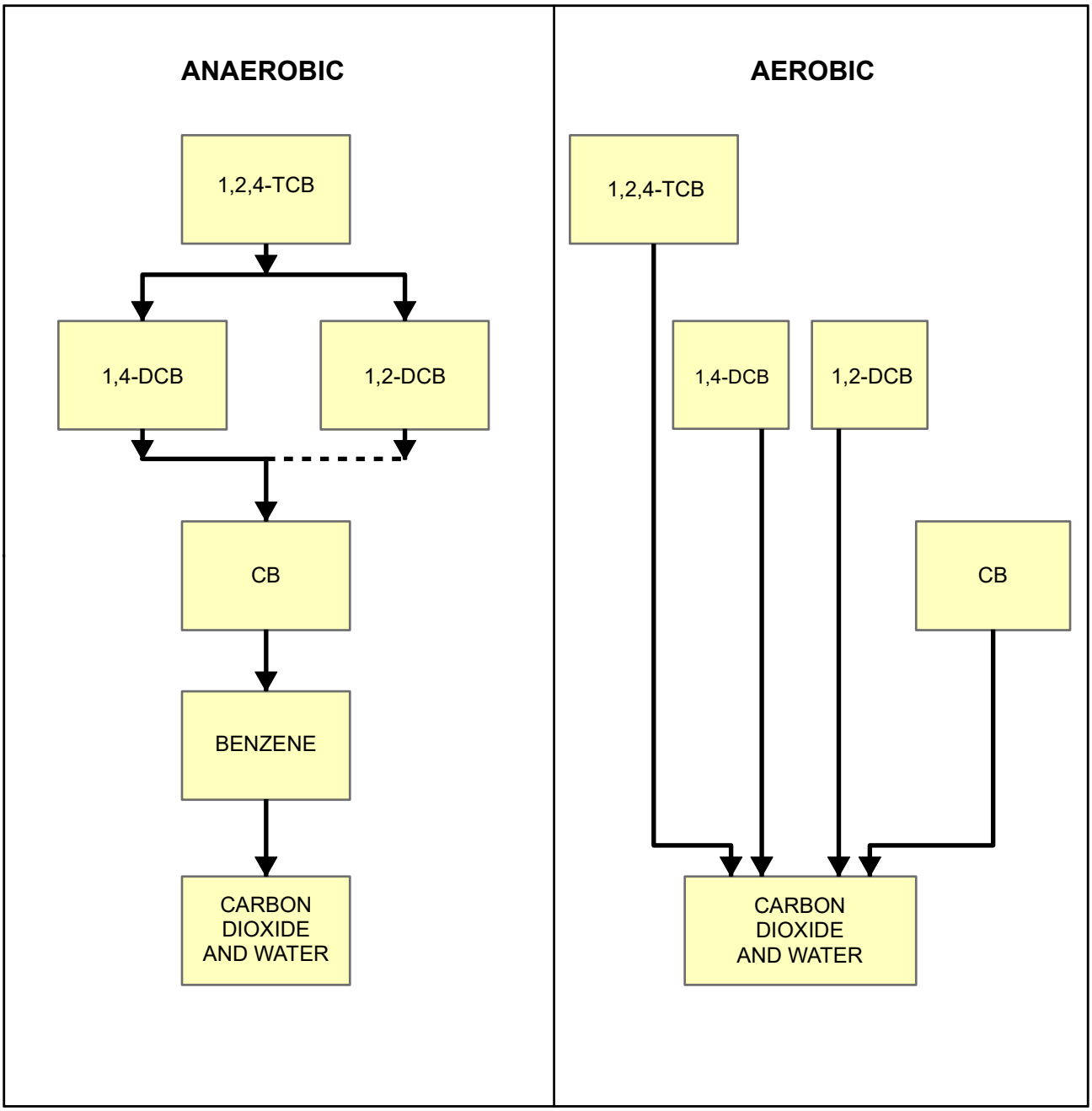

Legend

CB – Chlorobenzene
DCB – Dichlorobenzene
TCB – Trichlorobenzene

→ Confirmed Pathway
- - ▶ Unconfirmed Pathway

Derived from: *Description, Properties, and Degradation of Selected Volatile Organic Compounds Detected in Ground Water — A Review of Selected Literature, USGS, 2006.*

FIGURE 2-20

SIMPLIFIED DEGRADATION PATHWAYS OF CHLORINATED BENZENES

Lockheed Martin Middle River Complex
Middle River, Maryland

DATE MODIFIED:	CREATED BY:
09/09/20	JAZ

TETRA TECH

Map Document: (P:\GIS\Middle_River\MapDocs\MXD\Block_E\TCB_flowchart.mxd)
09/09/20 -- JAZ



FIGURE 3-1

ALTERNATIVE 2 - EXTRACTION AND TREATMENT OF CHLORINATED BENZENE PLUMES

LEGEND

- PROPOSED TCB EXTRACTION WELL
- MONITORING WELL
- ABANDONED MONITORING WELL
- 1,2,4-TRICHOLORBENZENE ISOCONTOUR FOR HYDROGEOLOGIC UNIT 1 (IN UG/L)
- PROPOSED TCB EXTRACTION PIPING
- TCE PLUME TREATMENT BUILDING
- TCE PLUME PERMEABLE REACTIVE BARRIER
- TCE PLUME EXTRACTION PIPING
- FORMER TRANSFORMER ROOM
- TAX BLOCK

2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 50 100 Feet

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DATE MODIFIED: 07/06/20

CREATED BY: JEE

TETRA TECH

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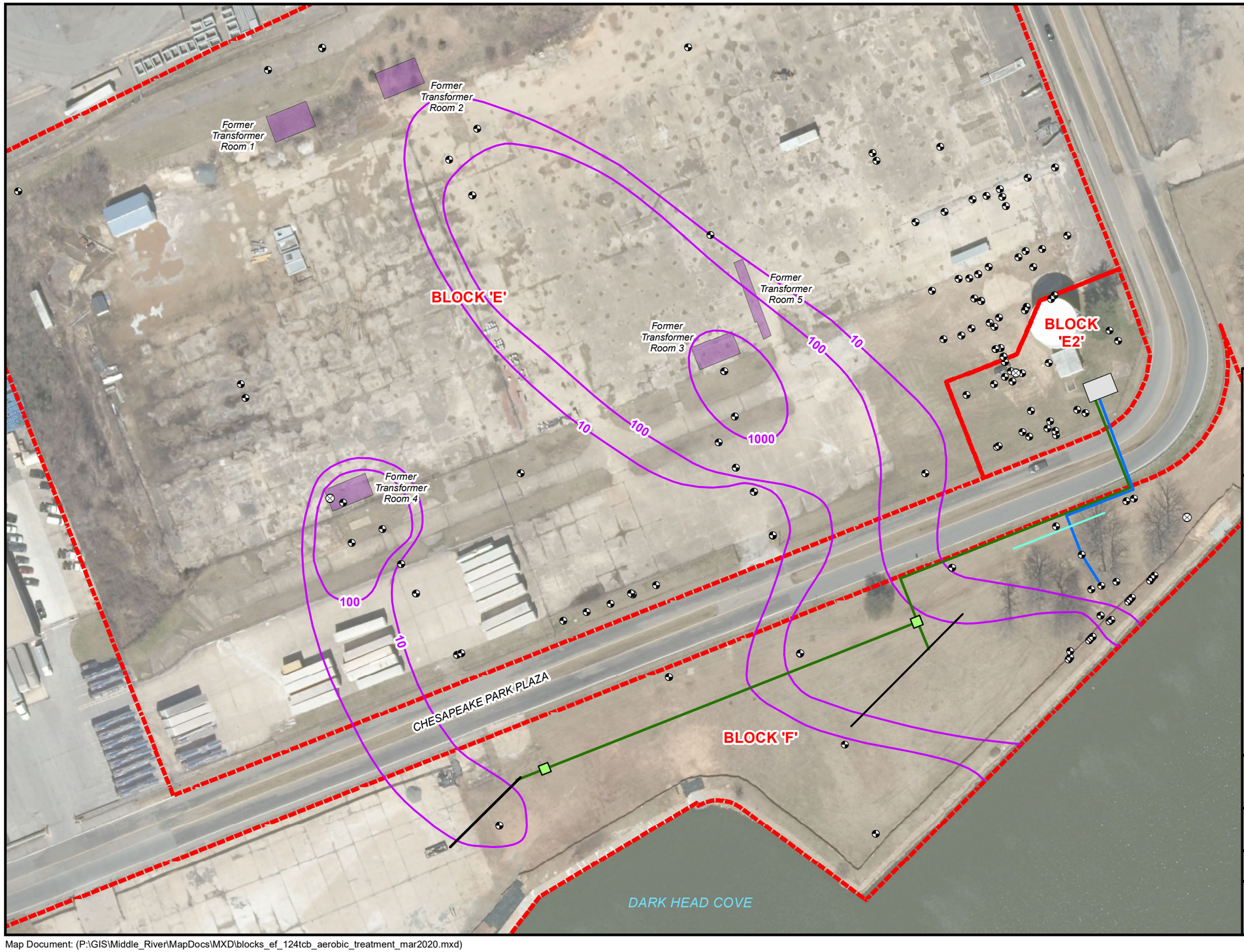

FIGURE 3-2

ALTERNATIVE 4 - AEROBIC PRB TREATMENT OF CHLORINATED BENZENE PLUMES

LEGEND

- MONITORING WELL
- ABANDONED MONITORING WELL
- 1,2,4-TRICHOLORBENZENE ISOCONTOUR FOR HYDROGEOLOGIC UNIT 1(IN UG/L)
- PROPOSED COMPRESSED AIR LINE
- PROPOSED BIOSPARGE WELL LINE
- PROPOSED DISTRIBUTION MANIFOLD
- TCE PLUME TREATMENT BUILDING
- TCE PLUME EXTRACTION PIPING
- TCE PLUME PERMEABLE REACTIVE BARRIER
- FORMER TRANSFORMER ROOM
- TAX BLOCK

2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 50 100 Feet

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DATE MODIFIED: 07/06/20

CREATED BY: JEE

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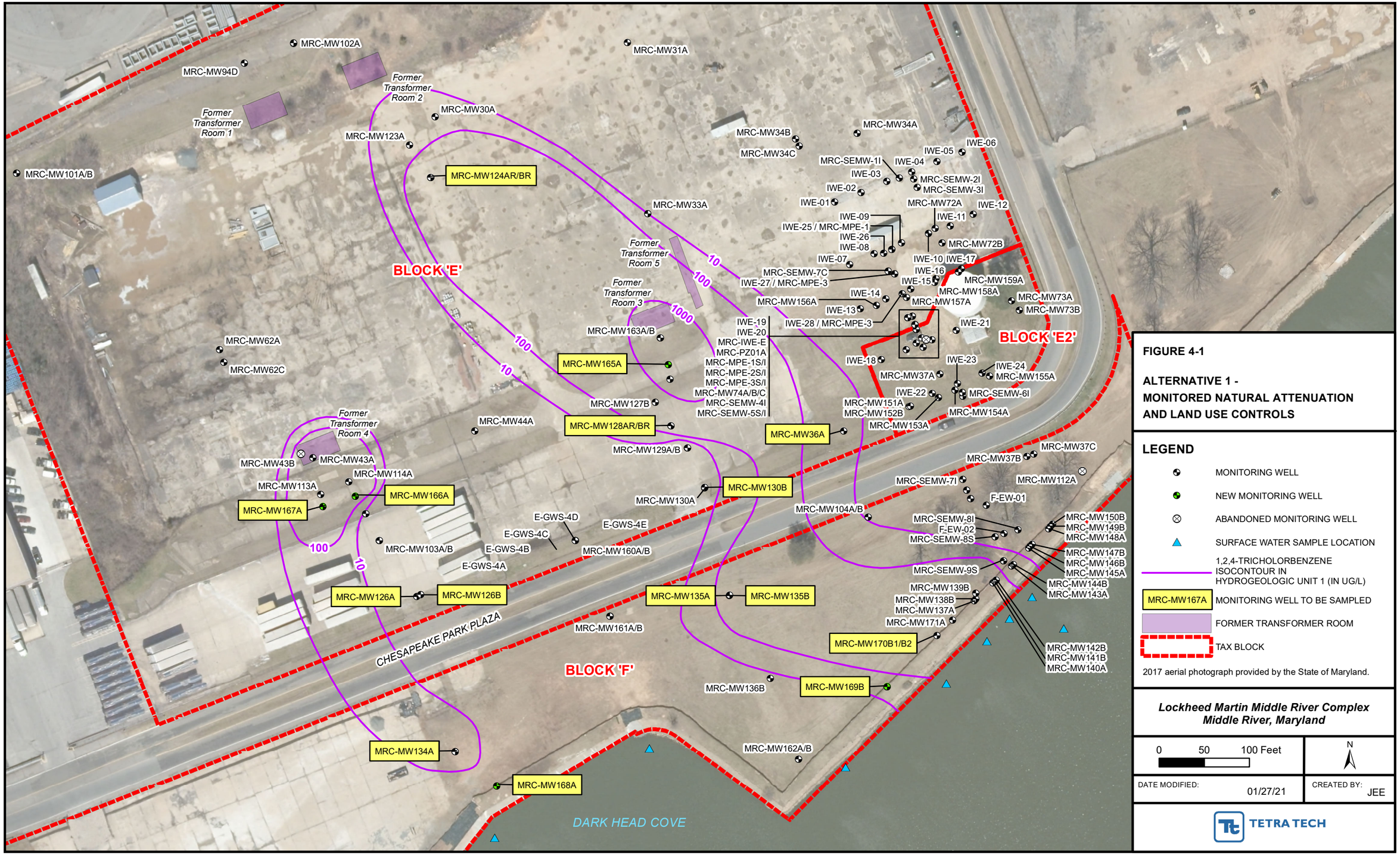

FIGURE 4-1

ALTERNATIVE 1 - MONITORED NATURAL ATTENUATION AND LAND USE CONTROLS

LEGEND

- MONITORING WELL
- NEW MONITORING WELL
- ABANDONED MONITORING WELL
- SURFACE WATER SAMPLE LOCATION
- 1,2,4-TRICHOLORBENZENE ISOCONTOUR IN HYDROGEOLOGIC UNIT 1 (IN UG/L)
- MRC-MW167A — MONITORING WELL TO BE SAMPLED
- FORMER TRANSFORMER ROOM
- TAX BLOCK

2017 aerial photograph provided by the State of Maryland.

Lockheed Martin Middle River Complex
Middle River, Maryland

0 50 100 Feet

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DATE MODIFIED: 01/27/21

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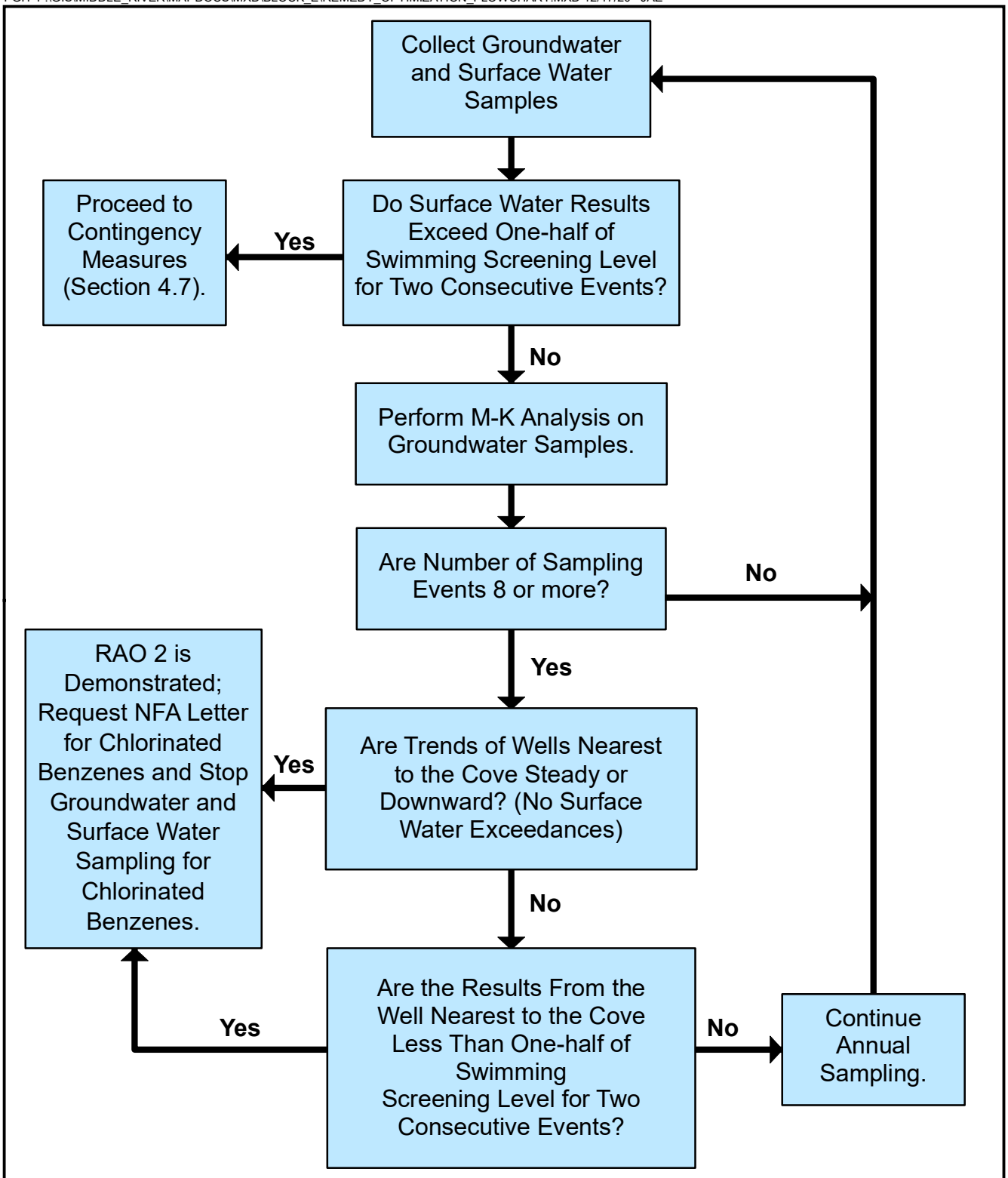

TETRA TECH

REMEDY OPTIMIZATION FLOW CHART

DRAWN BY: J. ZAMUDIO 12/02/20
CHECKED BY: J. LOGAN 12/17/20
APPROVED BY:

CONTRACT NUMBER: 112IC09007

FIGURE NUMBER	REV
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TABLES

Table 3-1 Screening of Technologies and Process Options for the TCB Groundwater Response Action Plan

Table 3-2 Technologies and Process Options Retained for the TCB Groundwater Response Action Plan

Table 3-3 Long List of Remedial Alternatives for the TCB Groundwater Response Action Plan

Table 3-4 Analysis of Short-List Alternatives Using CERCLA Criteria for the TCB Groundwater Response Action Plan

Table 3-5 Chemical-Specific ARARs and TBCs TCB Groundwater Response Action Plan

Table 3-6 Location-Specific ARARs and TBCs TCB Groundwater Response Action Plan

Table 3-7 Action-Specific ARARs and TBCs TCB Groundwater Response Action Plan

Table 4-1 Monitoring Wells for Alternative 1

Table 3-1

Screening of Technologies and Process Options for the TCB Groundwater Response Action Plan
Lockheed Martin Middle River Complex, Middle River, Maryland

General Response Action	Response Action Technology	Process Option	Description	Screening Comment
No action	None	Not applicable	No activities conducted on the trichlorobenzene (TCB) plumes to address contamination. Biodegradation of contaminants may occur through natural attenuation processes, but would not be verified.	Eliminate. This option does not meet response action objectives (RAOs) and has been eliminated from consideration.
Limited action	Land use controls (LUCs)	Institutional controls	Administrative action using property deeds or other land use prohibitions to restrict future site activities.	Retain. Would be protective of human health and the environment at this time. LUCs are already in place in Block F and are proposed for Block E
	Monitoring and monitored natural attenuation (MNA)	Groundwater sampling	Sampling and analysis of groundwater to evaluate the effectiveness of source removal, plume treatment, and the progress of natural attenuation following active remediation. Natural attenuation includes, biodegradation, dispersion, dilution, sorption, volatilization, and chemical or biological stabilization, transformation, or destruction of contaminants.	Retain. Alone, would not meet RAOs; however, would be protective of human health and the environment at this time and would provide data to confirm protectiveness moving forward. Chlorinated benzenes (CBs) can be degraded aerobically and anaerobically.
Containment	Hydraulic containment	Groundwater extraction	Extraction wells or trenches to prevent migration of 1,2,4-TCB and other CBs toward Dark Head Cove.	Retain. The technology could be used to prevent contaminant migration toward Dark Head Cove.

Table 3-1

Screening of Technologies and Process Options for the TCB Groundwater Response Action Plan
Lockheed Martin Middle River Complex, Middle River, Maryland

General Response Action	Response Action Technology	Process Option	Description	Screening Comment
Containment (Cont.)	Barrier	Permeable reactive barrier (PRB)	PRBs use reactive media to prevent migration of CBs toward Dark Head Cove. Reactive media can be placed in a trench or injected via a series of injection points or wells or air can be injected.	Retain. The technology could be used with other technologies to reduce contaminant migration toward Dark Head Cove.
	Barrier	Air sparge curtain	Air sparge curtain utilizes air to remove volatile organic compounds (VOCs) from passing groundwater. Air can be injected via horizontal laterals within a trench or via a series of injection wells.	Eliminate. Heterogeneity and low permeability limit effectiveness of the distribution of large volumes of air.
Ex situ treatment	Biological	Aerobic/ anaerobic	Natural degradation of organic chemicals of concern (COC) via microorganisms in an aerobic (oxygen-rich) or anaerobic (oxygen-deficient) environment.	Eliminate. CBs are more readily treated by air stripping and/or granular activated carbon (GAC).
	Physical	Filtration	Separation of suspended solids from water via entrapment in a bed of granular media or membrane.	Retain. May be useful in combination with other *ex situ* treatment options, but little effect on CBs. Extra capacity is present in trichloroethene (TCE) treatment system.
		Air stripping	Contact of water with an air stream to remove VOCs.	Retain. Proven treatment method for removal of CBs. Extra capacity is present in TCE treatment system.

Table 3-1

Screening of Technologies and Process Options for the TCB Groundwater Response Action Plan
Lockheed Martin Middle River Complex, Middle River, Maryland

General Response Action	Response Action Technology	Process Option	Description	Screening Comment
Ex situ treatment (Cont.)	Physical (Cont.)	GAC adsorption	Separation of dissolved contaminants from water or air streams via adsorption onto GAC.	Retain. Proven treatment method for removal of CBs from contaminated groundwater and air stripper off-gas. Extra capacity is present in TCE treatment system.
		Solvent extraction	Separation of contaminants from a solution by contact with an immiscible liquid with a higher COC affinity.	Eliminate. Not proven to be cost-effective for removal of CBs.
		Sedimentation	Separation of solids from water via gravity settling.	Eliminate. Will not be needed based on multi-phase extraction (MPE, in the TCE plume treatment system) operational experience. Would not remove CBs.

Table 3-1

Screening of Technologies and Process Options for the TCB Groundwater Response Action Plan
Lockheed Martin Middle River Complex, Middle River, Maryland

General Response Action	Response Action Technology	Process Option	Description	Screening Comment
Ex situ treatment (Cont.)	Chemical	Coagulation/ flocculation	Use of chemicals to neutralize surface charges and promote attraction of colloidal particles to facilitate settling.	Eliminate. Will not be needed based on MPE (TCE plume treatment system) operational experience. Would not remove CBs.
		Chemical precipitation	Use of reagents to convert soluble compounds into insoluble compounds.	Eliminate. Will not be needed based on MPE (TCE plume treatment system) operational experience. Would not remove CBs.
		Ion exchange	Removal of dissolved ions through exchange with similarly charged ions held on the active sites of a synthetic resin that is contacted with the liquid to be treated.	Eliminate. Will not be needed based on MPE (TCE plume treatment system) operational experience. Would not remove CBs.
		Advanced oxidation	Use of oxidizers such as ozone, hydrogen peroxide, or potassium permanganate to break down certain organic compounds.	Eliminate. Other technologies (air stripping and GAC) have been demonstrated for treatment of CBs.

Table 3-1

Screening of Technologies and Process Options for the TCB Groundwater Response Action Plan
Lockheed Martin Middle River Complex, Middle River, Maryland

General Response Action	Response Action Technology	Process Option	Description	Screening Comment
In situ treatment	Biological	Enhanced anaerobic reductive dechlorination (ARD)	Injection of substrates and/or bioamendments to create conditions suitable for reductive dechlorination.	Retain. ARD of TCB often stalls at dichlorobenzene (DCB) and CB, although these compounds are much less toxic than TCB.
		Aerobic	Injection of air (biosparging) or oxygen-releasing compounds (ORC) to promote aerobic biological activity.	Retain. Aerobic biological treatment is effective in treating CBs, although biosparging examples of CBs were not found. Heterogeneity and fines will limit efficient distribution of air and ORC.
	Physical	Air sparging	Injection of air to remove VOCs from groundwater. Vapors may be collected for *ex situ* treatment.	Eliminate. Heterogeneity and low permeability limit effectiveness of the distribution of large volumes of air.
	Chemical	Oxidation via oxidant addition	Destroy contaminants via oxidation using an oxidant injected into the aquifer	Eliminate. Could potentially be effective. However, chemicals could migrate to Dark Head Cove. Heterogeneity and fines will limit efficient distribution of reagents.
		Reduction with zero-valent iron (ZVI)	ZVI can create reducing conditions to treat chlorinated compounds, such as CBs.	Eliminate. Few if any applications of ZVI on sites contaminated with CBs.
	Thermal	Subsurface heating	Volatilization of organic COC through groundwater and soil heating in combination with vacuum extraction of volatilized material.	Eliminate. Would not be cost-effective to treat large, low-concentration plume.

Table 3-1

Screening of Technologies and Process Options for the TCB Groundwater Response Action Plan
Lockheed Martin Middle River Complex, Middle River, Maryland

General Response Action	Response Action Technology	Process Option	Description	Screening Comment
Discharge/ disposal	Surface discharge	Direct discharge	Discharge of treated water to surface water.	Eliminate. Effluent limitations would be stringent with the potential for exceedances and notices of violations.
		Indirect discharge	Discharge of collected/treated water to local publicly-owned treatment works (POTW).	Retain. POTW may have flow rate and influent limitations. TCE treatment system discharges to POTW.
		Off-site treatment facility	Treatment and disposal of water at an off-site treatment works.	Eliminate. Large volume of water would be too costly to transport.
	Subsurface discharge	Reinjection	Use of injection wells or infiltration for discharge of treated groundwater underground.	Eliminate. Continuous reinjection would be difficult due to the heterogenous, low permeability soil at the site.

Table 3-2

Technologies and Process Options Retained for the TCB Groundwater Response Action Plan Lockheed Martin Middle River Complex, Middle River, Maryland

General Response Action	Response	Process Option
Limited action	Land use controls	Institutional controls
	Monitoring/monitored natural attenuation (MNA)	Groundwater sampling
Containment	Barrier	Groundwater extraction via wells
		Permeable reactive barrier (PRB)
Collection	Groundwater extraction	Groundwater extraction via wells
Ex situ treatment	Physical	Filtration
		Air stripping
		Granular activated carbon (GAC) adsorption
In situ treatment	Biological	Aerobic - biosparging
Discharge/disposal	Surface discharge (treated water)	Indirect discharge – through publicly owned treatment works (POTW)

Table 3-3
Long List of Remedial Alternatives for the TCB Groundwater Response Action Plan
Lockheed Martin Middle River Complex, Middle River, Maryland

Number	Alternative	Description	Effectiveness	Implementability	Cost
1	**Monitored natural attenuation (MNA) and land use controls (LUCs)**	**Institutional controls to prevent certain site uses to ensure acceptable risk to site users. Sampling of groundwater and surface water to confirm that surface water criteria per RAO 2 are not exceeded.**	**No chlorinated benzenes have been detected in surface water at concentrations greater than RAO 2 criteria. RAOs are currently maintained. Does not prevent migration of chlorinated benzenes.**	**Readily implementable. Numerous contractors available for sampling. LUC documents easy to prepare.**	**Low Cost**
2	**Complete Hydraulic Containment, MNA/LUCs**	**Use pumping wells in Block F to prevent migration of chlorinated benzenes to Dark Head Cove. Trichloroethene (TCE) groundwater treatment system would be used to treat extracted groundwater. Sampling of groundwater and surface water to confirm that surface water criteria per RAO 2 are not exceeded.**	**Extraction wells would prevent plumes from entering Dark Head Cove. Long-duration operation would be required for extraction wells and treatment system.**	**Readily implementable. Numerous contractors can install wells and piping and perform sampling. Treatment capacity is available in TCE GWETS. Long-term operation of treatment system is required. LUC documents easy to prepare.**	**Medium capital cost. Relatively high long-term operating cost for fees to POTW.**
3	Anaerobic permeable reactive barriers (PRBs), MNA/LUCs	Anaerobic PRBs using injections of electron donor, such as emulsified vegetable oil in Block F across TCB plumes to prevent migration of chlorinated benzenes to Dark Head Cove. Sampling of groundwater and surface water to confirm that surface water criteria per RAO 2 are not exceeded.	Anaerobic PRBs would treat plumes before entering Dark Head Cove. Complete dechlorination of 1,2,4-TCB is uncertain.	Readily implementable. Numerous contractors can inject electron donor and perform sampling. No long-term O&M is required. LUC documents easy to prepare.	Medium capital and recurring electron donor replacement cost.
4	**Aerobic PRBs (biosparging), MNA/LUCs**	**Similar to Alternative 3 but utilizes biosparge curtain via a series of injection wells. Sampling of groundwater and surface water to confirm that surface water criteria per RAO 2 are not exceeded.**	**Aerobic PRBs would treat plumes before entering Dark Head Cove. Uncertain performance of barrier due to heterogeneous geology and low permeability which affects distribution of air and oxygen. No examples of air sparge barriers for chlorinated benzenes found in literature.**	**Readily implementable. Numerous contractors can install wells and piping and perform sampling. Long-term operation of treatment system is required. LUC documents easy to prepare.**	**Medium capital cost and long-term costs for compressor operation.**

Bolded Alternatives are retained.

Table 3-4
Analysis of Short-List Alternatives for the TCB Groundwater Response Action Plan using CERCLA Criteria
Lockheed Martin Middle River Complex, Middle River, Maryland

Evaluation Criterion	Alternative 1 Monitored natural attenuation (MNA); land use controls (LUCs)	Alternative 2 Hydraulic containment; MNA/LUCs	Alternative 4 Aerobic permeable reactive barrier (PRB); MNA/LUCs
Overall Protection of Human Health and Environment	Currently protective of human health and the environment based on current site conditions; but, does not provide containment of contaminated groundwater migrated toward Dark Head Cove. A contingency could be required if conditions change and risk is present.	Protective. Provides containment of groundwater using extraction.	Protective. Provides treatment of groundwater using biosparge PRB.
Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)/Meets Remedial Action Alternatives (RAOs):	Compliant with ARARs and will meet or maintain RAOs. RAOs 2 and 3 are currently being met. RAOs 1 and 4 would be met when LUCs are implemented.	Compliant with ARARs and will meet or maintain RAOs. RAOs 2 and 3 are currently being met. RAOs 1 and 4 would be met when LUCs are implemented.	Compliant with ARARs and will meet or maintain RAOs. RAOs 2 and 3 are currently being met. RAOs 1 and 4 would be met when LUCs are implemented.
Long-Term Effectiveness and Permanence	Does not provide long-term effectiveness in the prevention of migration of contaminated groundwater toward Dark Head Cove.	Provides for long-term effectiveness in meeting RAOs, as long as system is operated. Chlorinated benzenes are permanently removed.	Provides for long-term effectiveness in meeting RAOs, as long as system is operated. Chlorinated benzenes are permanently removed. Uncertain effectiveness of aeration and distribution of air.
Reduction of Contaminant Toxicity, Mobility, or Volume through Treatment	Does not provide any treatment. Reductions would be through natural attenuation.	Provides reductions in volume through containment, but treatment transfers the contaminants to GAC, rather than destroy them (until off-site regeneration).	Provides reductions in toxicity and volume through treatment in the biosparging PRB.
Short-Term Effectiveness	Would require 50 years or more of monitoring to verify that RAO 2 criteria are being met. Provides the most protection to workers and the community during implementation because there are no associated construction activities.	Would require 50 years or more of operation to verify that RAO 2 criteria are being met. Less intensive construction activities than Alternative 4. Potential risks to workers during well and piping installation. Slight risk to community during transport of GAC. Provides reductions in migration toward Dark Head Cove as soon as the groundwater extraction is initiated.	Would require 50 years or more of operation to verify that RAO 2 criteria are being met. Relatively non-intensive construction activities. Potential risks to workers during well and piping installation. Provides reductions in migration toward Dark Head Cove as soon as biosparging system is installed and initiated.
Implementability	Readily implementable; all infrastructure currently on site and permits obtained. Monitoring of the remedy is straightforward.	Readily implementable; multiple subcontractors available to complete well installation. Monitoring of the remedy is straightforward.	Readily implementable; multiple subcontractors available to complete biosparge PRB installation. Monitoring of the remedy is straightforward. Uncertain effectiveness of aeration and distribution of air.
Life Cycle Impacts			
SiteWise Results	79 metric tons	630 metric tons	650 metric tons
Greenhouse gases	0.35 metric ton	1.4 metric tons	0.70 metric ton
Nitrogen oxides	0.25 metric ton	3.2 metric tons	4.4 metric tons
Sulfur oxides	0.03 metric ton	0.74 metric ton	1.2 metric tons
Particulate matter	1,100 MMBTU	7,900 MMBTU	9,200 MMBTU
Energy	5,600 gallons	270,000 gallons	490,000 gallons
Water			
Costs:			
Capital	$40,000	$395,000	$418,000
O&M/LTM (Total Project)	$919,000	$3,678,000	$2,447,000
Total	$959,000	$4,073,000	$2,865,000

MMBTU – Million British thermal units

Table 3-5

Chemical-Specific ARARs and TBCs
TCB Groundwater Response Action Plan
Lockheed Martin Middle River Complex, Middle River, Maryland

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
Safe Drinking Water Act (SWDA) Regulations, Maximum Contaminant Levels (MCLs)	40 Code of Federal Regulations (CFR) Part 141, Subparts B and G	Relevant and Appropriate	Establishes enforceable standards for potable water for specific contaminants that have been determined to adversely affect human health.	Would be used as protective levels for groundwater. MCLs are available for 1,2,4-TCB, 1,2-DCB, 1,4-DCB, and chlorobenzene.
Cancer Slope Factors (CSFs)	NA	To Be Considered	CSFs are guidance values used to evaluate the potential carcinogenic hazard caused by exposure to contaminants.	CSFs would be considered for development of human health protection preliminary remediation goals (PRGs) for groundwater at this site if MCLs are unavailable and for swimming screening levels.
Reference Doses (RfDs)	NA	To Be Considered	RfDs are guidance values used to evaluate the potential non-carcinogenic hazard caused by exposure to contaminants.	RfDs would be considered for development of human health protection PRGs for groundwater at this site if MCLs are unavailable and for swimming screening levels.
State				
Cleanup Standards for Soil and Groundwater	Maryland Annotated Code 7-508	To Be Considered	This guidance document presents the approach and supporting documentation used to develop numeric cleanup standards for hazardous substances in soil and groundwater in the State of Maryland.	These non-promulgated standards would be used in determining cleanup goals for groundwater if MCLs are unavailable. For contaminants in the plume, the Cleanup Standards are the same as MCLs.

Table 3-6

Location-Specific ARARs and TBCs
TCB Groundwater Response Action Plan
Lockheed Martin Middle River Complex, Middle River, Maryland

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
Floodplain Management	Executive Order 11988	To be considered	If no practicable alternative exists to performing cleanup in a floodplain, potential harm must be mitigated and actions taken to preserve the beneficial value of the floodplain.	Although activities will be close to the floodplain boundary, remedial actions are not expected to take place in a floodplain. Alternatives would be considered that would reduce the risk of flood loss and restore and preserve the floodplain.
Coastal Zone Management Act	16 United States Code (U.S.C.) Parts 1451 et. seq.	Applicable	Requires that any actions must be conducted in a manner consistent with state-approved management programs.	The site is located in a coastal zone management area: therefore, applicable coastal zone management requirements need to be addressed.
Requirement	**Citation**	**Status**	**Synopsis**	**Evaluation/Action to be Taken**
State				
Coastal Zone Management Program	Maryland Executive Order 01.01.1978.05 Coastal Zone Management	Applicable	Maryland's Coastal Program is based on existing state laws and policies designed to protect coastal and marine resources.	The site is located in a coastal zone management area: therefore, applicable coastal zone management requirements need to be addressed.

Table 3-7

Action-Specific ARARs and TBCs
TCB Groundwater Response Action Plan
Lockheed Martin Middle River Complex, Middle River, Maryland

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Federal				
Resource Conservation and Recovery Act (RCRA) Regulations, Identification and Listing of Hazardous Wastes	40 Code of Federal Regulations (CFR) 261, Subparts A, B, C, and D	Applicable	Defines the listed and characteristic hazardous wastes subject to RCRA.	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, Generator Standards	40 CFR 262, Subparts A, B, C, and D	Applicable	Describes requirements for hazardous waste generators including storage, labelling, manifesting, recordkeeping, emergency planning, and preparedness and prevention planning.	Any wastes that are determined to be hazardous must be managed according to these regulations before disposal.
Clean Water Act (CWA), Pretreatment Regulations	40 CFR 403.5 and 403.8	Applicable	Describes prohibited discharges to publicly owned treatment works (POTWs) and pretreatment program requirements.	Extracted groundwater would be treated as required before discharge to the POTW. This is an off-site activity, so all administrative and substantive requirements must be met.

Table 3-7

Action-Specific ARARs and TBCs
TCB Groundwater Response Action Plan
Lockheed Martin Middle River Complex, Middle River, Maryland

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
State				
Maryland Hazardous Waste Management System	Code of Maryland Regulations (COMAR) Title 26, Subtitle 13, Chapter 02 – Identification; Chapter 03 - Generators	Applicable	Defines the listed and characteristic hazardous wastes. Describes requirements for hazardous waste generators including storage, labelling, manifesting, recordkeeping, emergency planning, and preparedness and prevention planning.	These regulations would apply if waste generated on site was determined to be hazardous prior to off-site disposal.
Maryland General Permit for Construction Activity	COMAR Title 26, Subtitle 17, Chapter 01 – E&S Control	Applicable	Establishes requirements for stormwater management and erosion and sediment control at construction sites. Permits through Baltimore County are required for disturbances over 5,000 square feet or within 100 feet of tidal waters.	Response actions involving disturbances over 5,000 square feet would require submittal of an erosion and sediment control plan.
Maryland Stormwater Management	COMAR Title 26, Subtitle 17, Chapter 02 – Stormwater Management	Applicable	Establishes requirements for stormwater management. A stormwater management plan through Baltimore County is required for disturbances over 5,000 square feet.	Response actions involving disturbances over 5,000 square feet would require submittal of a stormwater management plan.

Table 3-7

Action-Specific ARARs and TBCs
TCB Groundwater Response Action Plan
Lockheed Martin Middle River Complex, Middle River, Maryland

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
State (continued)				
Maryland Water Pollution Control	COMAR Title 26, Subtitle 8, Chapter 08 – Pretreatment Requirements to POTWs	Applicable	These standards govern discharge of water to POTWs. Discharges must meet pretreatment requirements of the POTW.	Extracted groundwater would be treated as required prior to discharge.
Criteria for Local Critical Area Development	COMAR Title 27, Subtitle1, Chapter 9 - Habitat Protection Areas in the Critical Area	Applicable	These regulations control development and activities to provide for the conservation of habitat and the protection of water quality in the Chesapeake Bay Critical Area and Buffer.	Impacts to regulated features must be mitigated as necessary.
Well Standards	COMAR Title 26, Subtitle 4, Chapter 04 – Well Construction	Applicable	Identifies the standards and specification that must be followed for the installation of all wells.	Applies to wells installed for monitoring, groundwater treatment, and/or extraction.

Table 3-7

Action-Specific ARARs and TBCs
TCB Groundwater Response Action Plan
Lockheed Martin Middle River Complex, Middle River, Maryland

Requirement	Citation	Status	Synopsis	Evaluation/Action to be Taken
Toxic Air Pollutants	COMAR Title 26, Subtitle 11, Chapter 15 – Toxic Air Pollutants; Chapter 16.06 – Class I Toxic Air Pollutants	Applicable	Regulates the emissions of toxic air pollutants.	Control of emissions during treatment of groundwater would be implemented.

Table 4-1

Monitoring Wells for Alternative 1
Lockheed Martin Middle River Complex, Middle River, Maryland

Eastern Plume	Western Plume
124AR (Source)	166A* (Source)
124BR (HU2)	167A* (Source)
165A* (Source)	126A (Mid-plume)
128AR (Mid-plume)	126B (HU2)
128BR (HU2)	134A (Downgradient)
135A (Mid-plume)	168A (New) (Downgradient)
135B (HU2)	
36A (Sidegradient)	
130B (Sidegradient) (HU2)	
169B (New) (Downgradient)	
170B1 (New) (Downgradient)	
170B2 (New) (Downgradient)	

* is a replacement well near the position of a former well.
R indicates a replacement well at the same location as a former well with the same number.

(HU2) The monitoring well monitors hydrogeologic unit 2. All other wells monitor hydrogeologic unit 1.

"New" indicates a well to be installed for this program.
Other notes in parentheses indicate the well's relationship to the monitored natural attenuation evaluation of the plume.
Samples to be analyzed for chlorinated benzenes and natural attenuation parameters.

Samples would be collected semiannually for three years followed by annual sampling thereafter.

APPENDICES

Appendix A—Annual Sampling Locations

Appendix B—*SiteWise* Analysis

Appendix C—Remedial Alternative Cost Estimates

Appendix D—Groundwater Modeling

APPENDIX A—ANNUAL SAMPLING LOCATIONS

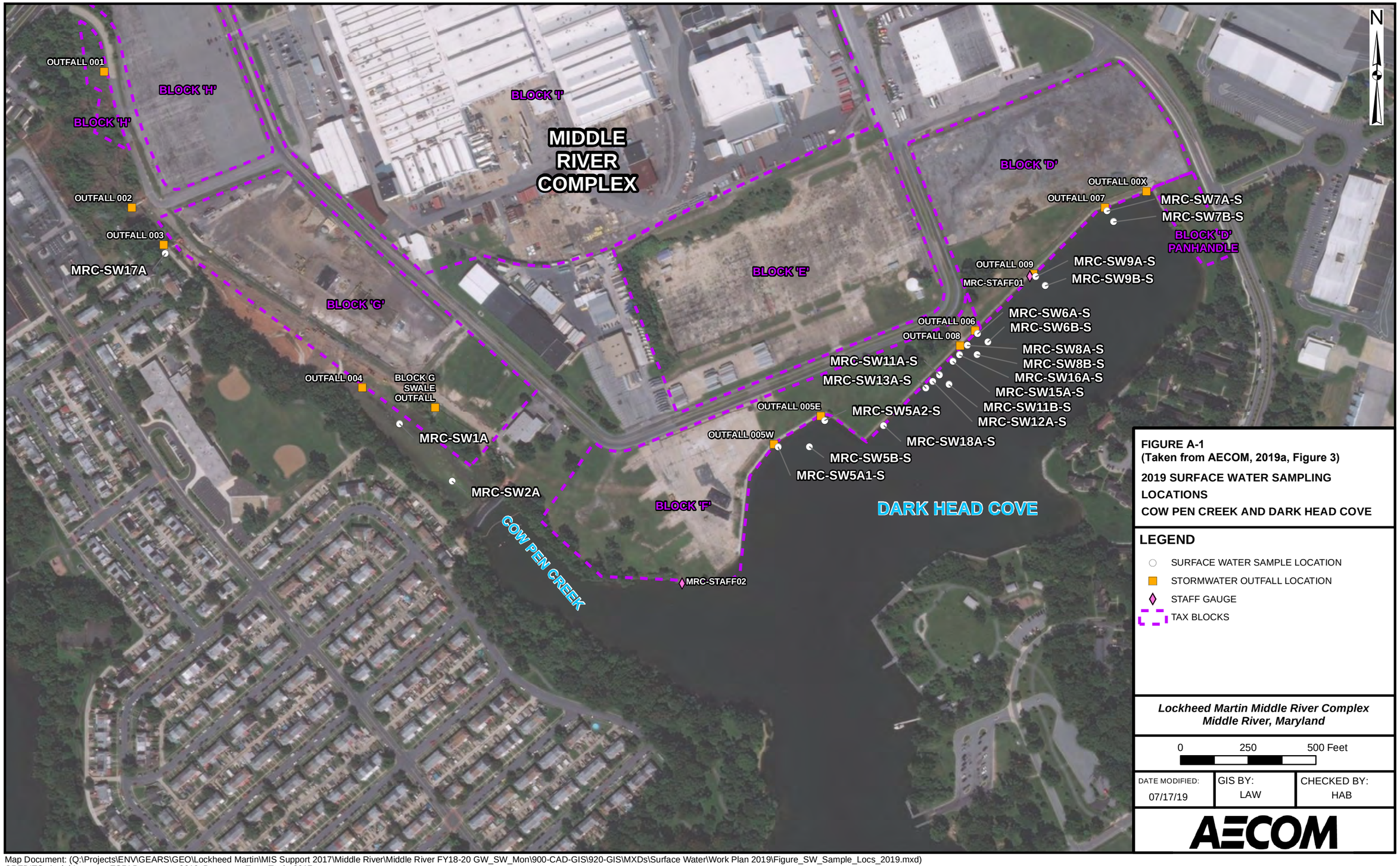

FIGURE A-1
(Taken from AECOM, 2019a, Figure 3)

2019 SURFACE WATER SAMPLING LOCATIONS
COW PEN CREEK AND DARK HEAD COVE

LEGEND

- SURFACE WATER SAMPLE LOCATION
- STORMWATER OUTFALL LOCATION
- STAFF GAUGE
- TAX BLOCKS

Lockheed Martin Middle River Complex
Middle River, Maryland

0 250 500 Feet

DATE MODIFIED:	GIS BY:	CHECKED BY:
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AECOM

Map Document: (Q:\Projects\ENV\GEARS\GEO\Lockheed Martin\MIS Support 2017\Middle River\Middle River FY18-20 GW_SW_Mon\900-CAD-GIS\920-GIS\MXDs\Surface Water\Work Plan 2019\Figure_SW_Sample_Locs_2019.mxd)
CREDITS: Aerial Imagery, ESRI Basemaps, 2019; Basemap, Tetra Tech, 2017

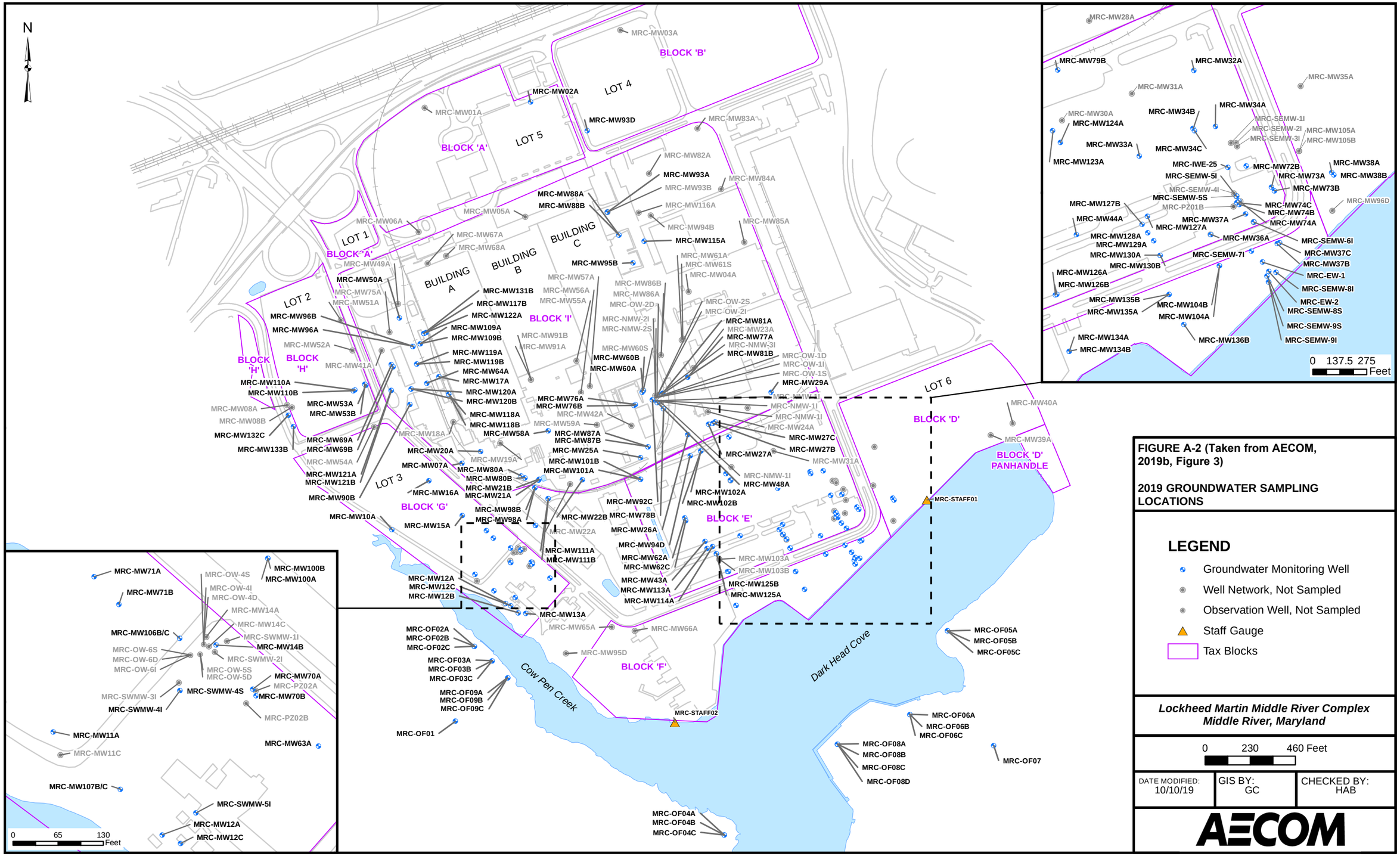


FIGURE A-2 (Taken from AECOM, 2019b, Figure 3)

2019 GROUNDWATER SAMPLING LOCATIONS

LEGEND

- Groundwater Monitoring Well
- Well Network, Not Sampled
- Observation Well, Not Sampled
- Staff Gauge
- Tax Blocks

Lockheed Martin Middle River Complex
Middle River, Maryland

DATE MODIFIED:	GIS BY:	CHECKED BY:
10/10/19	GC	HAB

AECOM

Map Document: (\\ursgermantown.us.ie.urs\germantown\Projects\ENV\GEARS\GEO\Lockheed Martin\MIS Support 2017\Middle River\Middle River FY18-20 GW_SW_Mon\900-CAD-GIS\920-GIS\MXDs\2019_GWMR\GW_Sampling_Locs_2019_GWMR.mxd)
Credits: Basemap, Tetra Tech, 2017

APPENDIX B—SITEWISE ANALYSIS

GSRx Results Alternative 1
Lockheed Martin, Middle River Complex, Block E and F
Middle River, Maryland

Stage	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions CO_2e	CO_2	N_20	CH_4	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption	Material Conversion Factor		mission Factor CO_2 EF	N_20 EF	CH_4 EF	NO_x EF	SO_x EF	PM_{10} EF	Energy Consumption Factor	Water Consumption Factor
	Materials								**Tonnes**				**MWhr**	**gal x 1000**			**lbs/lbs material**						**MWhr/lbs Material**	**gal/lbs material**
					lft	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	1.615	lbs PVC / ft PVC[1]	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lft	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.1022	lbs HDPE/lb HDPE	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lft	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	2.01	lbs PVC / ft PVC[1]	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lft	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.43	lbs PVC / ft PVC[1]	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
RAC	GW Monitoring Wells	PVC	4 wells 20 feet deep each	80	lft	0.12	0.06	0.00	0.00	0.00	0.00	0.00	2.25	0.14	0.68	lbs PVC / ft PVC[1]	2.50E+00	6.00E-03	2.90E-02	0.00E+00	9.70E-03	1.40E-03	4.13E-02	1.72E+00
					lft	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	0.68	lbs PVC / ft PVC[1]	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lft	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	2.01	lbs PVC / ft PVC[1]	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
RAC	Concrete well pads	General Concrete	4 pads, 2'x2'x6"	900	lbs	0.053	0.053	0.000	0.000	0.000	0.000	0.000	0.52	0.000			1.30E-01	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.82E-04	0.00E+00
RAC	Decon pad liner	HDPE	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3	730	lbs	1.63	0.86	0.00	0.0063	0.00	0.00	0.00	9.55	0.26			2.60E+00	6.20E-03	1.90E-02	0.00E+00	1.10E-02	1.60E-03	1.31E-02	3.59E-01
RAC	Decon Pad fame		Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3	368	lbs	0.0039	0.0039	0.00	0.00	0.00	0.00	0.00	0.0042	0.0025			2.33E-02						1.15E-05	6.88E-03
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A			#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
	Subtotal					**#N/A**	**#N/A**	**#N/A**	**#N/A**	**#N/A**	**#N/A**	**#N/A**	**#N/A**	**#N/A**										
	Transportation						**Tonnes**						**MWhr**	**gal x 1000**			**lbs/mile**						**MWhr/gal fuel**	
	Input Into Sitewise				miles										#N/A	mpg								
	Subtotal					**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0**										
	Construction Equipment								**Tonnes**				**MWhr**	**gal x 1000**			**lbs/hr**						**MWhr/hr operation**	
RAC	HSA Drill Rig	Drill Rig, HSA (diesel)	2 days, 8 hour/day	16	hrs	0.89	0.87	0.00	0.00	0.01	0.00	0.00	4.07				120.10		1.07E-01	1.41E+00	2.58E-02	8.69E-02	2.55E-01	
					hrs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
					hrs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
					hrs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
					hrs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
					hrs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
					hrs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A				#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	
	Subtotal					**#N/A**	**#N/A**	**#N/A**	**#N/A**	**#N/A**	**#N/A**	**#N/A**	**#N/A**	**0**										
	Total					**#N/A**	**#N/A**	**#N/A**	**#N/A**	**#N/A**	**#N/A**	**#N/A**	**#N/A**	**#N/A**										



Alternative 1
Values Input into SiteWise as "Other"

Module	Greenhouse Gas Emissions CO_2e	CO_2	N_20 (CO_2e)	CH_4 (CO_2e)	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
				Tonnes				**MMBTU**	**gal**
RI	-	-	-	-	-	-	-	-	-
RAC	2.70	1.85	0.68	0.16	0.01	0.00	0.00	55.96	402.36
RAO	-	-	-	-	-	-	-	-	-
LTM	-	-	-	-	-	-	-	-	-

Note: 1 MWhr = 3412141.4799 BTU, 1MMTBU = 10^6 BTU

OTHER KNOWN ONSITE ACTIVITIES	RI	RAC	RAO	LTM
Input energy usage (MMBTU)	0.0E+00	5.6E+01	0.0E+00	0.0E+00
Water consumption (gallon)	0.0E+00	4.0E+02	0.0E+00	0.0E+00
Input CO_2 emission (metric ton)	0.0E+00	1.9E+00	0.0E+00	0.0E+00
Input N_2O emission (metric ton CO_2 e)	0.0E+00	6.8E-01	0.0E+00	0.0E+00
Input CH_4 emissions (metric ton CO_2 e)	0.0E+00	1.6E-01	0.0E+00	0.0E+00
Input NOx emission (metric ton)	0.0E+00	1.0E-02	0.0E+00	0.0E+00
Input SOx emission (metric ton)	0.0E+00	4.1E-03	0.0E+00	0.0E+00
Input PM_{10} emission (metric ton)	0.0E+00	1.2E-03	0.0E+00	0.0E+00
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

BASELINE INFORMATION

COMPONENT 1 DURATION AND COST	Entire Site
Input duration of the component (unit time)	1
Input component cost per unit time ($)	

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Choose specific casing material schedule from drop down menu	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC
Choose well diameter (in) from drop down menu	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
Input total quantity of Sand (kg)												
Input total quantity of Gravel (kg)												
Input total quantity of Bentonite (kg)												
Input total quantity of Typical Cement (kg)												
Input total quantity of General Concrete (kg)												
Input total quantity of Steel (kg)												

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input number of injection points												
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	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												

TREATMENT MEDIA	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input weight of media used (lbs)												
Choose media type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	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	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft2)												
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	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Input well diameter (in)												
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil

SILT CURTAIN MATERIALS	Curtain 1	Curtain 2	Curtain 3	Curtain 4	Curtain 5	Curtain 6	Curtain 7	Curtain 8	Curtain 9	Curtain 10	Curtain 11	Curtain 12
Input length or perimeter of silt curtain (ft)												
Input depth of silt curtain (ft)												

BULK MATERIAL QUANTITIES	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material from drop down menu	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid
Choose units of material quantity from drop down menu	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds
Input material quantity												

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	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 - DEDICATED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Account for an empty return trip?	No	No	No	No	No	No	No	No	No	No	No	No
Input one-way distance traveled (miles) with a given load. If applicable, impact for an empty return trip will be accounted for (no additional input is needed).												
Input weight of equipment transported per truck load (tons)												

EQUIPMENT TRANSPORTATION - SHARED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (miles)												
Input weight of load (tons)												

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (mile)												
Input weight of load (tons)												

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12
Input number of drilling locations												
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)												
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

TRENCHING	Trencher 1	Trencher 2	Trencher 3	Trencher 4	Trencher 5	Trencher 6	Trencher 7	Trencher 8	Trencher 9	Trencher 10	Trencher 11	Trencher 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input operating hours (hr)												

SEDIMENT DREDGING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose dredge equipment type from drop down menu	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Choose dredge fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be dredged (yd3)												
Choose dredge equipment size	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C
Suggested dredge equipment size	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose dredge tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	2	2	2	2	2	2	2	2	2	2	2	2
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT MANAGEMENT (STAGING AND DRYING)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Is volume input that of saturated sediment?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Will the sediment be dry when this work is performed?	No	No	No	No	No	No	No	No	No	No	No	No
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT CAPPING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose capping method from drop down menu	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release
Choose capping equipment fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of capping material to be placed (yd3)												
Choose capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Suggested capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Input number of dredge tenders (hr) (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

WATERCRAFT OPERATION	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of vessels												
Input operating time (hours)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

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	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	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	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN												
Input flow rate (gpm)	0	0	0	0	0	0	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Pump efficiency (default already present, user override possible)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN												
Input pump horsepower (hp)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for pump motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Pump load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input pump load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower	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	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	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Equipment load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input equipment load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Equipment motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	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	0	0	0	0	0	0
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6	Generator 7	Generator 8	Generator 9	Generator 10	Generator 11	Generator 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
Input operating hours (hr)												

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6	Tillage Tractor 7	Tillage Tractor 8	Tillage Tractor 9	Tillage Tractor 10	Tillage Tractor 11	Tillage Tractor 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
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	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input area (ft2)												
Input time available (work days)												

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6	Mixer 7	Mixer 8	Mixer 9	Mixer 10	Mixer 11	Mixer 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd3)												
Input production rate (yd3/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)												

INTERNAL COMBUSTION ENGINES	Engine 1	Engine 2	Engine 3	Engine 4	Engine 5	Engine 6	Engine 7	Engine 8	Engine 9	Engine 10	Engine 11	Engine 12
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input fuel consumption rate (gal/hr or scf/hr)												
Input operating hours (hr)												

OTHER FUELED EQUIPMENT	Fuel 1	Fuel 2	Fuel 3	Fuel 4	Fuel 5	Fuel 6	Fuel 7	Fuel 8	Fuel 9	Fuel 10	Fuel 11	Fuel 12
Choose fuel type from drop down menu	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Input volume (scf for Natural gas, gallons for all others)												

DIESEL EQUIPMENT OPERATION (PER HOUR BASIS)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose equipment size for Dozer (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Loader (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Excavator (HP)	150	150	150	150	150	150	150	150	150	150	150	150
Choose equipment size for Scraper (HP)	330	330	330	330	330	330	330	330	330	330	330	330
Choose equipment size for Crawler Crane	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C
Choose equipment size for Tillage Tractor (HP)	16	16	16	16	16	16	16	16	16	16	16	16
Choose equipment size for Paver (HP)	25	25	25	25	25	25	25	25	25	25	25	25
Choose equipment size for Roller (HP)	6	6	6	6	6	6	6	6	6	6	6	6
Choose equipment size for Trencher (HP range)	6 to 11	7 to 11	8 to 11	9 to 11	10 to 11	11 to 11	12 to 11	13 to 11	14 to 11	15 to 11	16 to 11	17 to 11
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating hours (hr)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

OPERATOR LABOR	Occupation 1	Occupation 2	Occupation 3	Occupation 4	Occupation 5	Occupation 6	Occupation 7	Occupation 8	Occupation 9	Occupation 10	Occupation 11	Occupation 12
Choose occupation from drop-down menu	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers
Input total time worked onsite (hours)												

LABORATORY ANALYSIS	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5	Analysis 6	Analysis 7	Analysis 8	Analysis 9	Analysis 10	Analysis 11	Analysis 12
Input dollars spent on laboratory analysis ($)												

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO2 emission (metric ton)	
Input N2O emission (metric ton CO2 e)	
Input CH4 emission (metric ton CO2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM10 emission (metric ton)	
Input fatality risk	
Input injury risk	

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)												
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6
Choose landfill type for waste disposal	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous
Input amount of waste disposed in landfill (tons)												
Input landfill methane emissions (metric tons CH4)												
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	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	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	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	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)

RESOURCE CONSUMPTION

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6
Input total water consumed from potable water treatment facility (gal)												
Input total water disposed to wastewater treatment facility (gal)												

ONSITE LAND AND WATER RESOURCE CONSUMPTION	Entire Site 1	Entire Site 2	Entire Site 3	Entire Site 4	Entire Site 5	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6
Input volume of topsoil brought to site (cubic yards)												
Input volume of groundwater or surface water lost (gal)												

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

BASELINE INFORMATION

COMPONENT 2 DURATION AND COST	Entire Site
Input duration of the component (unit time)	1
Input component cost per unit time ($)	26375

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Choose specific casing material schedule from drop down menu	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC
Choose well diameter (in) from drop down menu	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
Input total quantity of Sand (kg)												
Input total quantity of Gravel (kg)												
Input total quantity of Bentonite (kg)												
Input total quantity of Typical Cement (kg)												
Input total quantity of General Concrete (kg)												
Input total quantity of Steel (kg)												

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input number of injection points												
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	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												

TREATMENT MEDIA	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input weight of media used (lbs)												
Choose media type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	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	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft2)												
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	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Input well diameter (in)												
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil

SILT CURTAIN MATERIALS	Curtain 1	Curtain 2	Curtain 3	Curtain 4	Curtain 5	Curtain 6	Curtain 7	Curtain 8	Curtain 9	Curtain 10	Curtain 11	Curtain 12
Input length or perimeter of silt curtain (ft)												
Input depth of silt curtain (ft)												

BULK MATERIAL QUANTITIES	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material from drop down menu	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid
Choose units of material quantity from drop down menu	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds
Input material quantity												

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	Sampling	Well Install	Util. Locate	Well Survey	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Light truck	Light truck	Light truck	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	50	50	50	50								
Input number of trips taken	6	6	1	1								
Input number of travelers	1	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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	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 - DEDICATED LOAD ROAD	HSA Rig	Wells	Concrete	Decon	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Account for an empty return trip?	No	Yes	Yes	Yes	No	No	No	No	No	No	No	No
Input one-way distance traveled (miles) with a given load. If applicable, impact for an empty return trip will be accounted for (no additional input is needed).	100	100	100	100								
Input weight of equipment transported per truck load (tons)	3.05	0.03	0.45	0.56								

EQUIPMENT TRANSPORTATION - SHARED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (miles)												
Input weight of load (tons)												

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (mile)												
Input weight of load (tons)												

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12
Input number of drilling locations												
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)												
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

TRENCHING	Trencher 1	Trencher 2	Trencher 3	Trencher 4	Trencher 5	Trencher 6	Trencher 7	Trencher 8	Trencher 9	Trencher 10	Trencher 11	Trencher 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input operating hours (hr)												

SEDIMENT DREDGING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose dredge equipment type from drop down menu	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Choose dredge fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be dredged (yd3)												
Choose dredge equipment size	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1 C
Suggested dredge equipment size	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose dredge tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	2	2	2	2	2	2	2	2	2	2	2	2
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT MANAGEMENT (STAGING AND DRYING)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Is volume input that of saturated sediment?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Will the sediment be dry when this work is performed?	No	No	No	No	No	No	No	No	No	No	No	No
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT CAPPING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose capping method from drop down menu	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release
Choose capping equipment fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of capping material to be placed (yd3)												
Choose capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Suggested capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

WATERCRAFT OPERATION	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of vessels												
Input operating time (hours)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

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	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	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	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN												
Input flow rate (gpm)	0	0	0	0	0	0	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Pump efficiency (default already present, user override possible)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN												
Input pump horsepower (hp)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for pump motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Pump load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input pump load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower	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	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	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Equipment load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input equipment load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Equipment motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	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	0	0	0	0	0	0
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6	Generator 7	Generator 8	Generator 9	Generator 10	Generator 11	Generator 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
Input operating hours (hr)												

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6	Tillage Tractor 7	Tillage Tractor 8	Tillage Tractor 9	Tillage Tractor 10	Tillage Tractor 11	Tillage Tractor 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
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	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input area (ft2)												
Input time available (work days)												

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6	Mixer 7	Mixer 8	Mixer 9	Mixer 10	Mixer 11	Mixer 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd3)												
Input production rate (yd3/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)												

INTERNAL COMBUSTION ENGINES	Engine 1	Engine 2	Engine 3	Engine 4	Engine 5	Engine 6	Engine 7	Engine 8	Engine 9	Engine 10	Engine 11	Engine 12
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input fuel consumption rate (gal/hr or scf/hr)												
Input operating hours (hr)												

OTHER FUELED EQUIPMENT	Fuel 1	Fuel 2	Fuel 3	Fuel 4	Fuel 5	Fuel 6	Fuel 7	Fuel 8	Fuel 9	Fuel 10	Fuel 11	Fuel 12
Choose fuel type from drop down menu	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Input volume (scf for Natural gas, gallons for all others)												

DIESEL EQUIPMENT OPERATION (PER HOUR BASIS)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose equipment size for Dozer (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Loader (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Excavator (HP)	150	150	150	150	150	150	150	150	150	150	150	150
Choose equipment size for Scraper (HP)	330	330	330	330	330	330	330	330	330	330	330	330
Choose equipment size for Crawler Crane	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C
Choose equipment size for Tillage Tractor (HP)	16	16	16	16	16	16	16	16	16	16	16	16
Choose equipment size for Paver (HP)	25	25	25	25	25	25	25	25	25	25	25	25
Choose equipment size for Roller (HP)	6	6	6	6	6	6	6	6	6	6	6	6
Choose equipment size for Trencher (HP range)	6 to 11	7 to 11	8 to 11	9 to 11	10 to 11	11 to 11	12 to 11	13 to 11	14 to 11	15 to 11	16 to 11	17 to 11
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating hours (hr)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

OPERATOR LABOR	Sampler	Drillers	Oversight	Surveyors	Util. Locator	Occupation 6	Occupation 7	Occupation 8	Occupation 9	Occupation 10	Occupation 11	Occupation 12
Choose occupation from drop-down menu	ntific and technical serv	Operating engineers	ntific and technical serv	ntific and technical serv	ntific and technical serv	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers
Input total time worked onsite (hours)	48.0	32.0	16.0	16.0	8.0							

LABORATORY ANALYSIS	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5	Analysis 6	Analysis 7	Analysis 8	Analysis 9	Analysis 10	Analysis 11	Analysis 12
Input dollars spent on laboratory analysis ($)	4,495.00											

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	5.6E+01
Water consumption (gallon)	4.0E+02
Input CO2 emission (metric ton)	1.9E+00
Input N2O emission (metric ton CO2 e)	6.8E-01
Input CH4 emission (metric ton CO2 e)	1.6E-01
Input NOx emission (metric ton)	1.0E-02
Input SOx emission (metric ton)	4.1E-03
Input PM10 emission (metric ton)	1.2E-03
Input fatality risk	
Input injury risk	

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)	1.4											
Choose fuel used from drop down menu	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips	1.0											
Input number of miles per trip	100.0											

LANDFILL OPERATIONS	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6
Choose landfill type for waste disposal	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous
Input amount of waste disposed in landfill (tons)	1.4											
Input landfill methane emissions (metric tons CH4)												
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	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	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	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	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)

RESOURCE CONSUMPTION

WATER CONSUMPTION	Development Water	Decon Water	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6
Input total water consumed from potable water treatment facility (gal)	220	5000										
Input total water disposed to wastewater treatment facility (gal)	220	5000										

ONSITE LAND AND WATER RESOURCE CONSUMPTION	Entire Site 1	Entire Site 2	Entire Site 3	Entire Site 4	Entire Site 5	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6
Input volume of topsoil brought to site (cubic yards)												
Input volume of groundwater or surface water lost (gal)												

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

BASELINE INFORMATION

COMPONENT 3 DURATION AND COST	Entire Site
Input duration of the component (unit time)	1
Input component cost per unit time ($)	

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Choose specific casing material schedule from drop down menu	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC
Choose well diameter (in) from drop down menu	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
Input total quantity of Sand (kg)												
Input total quantity of Gravel (kg)												
Input total quantity of Bentonite (kg)												
Input total quantity of Typical Cement (kg)												
Input total quantity of General Concrete (kg)												
Input total quantity of Steel (kg)												

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input number of injection points												
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	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												

TREATMENT MEDIA	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input weight of media used (lbs)												
Choose media type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	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	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft2)												
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	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Input well diameter (in)												
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil

SILT CURTAIN MATERIALS	Curtain 1	Curtain 2	Curtain 3	Curtain 4	Curtain 5	Curtain 6	Curtain 7	Curtain 8	Curtain 9	Curtain 10	Curtain 11	Curtain 12
Input length or perimeter of silt curtain (ft)												
Input depth of silt curtain (ft)												

BULK MATERIAL QUANTITIES	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material from drop down menu	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid
Choose units of material quantity from drop down menu	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds
Input material quantity												

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	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 - DEDICATED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Account for an empty return trip?	No	No	No	No	No	No	No	No	No	No	No	No
Input one-way distance traveled (miles) with a given load. If applicable, impact for an empty return trip will be accounted for (no additional input is needed).												
Input weight of equipment transported per truck load (tons)												

EQUIPMENT TRANSPORTATION - SHARED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (miles)												
Input weight of load (tons)												

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (mile)												
Input weight of load (tons)												

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12
Input number of drilling locations												
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)												
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

TRENCHING	Trencher 1	Trencher 2	Trencher 3	Trencher 4	Trencher 5	Trencher 6	Trencher 7	Trencher 8	Trencher 9	Trencher 10	Trencher 11	Trencher 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input operating hours (hr)												

SEDIMENT DREDGING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose dredge equipment type from drop down menu	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Choose dredge fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be dredged (yd3)												
Choose dredge equipment size	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1 C
Suggested dredge equipment size	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose dredge tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	2	2	2	2	2	2	2	2	2	2	2	2
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT MANAGEMENT (STAGING AND DRYING)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Is volume input that of saturated sediment?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Will the sediment be dry when this work is performed?	No	No	No	No	No	No	No	No	No	No	No	No
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT CAPPING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose capping method from drop down menu	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release
Choose capping equipment fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of capping material to be placed (yd3)												
Choose capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Suggested capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

WATERCRAFT OPERATION	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of vessels												
Input operating time (hours)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

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	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	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	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN												
Input flow rate (gpm)	0	0	0	0	0	0	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Pump efficiency (default already present, user override possible)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN												
Input pump horsepower (hp)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for pump motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Pump load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input pump load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower	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	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	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Equipment load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input equipment load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Equipment motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	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	0	0	0	0	0	0

Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6	Generator 7	Generator 8	Generator 9	Generator 10	Generator 11	Generator 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
Input operating hours (hr)												

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6	Tillage Tractor 7	Tillage Tractor 8	Tillage Tractor 9	Tillage Tractor 10	Tillage Tractor 11	Tillage Tractor 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
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	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input area (ft2)												
Input time available (work days)												

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6	Mixer 7	Mixer 8	Mixer 9	Mixer 10	Mixer 11	Mixer 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd3)												
Input production rate (yd3/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)												

INTERNAL COMBUSTION ENGINES	Engine 1	Engine 2	Engine 3	Engine 4	Engine 5	Engine 6	Engine 7	Engine 8	Engine 9	Engine 10	Engine 11	Engine 12
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input fuel consumption rate (gal/hr or scf/hr)												
Input operating hours (hr)												

OTHER FUELED EQUIPMENT	Fuel 1	Fuel 2	Fuel 3	Fuel 4	Fuel 5	Fuel 6	Fuel 7	Fuel 8	Fuel 9	Fuel 10	Fuel 11	Fuel 12
Choose fuel type from drop down menu	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Input volume (scf for Natural gas, gallons for all others)												

DIESEL EQUIPMENT OPERATION (PER HOUR BASIS)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose equipment size for Dozer (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Loader (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Excavator (HP)	150	150	150	150	150	150	150	150	150	150	150	150
Choose equipment size for Scraper (HP)	330	330	330	330	330	330	330	330	330	330	330	330
Choose equipment size for Crawler Crane	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C
Choose equipment size for Tillage Tractor (HP)	16	16	16	16	16	16	16	16	16	16	16	16
Choose equipment size for Paver (HP)	25	25	25	25	25	25	25	25	25	25	25	25
Choose equipment size for Roller (HP)	6	6	6	6	6	6	6	6	6	6	6	6
Choose equipment size for Trencher (HP range)	6 to 11	7 to 11	8 to 11	9 to 11	10 to 11	11 to 11	12 to 11	13 to 11	14 to 11	15 to 11	16 to 11	17 to 11
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating hours (hr)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

OPERATOR LABOR	Occupation 1	Occupation 2	Occupation 3	Occupation 4	Occupation 5	Occupation 6	Occupation 7	Occupation 8	Occupation 9	Occupation 10	Occupation 11	Occupation 12
Choose occupation from drop-down menu	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers
Input total time worked onsite (hours)												

LABORATORY ANALYSIS	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5	Analysis 6	Analysis 7	Analysis 8	Analysis 9	Analysis 10	Analysis 11	Analysis 12
Input dollars spent on laboratory analysis ($)												

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO2 emission (metric ton)	
Input N2O emission (metric ton CO2 e)	
Input CH4 emission (metric ton CO2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM10 emission (metric ton)	
Input fatality risk	
Input injury risk	

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)												
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6
Choose landfill type for waste disposal	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous
Input amount of waste disposed in landfill (tons)												
Input landfill methane emissions (metric tons CH4)												
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	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	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	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	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)

RESOURCE CONSUMPTION

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6
Input total water consumed from potable water treatment facility (gal)												
Input total water disposed to wastewater treatment facility (gal)												

ONSITE LAND AND WATER RESOURCE CONSUMPTION	Entire Site 1	Entire Site 2	Entire Site 3	Entire Site 4	Entire Site 5	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6
Input volume of topsoil brought to site (cubic yards)												
Input volume of groundwater or surface water lost (gal)												

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

BASELINE INFORMATION

COMPONENT 4 DURATION AND COST	Entire Site
Input duration of the component (unit time)	1
Input component cost per unit time ($)	738375

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Choose specific casing material schedule from drop down menu	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC
Choose well diameter (in) from drop down menu	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
Input total quantity of Sand (kg)												
Input total quantity of Gravel (kg)												
Input total quantity of Bentonite (kg)												
Input total quantity of Typical Cement (kg)												
Input total quantity of General Concrete (kg)												
Input total quantity of Steel (kg)												

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input number of injection points												
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	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												

TREATMENT MEDIA	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input weight of media used (lbs)												
Choose media type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	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	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft2)												
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	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Input well diameter (in)												
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil

SILT CURTAIN MATERIALS	Curtain 1	Curtain 2	Curtain 3	Curtain 4	Curtain 5	Curtain 6	Curtain 7	Curtain 8	Curtain 9	Curtain 10	Curtain 11	Curtain 12
Input length or perimeter of silt curtain (ft)												
Input depth of silt curtain (ft)												

BULK MATERIAL QUANTITIES	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material from drop down menu	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid
Choose units of material quantity from drop down menu	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds
Input material quantity												

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	Sampler	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	50											
Input number of trips taken	198											
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	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 - DEDICATED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Account for an empty return trip?	No	No	No	No	No	No	No	No	No	No	No	No
Input one-way distance traveled (miles) with a given load. If applicable, impact for an empty return trip will be accounted for (no additional input is needed).												
Input weight of equipment transported per truck load (tons)												

EQUIPMENT TRANSPORTATION - SHARED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (miles)												
Input weight of load (tons)												

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (mile)												
Input weight of load (tons)												

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12
Input number of drilling locations												
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)												
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

TRENCHING	Trencher 1	Trencher 2	Trencher 3	Trencher 4	Trencher 5	Trencher 6	Trencher 7	Trencher 8	Trencher 9	Trencher 10	Trencher 11	Trencher 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input operating hours (hr)												

SEDIMENT DREDGING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose dredge equipment type from drop down menu	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Choose dredge fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be dredged (yd3)												
Choose dredge equipment size	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1 C
Suggested dredge equipment size	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose dredge tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	2	2	2	2	2	2	2	2	2	2	2	2
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT MANAGEMENT (STAGING AND DRYING)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Is volume input that of saturated sediment?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Will the sediment be dry when this work is performed?	No	No	No	No	No	No	No	No	No	No	No	No
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT CAPPING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose capping method from drop down menu	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release
Choose capping equipment fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of capping material to be placed (yd3)												
Choose capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Suggested capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

WATERCRAFT OPERATION	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of vessels												
Input operating time (hours)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

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	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	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	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN												
Input flow rate (gpm)	0	0	0	0	0	0	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Pump efficiency (default already present, user override possible)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN												
Input pump horsepower (hp)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for pump motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Pump load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input pump load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower	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	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	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Equipment load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input equipment load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Equipment motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	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	0	0	0	0	0	0

Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6	Generator 7	Generator 8	Generator 9	Generator 10	Generator 11	Generator 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
Input operating hours (hr)												

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6	Tillage Tractor 7	Tillage Tractor 8	Tillage Tractor 9	Tillage Tractor 10	Tillage Tractor 11	Tillage Tractor 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
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	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input area (ft2)												
Input time available (work days)												

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6	Mixer 7	Mixer 8	Mixer 9	Mixer 10	Mixer 11	Mixer 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd3)												
Input production rate (yd3/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)												

INTERNAL COMBUSTION ENGINES	Engine 1	Engine 2	Engine 3	Engine 4	Engine 5	Engine 6	Engine 7	Engine 8	Engine 9	Engine 10	Engine 11	Engine 12
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input fuel consumption rate (gal/hr or scf/hr)												
Input operating hours (hr)												

OTHER FUELED EQUIPMENT	Fuel 1	Fuel 2	Fuel 3	Fuel 4	Fuel 5	Fuel 6	Fuel 7	Fuel 8	Fuel 9	Fuel 10	Fuel 11	Fuel 12
Choose fuel type from drop down menu	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Input volume (scf for Natural gas, gallons for all others)												

DIESEL EQUIPMENT OPERATION (PER HOUR BASIS)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose equipment size for Dozer (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Loader (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Excavator (HP)	150	150	150	150	150	150	150	150	150	150	150	150
Choose equipment size for Scraper (HP)	330	330	330	330	330	330	330	330	330	330	330	330
Choose equipment size for Crawler Crane	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C
Choose equipment size for Tillage Tractor (HP)	16	16	16	16	16	16	16	16	16	16	16	16
Choose equipment size for Paver (HP)	25	25	25	25	25	25	25	25	25	25	25	25
Choose equipment size for Roller (HP)	6	6	6	6	6	6	6	6	6	6	6	6
Choose equipment size for Trencher (HP range)	6 to 11	7 to 11	8 to 11	9 to 11	10 to 11	11 to 11	12 to 11	13 to 11	14 to 11	15 to 11	16 to 11	17 to 11
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating hours (hr)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

OPERATOR LABOR	Sampler	Occupation 2	Occupation 3	Occupation 4	Occupation 5	Occupation 6	Occupation 7	Occupation 8	Occupation 9	Occupation 10	Occupation 11	Occupation 12
Choose occupation from drop-down menu	ntific and technical serv	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers
Input total time worked onsite (hours)	1584.0											

LABORATORY ANALYSIS	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5	Analysis 6	Analysis 7	Analysis 8	Analysis 9	Analysis 10	Analysis 11	Analysis 12
Input dollars spent on laboratory analysis ($)	148,335.00											

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO2 emission (metric ton)	
Input N2O emission (metric ton CO2 e)	
Input CH4 emission (metric ton CO2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM10 emission (metric ton)	
Input fatality risk	
Input injury risk	

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)												
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6
Choose landfill type for waste disposal	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous
Input amount of waste disposed in landfill (tons)												
Input landfill methane emissions (metric tons CH4)												
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	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	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	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	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)

RESOURCE CONSUMPTION

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6
Input total water consumed from potable water treatment facility (gal)												
Input total water disposed to wastewater treatment facility (gal)												

ONSITE LAND AND WATER RESOURCE CONSUMPTION	Entire Site 1	Entire Site 2	Entire Site 3	Entire Site 4	Entire Site 5	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6
Input volume of topsoil brought to site (cubic yards)												
Input volume of groundwater or surface water lost (gal)												

Sustainable Remediation Summary - Feasibility Study

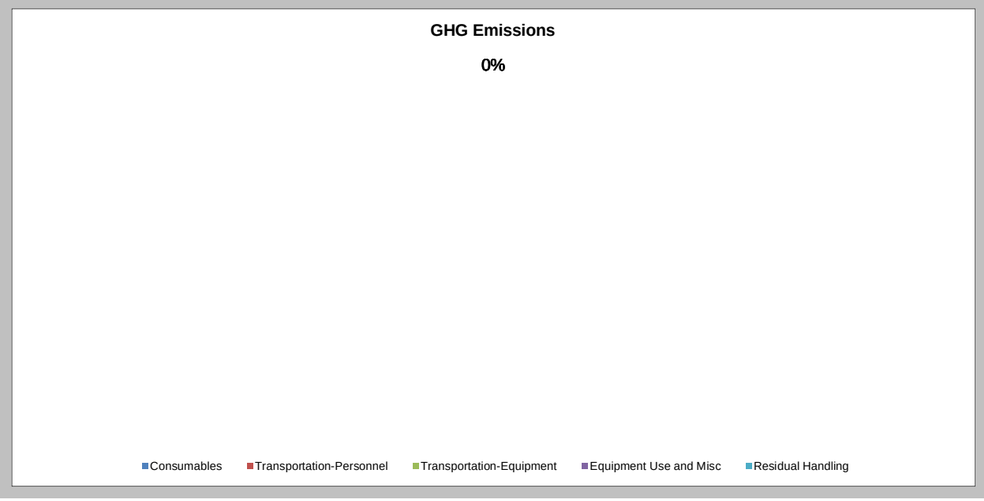
Activities	GHG Emissions	Percent Total	Total Energy Used	Percent Total	Water Consumption	Percent Total	Electricity Usage	Percent Total	Onsite NOx Emissions	Percent Total	Onsite SOx Emissions	Percent Total	Onsite PM10 Emissions	Percent Total	Total NOx Emissions	Percent Total	Total SOx Emissions	Percent Total	Total PM10 Emissions	Percent Total	Accident Risk Fatality	Percent Total	Accident Risk Injury	Percent Total
	metric ton	%	MMBTU	%	gallons	%	MWH	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%		%		%
Consumables	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	NA	NA	NA	NA
Transportation-Personnel	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Transportation-Equipment	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	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	0.0	0.0E+00	0.0	0.0E+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	NA	NA	NA	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Total	0.00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0

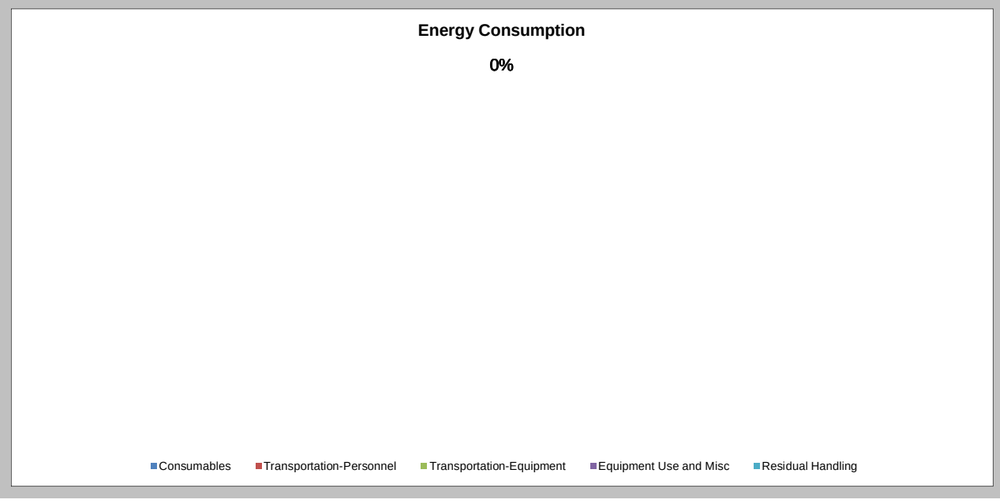
Additional Sustainability Metrics

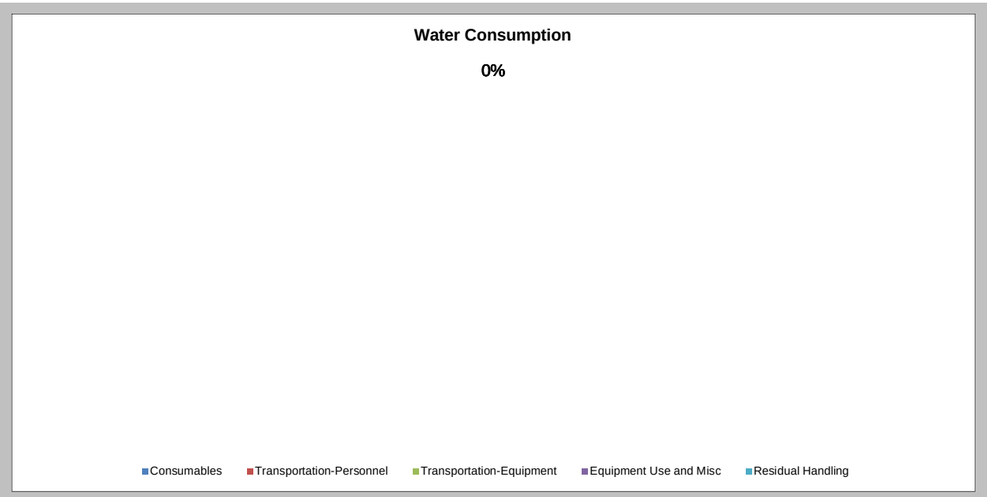
Non-Hazardous Waste Landfill Space (tons)	0.0
Hazardous Waste Landfill Space (tons)	0.0
Topsoil Consumption (yd^3)	0.0
Cost of Phase ($)	0.0
Lost Hours - Injury	0.0

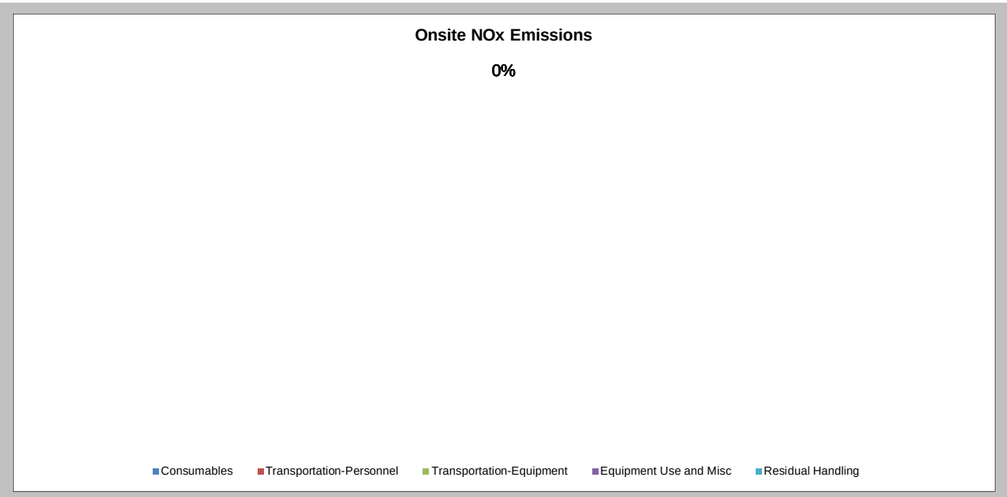
Footprint Reduction

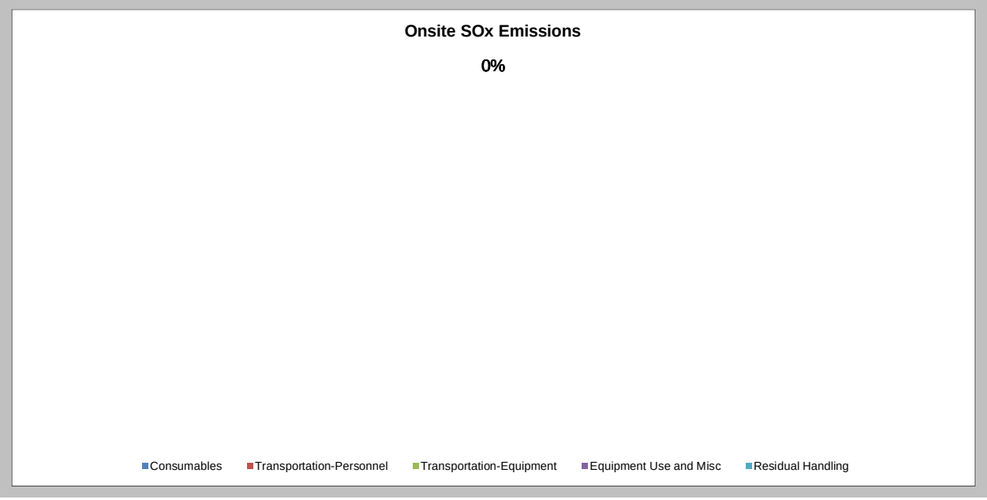
Total electricity replacement (MWh)	0.00E+00
Total electricity replacement (mmBtu)	0.00E+00
Percent electricity from renewable sources (%)	0.0%
Landfill gas reduction (metric ton CO_2 e)	0.00E+00
GHG emissions (metric ton CO2 e)	0.00E+00
NOx emissions (metric ton)	0.00E+00
SOx emissions (metric ton)	0.00E+00
PM10 emissions (metric ton)	0.00E+00

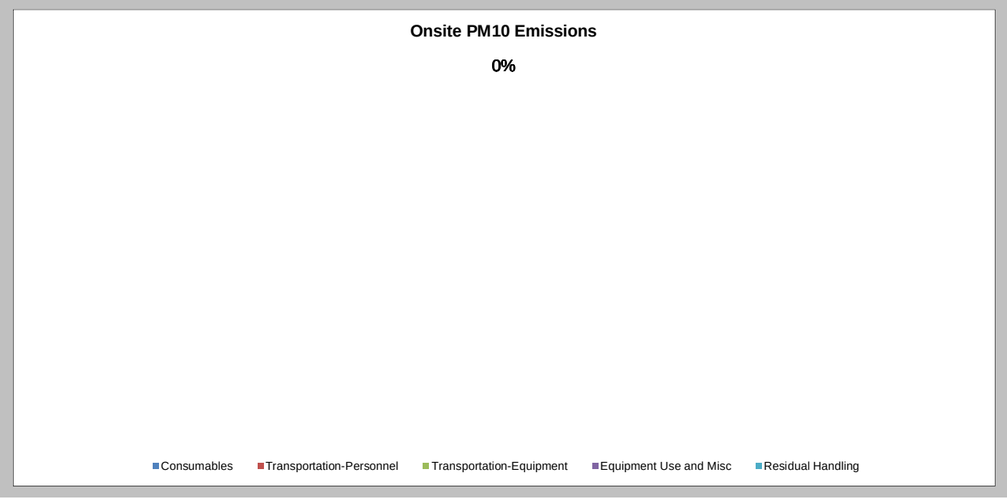


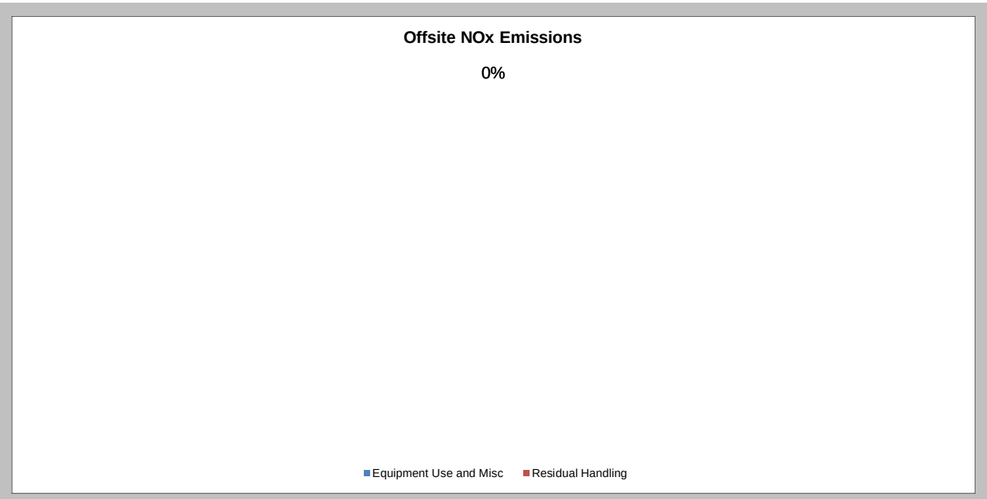


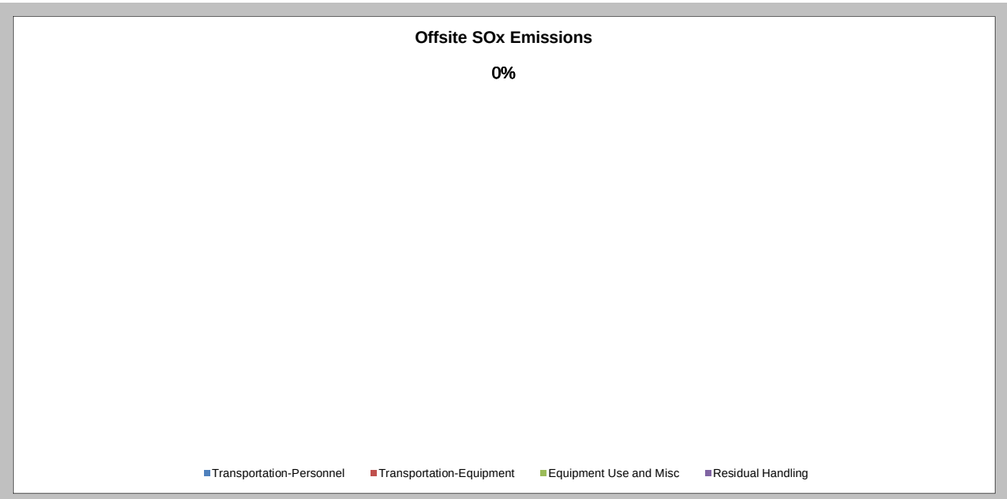

Water Consumption
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

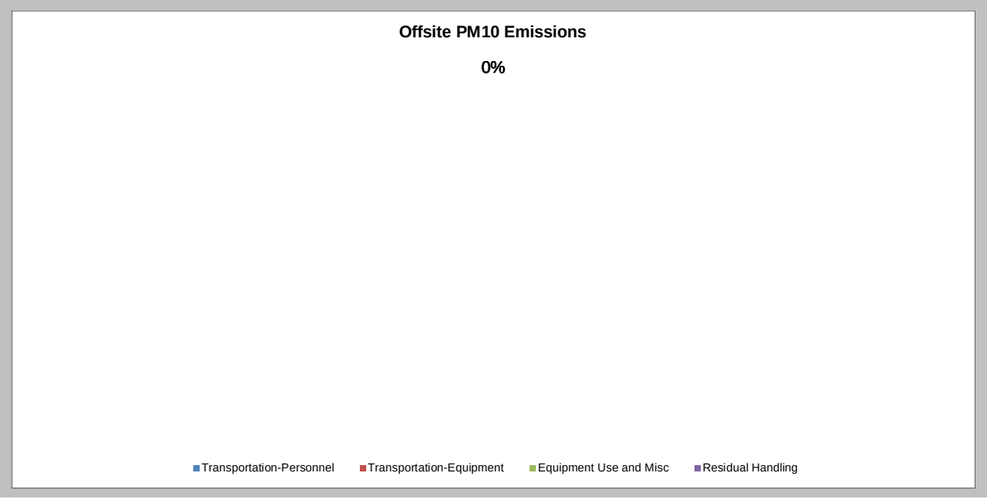

Onsite NOx Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Onsite SOx Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

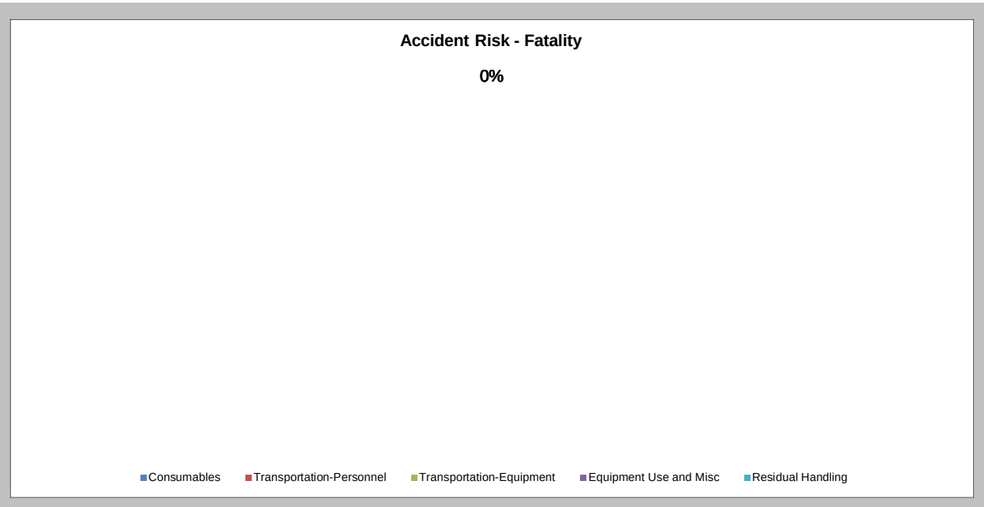

Onsite PM10 Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite NOx Emissions
0%
Equipment Use and Misc
Residual Handling


Offsite SOx Emissions
0%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite PM10 Emissions
0%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Injury
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

Sustainable Remediation Summary - Remedial Action Construction

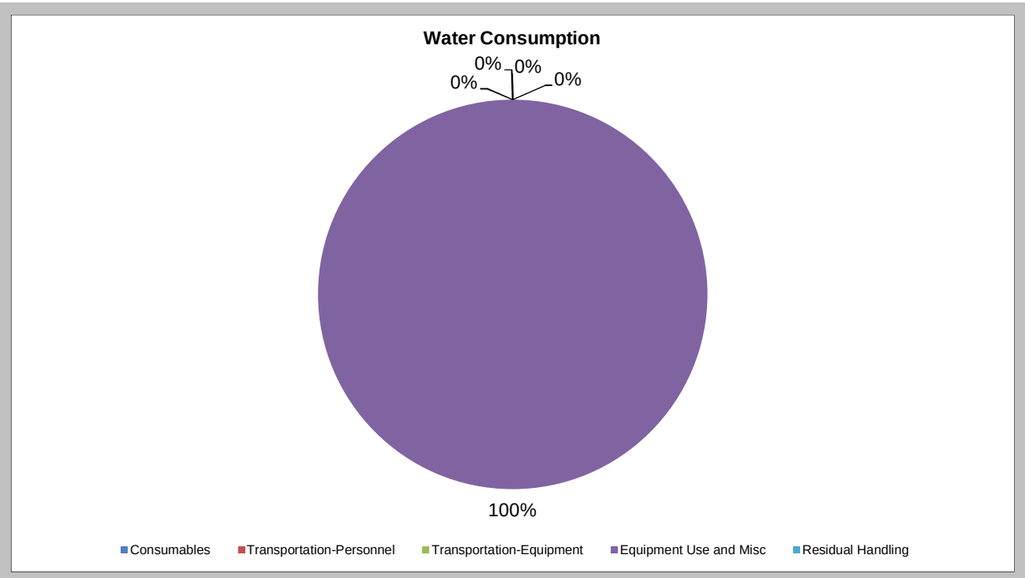
Activities	GHG Emissions	Percent Total	Total Energy Used	Percent Total	Water Consumption	Percent Total	Electricity Usage	Percent Total	Onsite NOx Emissions	Percent Total	Onsite SOx Emissions	Percent Total	Onsite PM10 Emissions	Percent Total	Total NOx Emissions	Percent Total	Total SOx Emissions	Percent Total	Total PM10 Emissions	Percent Total	Accident Risk Fatality	Percent Total	Accident Risk Injury	Percent Total
	metric ton	%	MMBTU	%	gallons	%	MWH	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%		%		%
Consumables	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	NA	NA	NA	NA
Transportation-Personnel	0.39	6.1	4.9E+00	4.6	NA	NA	NA	NA	NA	-	NA	-	NA	-	1.6E-04	0.8	5.0E-06	0.0	2.3E-05	1.0	5.5E-06	47.6	4.4E-04	22.3
Transportation-Equipment	0.99	15.8	1.3E+01	12.3	NA	NA	NA	NA	NA	-	NA	-	NA	-	3.1E-04	1.5	5.5E-06	0.0	2.8E-05	1.2	3.1E-06	27.2	2.5E-04	12.7
Equipment Use and Misc	4.76	75.6	8.5E+01	81.0	5.6E+03	100.0	0.0E+00	0.0	1.0E-02	100.0	4.1E-03	100.0	1.2E-03	100.0	2.0E-02	97.1	1.1E-02	99.5	2.1E-03	86.9	2.1E-06	18.4	1.2E-03	61.8
Residual Handling	0.16	2.5	2.2E+00	2.1	NA	NA	NA	NA	0.0E+00	-	0.0E+00	-	0.0E+00	-	1.3E-04	0.6	4.8E-05	0.4	2.6E-04	10.9	7.8E-07	6.8	6.3E-05	3.2
Total	6.29	100.0	1.05E+02	100.0	5.62E+03	100.0	0.00E+00	0.0	1.02E-02	100.0	4.07E-03	100.0	1.19E-03	100.0	2.07E-02	100.0	1.15E-02	100.0	2.36E-03	100.0	1.15E-05	100.0	1.97E-03	100.0

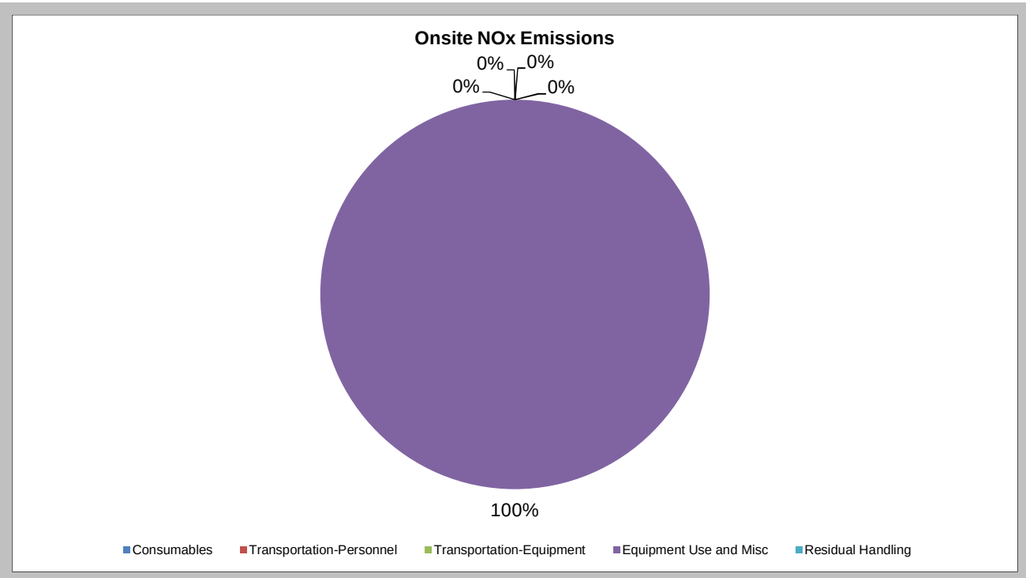
Additional Sustainability Metrics

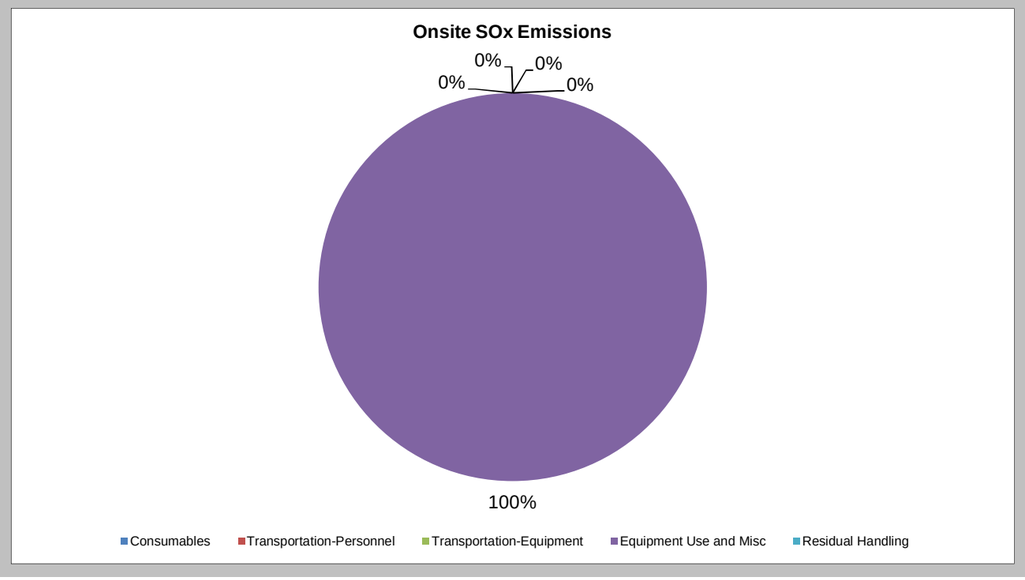
Non-Hazardous Waste Landfill Space (tons)	1.4
Hazardous Waste Landfill Space (tons)	0.0
Topsoil Consumption (yd^3)	0.0
Cost of Phase ($)	26375.0
Lost Hours - Injury	0.0

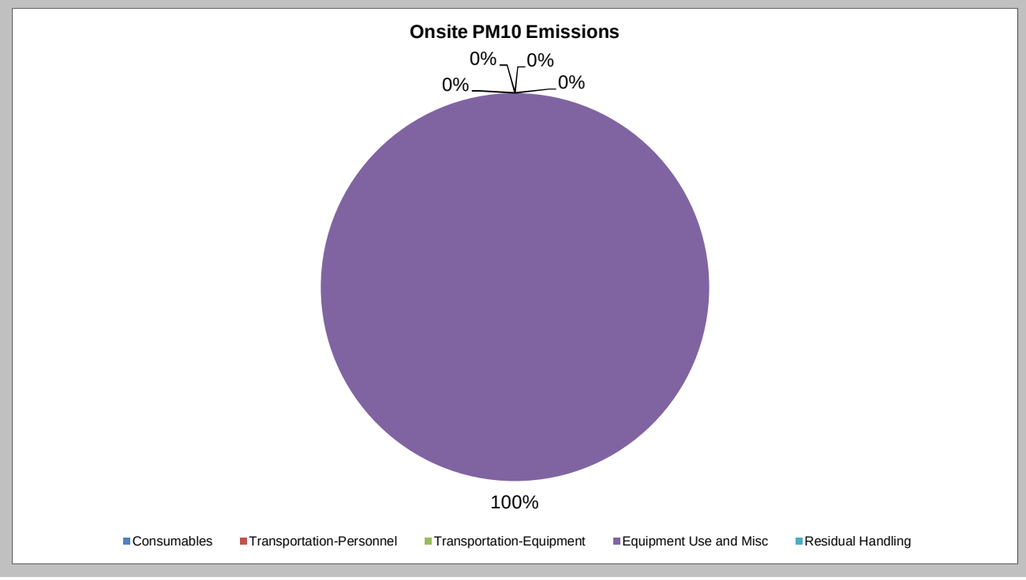
Footprint Reduction

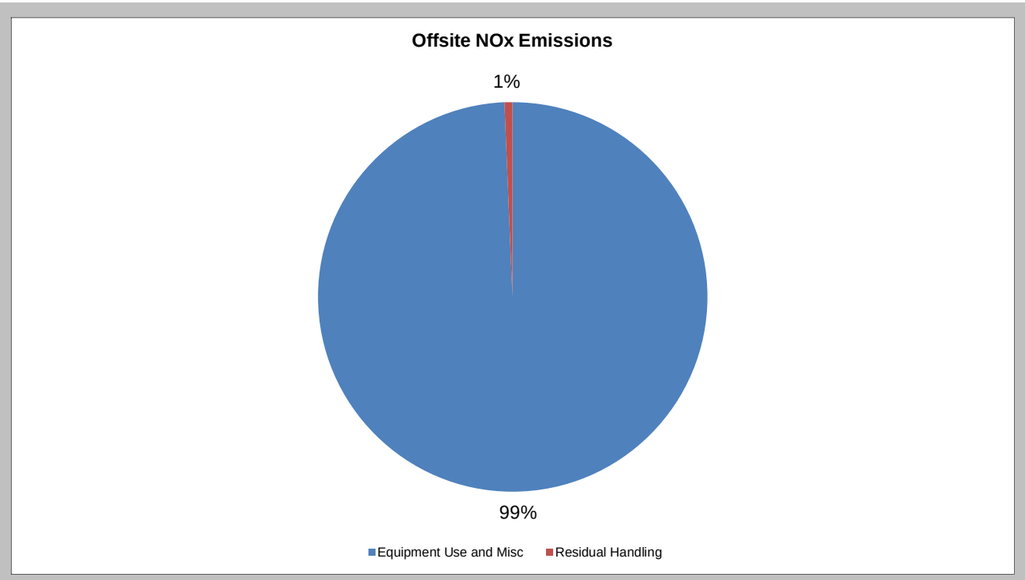
Total electricity replacement (MWh)	0.00E+00
Total electricity replacement (mmBtu)	0.00E+00
Percent electricity from renewable sources (%)	0.0%
Landfill gas reduction (metric ton CO_2 e)	0.00E+00
GHG emissions (metric ton CO2 e)	0.00E+00
NOx emissions (metric ton)	0.00E+00
SOx emissions (metric ton)	0.00E+00
PM10 emissions (metric ton)	0.00E+00

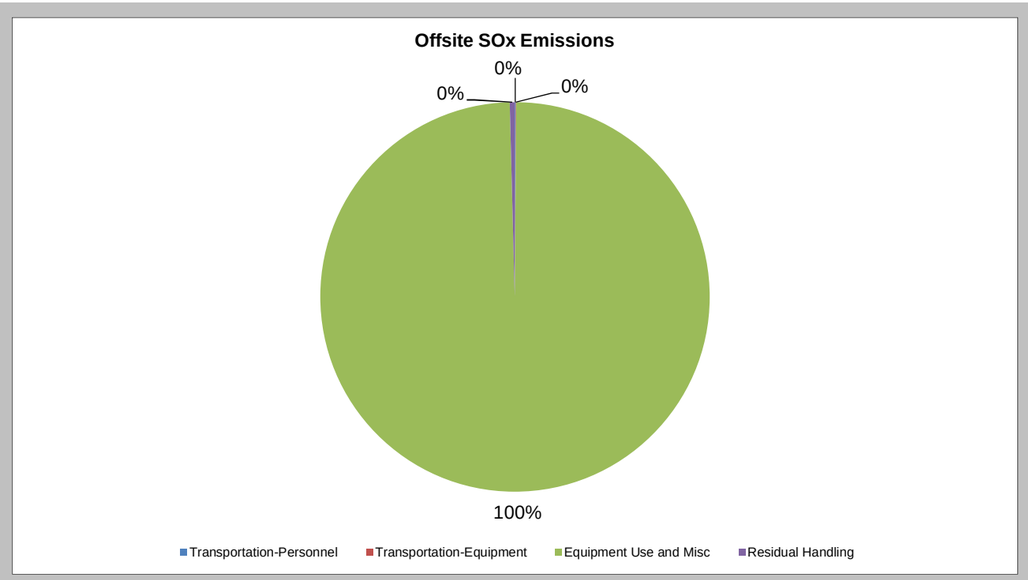

Water Consumption
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

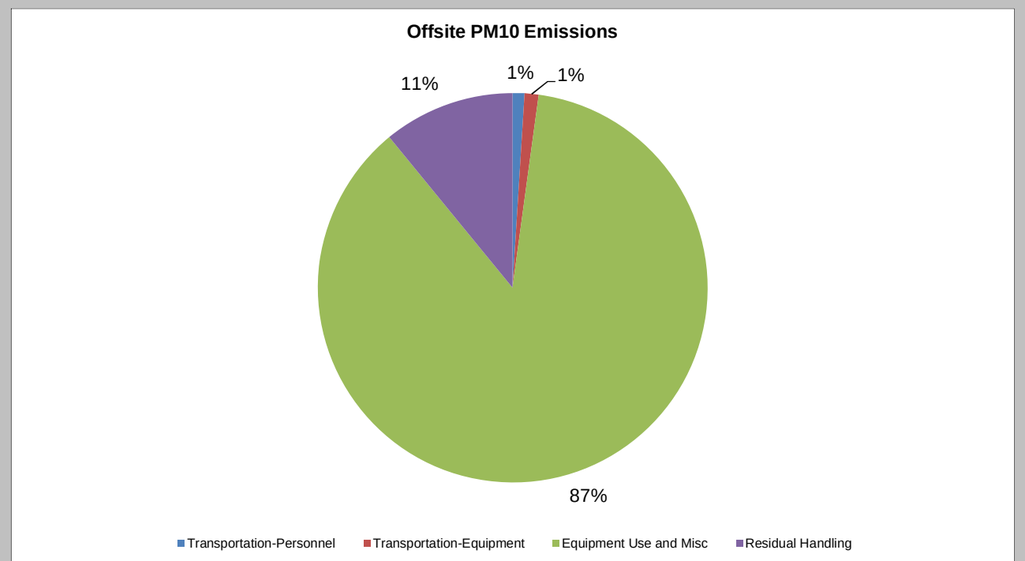

Onsite NOx Emissions
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

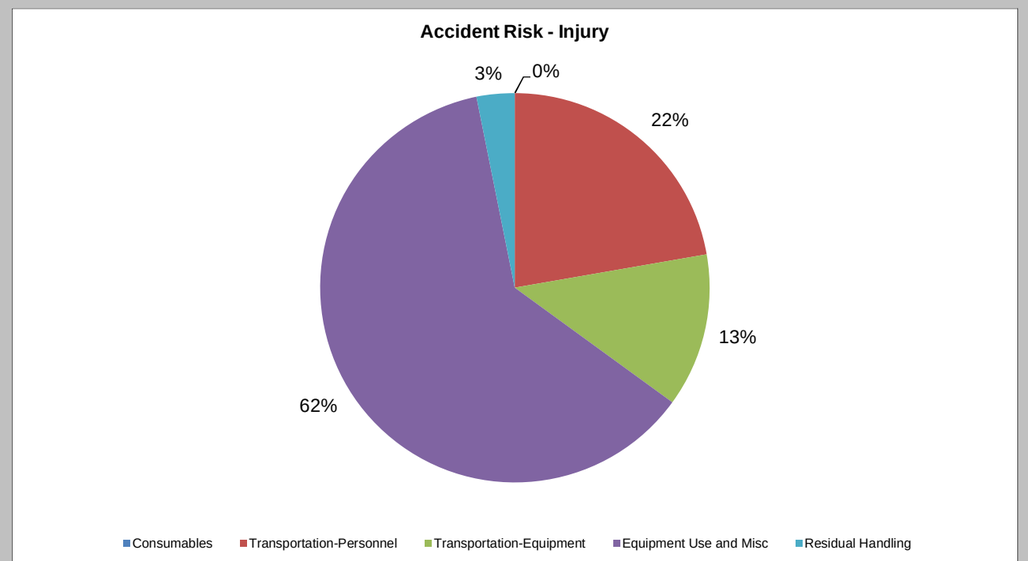

Onsite SOx Emissions
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

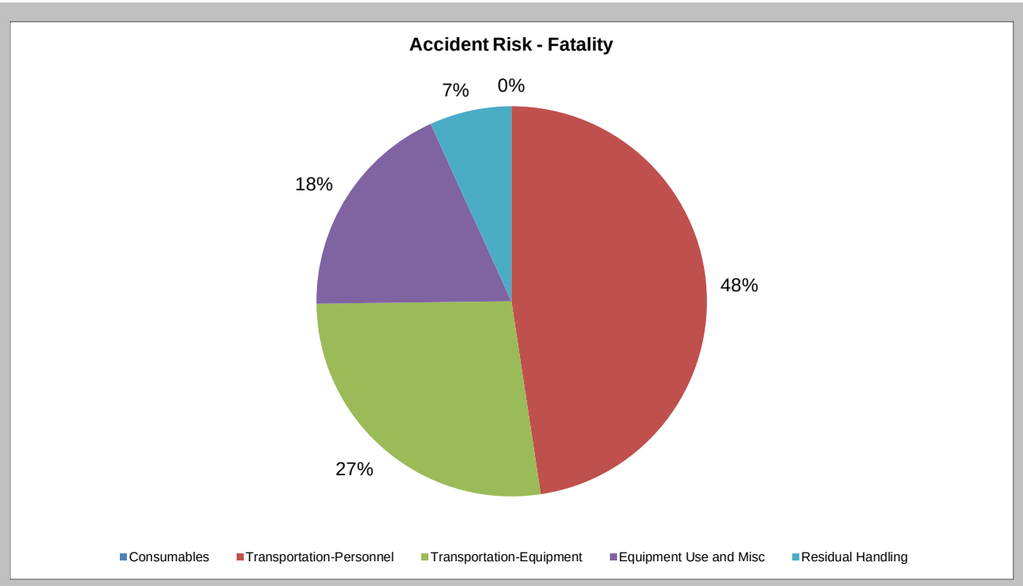

Onsite PM10 Emissions
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite NOx Emissions
1%
99%
Equipment Use and Misc
Residual Handling


Offsite SOx Emissions
0%
0%
0%
100%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite PM10 Emissions
11%
1%
1%
87%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Injury
3%
0%
22%
13%
62%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
7%
0%
18%
48%
27%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

Sustainable Remediation Summary - Remedial Action Operations

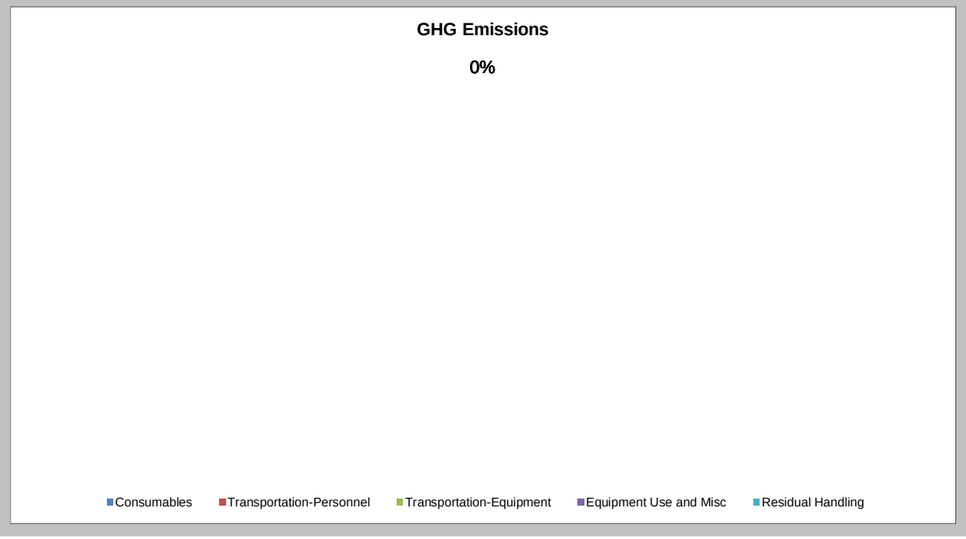
Activities	GHG Emissions	Percent Total	Total Energy Used	Percent Total	Water Consumption	Percent Total	Electricity Usage	Percent Total	Onsite NOx Emissions	Percent Total	Onsite SOx Emissions	Percent Total	Onsite PM10 Emissions	Percent Total	Total NOx Emissions	Percent Total	Total SOx Emissions	Percent Total	Total PM10 Emissions	Percent Total	Accident Risk Fatality	Percent Total	Accident Risk Injury	Percent Total
	metric ton	%	MMBTU	%	gallons	%	MWH	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%		%		%
Consumables	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	NA	NA	NA	NA
Transportation-Personnel	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Transportation-Equipment	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	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	0.0	0.0E+00	0.0	0.0E+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	NA	NA	NA	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Total	0.00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0

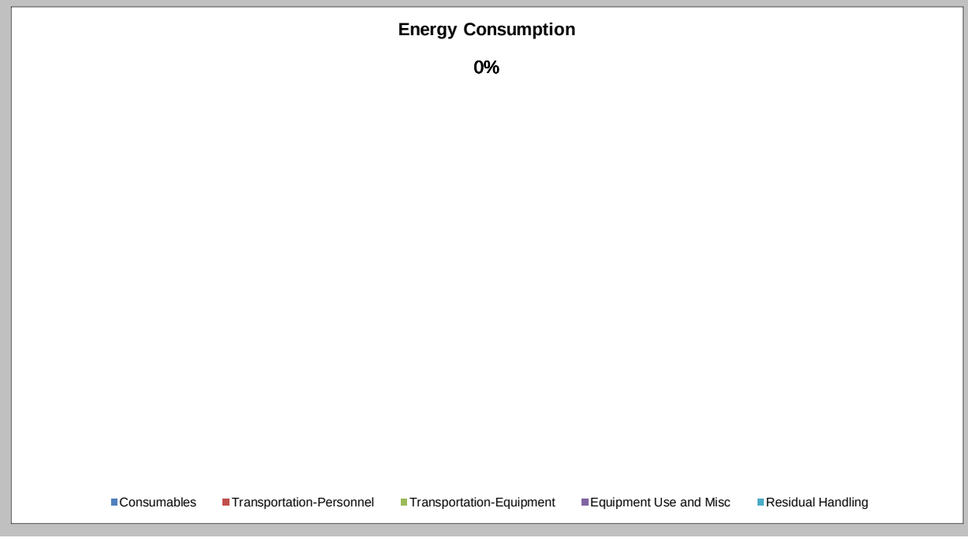
Additional Sustainability Metrics

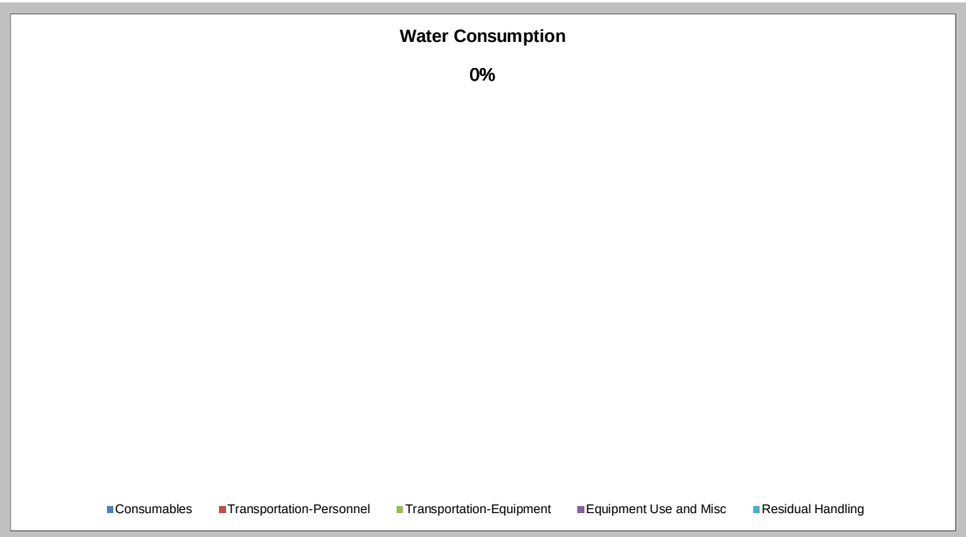
Non-Hazardous Waste Landfill Space (tons)	0.0
Hazardous Waste Landfill Space (tons)	0.0
Topsoil Consumption (yd^3)	0.0
Cost of Phase ($)	0.0
Lost Hours - Injury	0.0

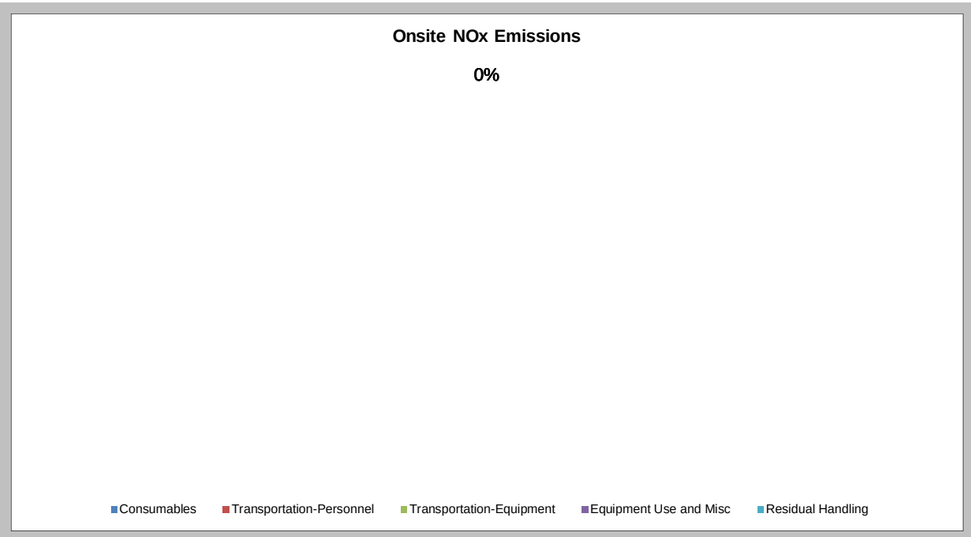
Footprint Reduction

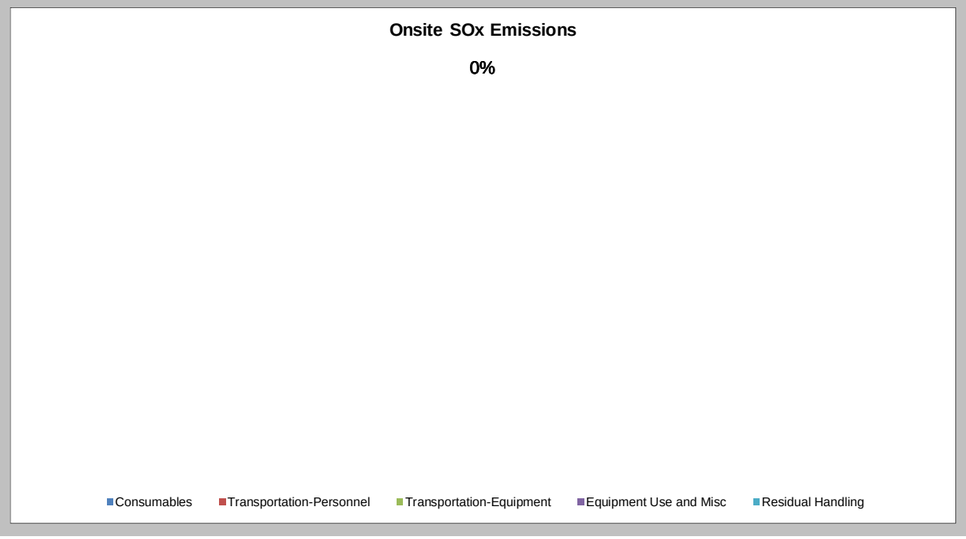
Total electricity replacement (MWh)	0.00E+00
Total electricity replacement (mmBtu)	0.00E+00
Percent electricity from renewable sources (%)	0.0%
Landfill gas reduction (metric ton CO_2 e)	0.00E+00
GHG emissions (metric ton CO2 e)	0.00E+00
NOx emissions (metric ton)	0.00E+00
SOx emissions (metric ton)	0.00E+00
PM10 emissions (metric ton)	0.00E+00

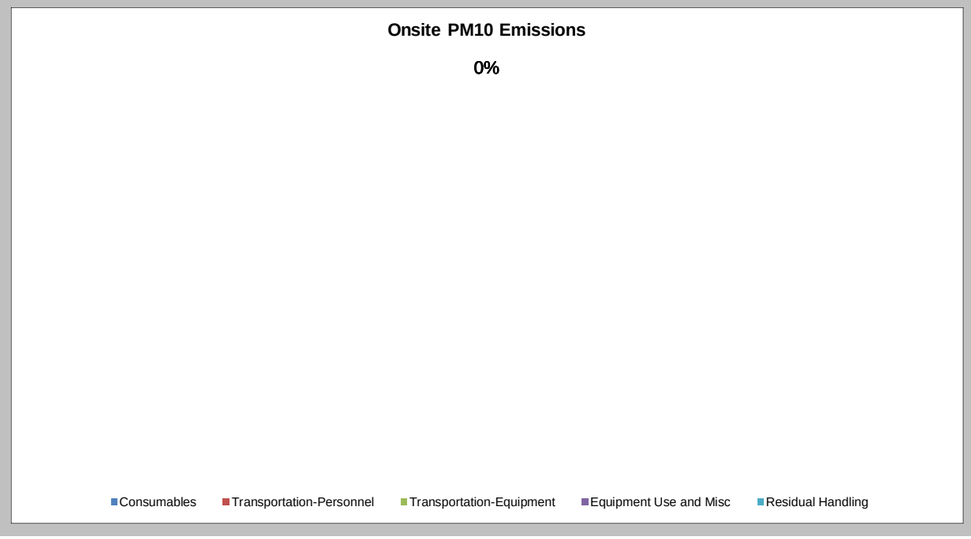


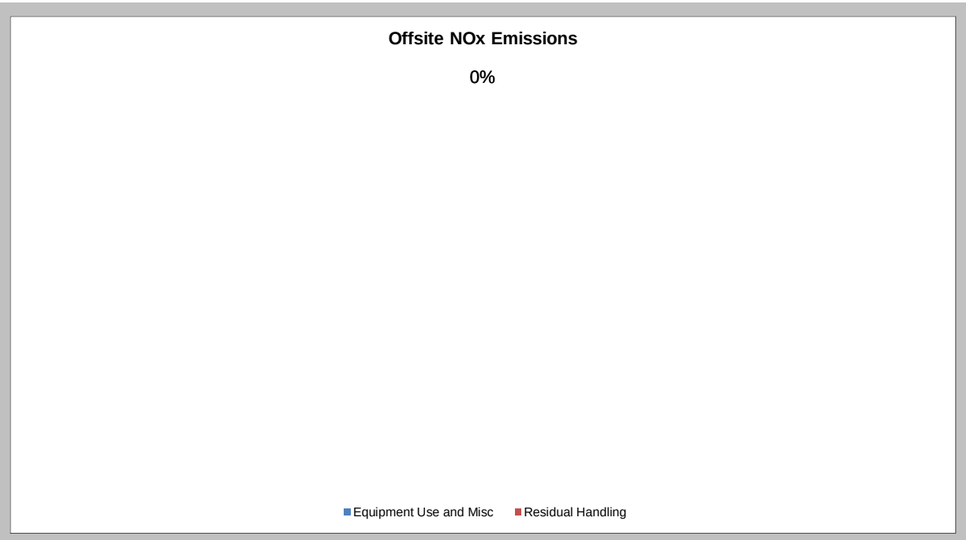


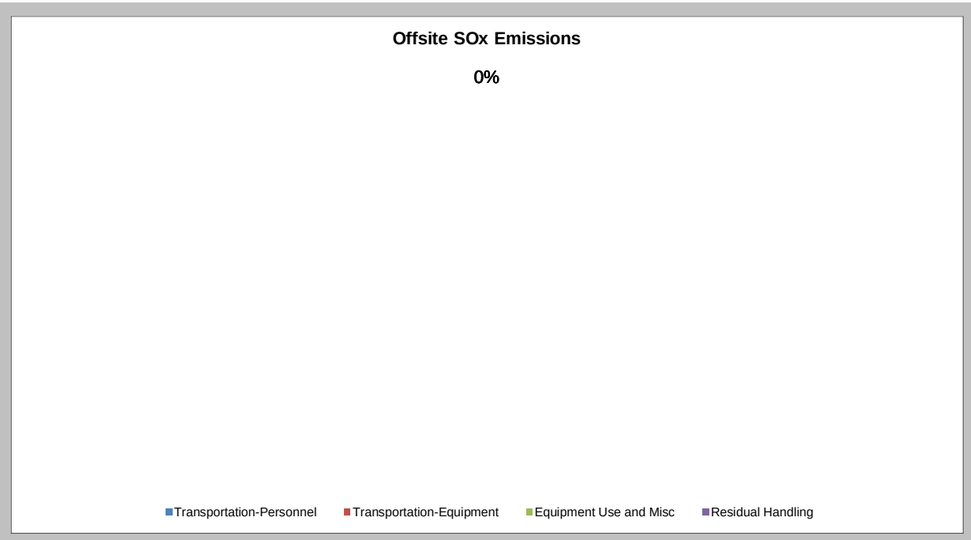

Water Consumption
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

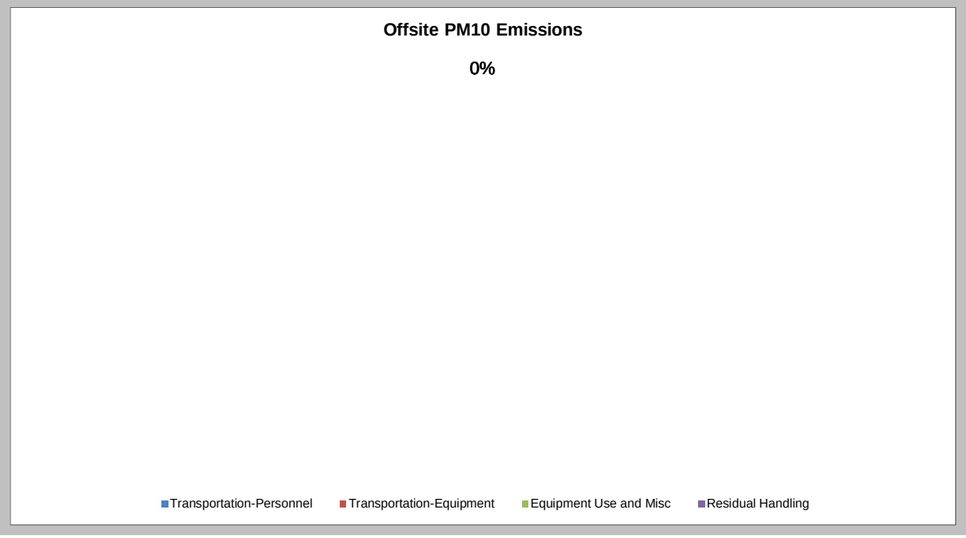

Onsite NOx Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Onsite SOx Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

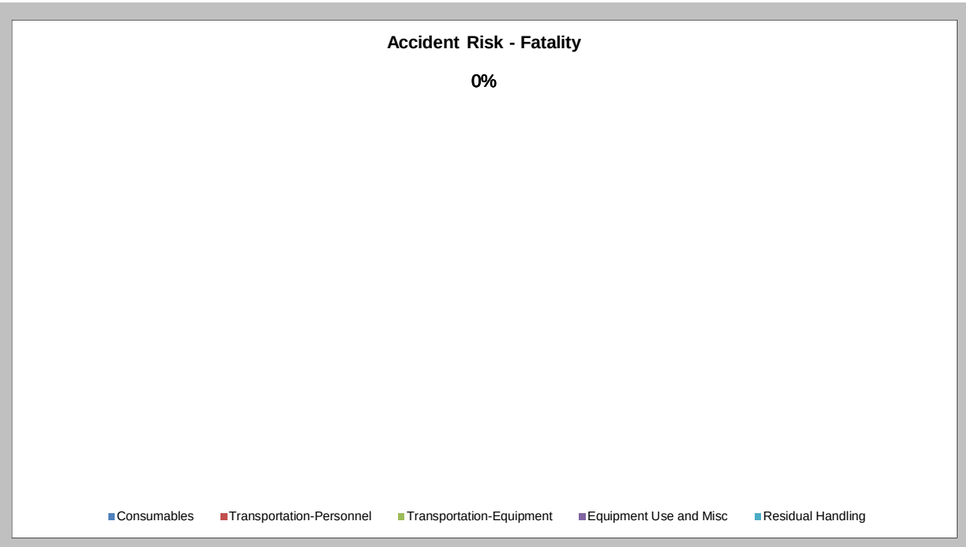

Onsite PM10 Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite NOx Emissions
0%
Equipment Use and Misc
Residual Handling


Offsite SOx Emissions
0%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite PM10 Emissions
0%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Injury
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

Sustainable Remediation Summary - Long-term Monitoring

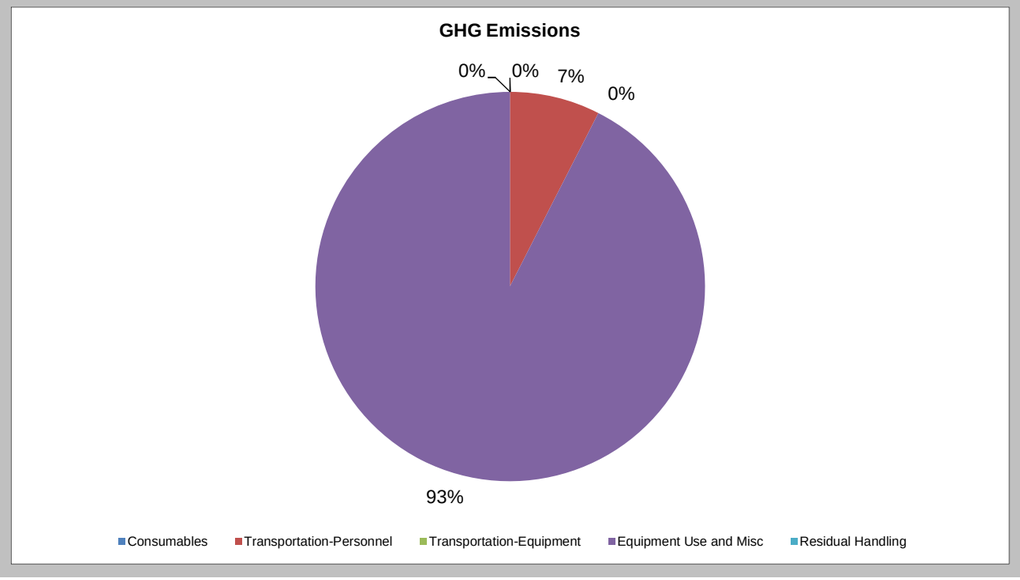
Activities	GHG Emissions	Percent Total	Total Energy Used	Percent Total	Water Consumption	Percent Total	Electricity Usage	Percent Total	Onsite NOx Emissions	Percent Total	Onsite SOx Emissions	Percent Total	Onsite PM10 Emissions	Percent Total	Total NOx Emissions	Percent Total	Total SOx Emissions	Percent Total	Total PM10 Emissions	Percent Total	Accident Risk Fatality	Percent Total	Accident Risk Injury	Percent Total
	metric ton	%	MMBTU	%	gallons	%	MWH	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%		%		%
Consumables	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	NA	NA	NA	NA
Transportation-Personnel	5.45	7.5	6.9E+01	6.7	NA	NA	NA	NA	NA	-	NA	-	NA	-	2.3E-03	0.7	7.1E-05	0.0	3.2E-04	1.2	7.7E-05	91.5	6.2E-03	41.6
Transportation-Equipment	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Equipment Use and Misc	67.28	92.5	9.6E+02	93.3	0.0E+00	0.0	0.0E+00	0.0	0.0E+00	-	0.0E+00	-	0.0E+00	-	3.2E-01	99.3	2.4E-01	100.0	2.7E-02	98.8	7.1E-06	8.5	8.7E-03	58.4
Residual Handling	0.00	-	0.0E+00	-	NA	NA	NA	NA	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Total	72.74	100.0	1.03E+03	100.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	3.25E-01	100.0	2.42E-01	100.0	2.72E-02	100.0	8.43E-05	100.0	1.49E-02	100.0

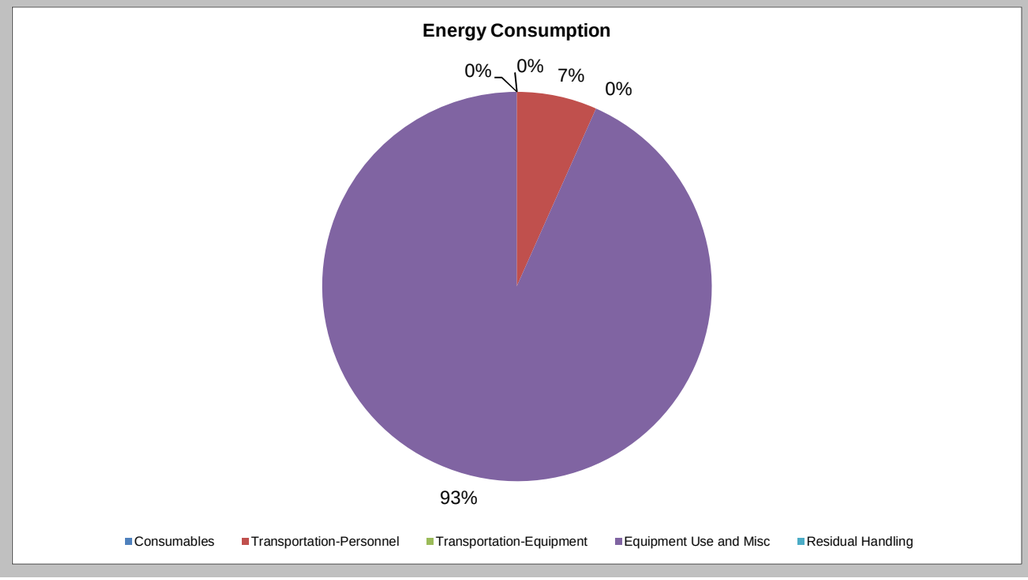
Additional Sustainability Metrics

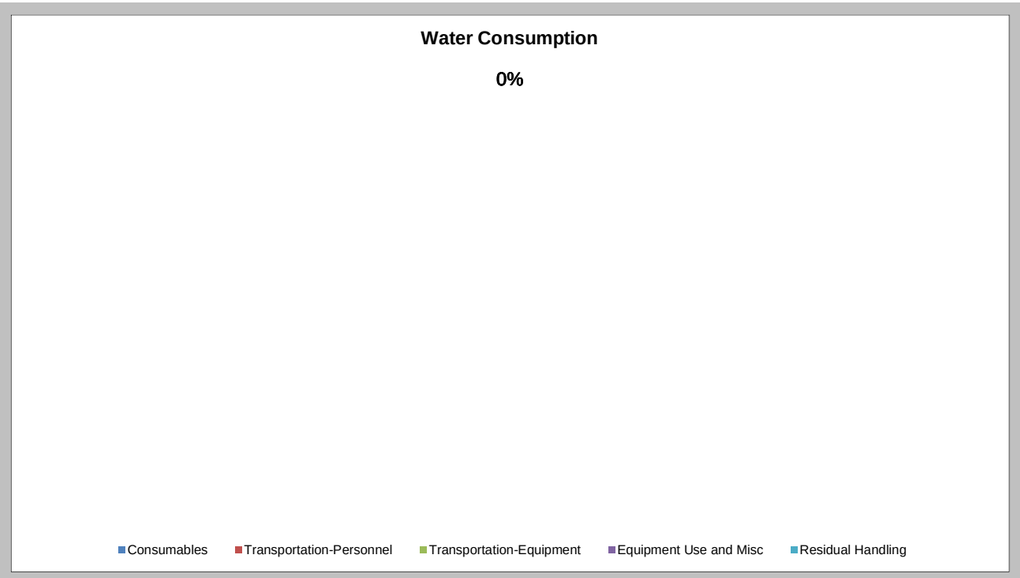
Non-Hazardous Waste Landfill Space (tons)	0.0
Hazardous Waste Landfill Space (tons)	0.0
Topsoil Consumption (yd^3)	0.0
Cost of Phase ($)	738375.0
Lost Hours - Injury	0.1

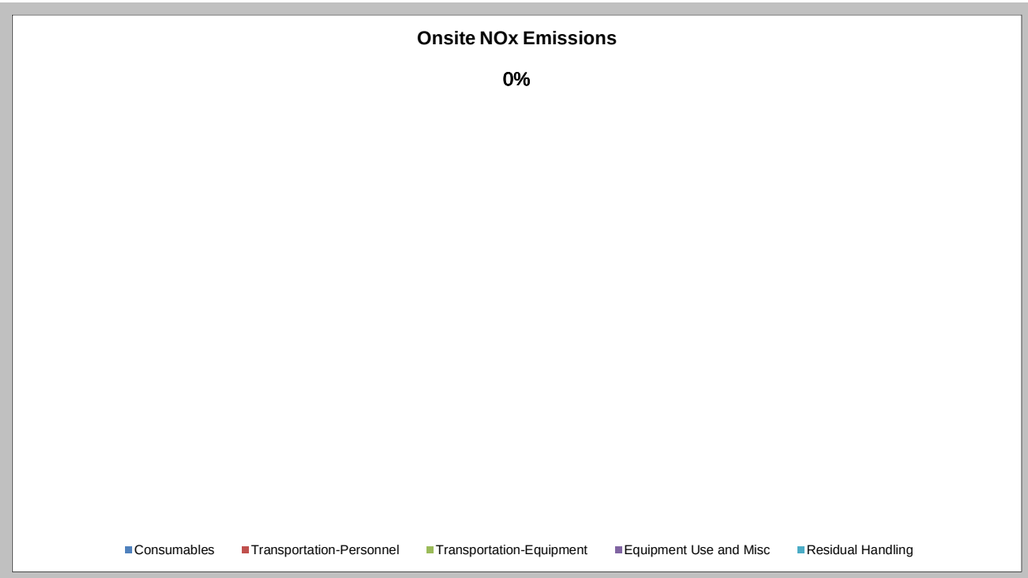
Footprint Reduction

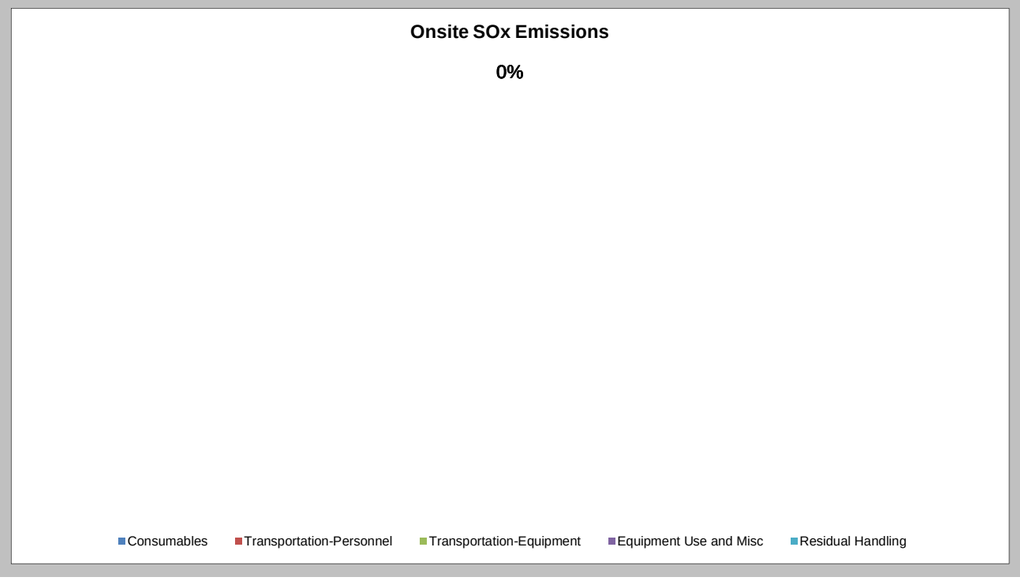
Total electricity replacement (MWh)	0.00E+00
Total electricity replacement (mmBtu)	0.00E+00
Percent electricity from renewable sources (%)	0.0%
Landfill gas reduction (metric ton CO_2 e)	0.00E+00
GHG emissions (metric ton CO2 e)	0.00E+00
NOx emissions (metric ton)	0.00E+00
SOx emissions (metric ton)	0.00E+00
PM10 emissions (metric ton)	0.00E+00

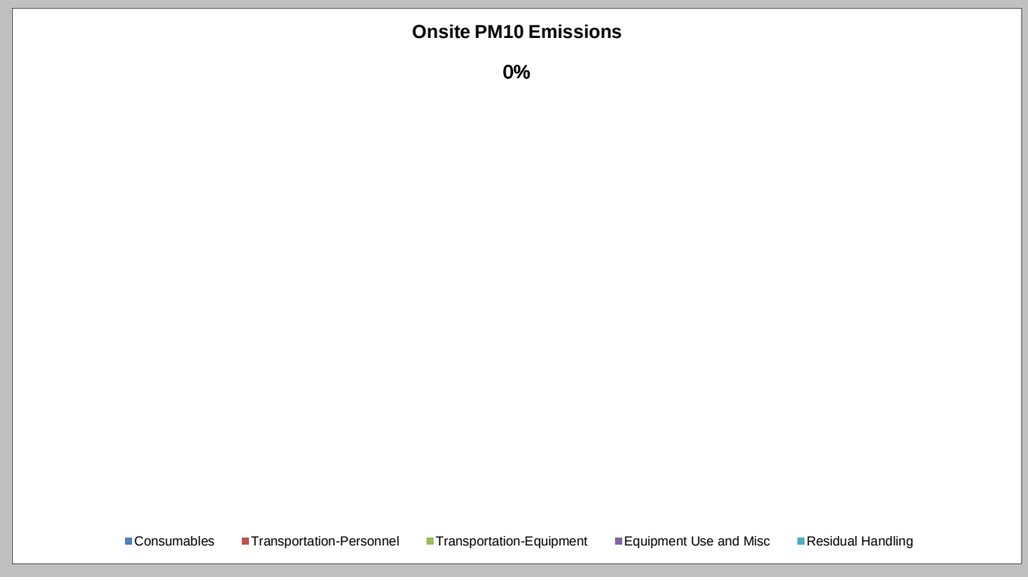


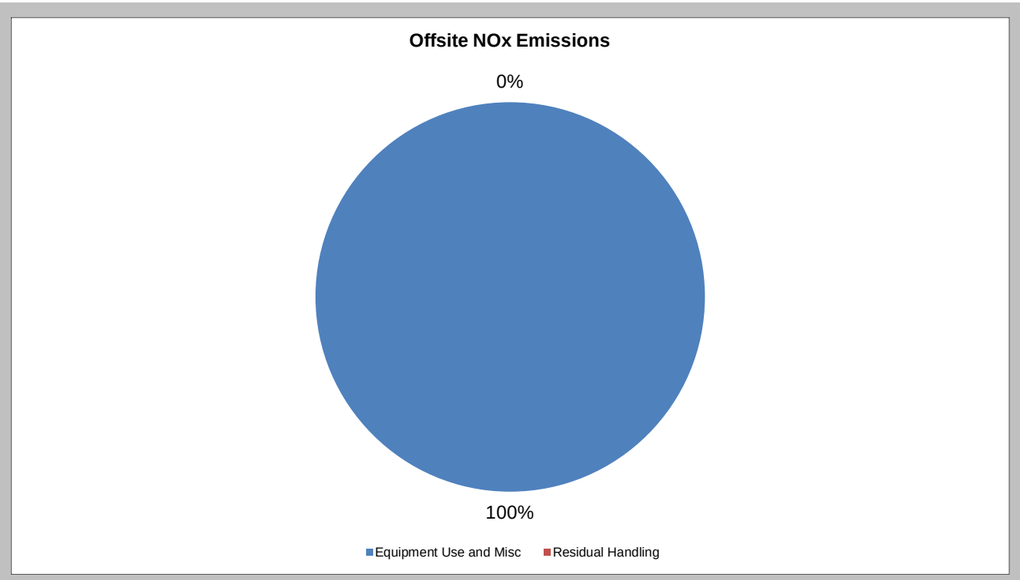


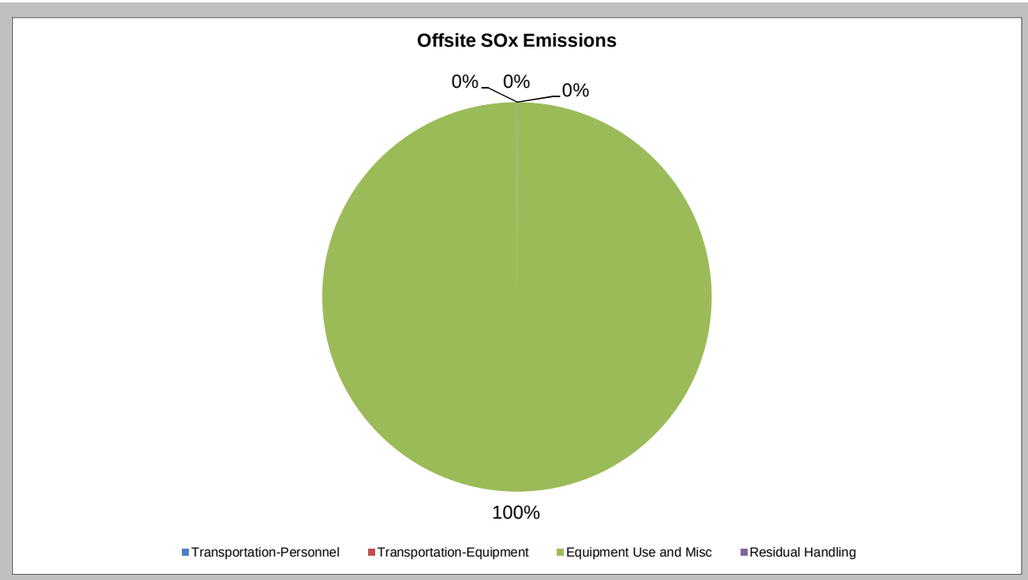

Water Consumption
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

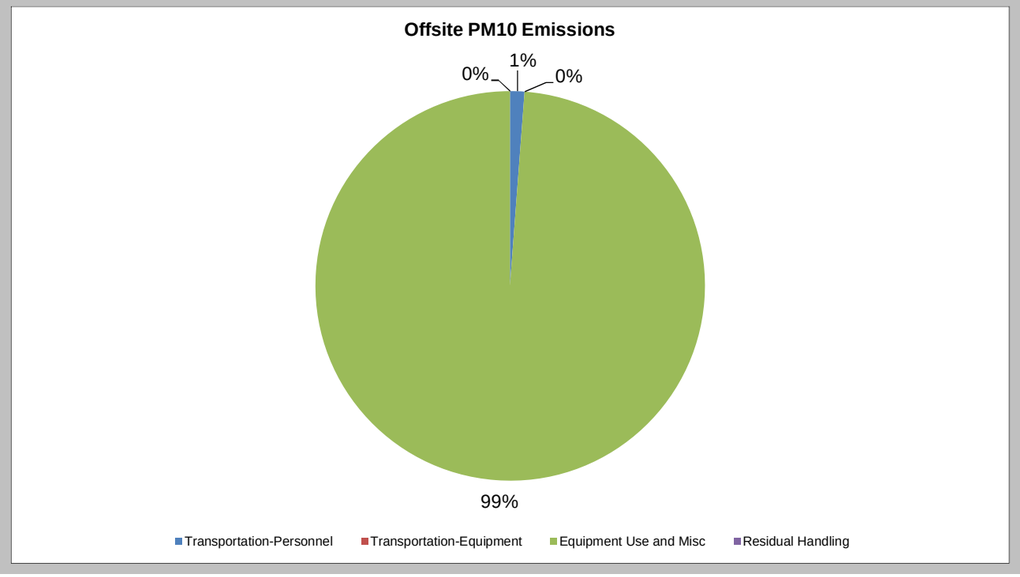

Onsite NOx Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

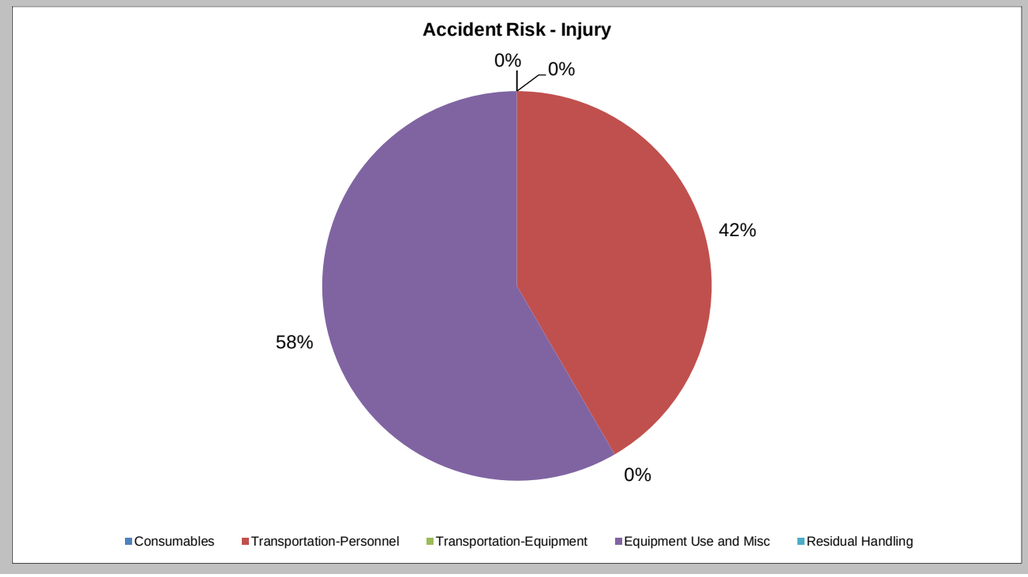

Onsite SOx Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

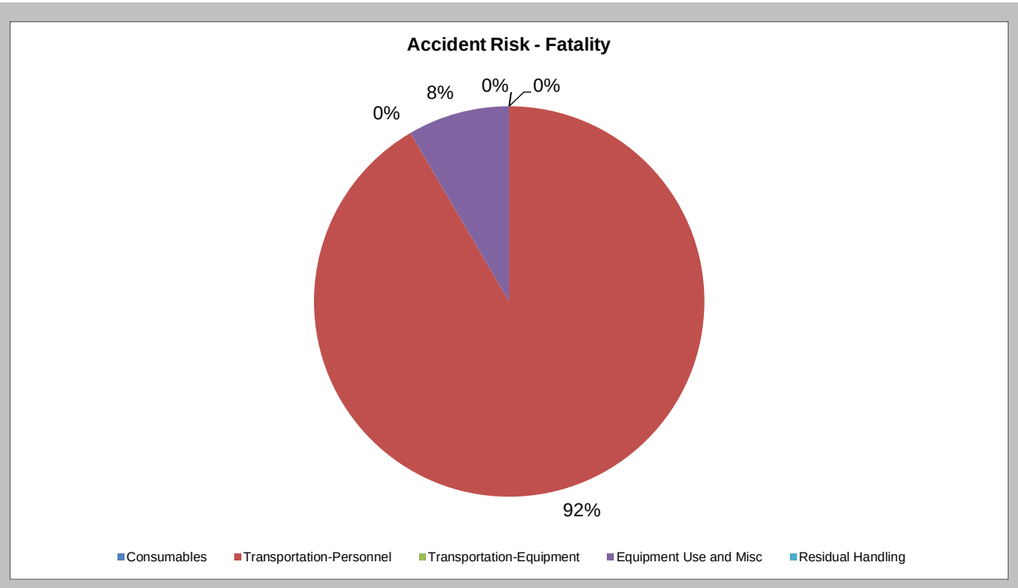

Onsite PM10 Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite NOx Emissions
0%
100%
Equipment Use and Misc
Residual Handling


Offsite SOx Emissions
0%
0%
0%
100%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite PM10 Emissions
0%
1%
0%
99%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

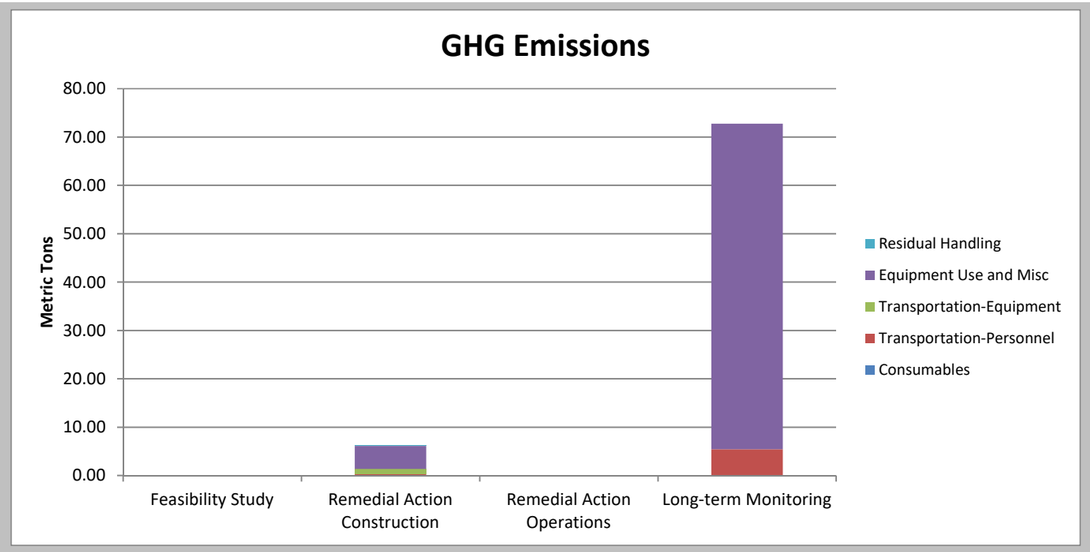

Accident Risk - Injury
0%
0%
42%
58%
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

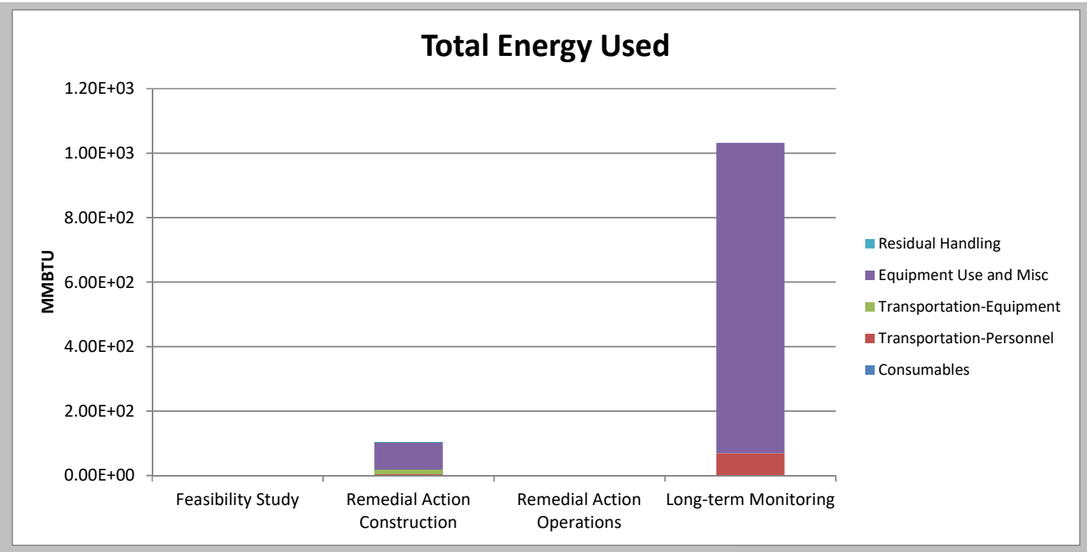

Accident Risk - Fatality
0%
0%
8%
0%
92%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

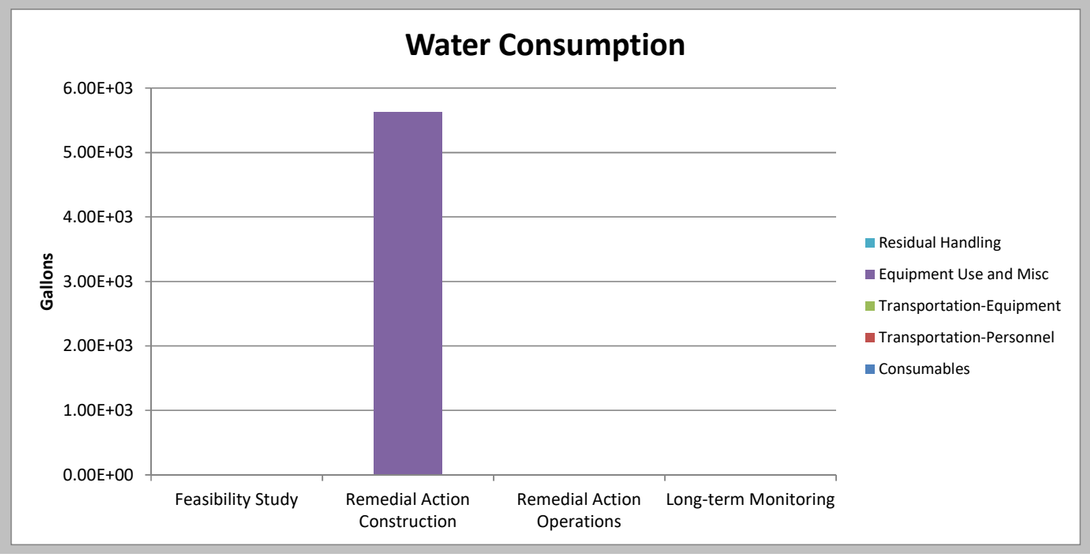
Sustainable Remediation - Environmental Footprint Summary
Alt 1

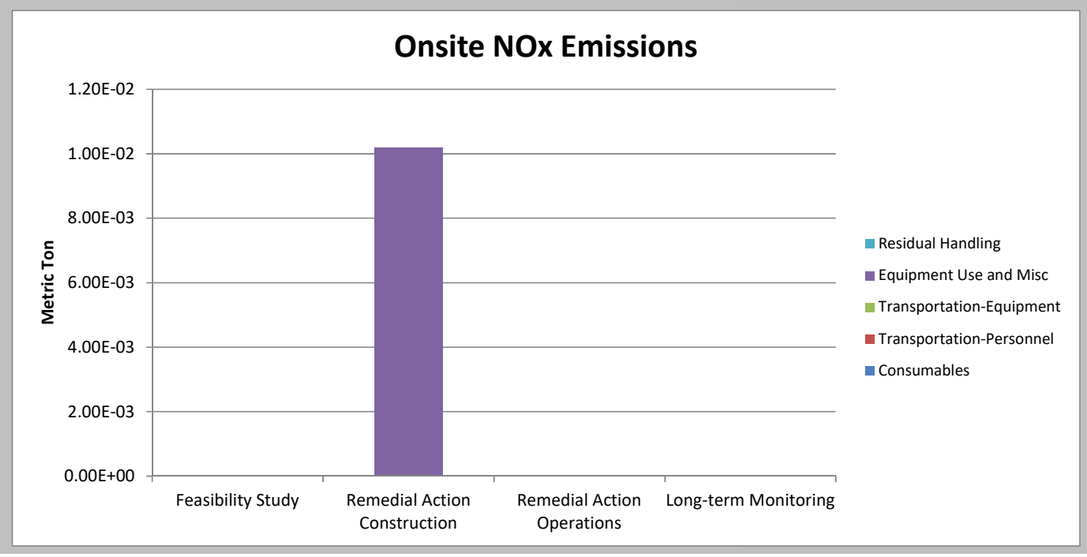
Phase	Activities	GHG Emissions	Total Energy Used	Water Consumption	Electricity Usage	Onsite NOx Emissions	Onsite SOx Emissions	Onsite PM10 Emissions	Total NOx Emissions	Total SOx Emissions	Total PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	MWH	metric ton	metric ton	metric ton	metric ton	metric ton	metric ton		
Feasibility Study	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	NA	NA	NA	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	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	0.39	4.9E+00	NA	NA	NA	NA	NA	1.6E-04	5.0E-06	2.3E-05	5.5E-06	4.4E-04
	Transportation-Equipment	0.99	1.3E+01	NA	NA	NA	NA	NA	3.1E-04	5.5E-06	2.8E-05	3.1E-06	2.5E-04
	Equipment Use and Misc	4.76	8.5E+01	5.6E+03	0.0E+00	1.0E-02	4.1E-03	1.2E-03	2.0E-02	1.1E-02	2.1E-03	2.1E-06	1.2E-03
	Residual Handling	0.16	2.2E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	1.3E-04	4.8E-05	2.6E-04	7.8E-07	6.3E-05
	Sub-Total	6.29	1.05E+02	5.62E+03	0.00E+00	1.02E-02	4.07E-03	1.19E-03	2.07E-02	1.15E-02	2.36E-03	1.15E-05	1.97E-03
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	NA	NA	NA	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	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Long-term Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	5.45	6.9E+01	NA	NA	NA	NA	NA	2.3E-03	7.1E-05	3.2E-04	7.7E-05	6.2E-03
	Transportation-Equipment	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	67.28	9.6E+02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	3.2E-01	2.4E-01	2.7E-02	7.1E-06	8.7E-03
	Residual Handling	0.00	0.0E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	72.74	1.03E+03	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.25E-01	2.42E-01	2.72E-02	8.43E-05	1.49E-02
Total		**7.9E+01**	**1.1E+03**	**5.6E+03**	**0.0E+00**	**1.0E-02**	**4.1E-03**	**1.2E-03**	**3.5E-01**	**2.5E-01**	**3.0E-02**	**9.6E-05**	**1.7E-02**

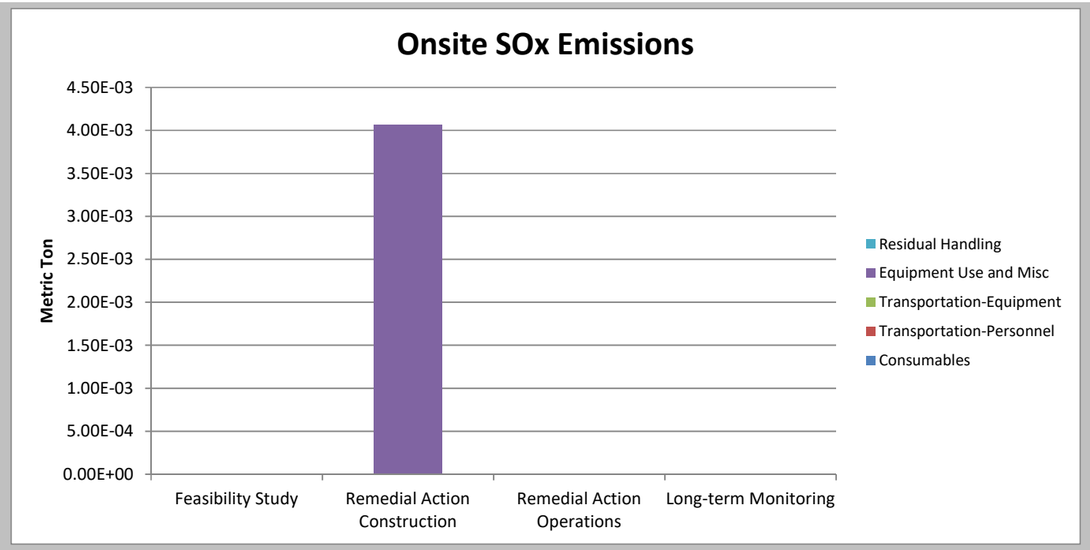
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury	Percent electricity from renewable sources	Total Cost with Footprint Reduction
	tons	tons	cubic yards	$		%	
Feasibility Study	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00	0.0%	$764,750
Remedial Action Construction	1.4E+00	0.0E+00	0.0E+00	26,375	1.6E-02	0.0%	
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00	0.0%	
Long-term Monitoring	0.0E+00	0.0E+00	0.0E+00	738,375	1.2E-01	0.0%	
Total	**1.4E+00**	**0.0E+00**	**0.0E+00**	**$764,750**	**1.4E-01**	**0.0%**	

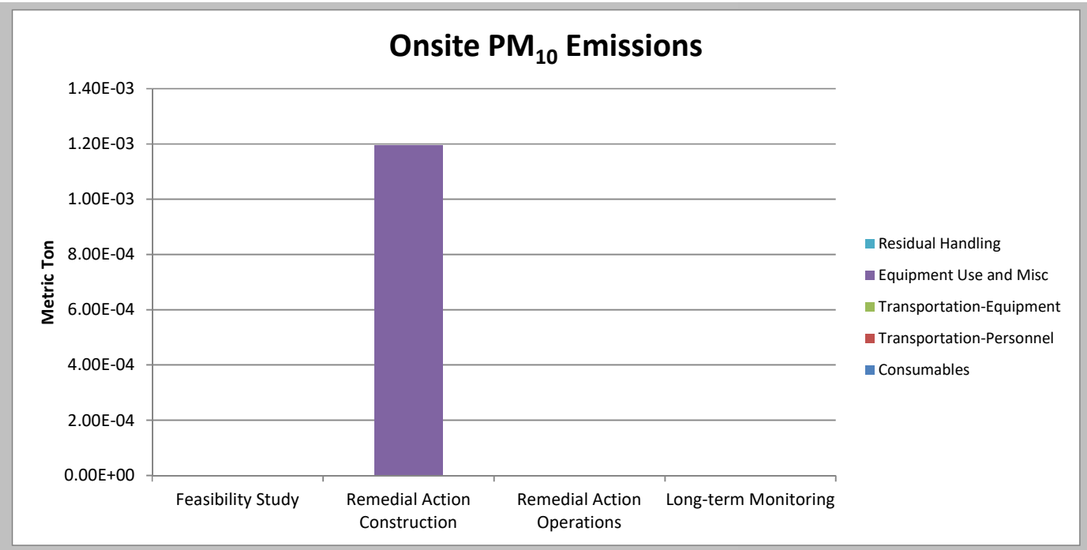

GHG Emissions
Metric Tons
80.00
70.00
60.00
50.00
40.00
30.00
20.00
10.00
0.00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

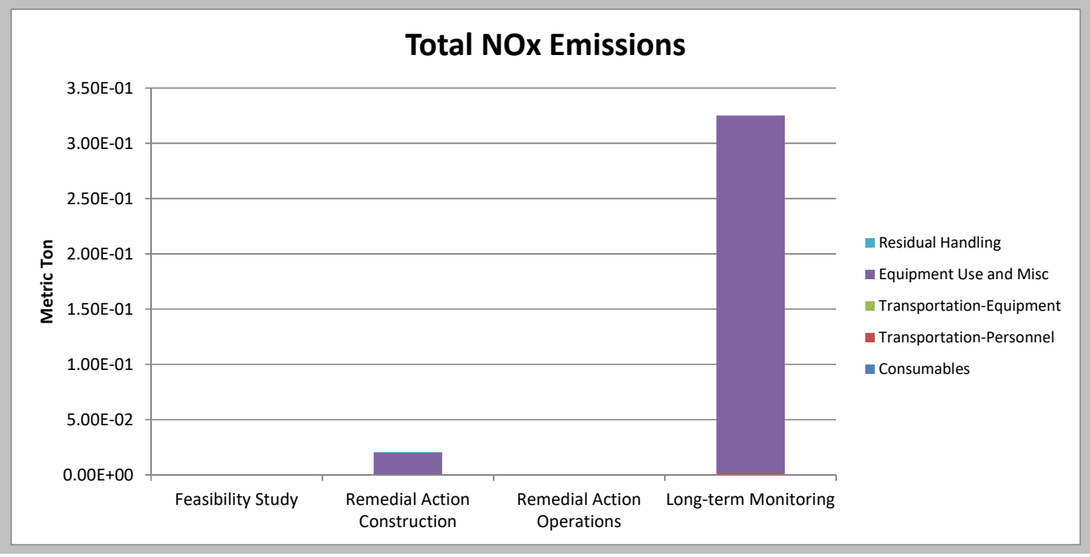

Total Energy Used
MMBTU
1.20E+03
1.00E+03
8.00E+02
6.00E+02
4.00E+02
2.00E+02
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

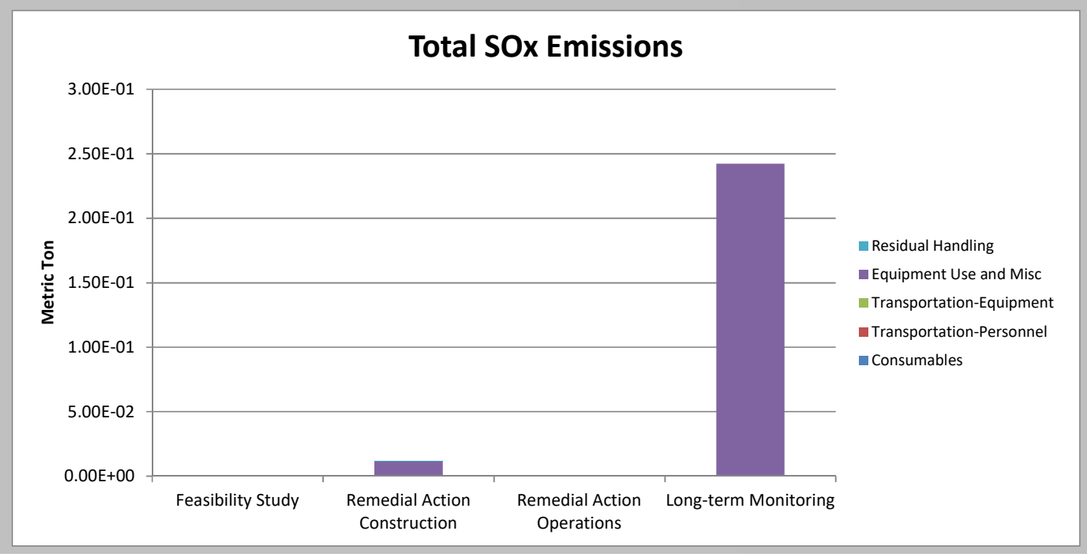

Water Consumption
Gallons
6.00E+03
5.00E+03
4.00E+03
3.00E+03
2.00E+03
1.00E+03
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

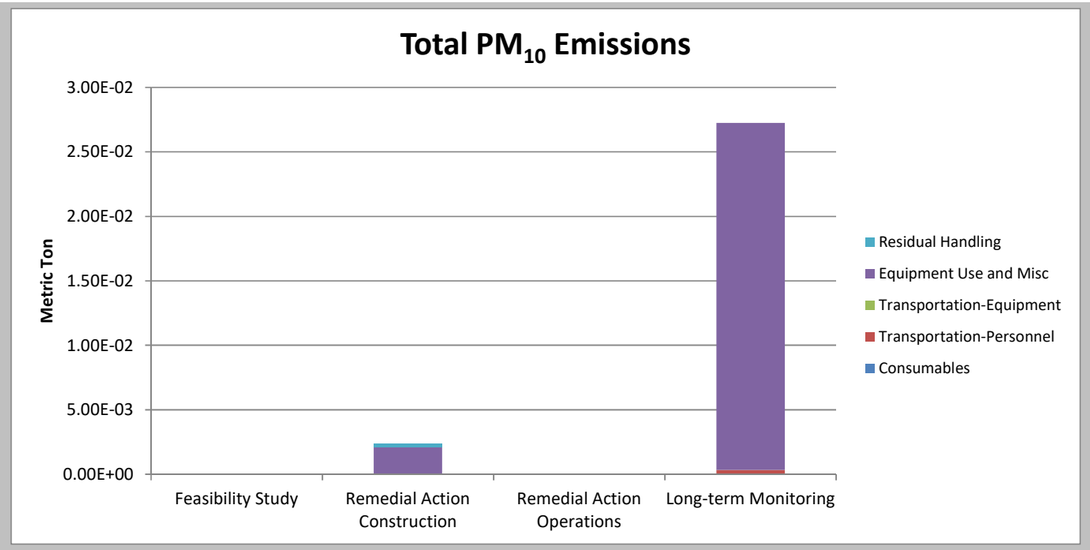

Onsite NOx Emissions
Metric Ton
1.20E-02
1.00E-02
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

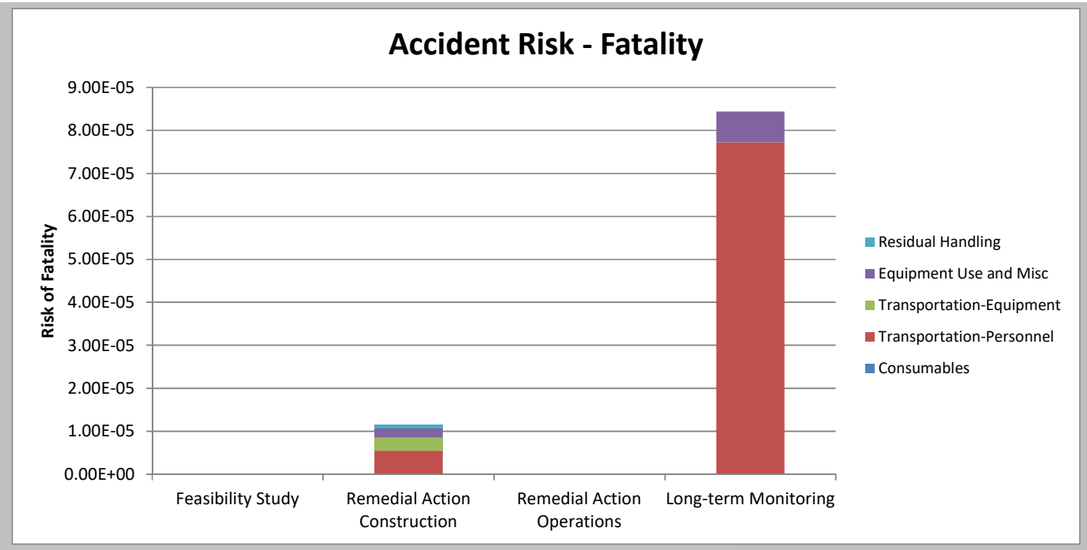

Onsite SOx Emissions
Metric Ton
4.50E-03
4.00E-03
3.50E-03
3.00E-03
2.50E-03
2.00E-03
1.50E-03
1.00E-03
5.00E-04
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

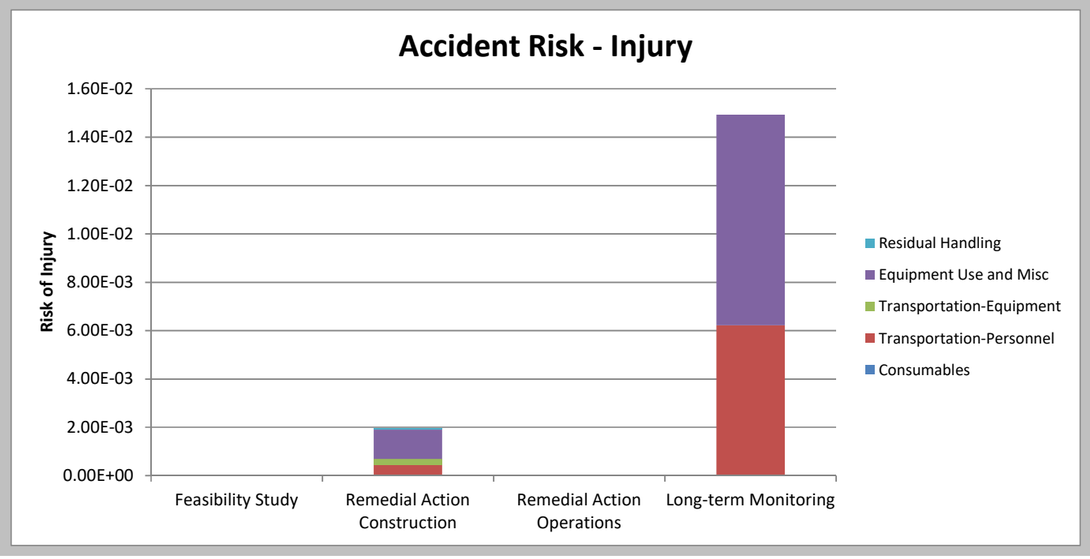

Onsite PM10 Emissions
Metric Ton
1.40E-03
1.20E-03
1.00E-03
8.00E-04
6.00E-04
4.00E-04
2.00E-04
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

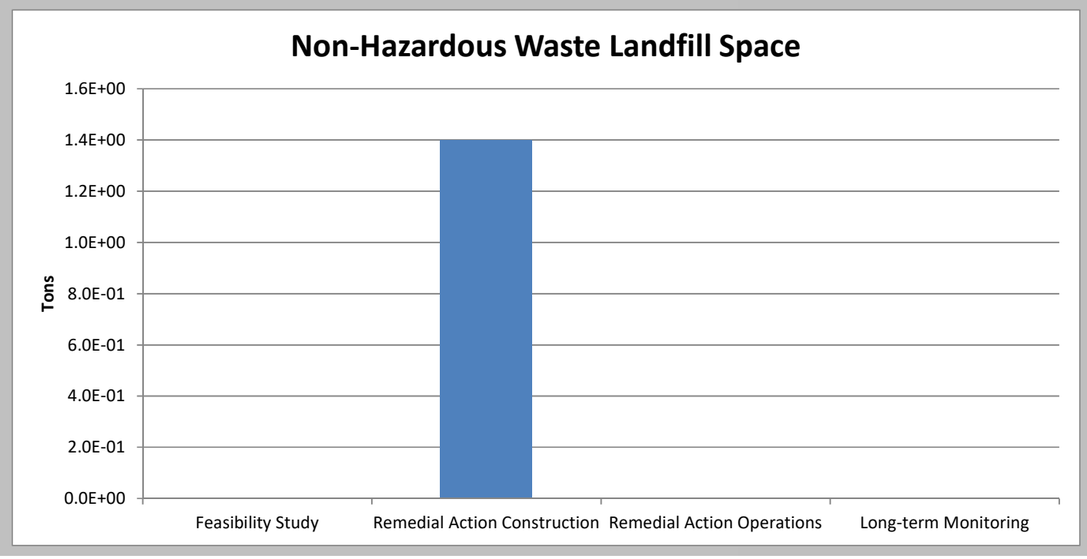

Total NOx Emissions
Metric Ton
3.50E-01
3.00E-01
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Total SOx Emissions
Metric Ton
3.00E-01
2.50E-01
2.00E-01
1.50E-01
1.00E-01
5.00E-02
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

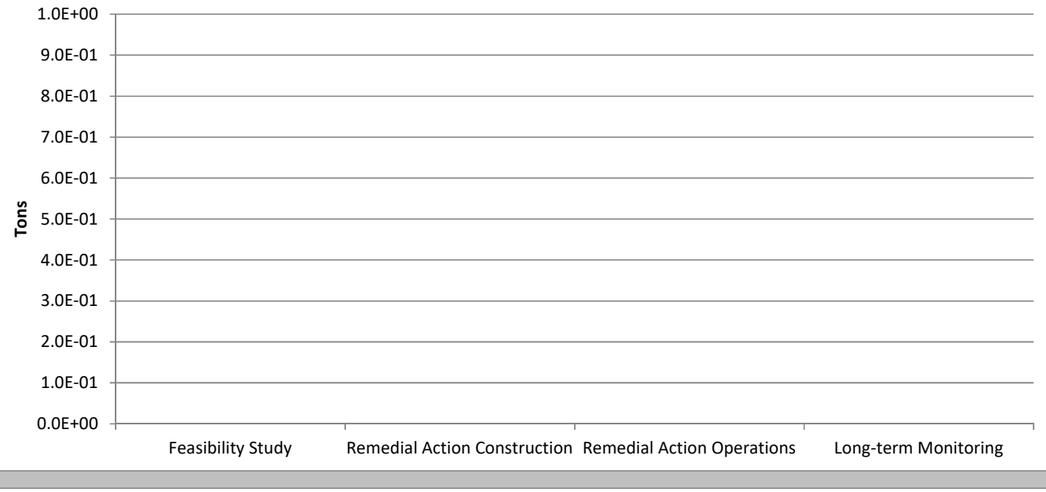

Total PM10 Emissions
Metric Ton
3.00E-02
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
9.00E-05
8.00E-05
7.00E-05
6.00E-05
5.00E-05
4.00E-05
3.00E-05
2.00E-05
1.00E-05
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

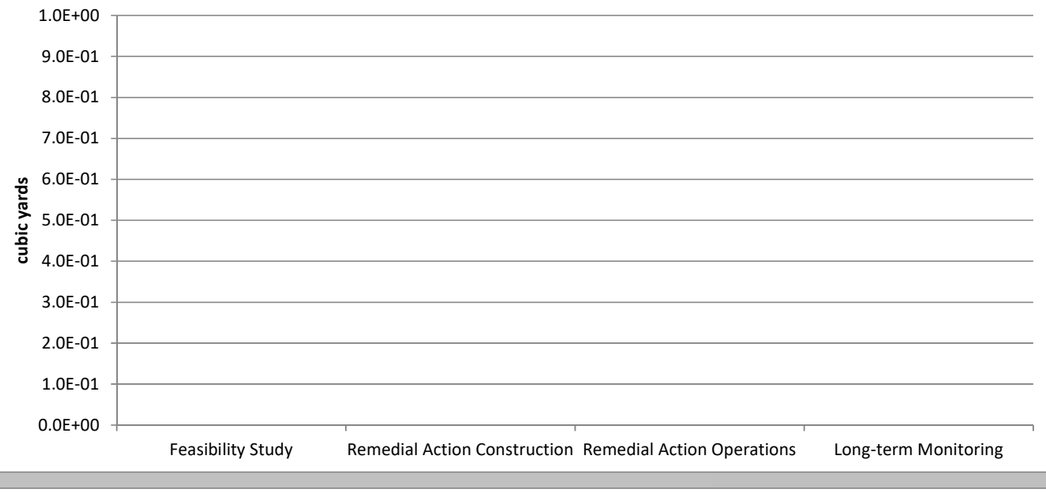

Accident Risk - Injury
Risk of Injury
1.60E-02
1.40E-02
1.20E-02
1.00E-02
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Non-Hazardous Waste Landfill Space
Tons
1.6E+00
1.4E+00
1.2E+00
1.0E+00
8.0E-01
6.0E-01
4.0E-01
2.0E-01
0.0E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring

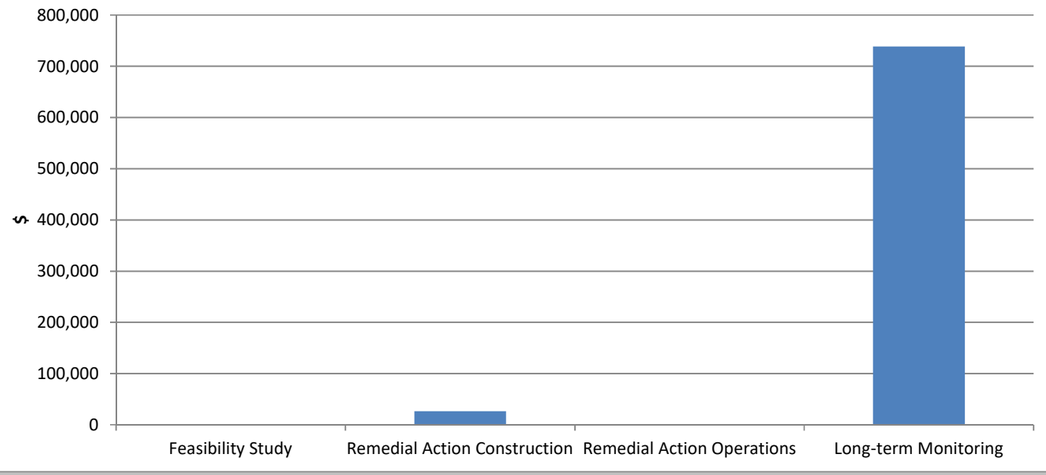
Hazardous Waste Landfill Space



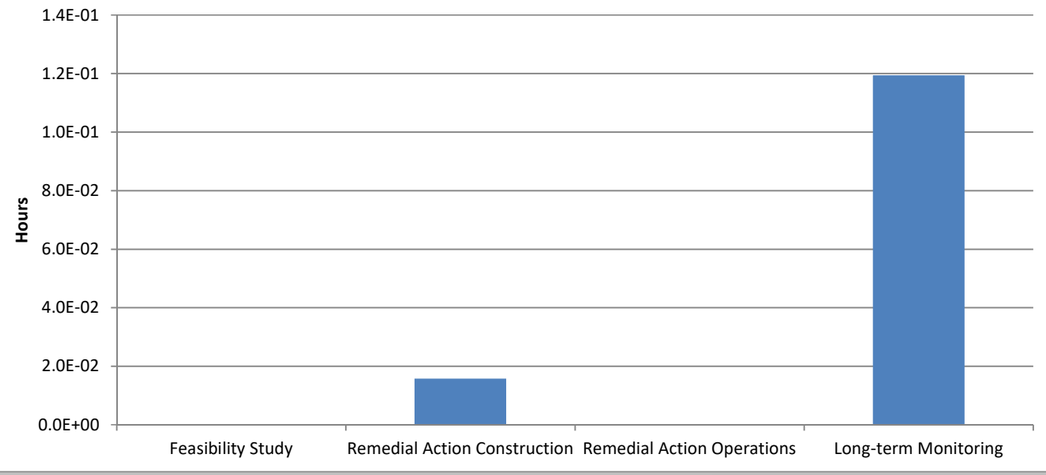
Topsoil Consumption



Costing



Lost Hours - Injury



GSRx Results Alternative 2
Lockheed Martin, Middle River Complex , Blocks E and F
Middle River, Maryland

Stage	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	Greenhouse Gas Emissions CO_2e	CO_2	N_20	CH_4	Criteria Pollutant Emission NO_x	SO_x	PM_{10}	Energy Consumption	Water Consumption
Materials						**Tonnes**							**MWhr**	**gal x 1000**
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
RAC	GW Monitoring Wells	PVC	4 wells 20 feet deep each, 2" Schedule 40	80	lft	0.12	0.06	0.00	0.00	0.00	0.00	0.00	2.25	0.14
					lft	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
RAC	GW Extraction Wells	PVC	7 wells, 4" Schedule 40, 25 feet deep	175	lft	0.79	0.40	0.00	0.00	0.00	0.00	0.00	14.54	0.30
RAC	Concrete well pads	General Concrete	4 pads, 2'x2'x6"	900	lbs	0.053	0.053	0.000	0.000	0.000	0.000	0.000	0.52	0.000
RAC	Decon pad liner	HDPE	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3	730	lbs	1.63	0.86	0.00	0.0063	0.00	0.00	0.00	9.55	0.26
RAC	Decon Pad frame		Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3	368	lbs	0.0039	0.0039	0.00	0.00	0.00	0.00	0.00	0.0042	0.0025
RAC	Conveyance piping	HDPE	2" PEX pipe, assume HDPE, 900', 0.26 lbs/ft	540	lbs	1.21	0.64	0.00	0.00	0.00	0.00	0.00	7.07	0.19
RAC	Vaults for extraction wells	General Concrete	7 vaults, 1300 lbs each	9,100	lbs	0.54	0.54	0.00	0.00	0.00	0.00	0.00	5.30	0.00
RAC	Pads for vaults	General Concrete	5'x5'x6", 7 pads	13125	lbs	0.77	0.77	0.00	0.00	0.00	0.00	0.00	7.64	0.00
RAC	Treatment plant piping	HDPE	assume 2" PEX, 0.6 lbs/ft, $60/ft, $5,000 total	50	lbs	0.11	0.06	0.00	0.00	0.00	0.00	0.00	0.65	0.02
RAO	VGAC years 1-5	GAC - Virgin	100 pounds/year, 5 years	500	lbs	1.02	1.02	0.00	0.00	0.00	0.00	0.00	7.69	0.00
RAO	VGAC years 6-8	GAC - Virgin	50 pounds/tear, 3 years	150	lbs	0.31	0.31	0.00	0.00	0.00	0.00	0.00	2.31	0.00
RAO	VGAC years 9-30	GAC - Virgin	25 lbs/year, 22 years	550	lbs	1.12	1.12	0.00	0.00	0.00	0.00	0.00	8.46	0.00
RAC	Re-seeding	Fertilizer	fertilizer, 3.06 msf (thousand square feet), 3 lb of seed per 1.2 msf, 300 sy	7	lbs	0.0084	0.0084	1.11E-11	0.00E+00	0.00E+00	3.06E-06	6.15E-09	0.15	0.00
RAC	Re-seeding	Mulch	fertilizer, 3.06 msf (thousand square feet), 3 lb of seed per 1.2 msf, 300 sy	7	lbs	0.0021	0.00075	0.0000043	0.0000023	1.27E-09	7.29E-06	5.51E-07	0.02	0.00
RAC	Silt Fence	Medium Impact Material	9 100' rolls, 45lbs/roll	405	lbs	0.18	0.18	0.00E+00	0.00E+00	0.00055	0.00092	0.00018	7.44	0.00
RAC	Temporary Jute Erosion Control Matting	Low Impact Material	300 sy, 90lbs/100sy	270	lbs	0.06	0.06	0.00E+00	0.00E+00	0.00012	0.00024	0.000049	1.65	0.00
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

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

BASELINE INFORMATION

COMPONENT 1 DURATION AND COST	Entire Site
Input duration of the component (unit time)	1
Input component cost per unit time ($)	

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Choose specific casing material schedule from drop down menu	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC
Choose well diameter (in) from drop down menu	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
Input total quantity of Sand (kg)												
Input total quantity of Gravel (kg)												
Input total quantity of Bentonite (kg)												
Input total quantity of Typical Cement (kg)												
Input total quantity of General Concrete (kg)												
Input total quantity of Steel (kg)												

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input number of injection points												
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	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												

TREATMENT MEDIA	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input weight of media used (lbs)												
Choose media type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	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	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft2)												
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	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Input well diameter (in)												
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil

SILT CURTAIN MATERIALS	Curtain 1	Curtain 2	Curtain 3	Curtain 4	Curtain 5	Curtain 6	Curtain 7	Curtain 8	Curtain 9	Curtain 10	Curtain 11	Curtain 12
Input length or perimeter of silt curtain (ft)												
Input depth of silt curtain (ft)												

BULK MATERIAL QUANTITIES	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material from drop down menu	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid
Choose units of material quantity from drop down menu	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds
Input material quantity												

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	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 - DEDICATED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Account for an empty return trip?	No	No	No	No	No	No	No	No	No	No	No	No
Input one-way distance traveled (miles) with a given load. If applicable, impact for an empty return trip will be accounted for (no additional input is needed).												
Input weight of equipment transported per truck load (tons)												

EQUIPMENT TRANSPORTATION - SHARED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (miles)												
Input weight of load (tons)												

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (mile)												
Input weight of load (tons)												

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12
Input number of drilling locations												
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)												
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

TRENCHING	Trencher 1	Trencher 2	Trencher 3	Trencher 4	Trencher 5	Trencher 6	Trencher 7	Trencher 8	Trencher 9	Trencher 10	Trencher 11	Trencher 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input operating hours (hr)												

SEDIMENT DREDGING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose dredge equipment type from drop down menu	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Choose dredge fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be dredged (yd3)												
Choose dredge equipment size	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1 C
Suggested dredge equipment size	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose dredge tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	2	2	2	2	2	2	2	2	2	2	2	2
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT MANAGEMENT (STAGING AND DRYING)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Is volume input that of saturated sediment?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Will the sediment be dry when this work is performed?	No	No	No	No	No	No	No	No	No	No	No	No
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT CAPPING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose capping method from drop down menu	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release
Choose capping equipment fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of capping material to be placed (yd3)												
Choose capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Suggested capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Input number of dredge tenders (hr) (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

WATERCRAFT OPERATION	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of vessels												
Input operating time (hours)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

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	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	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	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN												
Input flow rate (gpm)	0	0	0	0	0	0	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Pump efficiency (default already present, user override possible)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN												
Input pump horsepower (hp)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for pump motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Pump load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input pump load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower	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	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	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Equipment load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input equipment load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Equipment motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	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	0	0	0	0	0	0
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6	Generator 7	Generator 8	Generator 9	Generator 10	Generator 11	Generator 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
Input operating hours (hr)												

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6	Tillage Tractor 7	Tillage Tractor 8	Tillage Tractor 9	Tillage Tractor 10	Tillage Tractor 11	Tillage Tractor 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
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	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input area (ft2)												
Input time available (work days)												

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6	Mixer 7	Mixer 8	Mixer 9	Mixer 10	Mixer 11	Mixer 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd3)												
Input production rate (yd3/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)												

INTERNAL COMBUSTION ENGINES	Engine 1	Engine 2	Engine 3	Engine 4	Engine 5	Engine 6	Engine 7	Engine 8	Engine 9	Engine 10	Engine 11	Engine 12
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input fuel consumption rate (gal/hr or scf/hr)												
Input operating hours (hr)												

OTHER FUELED EQUIPMENT	Fuel 1	Fuel 2	Fuel 3	Fuel 4	Fuel 5	Fuel 6	Fuel 7	Fuel 8	Fuel 9	Fuel 10	Fuel 11	Fuel 12
Choose fuel type from drop down menu	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Input volume (scf for Natural gas, gallons for all others)												

DIESEL EQUIPMENT OPERATION (PER HOUR BASIS)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose equipment size for Dozer (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Loader (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Excavator (HP)	150	150	150	150	150	150	150	150	150	150	150	150
Choose equipment size for Scraper (HP)	330	330	330	330	330	330	330	330	330	330	330	330
Choose equipment size for Crawler Crane	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C
Choose equipment size for Tillage Tractor (HP)	16	16	16	16	16	16	16	16	16	16	16	16
Choose equipment size for Paver (HP)	25	25	25	25	25	25	25	25	25	25	25	25
Choose equipment size for Roller (HP)	6	6	6	6	6	6	6	6	6	6	6	6
Choose equipment size for Trencher (HP range)	6 to 11	7 to 11	8 to 11	9 to 11	10 to 11	11 to 11	12 to 11	13 to 11	14 to 11	15 to 11	16 to 11	17 to 11
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating hours (hr)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

OPERATOR LABOR	Occupation 1	Occupation 2	Occupation 3	Occupation 4	Occupation 5	Occupation 6	Occupation 7	Occupation 8	Occupation 9	Occupation 10	Occupation 11	Occupation 12
Choose occupation from drop-down menu	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers
Input total time worked onsite (hours)												

LABORATORY ANALYSIS	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5	Analysis 6	Analysis 7	Analysis 8	Analysis 9	Analysis 10	Analysis 11	Analysis 12
Input dollars spent on laboratory analysis ($)												

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO2 emission (metric ton)	
Input N2O emission (metric ton CO2 e)	
Input CH4 emission (metric ton CO2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM10 emission (metric ton)	
Input fatality risk	
Input injury risk	

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)												
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6
Choose landfill type for waste disposal	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous
Input amount of waste disposed in landfill (tons)												
Input landfill methane emissions (metric tons CH4)												
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	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	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	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	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)

RESOURCE CONSUMPTION

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6
Input total water consumed from potable water treatment facility (gal)												
Input total water disposed to wastewater treatment facility (gal)												

ONSITE LAND AND WATER RESOURCE CONSUMPTION	Entire Site 1	Entire Site 2	Entire Site 3	Entire Site 4	Entire Site 5	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6
Input volume of topsoil brought to site (cubic yards)												
Input volume of groundwater or surface water lost (gal)												

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

BASELINE INFORMATION

COMPONENT 2 DURATION AND COST	Entire Site
Input duration of the component (unit time)	1
Input component cost per unit time ($)	311000

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Choose specific casing material schedule from drop down menu	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC
Choose well diameter (in) from drop down menu	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
Input total quantity of Sand (kg)												
Input total quantity of Gravel (kg)												
Input total quantity of Bentonite (kg)												
Input total quantity of Typical Cement (kg)												
Input total quantity of General Concrete (kg)												
Input total quantity of Steel (kg)												

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input number of injection points												
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	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												

TREATMENT MEDIA	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input weight of media used (lbs)												
Choose media type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	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	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft2)												
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	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Input well diameter (in)												
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil

SILT CURTAIN MATERIALS	Curtain 1	Curtain 2	Curtain 3	Curtain 4	Curtain 5	Curtain 6	Curtain 7	Curtain 8	Curtain 9	Curtain 10	Curtain 11	Curtain 12
Input length or perimeter of silt curtain (ft)												
Input depth of silt curtain (ft)												

BULK MATERIAL QUANTITIES	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material from drop down menu	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid
Choose units of material quantity from drop down menu	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds
Input material quantity												

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	Baseline Sampling	Utility Clearance	MW Install	EW Install	Well Survey	Trench Install	Treatment Plant Const	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Light truck	Light truck	Light truck	Light truck	Light truck	Light truck	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	50	50	50	50	50	50	50					
Input number of trips taken	6	1	6	9	1	90	50					
Input number of travelers	1	1	1	1	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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	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 - DEDICATED LOAD ROAD	HAS Drill Rig	Back Hoe	Skid Steer	Porta John	Misc Equipment	Wells	Concrete	Piping	E&S Materials	Decon Materials	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Gasoline	Gasoline
Account for an empty return trip?	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No
Input one-way distance traveled (miles) with a given load. If applicable, impact for an empty return trip will be accounted for (no additional input is needed).	100	100	100	100	100	100	100	100	100	100		
Input weight of equipment transported per truck load (tons)	3.05	3.88	3.50	0.13	0.07	0.20	11.56	0.30	0.34	0.55		

EQUIPMENT TRANSPORTATION - SHARED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (miles)												
Input weight of load (tons)												

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (mile)												
Input weight of load (tons)												

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12
Input number of drilling locations	1											
Choose drilling method from drop down menu	Hollow Stem Auger	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)												
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

TRENCHING	Trencher 1	Trencher 2	Trencher 3	Trencher 4	Trencher 5	Trencher 6	Trencher 7	Trencher 8	Trencher 9	Trencher 10	Trencher 11	Trencher 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input operating hours (hr)												

SEDIMENT DREDGING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose dredge equipment type from drop down menu	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Choose dredge fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be dredged (yd3)												
Choose dredge equipment size	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1 C
Suggested dredge equipment size	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose dredge tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	2	2	2	2	2	2	2	2	2	2	2	2
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT MANAGEMENT (STAGING AND DRYING)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Is volume input that of saturated sediment?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Will the sediment be dry when this work is performed?	No	No	No	No	No	No	No	No	No	No	No	No
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT CAPPING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose capping method from drop down menu	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release
Choose capping equipment fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of capping material to be placed (yd3)												
Choose capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Suggested capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

WATERCRAFT OPERATION	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of vessels												
Input operating time (hours)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

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	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	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	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN												
Input flow rate (gpm)	0	0	0	0	0	0	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Pump efficiency (default already present, user override possible)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN												
Input pump horsepower (hp)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for pump motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Pump load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input pump load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower	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	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	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Equipment load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input equipment load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Equipment motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	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	0	0	0	0	0	0
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6	Generator 7	Generator 8	Generator 9	Generator 10	Generator 11	Generator 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
Input operating hours (hr)												

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6	Tillage Tractor 7	Tillage Tractor 8	Tillage Tractor 9	Tillage Tractor 10	Tillage Tractor 11	Tillage Tractor 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
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	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input area (ft2)												
Input time available (work days)												

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6	Mixer 7	Mixer 8	Mixer 9	Mixer 10	Mixer 11	Mixer 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd3)												
Input production rate (yd3/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)												

INTERNAL COMBUSTION ENGINES	Engine 1	Engine 2	Engine 3	Engine 4	Engine 5	Engine 6	Engine 7	Engine 8	Engine 9	Engine 10	Engine 11	Engine 12
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input fuel consumption rate (gal/hr or scf/hr)												
Input operating hours (hr)												

OTHER FUELED EQUIPMENT	Fuel 1	Fuel 2	Fuel 3	Fuel 4	Fuel 5	Fuel 6	Fuel 7	Fuel 8	Fuel 9	Fuel 10	Fuel 11	Fuel 12
Choose fuel type from drop down menu	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Input volume (scf for Natural gas, gallons for all others)												

DIESEL EQUIPMENT OPERATION (PER HOUR BASIS)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose equipment size for Dozer (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Loader (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Excavator (HP)	150	150	150	150	150	150	150	150	150	150	150	150
Choose equipment size for Scraper (HP)	330	330	330	330	330	330	330	330	330	330	330	330
Choose equipment size for Crawler Crane	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C
Choose equipment size for Tillage Tractor (HP)	16	16	16	16	16	16	16	16	16	16	16	16
Choose equipment size for Paver (HP)	25	25	25	25	25	25	25	25	25	25	25	25
Choose equipment size for Roller (HP)	6	6	6	6	6	6	6	6	6	6	6	6
Choose equipment size for Trencher (HP range)	6 to 11	7 to 11	8 to 11	9 to 11	10 to 11	11 to 11	12 to 11	13 to 11	14 to 11	15 to 11	16 to 11	17 to 11
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating hours (hr)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

OPERATOR LABOR	Drillers	Surveyor	Util. Locator	Oversight	Sampler	Construction	Occupation 7	Occupation 8	Occupation 9	Occupation 10	Occupation 11	Occupation 12
Choose occupation from drop-down menu	Operating engineers	ntific and technical serv	ntific and technical serv	ntific and technical serv	ntific and technical serv	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers
Input total time worked onsite (hours)	80.0	16.0	8.0	264.0	48.0	896.0						

LABORATORY ANALYSIS	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5	Analysis 6	Analysis 7	Analysis 8	Analysis 9	Analysis 10	Analysis 11	Analysis 12
Input dollars spent on laboratory analysis ($)	1,740.00											

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	3.1E+02
Water consumption (gallon)	9.2E+02
Input CO2 emission (metric ton)	8.5E+00
Input N2O emission (metric ton CO2 e)	1.5E+00
Input CH4 emission (metric ton CO2 e)	4.9E-01
Input NOx emission (metric ton)	5.1E-02
Input SOx emission (metric ton)	1.1E-02
Input PM10 emission (metric ton)	7.5E-03
Input fatality risk	
Input injury risk	

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	IDW	Construction Debris	Material Residue	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)	3.9	0.5										
Choose fuel used from drop down menu	Diesel	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips	1.0	1.0										
Input number of miles per trip	100.0	100.0										

LANDFILL OPERATIONS	IDW	Construction Debris	Operation 3	Operation 4	Operation 5	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6
Choose landfill type for waste disposal	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous
Input amount of waste disposed in landfill (tons)	3.9	0.5										
Input landfill methane emissions (metric tons CH4)												
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	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	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	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	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)

RESOURCE CONSUMPTION

WATER CONSUMPTION	Development Water	Decon Water	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6
Input total water consumed from potable water treatment facility (gal)	605	10000										
Input total water disposed to wastewater treatment facility (gal)	605	10000										

ONSITE LAND AND WATER RESOURCE CONSUMPTION	Entire Site 1	Entire Site 2	Entire Site 3	Entire Site 4	Entire Site 5	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6
Input volume of topsoil brought to site (cubic yards)												
Input volume of groundwater or surface water lost (gal)												

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

BASELINE INFORMATION

COMPONENT 3 DURATION AND COST	Entire Site
Input duration of the component (unit time)	1
Input component cost per unit time ($)	1826000

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Choose specific casing material schedule from drop down menu	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC
Choose well diameter (in) from drop down menu	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
Input total quantity of Sand (kg)												
Input total quantity of Gravel (kg)												
Input total quantity of Bentonite (kg)												
Input total quantity of Typical Cement (kg)												
Input total quantity of General Concrete (kg)												
Input total quantity of Steel (kg)												

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input number of injection points												
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	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												

TREATMENT MEDIA	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input weight of media used (lbs)												
Choose media type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	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	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft2)												
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	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Input well diameter (in)												
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil

SILT CURTAIN MATERIALS	Curtain 1	Curtain 2	Curtain 3	Curtain 4	Curtain 5	Curtain 6	Curtain 7	Curtain 8	Curtain 9	Curtain 10	Curtain 11	Curtain 12
Input length or perimeter of silt curtain (ft)												
Input depth of silt curtain (ft)												

BULK MATERIAL QUANTITIES	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material from drop down menu	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid
Choose units of material quantity from drop down menu	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds
Input material quantity												

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	O&M	Monthly Sampling	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Light truck	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	50	50										
Input number of trips taken	264	360										
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	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 - DEDICATED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Account for an empty return trip?	No	No	No	No	No	No	No	No	No	No	No	No
Input one-way distance traveled (miles) with a given load. If applicable, impact for an empty return trip will be accounted for (no additional input is needed).												
Input weight of equipment transported per truck load (tons)												

EQUIPMENT TRANSPORTATION - SHARED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (miles)												
Input weight of load (tons)												

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (mile)												
Input weight of load (tons)												

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12
Input number of drilling locations												
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)												
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

TRENCHING	Trencher 1	Trencher 2	Trencher 3	Trencher 4	Trencher 5	Trencher 6	Trencher 7	Trencher 8	Trencher 9	Trencher 10	Trencher 11	Trencher 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input operating hours (hr)												

SEDIMENT DREDGING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose dredge equipment type from drop down menu	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Choose dredge fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be dredged (yd3)												
Choose dredge equipment size	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C
Suggested dredge equipment size	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose dredge tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	2	2	2	2	2	2	2	2	2	2	2	2
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT MANAGEMENT (STAGING AND DRYING)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Is volume input that of saturated sediment?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Will the sediment be dry when this work is performed?	No	No	No	No	No	No	No	No	No	No	No	No
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT CAPPING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose capping method from drop down menu	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release
Choose capping equipment fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of capping material to be placed (yd3)												
Choose capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Suggested capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

WATERCRAFT OPERATION	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of vessels												
Input operating time (hours)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

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	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1
Method 1 - ELECTRICAL USAGE IS KNOWN												
Input pump electrical usage (KWh)	499320	0	0	0	0	0	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN												
Input flow rate (gpm)	0	0	0	0	0	0	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Pump efficiency (default already present, user override possible)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN												
Input pump horsepower (hp)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for pump motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Pump load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input pump load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower	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	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	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Equipment load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input equipment load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Equipment motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	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	0	0	0	0	0	0
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6	Generator 7	Generator 8	Generator 9	Generator 10	Generator 11	Generator 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
Input operating hours (hr)												

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6	Tillage Tractor 7	Tillage Tractor 8	Tillage Tractor 9	Tillage Tractor 10	Tillage Tractor 11	Tillage Tractor 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
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	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input area (ft2)												
Input time available (work days)												

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6	Mixer 7	Mixer 8	Mixer 9	Mixer 10	Mixer 11	Mixer 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd3)												
Input production rate (yd3/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)												

INTERNAL COMBUSTION ENGINES	Engine 1	Engine 2	Engine 3	Engine 4	Engine 5	Engine 6	Engine 7	Engine 8	Engine 9	Engine 10	Engine 11	Engine 12
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input fuel consumption rate (gal/hr or scf/hr)												
Input operating hours (hr)												

OTHER FUELED EQUIPMENT	Fuel 1	Fuel 2	Fuel 3	Fuel 4	Fuel 5	Fuel 6	Fuel 7	Fuel 8	Fuel 9	Fuel 10	Fuel 11	Fuel 12
Choose fuel type from drop down menu	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Input volume (scf for Natural gas, gallons for all others)												

DIESEL EQUIPMENT OPERATION (PER HOUR BASIS)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose equipment size for Dozer (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Loader (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Excavator (HP)	150	150	150	150	150	150	150	150	150	150	150	150
Choose equipment size for Scraper (HP)	330	330	330	330	330	330	330	330	330	330	330	330
Choose equipment size for Crawler Crane	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C
Choose equipment size for Tillage Tractor (HP)	16	16	16	16	16	16	16	16	16	16	16	16
Choose equipment size for Paver (HP)	25	25	25	25	25	25	25	25	25	25	25	25
Choose equipment size for Roller (HP)	6	6	6	6	6	6	6	6	6	6	6	6
Choose equipment size for Trencher (HP range)	6 to 11	7 to 11	8 to 11	9 to 11	10 to 11	11 to 11	12 to 11	13 to 11	14 to 11	15 to 11	16 to 11	17 to 11
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating hours (hr)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

OPERATOR LABOR	O&M	Sampler	Occupation 3	Occupation 4	Occupation 5	Occupation 6	Occupation 7	Occupation 8	Occupation 9	Occupation 10	Occupation 11	Occupation 12
Choose occupation from drop-down menu	Operating engineers	ntific and technical serv	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers
Input total time worked onsite (hours)	2112.0	2880.0										

LABORATORY ANALYSIS	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5	Analysis 6	Analysis 7	Analysis 8	Analysis 9	Analysis 10	Analysis 11	Analysis 12
Input dollars spent on laboratory analysis ($)	180,000.00											

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	6.3E+01
Water consumption (gallon)	0.0E+00
Input CO2 emission (metric ton)	2.4E+00
Input N2O emission (metric ton CO2 e)	0.0E+00
Input CH4 emission (metric ton CO2 e)	0.0E+00
Input NOx emission (metric ton)	4.9E-06
Input SOx emission (metric ton)	4.9E-06
Input PM10 emission (metric ton)	2.4E-07
Input fatality risk	
Input injury risk	

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	IDW	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)	5.5											
Choose fuel used from drop down menu	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips	1.0											
Input number of miles per trip	100.0											

LANDFILL OPERATIONS	Operation 1	Operation 2	Operation 3	Operation 4	Operation 5	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6
Choose landfill type for waste disposal	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous
Input amount of waste disposed in landfill (tons)	5.5											
Input landfill methane emissions (metric tons CH4)												
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	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	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	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	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)

RESOURCE CONSUMPTION

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6
Input total water consumed from potable water treatment facility (gal)												
Input total water disposed to wastewater treatment facility (gal)	78840000											

ONSITE LAND AND WATER RESOURCE CONSUMPTION	Entire Site 1	Entire Site 2	Entire Site 3	Entire Site 4	Entire Site 5	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6
Input volume of topsoil brought to site (cubic yards)												
Input volume of groundwater or surface water lost (gal)												

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

BASELINE INFORMATION

COMPONENT 4 DURATION AND COST	Entire Site
Input duration of the component (unit time)	1
Input component cost per unit time ($)	760000

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Choose specific casing material schedule from drop down menu	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC
Choose well diameter (in) from drop down menu	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
Input total quantity of Sand (kg)												
Input total quantity of Gravel (kg)												
Input total quantity of Bentonite (kg)												
Input total quantity of Typical Cement (kg)												
Input total quantity of General Concrete (kg)												
Input total quantity of Steel (kg)												

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input number of injection points												
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	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												

TREATMENT MEDIA	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input weight of media used (lbs)												
Choose media type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	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	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft2)												
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	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Input well diameter (in)												
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil

SILT CURTAIN MATERIALS	Curtain 1	Curtain 2	Curtain 3	Curtain 4	Curtain 5	Curtain 6	Curtain 7	Curtain 8	Curtain 9	Curtain 10	Curtain 11	Curtain 12
Input length or perimeter of silt curtain (ft)												
Input depth of silt curtain (ft)												

BULK MATERIAL QUANTITIES	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material from drop down menu	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid
Choose units of material quantity from drop down menu	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds
Input material quantity												

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	MNA	Post Treatment Samp.	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Light truck	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	50	50										
Input number of trips taken	198	24										
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	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 - DEDICATED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Account for an empty return trip?	No	No	No	No	No	No	No	No	No	No	No	No
Input one-way distance traveled (miles) with a given load. If applicable, impact for an empty return trip will be accounted for (no additional input is needed).												
Input weight of equipment transported per truck load (tons)												

EQUIPMENT TRANSPORTATION - SHARED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (miles)												
Input weight of load (tons)												

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (mile)												
Input weight of load (tons)												

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12
Input number of drilling locations												
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)												
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

TRENCHING	Trencher 1	Trencher 2	Trencher 3	Trencher 4	Trencher 5	Trencher 6	Trencher 7	Trencher 8	Trencher 9	Trencher 10	Trencher 11	Trencher 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input operating hours (hr)												

SEDIMENT DREDGING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose dredge equipment type from drop down menu	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Choose dredge fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be dredged (yd3)												
Choose dredge equipment size	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1 C
Suggested dredge equipment size	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose dredge tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	2	2	2	2	2	2	2	2	2	2	2	2
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT MANAGEMENT (STAGING AND DRYING)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Is volume input that of saturated sediment?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Will the sediment be dry when this work is performed?	No	No	No	No	No	No	No	No	No	No	No	No
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT CAPPING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose capping method from drop down menu	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release
Choose capping equipment fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of capping material to be placed (yd3)												
Choose capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Suggested capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

WATERCRAFT OPERATION	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of vessels												
Input operating time (hours)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

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	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	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	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN												
Input flow rate (gpm)	0	0	0	0	0	0	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Pump efficiency (default already present, user override possible)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN												
Input pump horsepower (hp)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for pump motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Pump load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input pump load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower	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	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	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Equipment load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input equipment load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Equipment motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	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	0	0	0	0	0	0
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6	Generator 7	Generator 8	Generator 9	Generator 10	Generator 11	Generator 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
Input operating hours (hr)												

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6	Tillage Tractor 7	Tillage Tractor 8	Tillage Tractor 9	Tillage Tractor 10	Tillage Tractor 11	Tillage Tractor 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
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	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input area (ft2)												
Input time available (work days)												

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6	Mixer 7	Mixer 8	Mixer 9	Mixer 10	Mixer 11	Mixer 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd3)												
Input production rate (yd3/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)												

INTERNAL COMBUSTION ENGINES	Engine 1	Engine 2	Engine 3	Engine 4	Engine 5	Engine 6	Engine 7	Engine 8	Engine 9	Engine 10	Engine 11	Engine 12
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input fuel consumption rate (gal/hr or scf/hr)												
Input operating hours (hr)												

OTHER FUELED EQUIPMENT	Fuel 1	Fuel 2	Fuel 3	Fuel 4	Fuel 5	Fuel 6	Fuel 7	Fuel 8	Fuel 9	Fuel 10	Fuel 11	Fuel 12
Choose fuel type from drop down menu	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Input volume (scf for Natural gas, gallons for all others)												

DIESEL EQUIPMENT OPERATION (PER HOUR BASIS)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose equipment size for Dozer (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Loader (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Excavator (HP)	150	150	150	150	150	150	150	150	150	150	150	150
Choose equipment size for Scraper (HP)	330	330	330	330	330	330	330	330	330	330	330	330
Choose equipment size for Crawler Crane	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C
Choose equipment size for Tillage Tractor (HP)	16	16	16	16	16	16	16	16	16	16	16	16
Choose equipment size for Paver (HP)	25	25	25	25	25	25	25	25	25	25	25	25
Choose equipment size for Roller (HP)	6	6	6	6	6	6	6	6	6	6	6	6
Choose equipment size for Trencher (HP range)	6 to 11	7 to 11	8 to 11	9 to 11	10 to 11	11 to 11	12 to 11	13 to 11	14 to 11	15 to 11	16 to 11	17 to 11
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating hours (hr)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

OPERATOR LABOR	Sampler	Occupation 2	Occupation 3	Occupation 4	Occupation 5	Occupation 6	Occupation 7	Occupation 8	Occupation 9	Occupation 10	Occupation 11	Occupation 12
Choose occupation from drop-down menu	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers
Input total time worked onsite (hours)	1776.0											

LABORATORY ANALYSIS	MNA	Post Treatment	Analysis 3	Analysis 4	Analysis 5	Analysis 6	Analysis 7	Analysis 8	Analysis 9	Analysis 10	Analysis 11	Analysis 12
Input dollars spent on laboratory analysis ($)	57,420.00	6,960.00										

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO2 emission (metric ton)	
Input N2O emission (metric ton CO2 e)	
Input CH4 emission (metric ton CO2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM10 emission (metric ton)	
Input fatality risk	
Input injury risk	

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)												
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6
Choose landfill type for waste disposal	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous
Input amount of waste disposed in landfill (tons)												
Input landfill methane emissions (metric tons CH4)												
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	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	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	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	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)

RESOURCE CONSUMPTION

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6
Input total water consumed from potable water treatment facility (gal)												
Input total water disposed to wastewater treatment facility (gal)												

ONSITE LAND AND WATER RESOURCE CONSUMPTION	Entire Site 1	Entire Site 2	Entire Site 3	Entire Site 4	Entire Site 5	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6
Input volume of topsoil brought to site (cubic yards)												
Input volume of groundwater or surface water lost (gal)												

Sustainable Remediation Summary - Feasibility Study

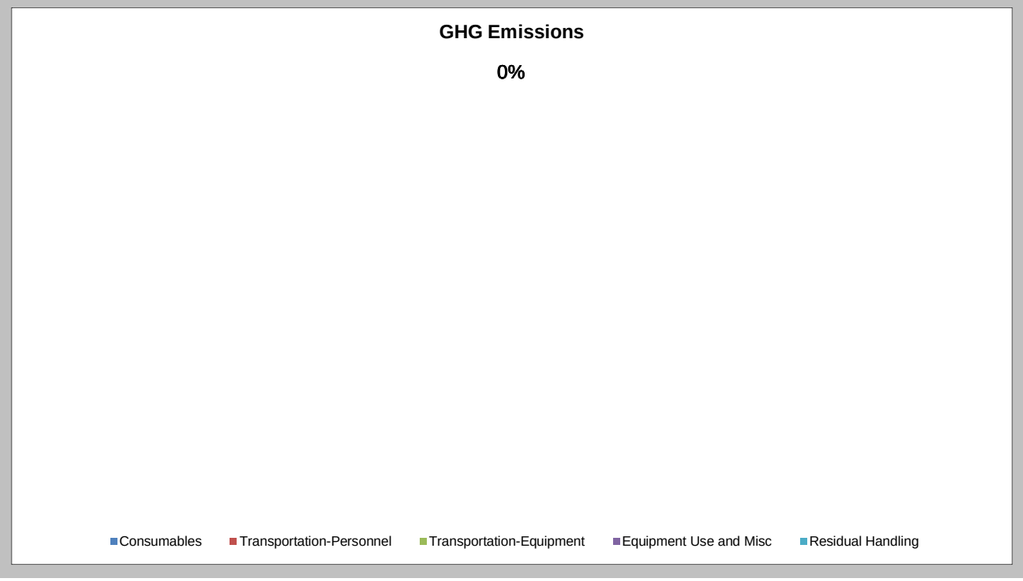
Activities	GHG Emissions	Percent Total	Total Energy Used	Percent Total	Water Consumption	Percent Total	Electricity Usage	Percent Total	Onsite NOx Emissions	Percent Total	Onsite SOx Emissions	Percent Total	Onsite PM10 Emissions	Percent Total	Total NOx Emissions	Percent Total	Total SOx Emissions	Percent Total	Total PM10 Emissions	Percent Total	Accident Risk Fatality	Percent Total	Accident Risk Injury	Percent Total
	metric ton	%	MMBTU	%	gallons	%	MWH	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%		%		%
Consumables	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	NA	NA	NA	NA
Transportation-Personnel	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Transportation-Equipment	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	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	0.0	0.0E+00	0.0	0.0E+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	NA	NA	NA	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Total	0.00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0

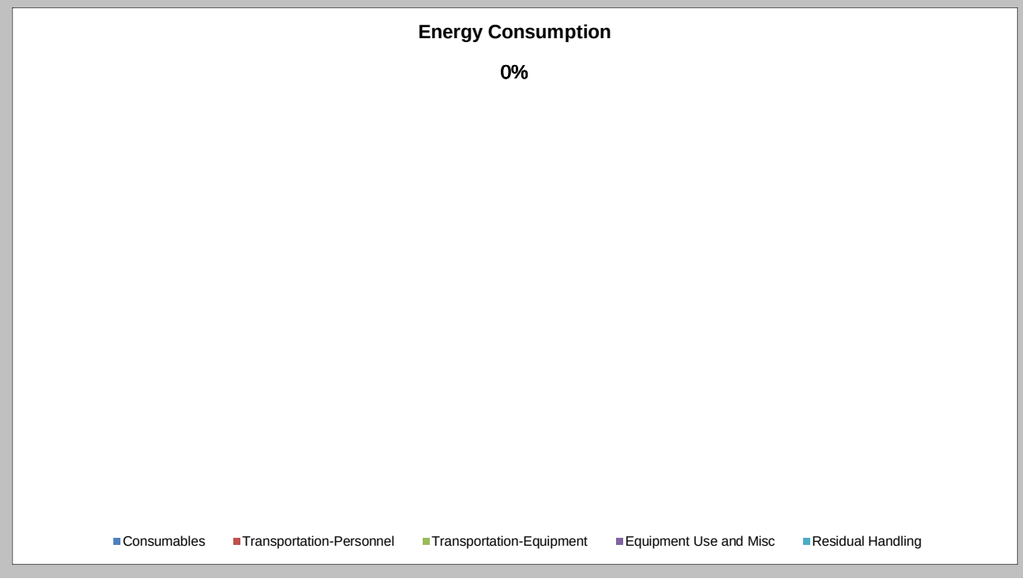
Additional Sustainability Metrics

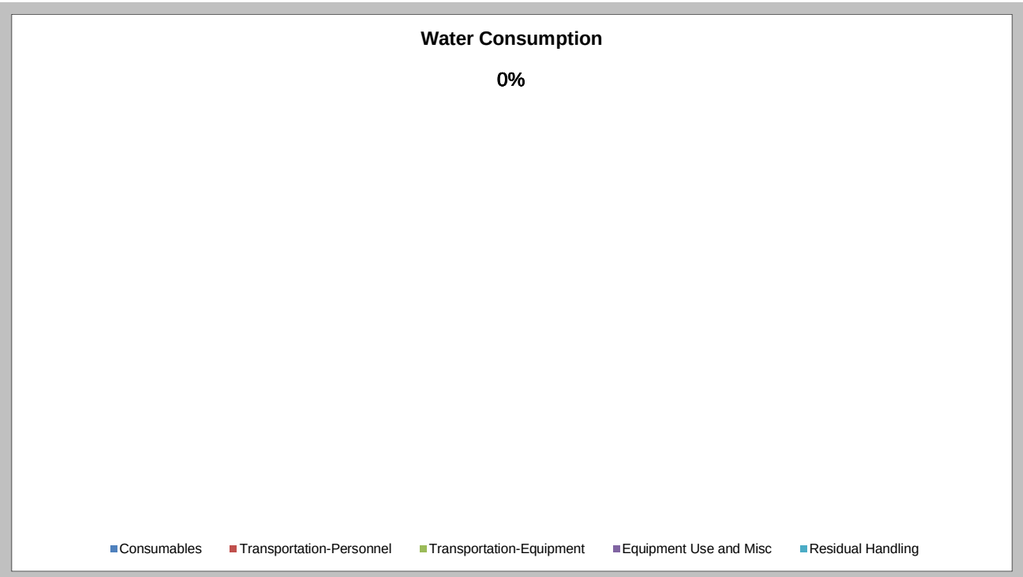
Non-Hazardous Waste Landfill Space (tons)	0.0
Hazardous Waste Landfill Space (tons)	0.0
Topsoil Consumption (yd^3)	0.0
Cost of Phase ($)	0.0
Lost Hours - Injury	0.0

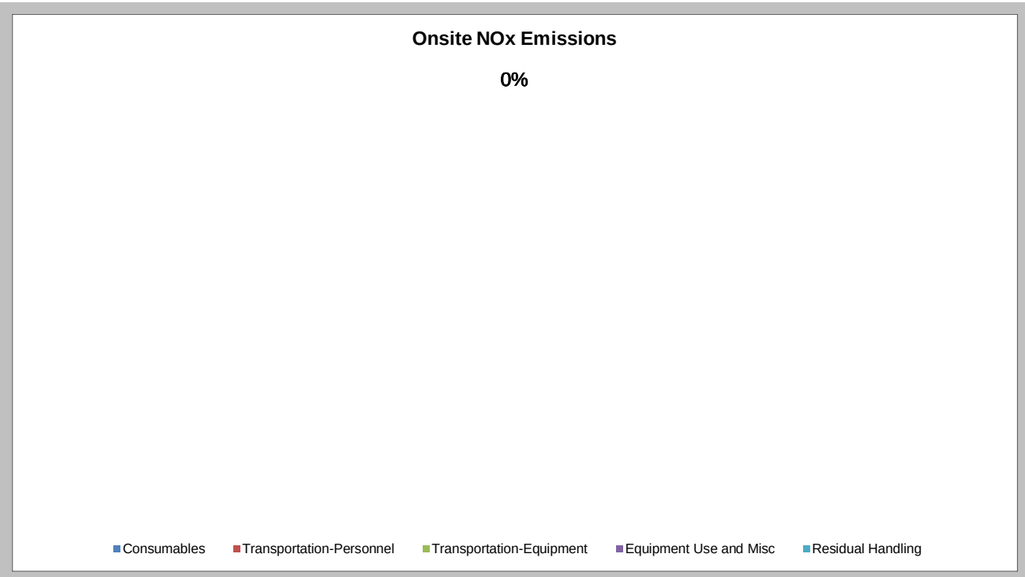
Footprint Reduction

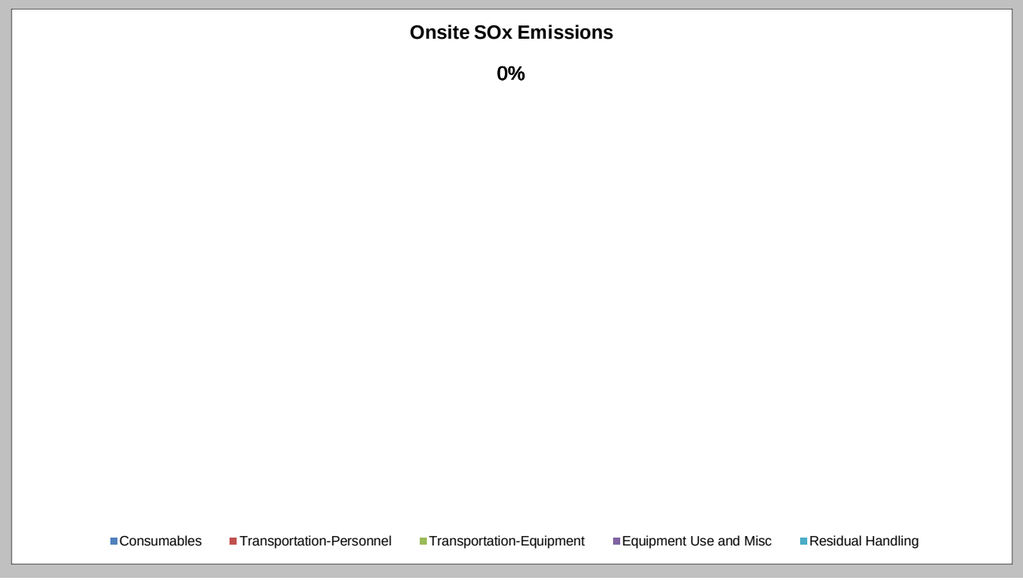
Total electricity replacement (MWh)	0.00E+00
Total electricity replacement (mmBtu)	0.00E+00
Percent electricity from renewable sources (%)	0.0%
Landfill gas reduction (metric ton CO_2 e)	0.00E+00
GHG emissions (metric ton CO2 e)	0.00E+00
NOx emissions (metric ton)	0.00E+00
SOx emissions (metric ton)	0.00E+00
PM10 emissions (metric ton)	0.00E+00

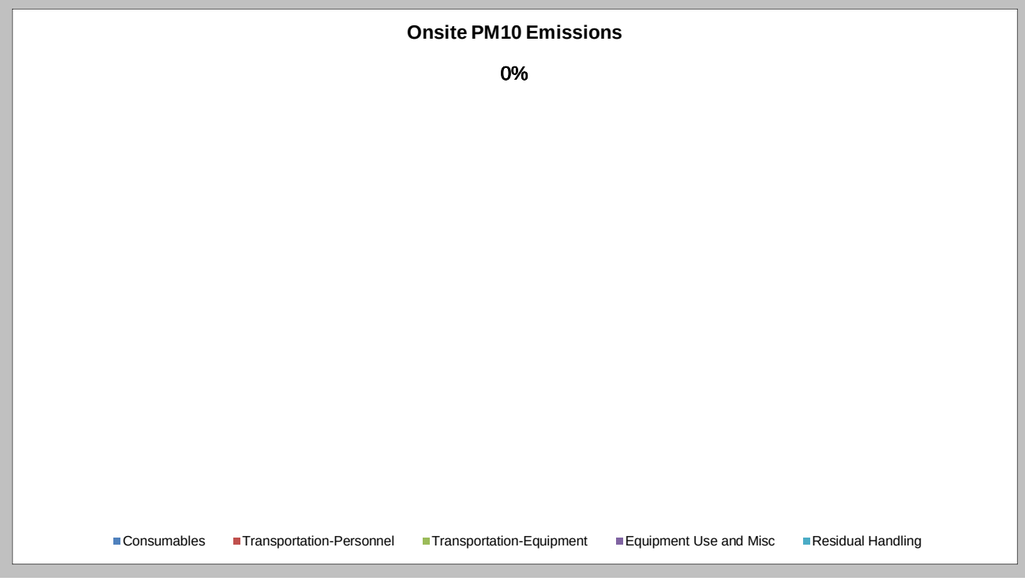


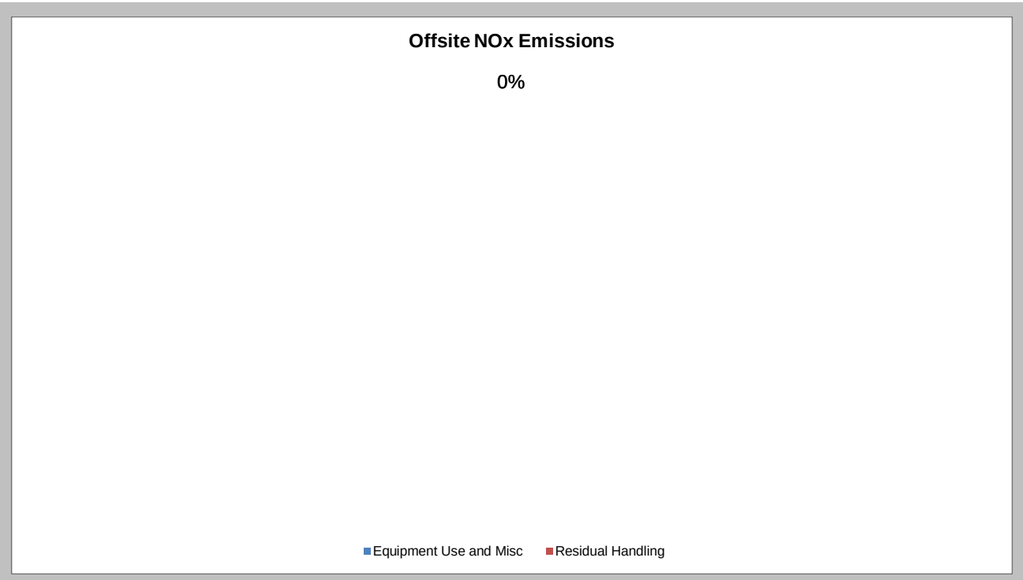


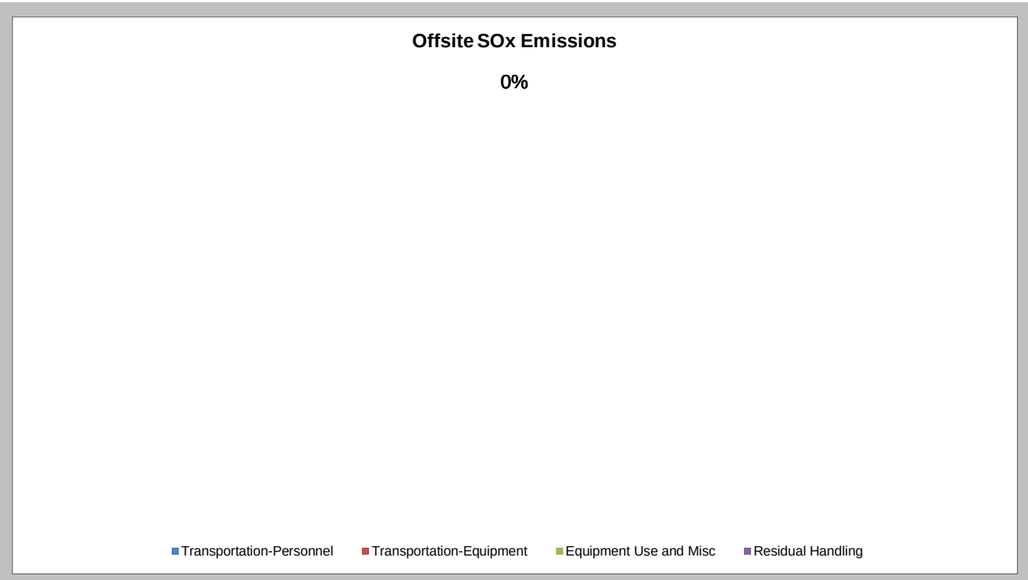

Water Consumption
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

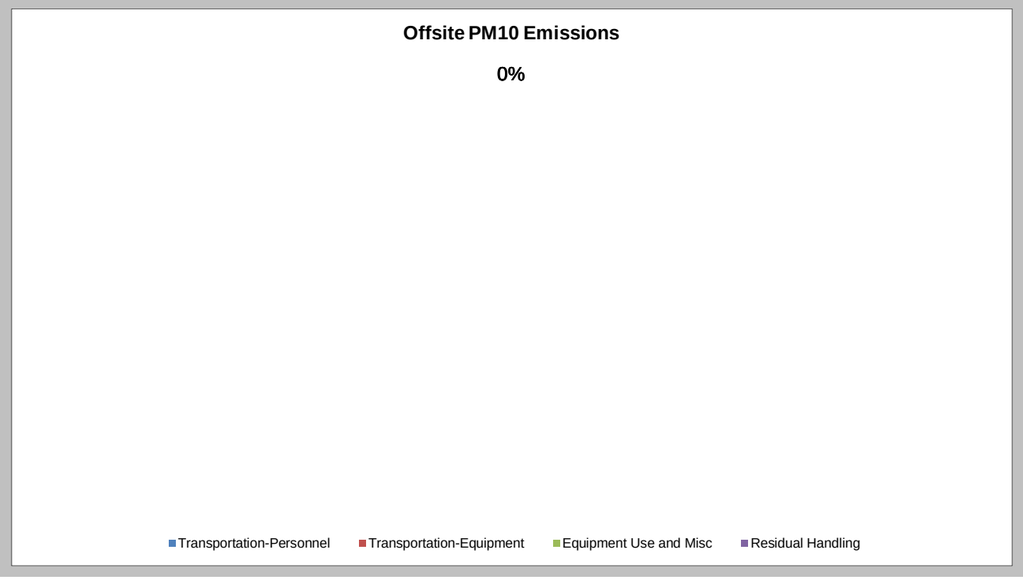

Onsite NOx Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Onsite SOx Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

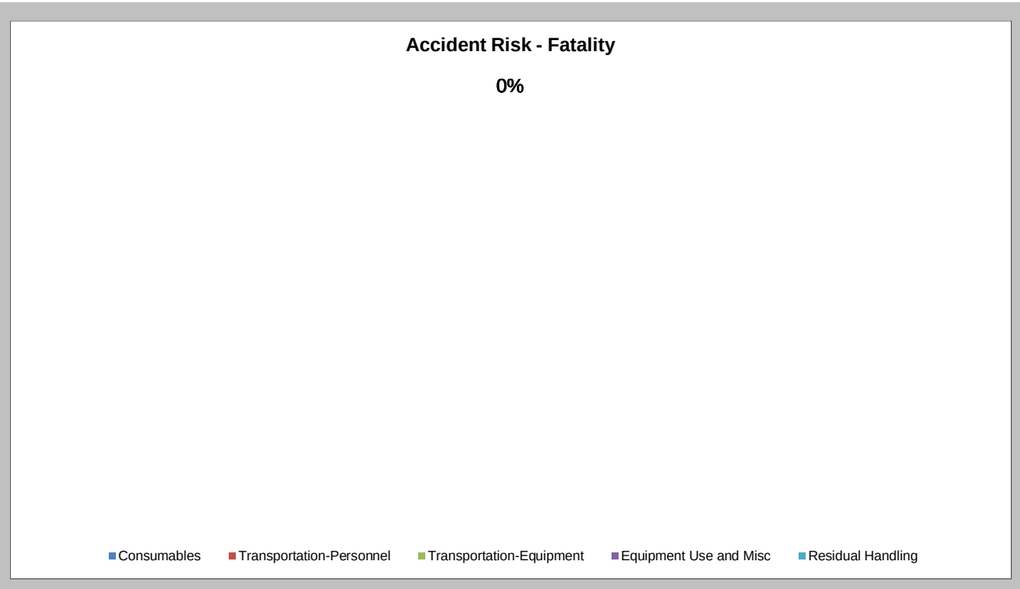

Onsite PM10 Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite NOx Emissions
0%
Equipment Use and Misc
Residual Handling


Offsite SOx Emissions
0%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite PM10 Emissions
0%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Injury
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

Sustainable Remediation Summary - Remedial Action Construction

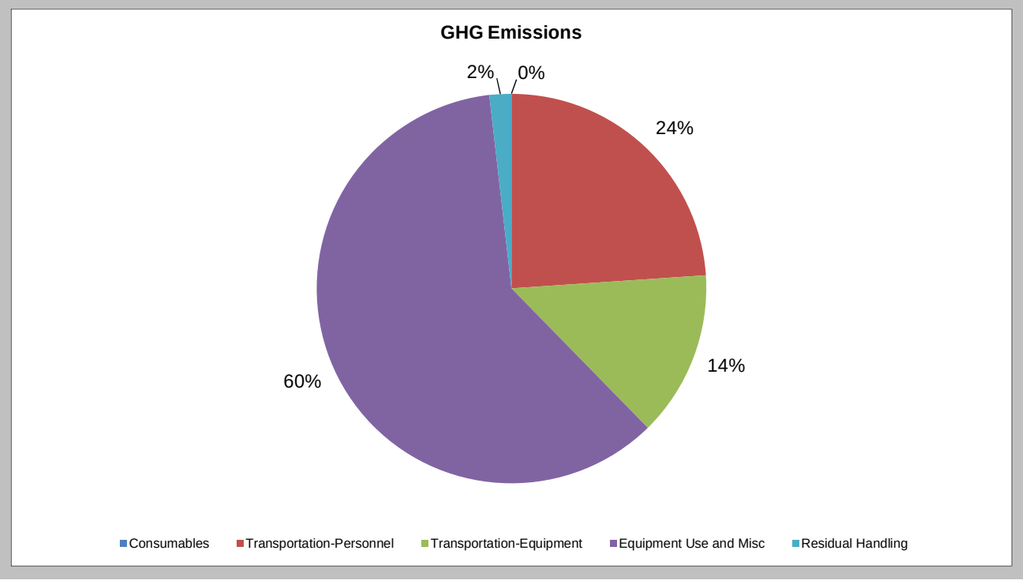
Activities	GHG Emissions	Percent Total	Total Energy Used	Percent Total	Water Consumption	Percent Total	Electricity Usage	Percent Total	Onsite NOx Emissions	Percent Total	Onsite SOx Emissions	Percent Total	Onsite PM10 Emissions	Percent Total	Total NOx Emissions	Percent Total	Total SOx Emissions	Percent Total	Total PM10 Emissions	Percent Total	Accident Risk Fatality	Percent Total	Accident Risk Injury	Percent Total
	metric ton	%	MMBTU	%	gallons	%	MWH	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%		%		%
Consumables	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	NA	NA	NA	NA
Transportation-Personnel	4.49	23.9	5.7E+01	13.5	NA	NA	NA	NA	NA	-	NA	-	NA	-	1.9E-03	3.2	5.9E-05	0.4	2.7E-04	3.0	6.4E-05	39.6	5.1E-03	17.0
Transportation-Equipment	2.58	13.8	3.4E+01	8.1	NA	NA	NA	NA	NA	-	NA	-	NA	-	8.1E-04	1.4	1.4E-05	0.1	7.2E-05	0.8	7.8E-06	4.9	6.3E-04	2.1
Equipment Use and Misc	11.36	60.5	3.2E+02	77.3	1.2E+04	100.0	0.0E+00	0.0	5.1E-02	100.0	1.1E-02	100.0	7.5E-03	100.0	5.5E-02	94.8	1.4E-02	98.4	7.9E-03	87.4	8.8E-05	54.6	2.4E-02	80.5
Residual Handling	0.34	1.8	4.8E+00	1.1	NA	NA	NA	NA	0.0E+00	-	0.0E+00	-	0.0E+00	-	3.7E-04	0.6	1.5E-04	1.1	8.0E-04	8.9	1.6E-06	1.0	1.3E-04	0.4
Total	18.77	100.0	4.18E+02	100.0	1.15E+04	100.0	0.00E+00	0.0	5.14E-02	100.0	1.06E-02	100.0	7.46E-03	100.0	5.83E-02	100.0	1.38E-02	100.0	9.00E-03	100.0	1.61E-04	100.0	3.02E-02	100.0

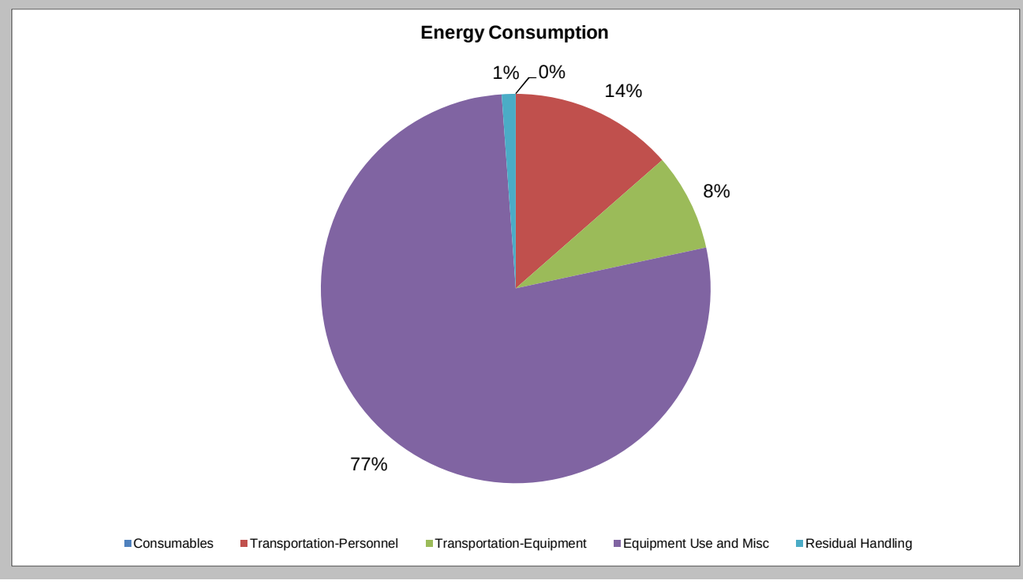
Additional Sustainability Metrics

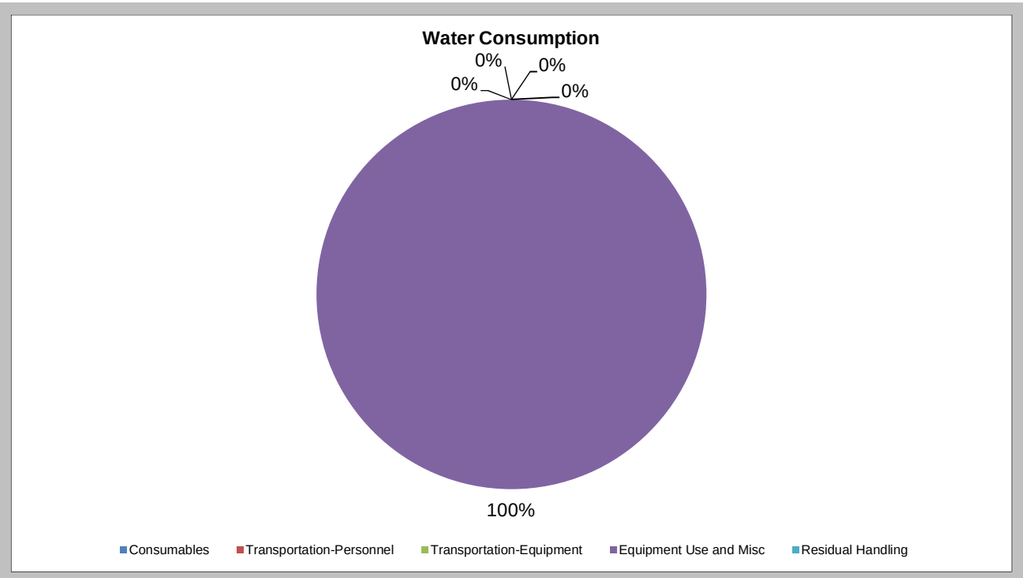
Non-Hazardous Waste Landfill Space (tons)	4.4
Hazardous Waste Landfill Space (tons)	0.0
Topsoil Consumption (yd^3)	0.0
Cost of Phase ($)	311000.0
Lost Hours - Injury	0.2

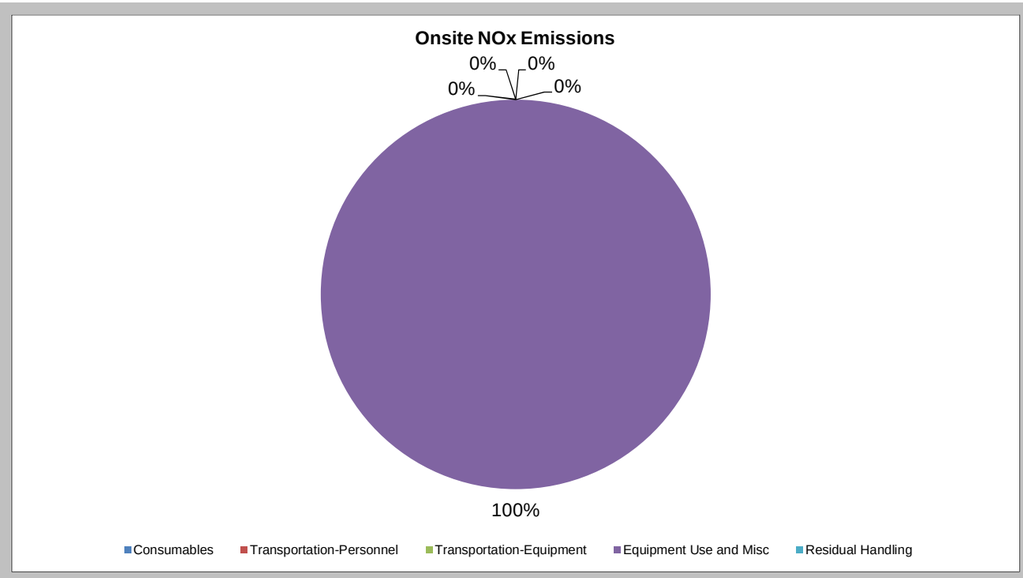
Footprint Reduction

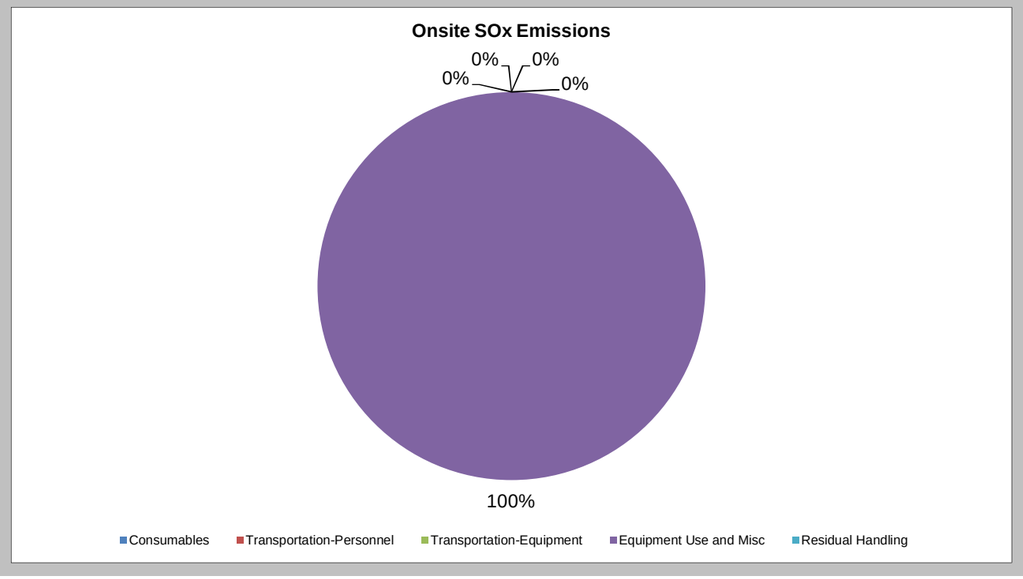
Total electricity replacement (MWh)	0.00E+00
Total electricity replacement (mmBtu)	0.00E+00
Percent electricity from renewable sources (%)	0.0%
Landfill gas reduction (metric ton CO_2 e)	0.00E+00
GHG emissions (metric ton CO2 e)	0.00E+00
NOx emissions (metric ton)	0.00E+00
SOx emissions (metric ton)	0.00E+00
PM10 emissions (metric ton)	0.00E+00

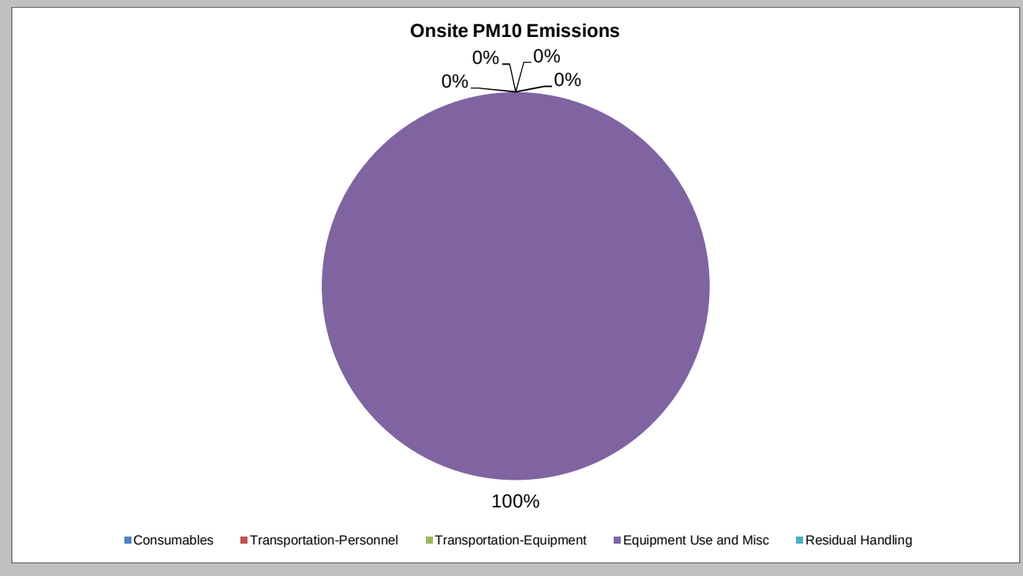


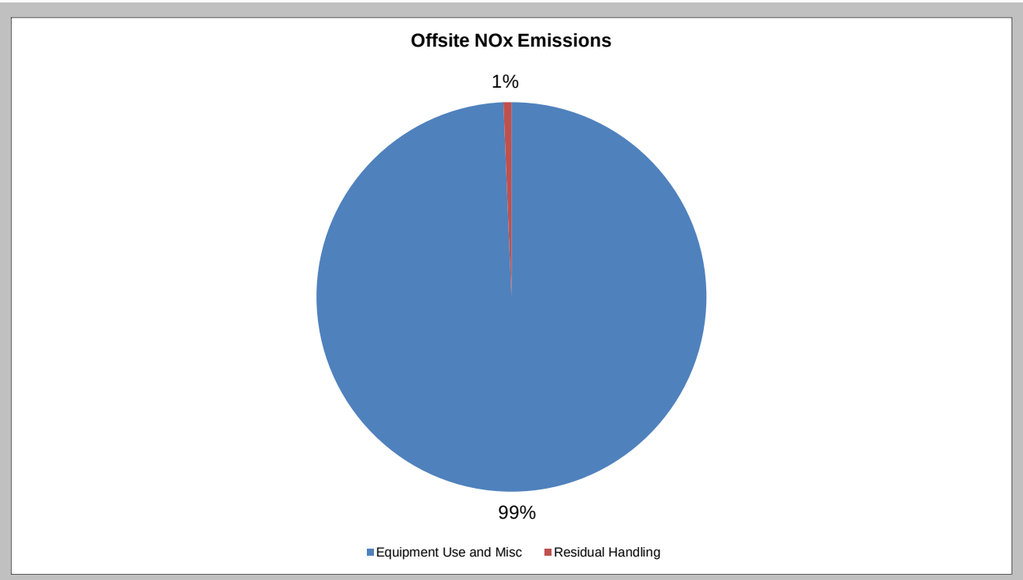


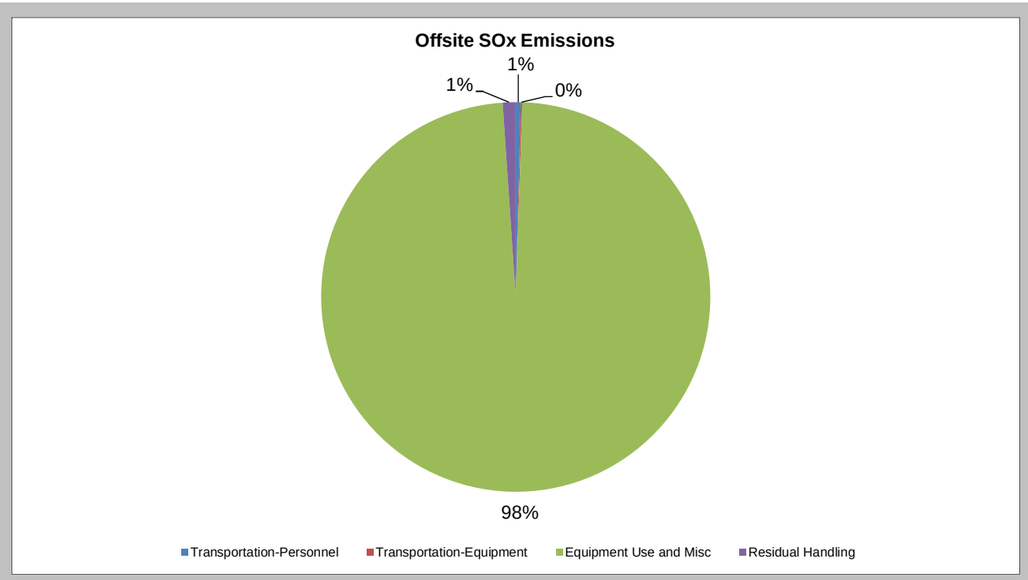

Water Consumption
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

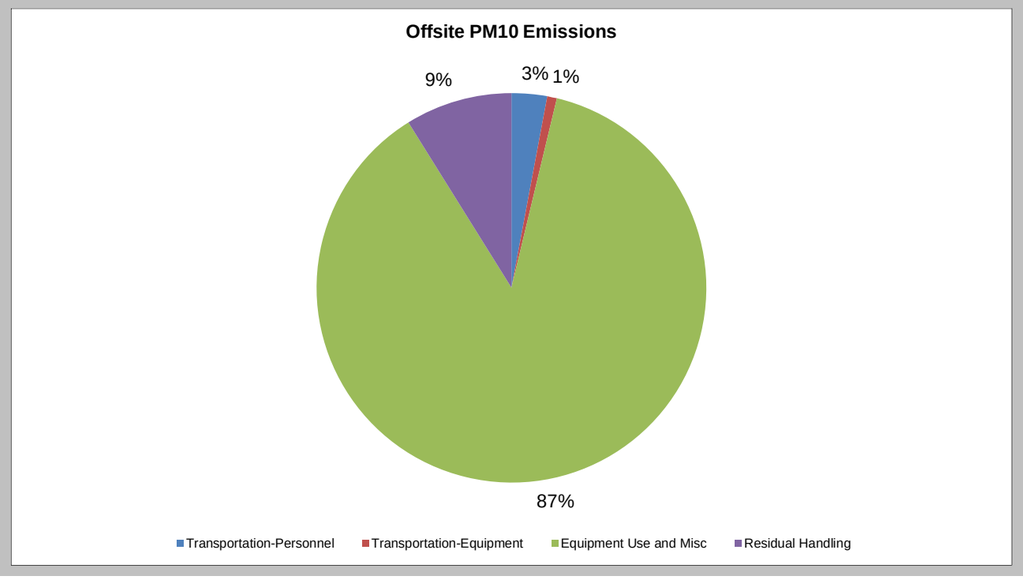

Onsite NOx Emissions
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

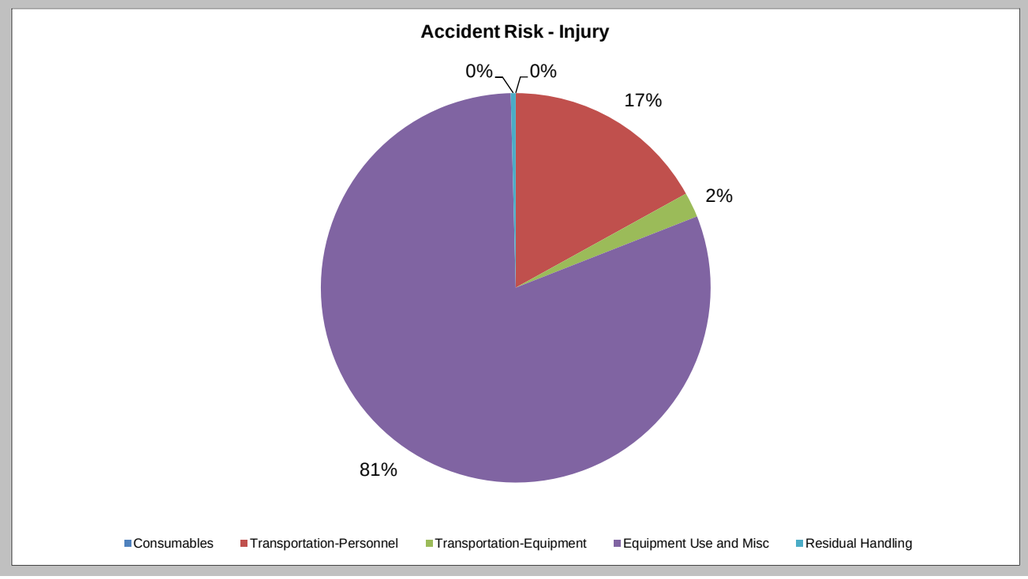

Onsite SOx Emissions
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

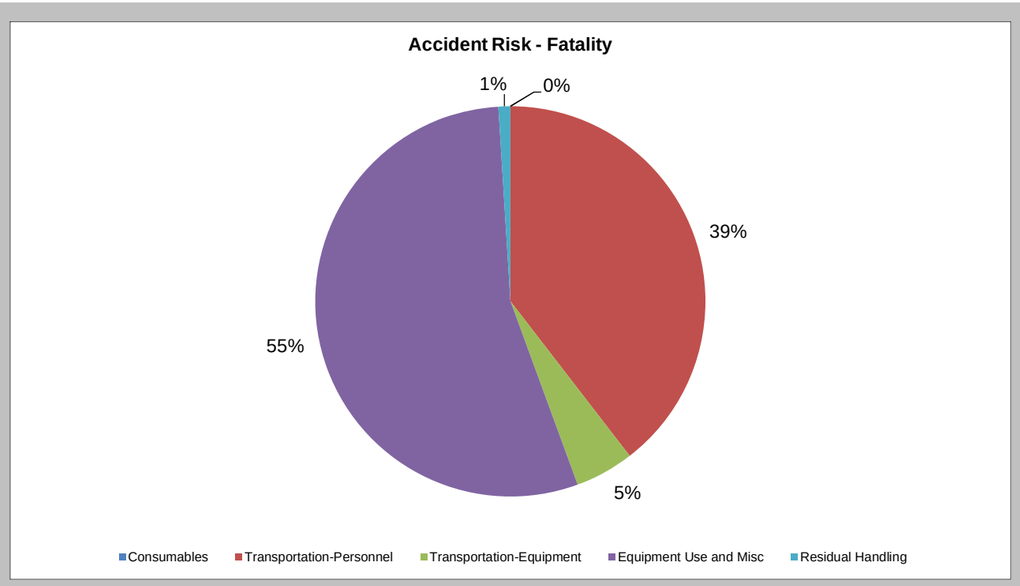

Onsite PM10 Emissions
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite NOx Emissions
1%
99%
Equipment Use and Misc
Residual Handling


Offsite SOx Emissions
1%
1%
0%
98%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite PM10 Emissions
9%
3%
1%
87%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Injury
0%
0%
17%
2%
81%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
1%
0%
39%
55%
5%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

Sustainable Remediation Summary - Remedial Action Operations

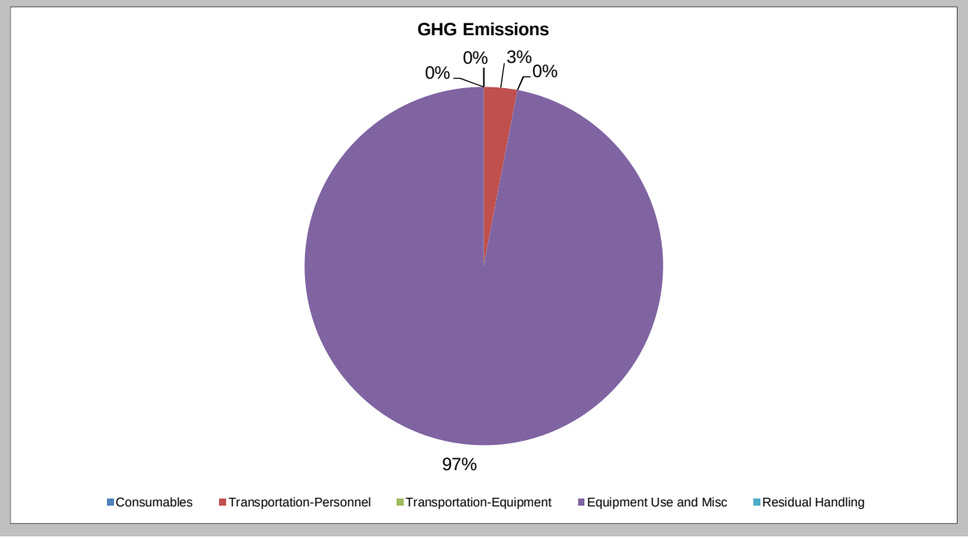
Activities	GHG Emissions	Percent Total	Total Energy Used	Percent Total	Water Consumption	Percent Total	Electricity Usage	Percent Total	Onsite NOx Emissions	Percent Total	Onsite SOx Emissions	Percent Total	Onsite PM10 Emissions	Percent Total	Total NOx Emissions	Percent Total	Total SOx Emissions	Percent Total	Total PM10 Emissions	Percent Total	Accident Risk Fatality	Percent Total	Accident Risk Injury	Percent Total
	metric ton	%	MMBTU	%	gallons	%	MWH	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%		%		%
Consumables	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	NA	NA	NA	NA
Transportation-Personnel	17.19	3.0	2.2E+02	3.1	NA	NA	NA	NA	NA	-	NA	-	NA	-	7.1E-03	0.6	2.2E-04	0.0	1.0E-03	0.1	2.4E-04	65.8	2.0E-02	23.3
Transportation-Equipment	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Equipment Use and Misc	556.70	97.0	6.8E+03	96.9	2.5E+05	100.0	5.0E+02	100.0	4.9E-06	100.0	4.9E-06	100.0	2.4E-07	100.0	1.2E+00	99.4	3.1E+00	100.0	7.2E-01	99.7	1.3E-04	34.0	6.4E-02	76.6
Residual Handling	0.21	0.0	3.2E+00	0.0	NA	NA	NA	NA	0.0E+00	-	0.0E+00	-	0.0E+00	-	4.0E-04	0.0	1.9E-04	0.0	1.0E-03	0.1	7.8E-07	0.2	6.3E-05	0.1
Total	574.11	100.0	7.02E+03	100.0	2.55E+05	100.0	4.99E+02	100.0	4.90E-06	100.0	4.90E-06	100.0	2.45E-07	100.0	1.24E+00	100.0	3.10E+00	100.0	7.23E-01	100.0	3.70E-04	100.0	8.41E-02	100.0

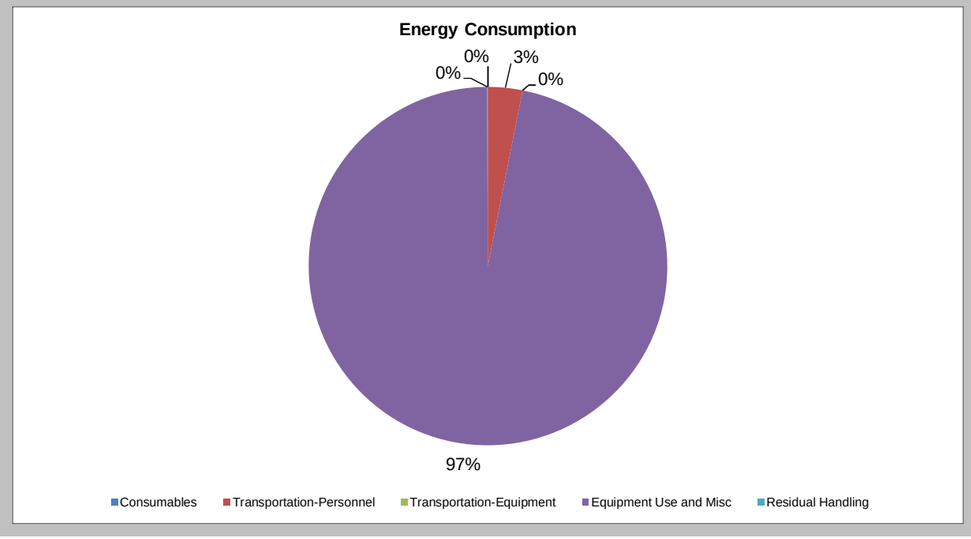
Additional Sustainability Metrics

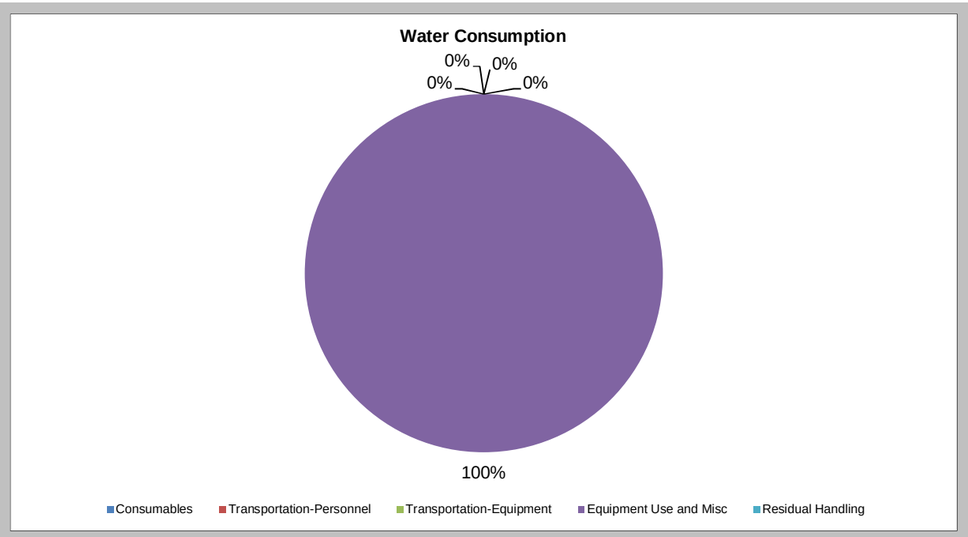
Non-Hazardous Waste Landfill Space (tons)	5.5
Hazardous Waste Landfill Space (tons)	0.0
Topsoil Consumption (yd^3)	0.0
Cost of Phase ($)	1826000.0
Lost Hours - Injury	0.7

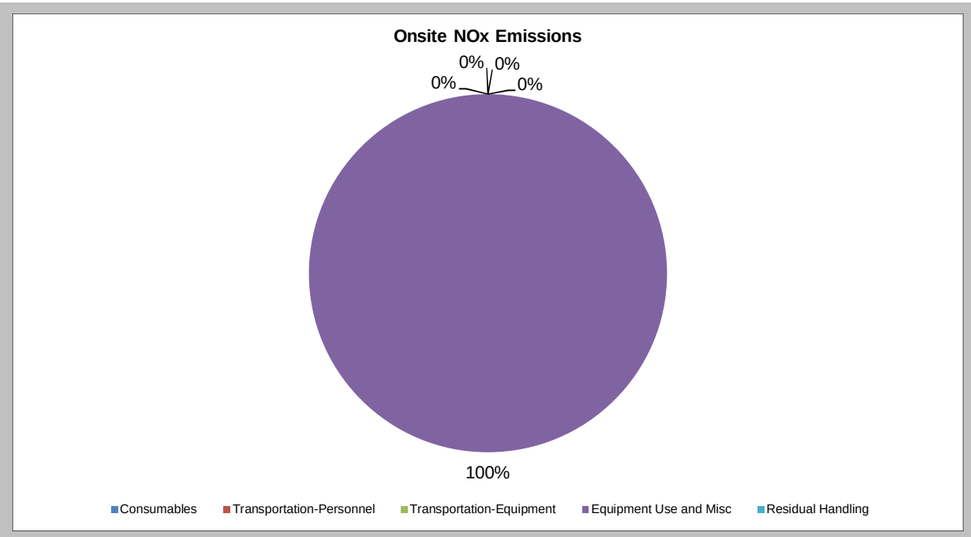
Footprint Reduction

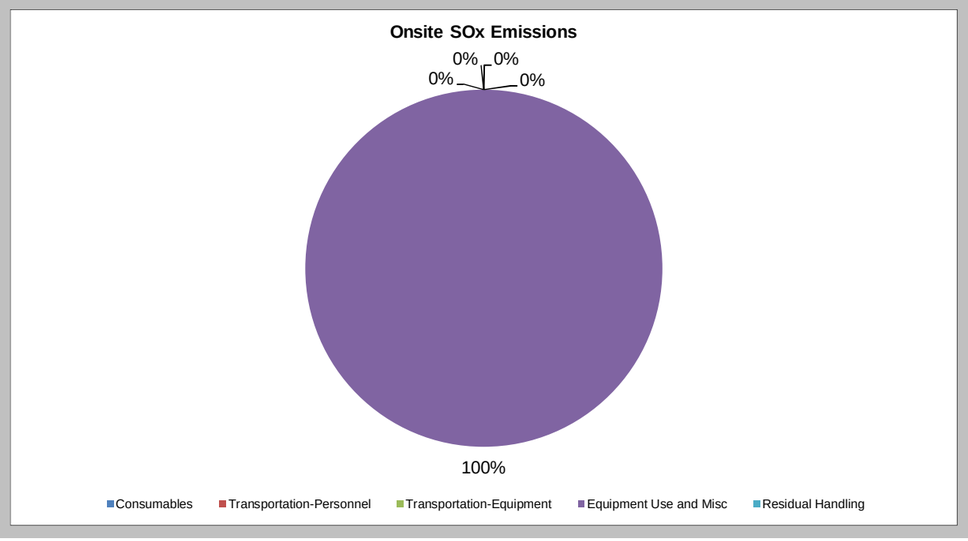
Total electricity replacement (MWh)	0.00E+00
Total electricity replacement (mmBtu)	0.00E+00
Percent electricity from renewable sources (%)	5.3%
Landfill gas reduction (metric ton CO_2 e)	0.00E+00
GHG emissions (metric ton CO2 e)	0.00E+00
NOx emissions (metric ton)	0.00E+00
SOx emissions (metric ton)	0.00E+00
PM10 emissions (metric ton)	0.00E+00

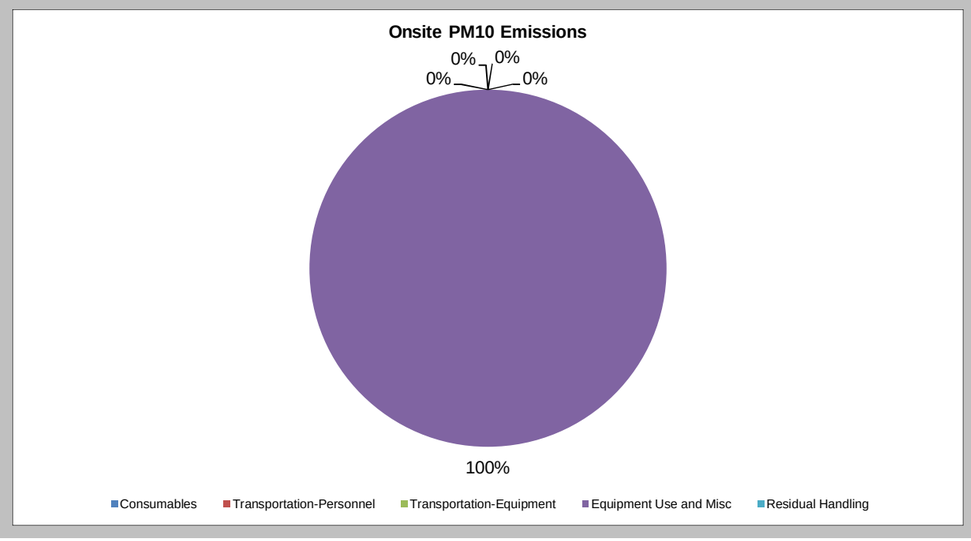


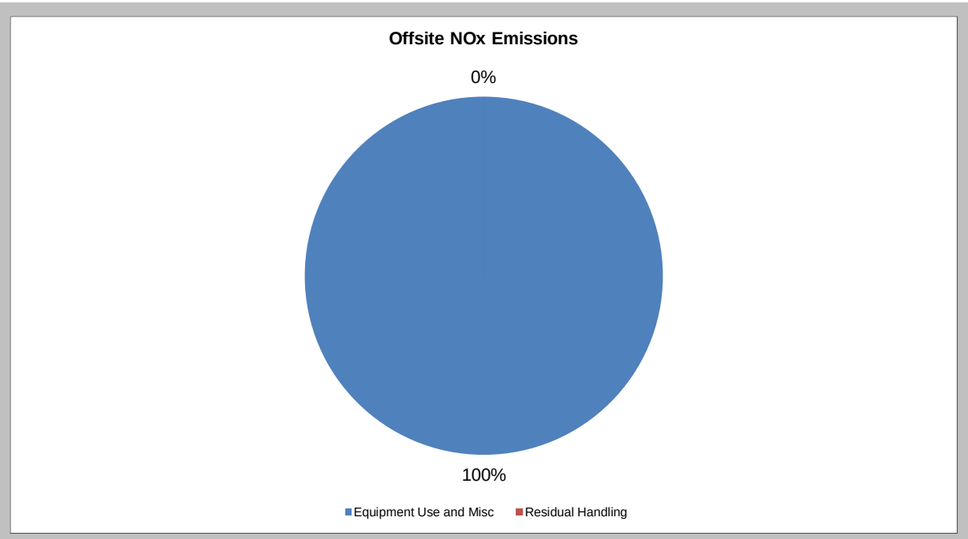


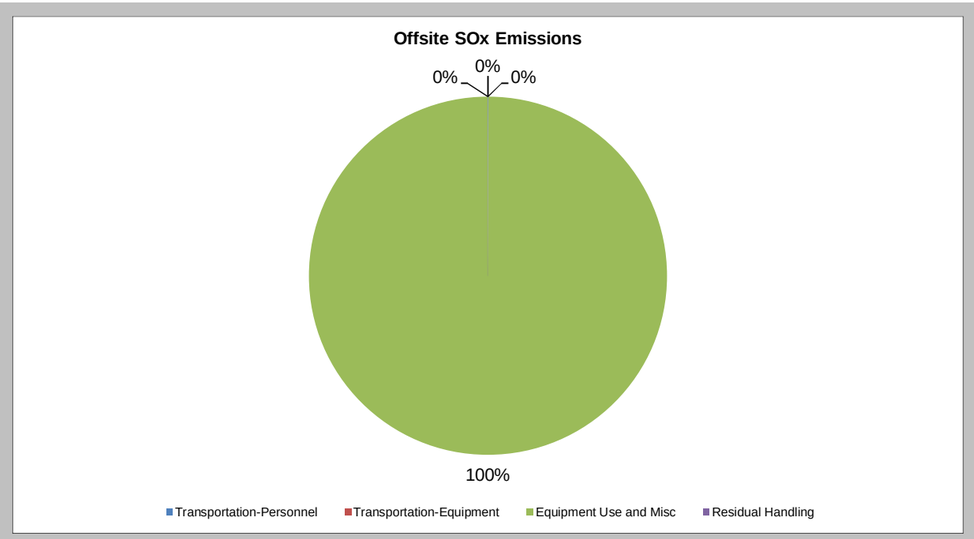

Water Consumption
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

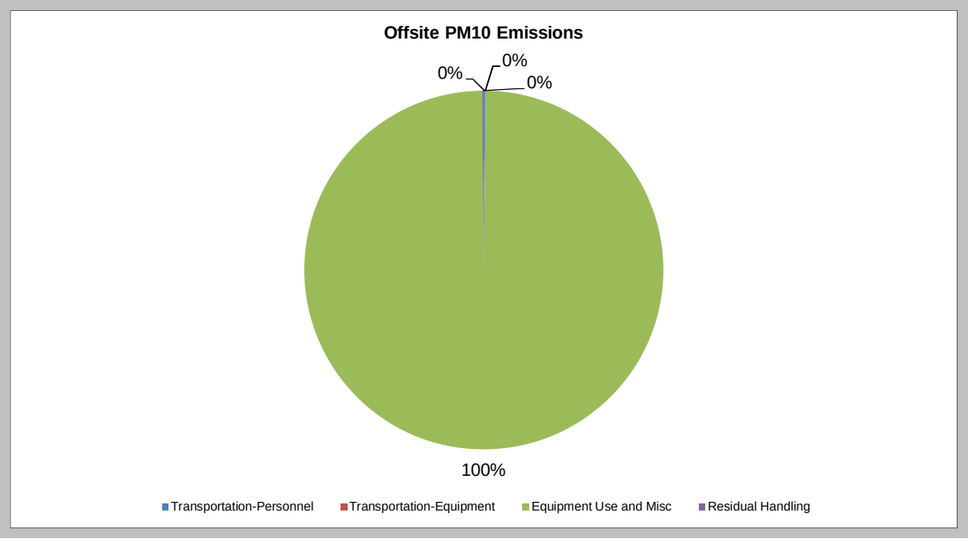

Onsite NOx Emissions
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

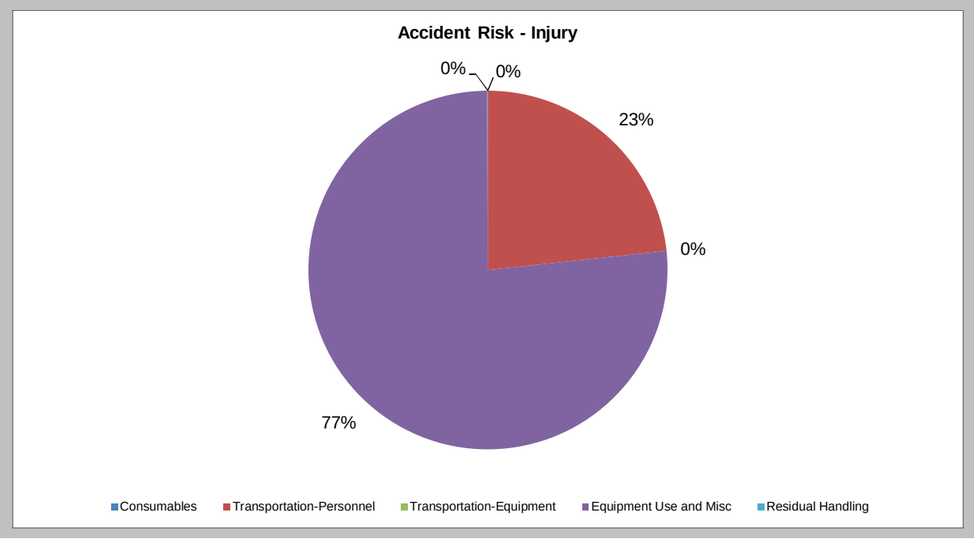

Onsite SOx Emissions
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

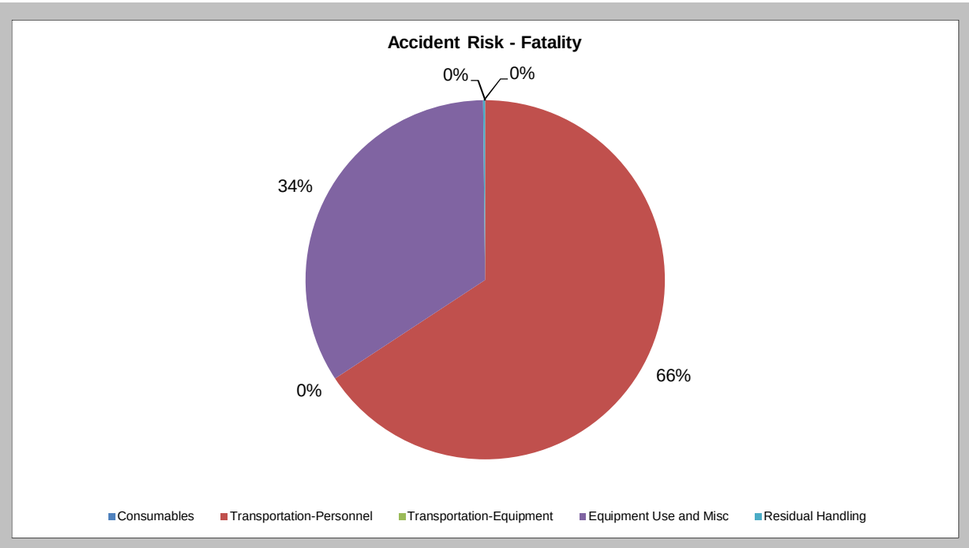

Onsite PM10 Emissions
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite NOx Emissions
0%
100%
Equipment Use and Misc
Residual Handling


Offsite SOx Emissions
0%
0%
0%
100%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite PM10 Emissions
0%
0%
0%
100%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Injury
0%
0%
23%
0%
77%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
0%
0%
34%
0%
66%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

Sustainable Remediation Summary - Long-term Monitoring

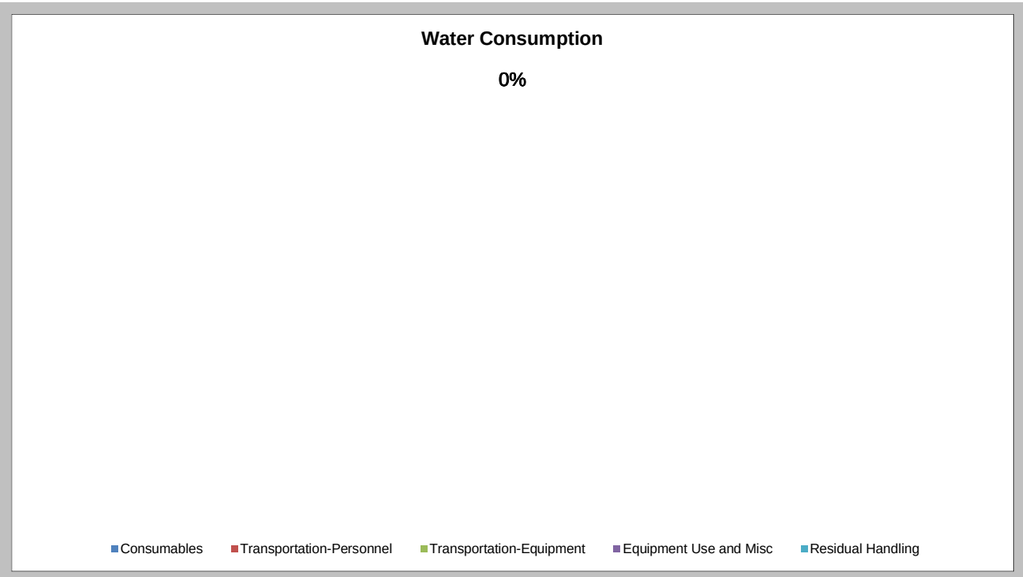
Activities	GHG Emissions	Percent Total	Total Energy Used	Percent Total	Water Consumption	Percent Total	Electricity Usage	Percent Total	Onsite NOx Emissions	Percent Total	Onsite SOx Emissions	Percent Total	Onsite PM10 Emissions	Percent Total	Total NOx Emissions	Percent Total	Total SOx Emissions	Percent Total	Total PM10 Emissions	Percent Total	Accident Risk Fatality	Percent Total	Accident Risk Injury	Percent Total
	metric ton	%	MMBTU	%	gallons	%	MWH	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%		%		%
Consumables	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	NA	NA	NA	NA
Transportation-Personnel	6.11	17.3	7.7E+01	15.6	NA	NA	NA	NA	NA	-	NA	-	NA	-	2.5E-03	1.8	8.0E-05	0.1	3.6E-04	3.0	8.7E-05	34.8	7.0E-03	14.6
Transportation-Equipment	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Equipment Use and Misc	29.20	82.7	4.2E+02	84.4	0.0E+00	0.0	0.0E+00	0.0	0.0E+00	-	0.0E+00	-	0.0E+00	-	1.4E-01	98.2	1.1E-01	99.9	1.2E-02	97.0	1.6E-04	65.2	4.1E-02	85.4
Residual Handling	0.00	-	0.0E+00	-	NA	NA	NA	NA	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Total	35.32	100.0	4.95E+02	100.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	1.43E-01	100.0	1.05E-01	100.0	1.20E-02	100.0	2.49E-04	100.0	4.78E-02	100.0

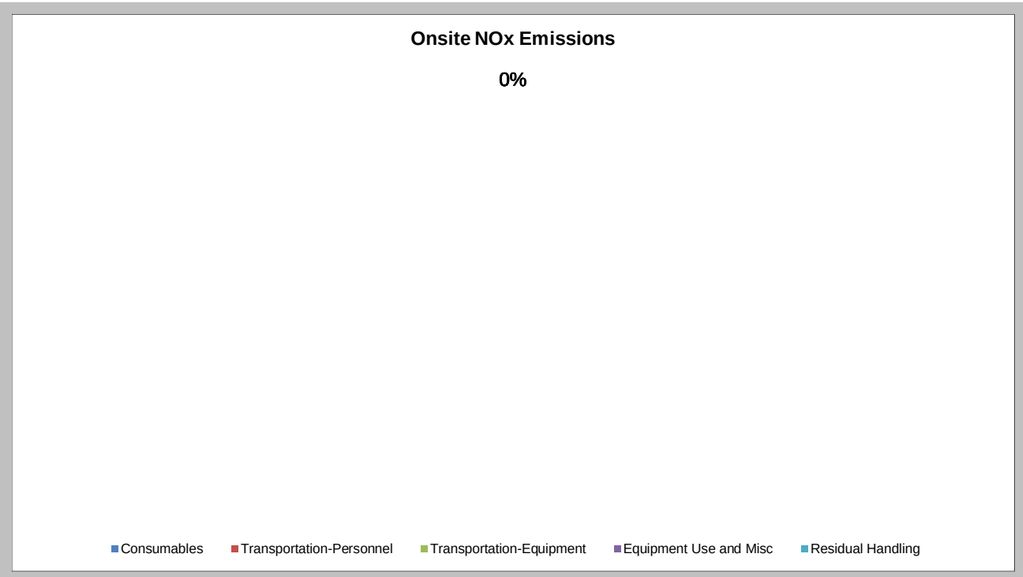
Additional Sustainability Metrics

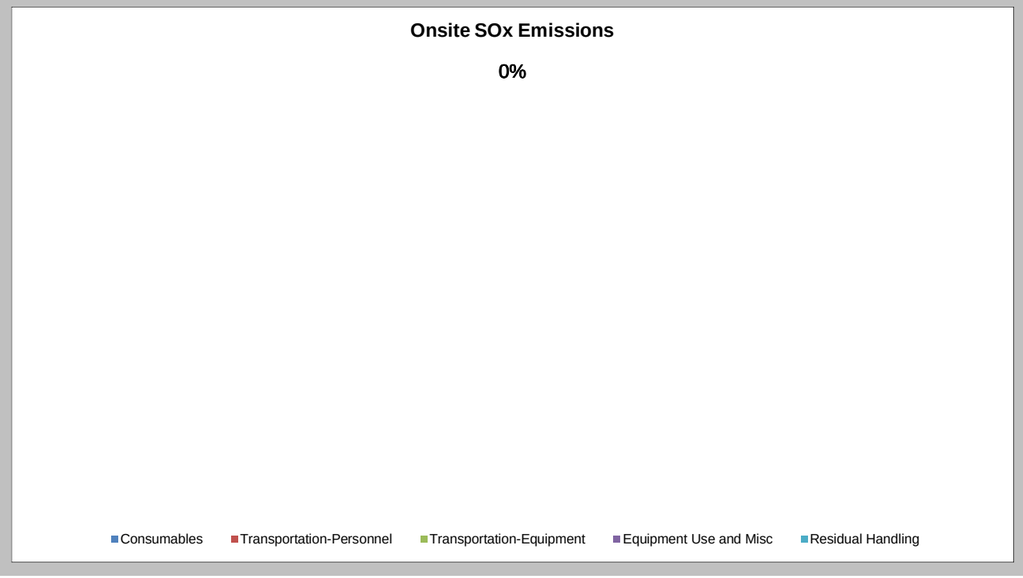
Non-Hazardous Waste Landfill Space (tons)	0.0
Hazardous Waste Landfill Space (tons)	0.0
Topsoil Consumption (yd^3)	0.0
Cost of Phase ($)	760000.0
Lost Hours - Injury	0.4

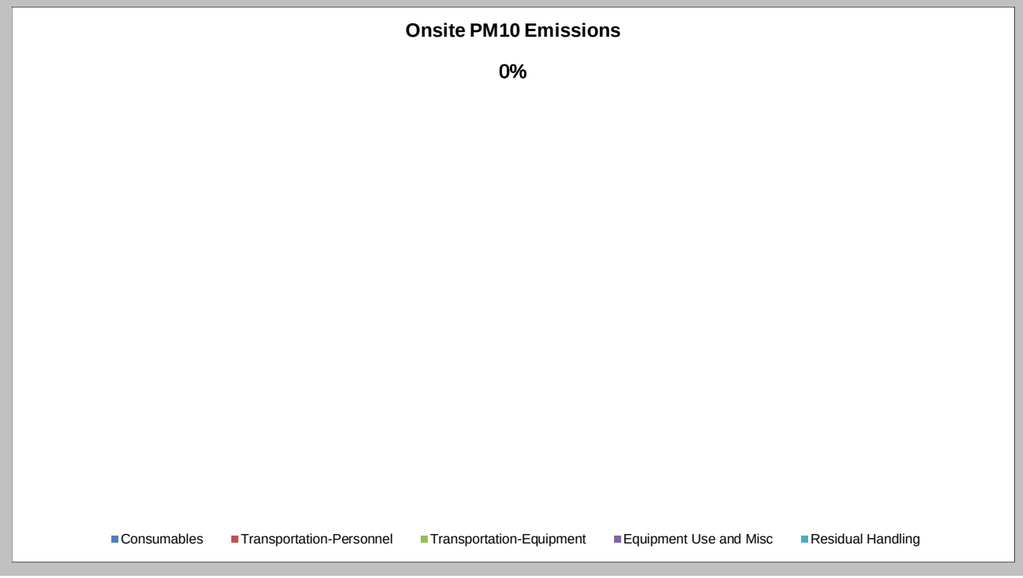
Footprint Reduction

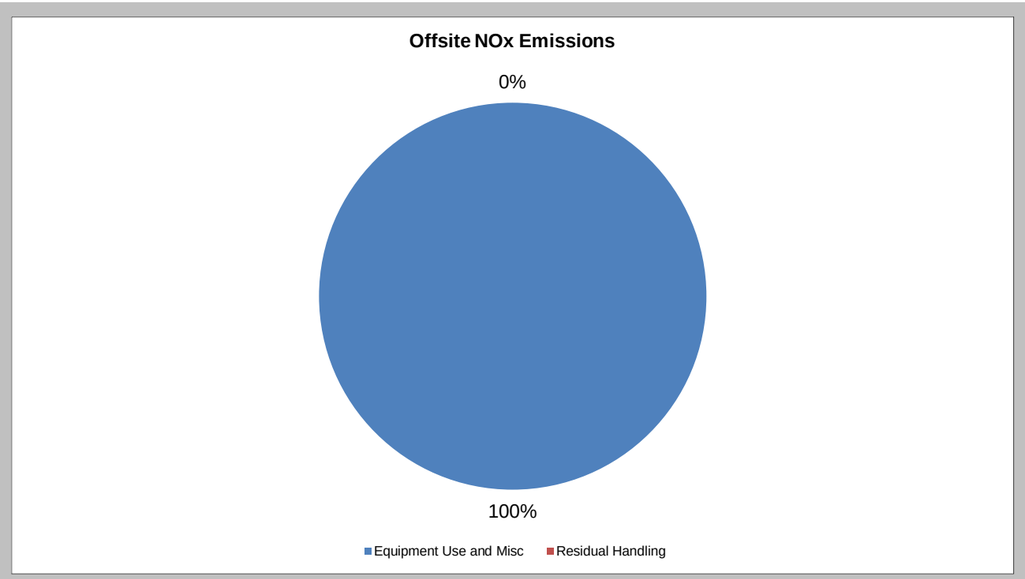
Total electricity replacement (MWh)	0.00E+00
Total electricity replacement (mmBtu)	0.00E+00
Percent electricity from renewable sources (%)	0.0%
Landfill gas reduction (metric ton CO_2 e)	0.00E+00
GHG emissions (metric ton CO2 e)	0.00E+00
NOx emissions (metric ton)	0.00E+00
SOx emissions (metric ton)	0.00E+00
PM10 emissions (metric ton)	0.00E+00

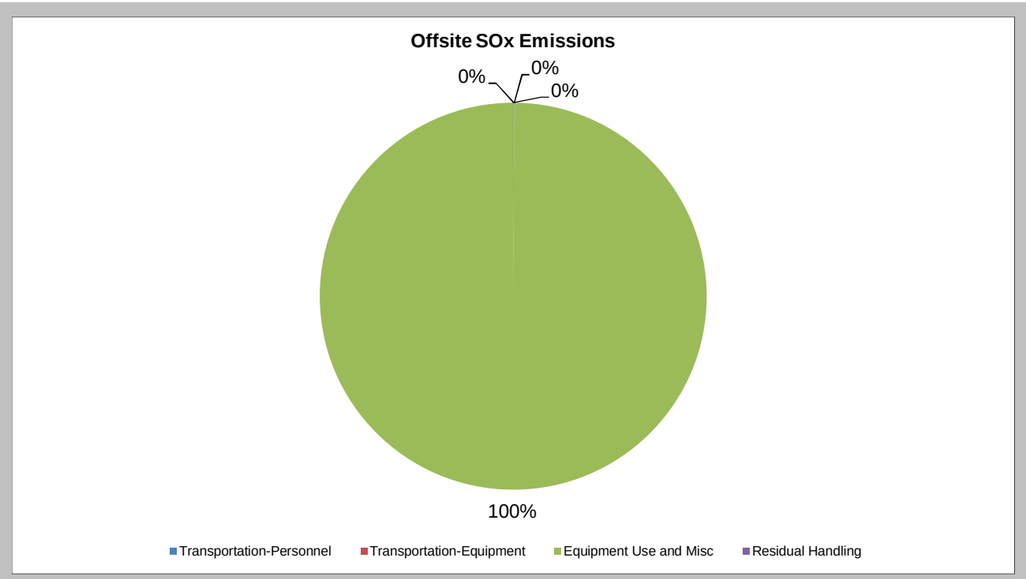

Water Consumption
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

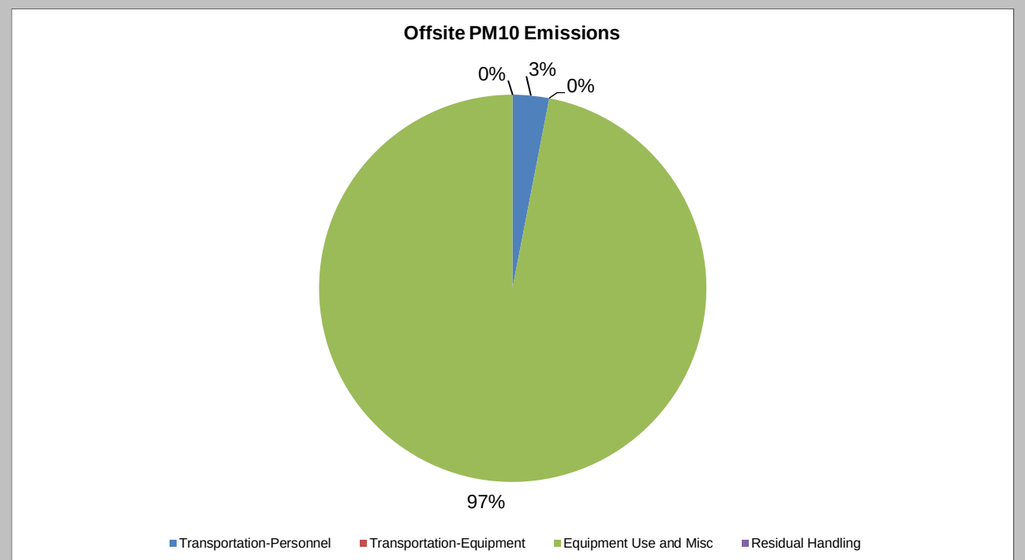

Onsite NOx Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

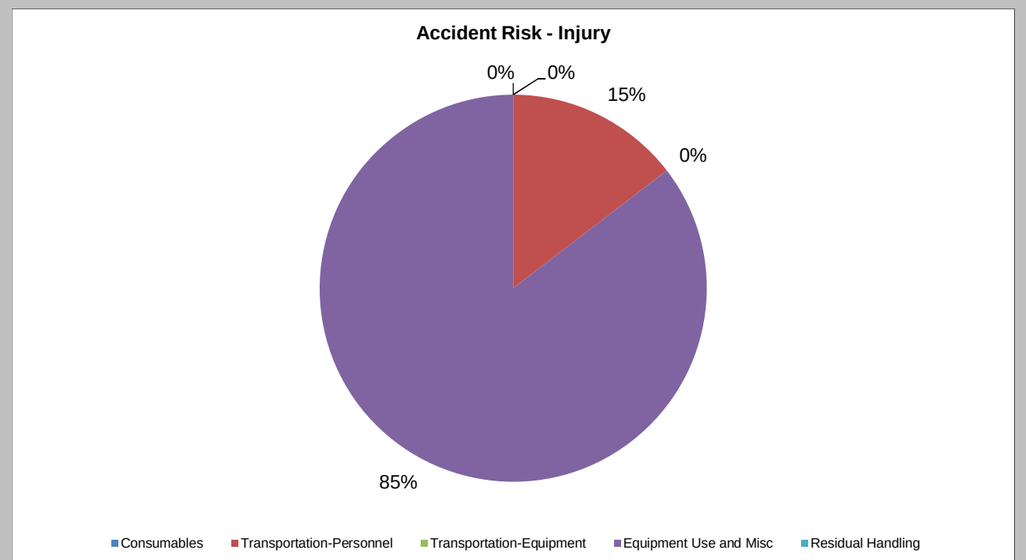

Onsite SOx Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

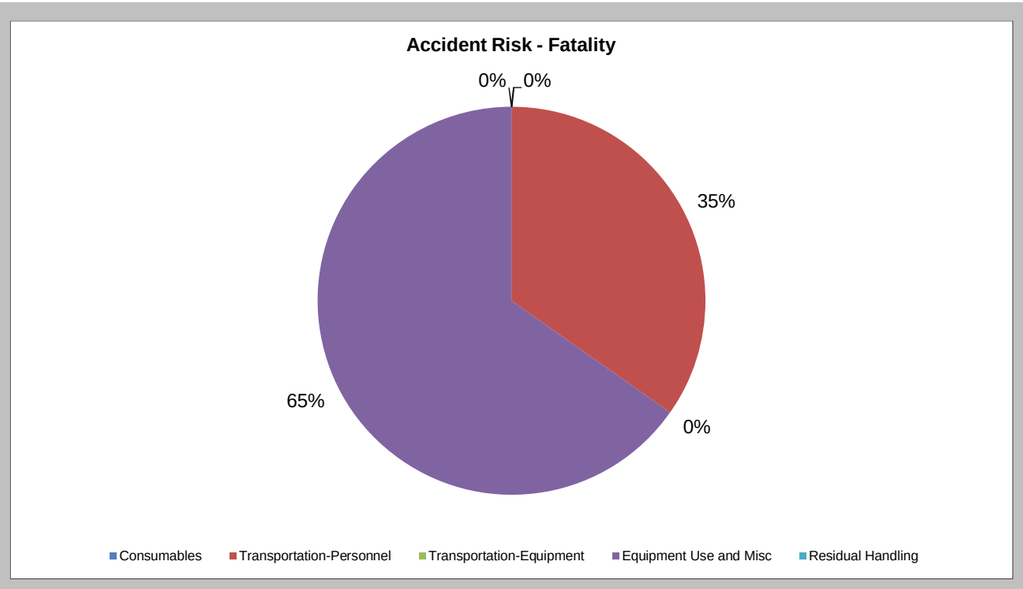

Onsite PM10 Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite NOx Emissions
0%
100%
Equipment Use and Misc
Residual Handling


Offsite SOx Emissions
0%
0%
0%
100%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite PM10 Emissions
0%
3%
0%
97%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

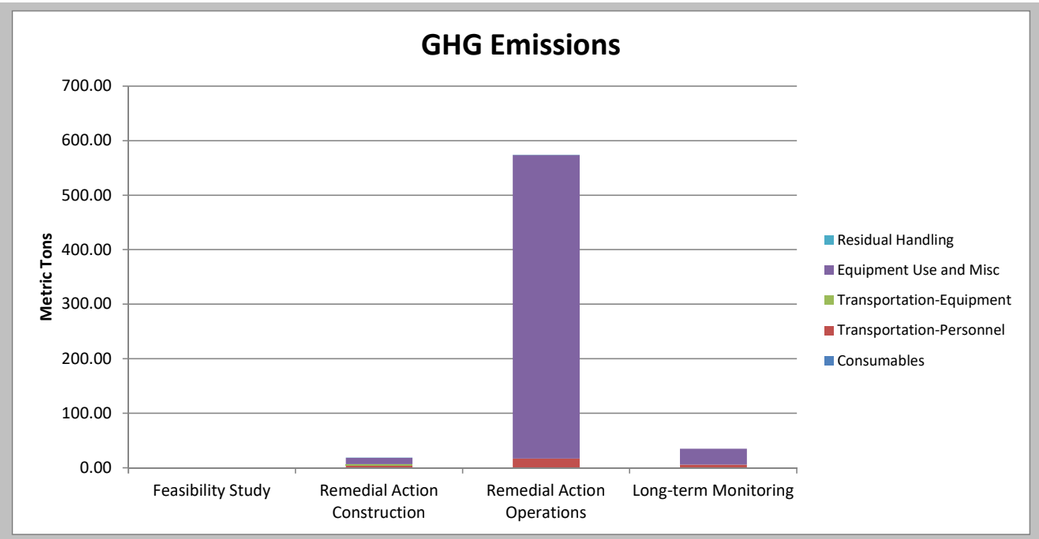

Accident Risk - Injury
0%
0%
15%
0%
85%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

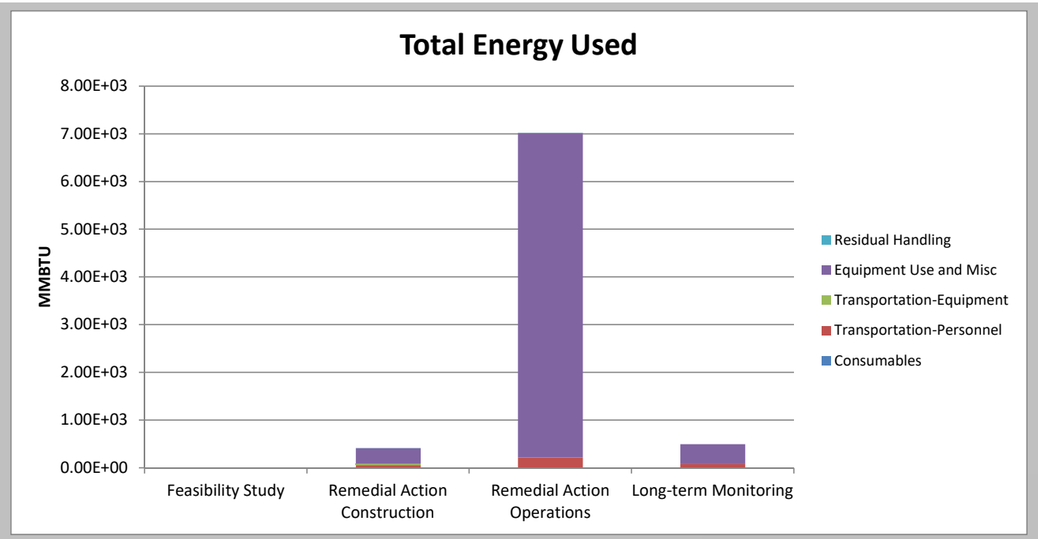

Accident Risk - Fatality
0%
0%
35%
65%
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

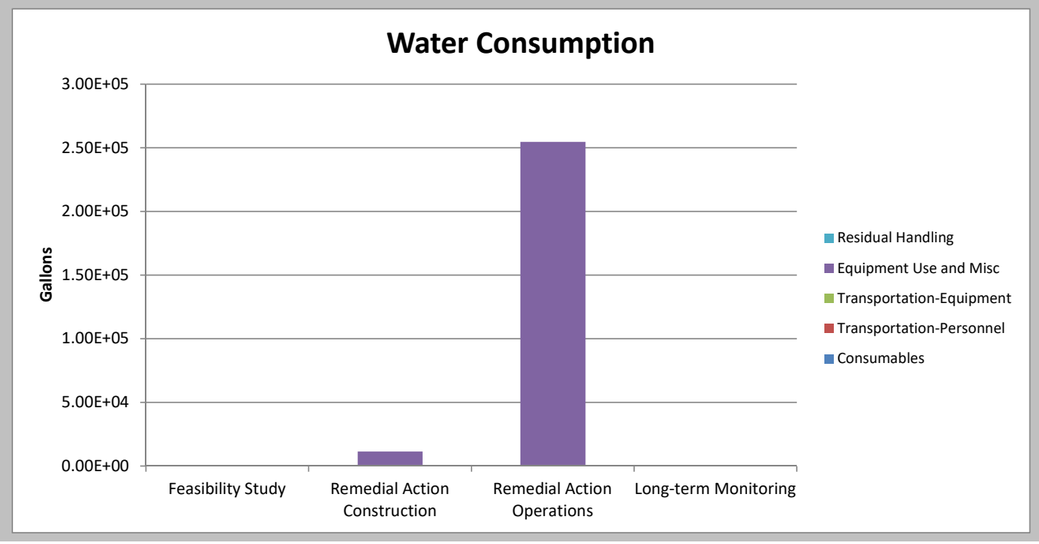
Sustainable Remediation - Environmental Footprint Summary
Alt 2

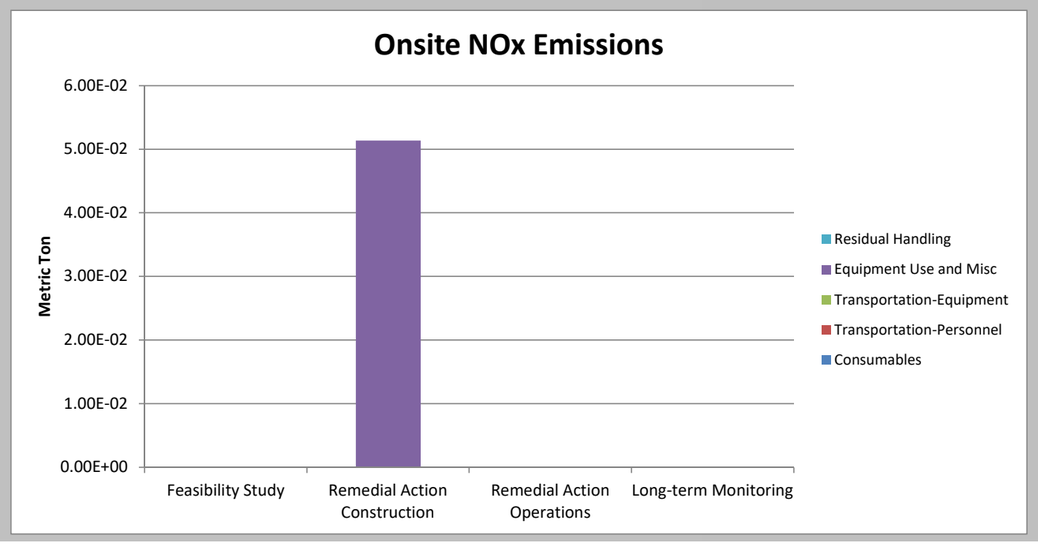
Phase	Activities	GHG Emissions	Total Energy Used	Water Consumption	Electricity Usage	Onsite NOx Emissions	Onsite SOx Emissions	Onsite PM10 Emissions	Total NOx Emissions	Total SOx Emissions	Total PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	MWH	metric ton	metric ton	metric ton	metric ton	metric ton	metric ton		
Feasibility Study	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	NA	NA	NA	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	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	4.49	5.7E+01	NA	NA	NA	NA	NA	1.9E-03	5.9E-05	2.7E-04	6.4E-05	5.1E-03
	Transportation-Equipment	2.58	3.4E+01	NA	NA	NA	NA	NA	8.1E-04	1.4E-05	7.2E-05	7.8E-06	6.3E-04
	Equipment Use and Misc	11.36	3.2E+02	1.2E+04	0.0E+00	5.1E-02	1.1E-02	7.5E-03	5.5E-02	1.4E-02	7.9E-03	8.8E-05	2.4E-02
	Residual Handling	0.34	4.8E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	3.7E-04	1.5E-04	8.0E-04	1.6E-06	1.3E-04
	Sub-Total	18.77	4.18E+02	1.15E+04	0.00E+00	5.14E-02	1.06E-02	7.46E-03	5.83E-02	1.38E-02	9.00E-03	1.61E-04	3.02E-02
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	17.19	2.2E+02	NA	NA	NA	NA	NA	7.1E-03	2.2E-04	1.0E-03	2.4E-04	2.0E-02
	Transportation-Equipment	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	556.70	6.8E+03	2.5E+05	5.0E+02	4.9E-06	4.9E-06	2.4E-07	1.2E+00	3.1E+00	7.2E-01	1.3E-04	6.4E-02
	Residual Handling	0.21	3.2E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	4.0E-04	1.9E-04	1.0E-03	7.8E-07	6.3E-05
	Sub-Total	574.11	7.02E+03	2.55E+05	4.99E+02	4.90E-06	4.90E-06	2.45E-07	1.24E+00	3.10E+00	7.23E-01	3.70E-04	8.41E-02
Long-term Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	6.11	7.7E+01	NA	NA	NA	NA	NA	2.5E-03	8.0E-05	3.6E-04	8.7E-05	7.0E-03
	Transportation-Equipment	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	29.20	4.2E+02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E-01	1.1E-01	1.2E-02	1.6E-04	4.1E-02
	Residual Handling	0.00	0.0E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	35.32	4.95E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E-01	1.05E-01	1.20E-02	2.49E-04	4.78E-02
Total		**6.3E+02**	**7.9E+03**	**2.7E+05**	**5.0E+02**	**5.1E-02**	**1.1E-02**	**7.5E-03**	**1.4E+00**	**3.2E+00**	**7.4E-01**	**7.8E-04**	**1.6E-01**

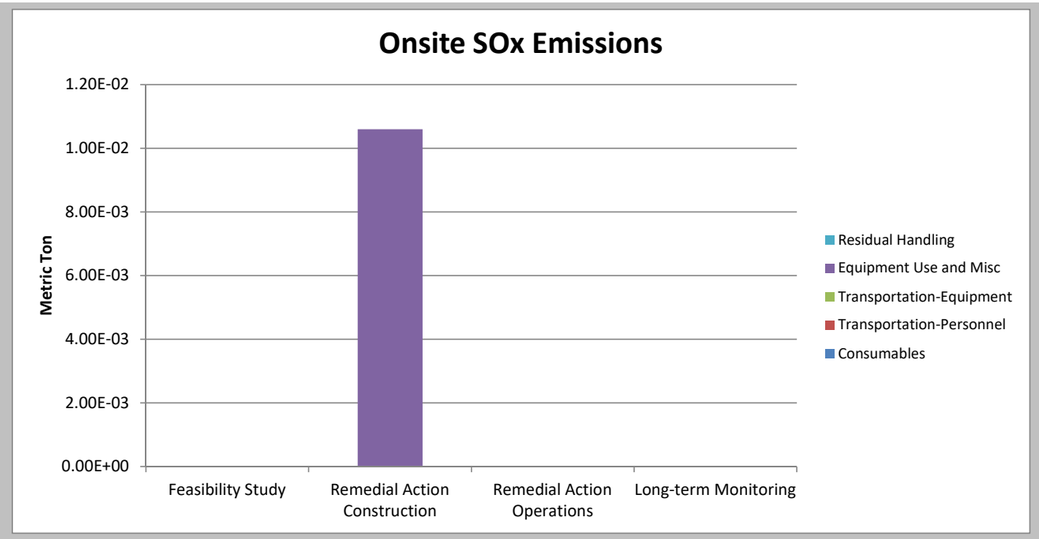
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury	Percent electricity from renewable sources	Total Cost with Footprint Reduction
	tons	tons	cubic yards	$		%	
Feasibility Study	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00	0.0%	$2,897,000
Remedial Action Construction	4.4E+00	0.0E+00	0.0E+00	311,000	2.4E-01	0.0%	
Remedial Action Operations	5.5E+00	0.0E+00	0.0E+00	1,826,000	6.7E-01	5.3%	
Long-term Monitoring	0.0E+00	0.0E+00	0.0E+00	760,000	3.8E-01	0.0%	
Total	**9.9E+00**	**0.0E+00**	**0.0E+00**	**$2,897,000**	**1.3E+00**	**1.3%**	

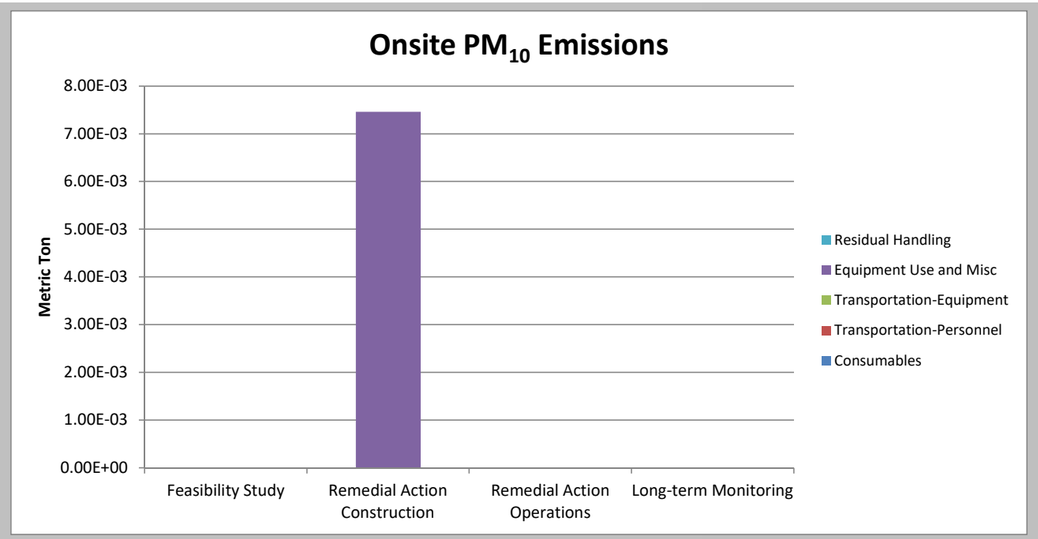

GHG Emissions
Metric Tons
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

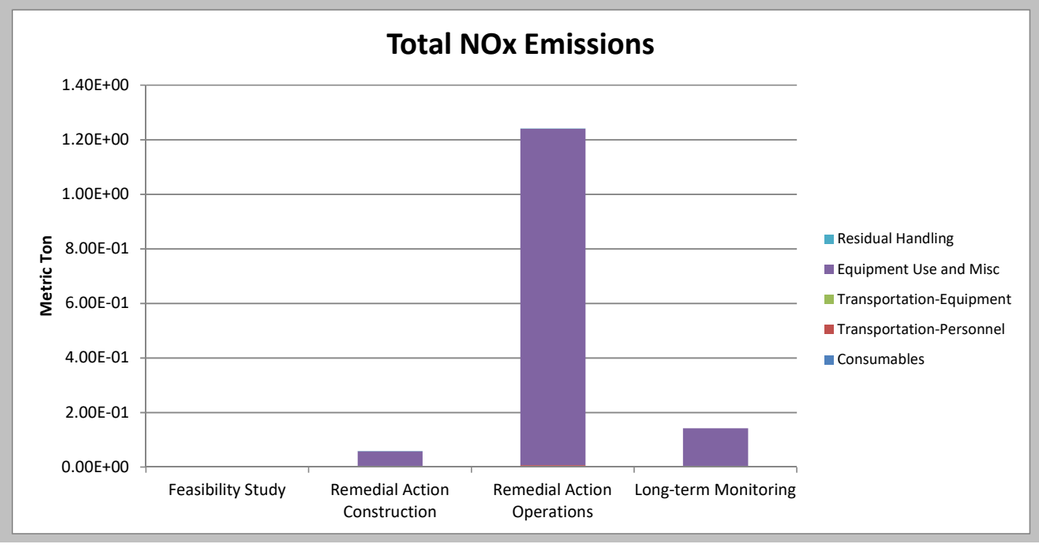

Total Energy Used
MMBTU
8.00E+03
7.00E+03
6.00E+03
5.00E+03
4.00E+03
3.00E+03
2.00E+03
1.00E+03
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

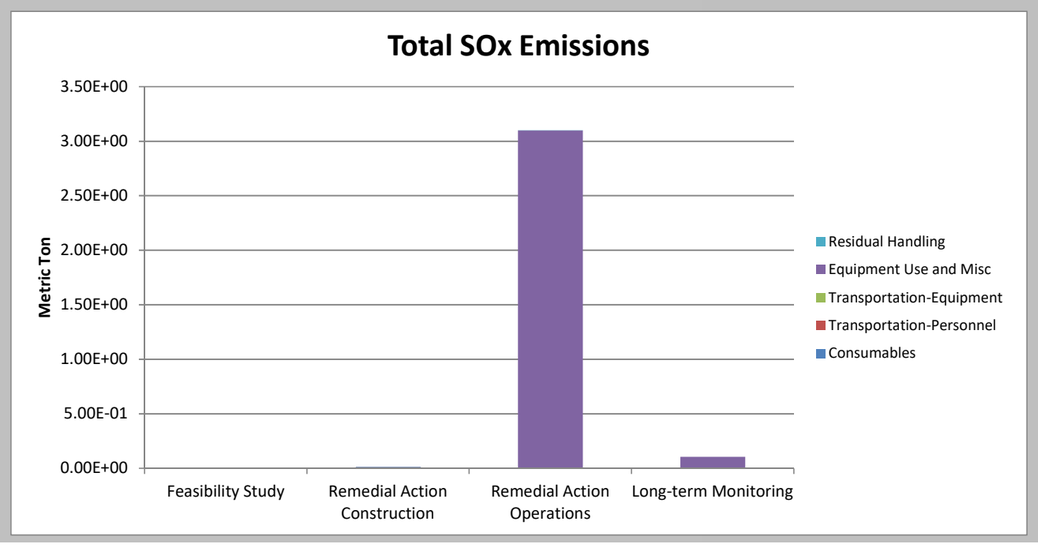

Water Consumption
Gallons
3.00E+05
2.50E+05
2.00E+05
1.50E+05
1.00E+05
5.00E+04
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

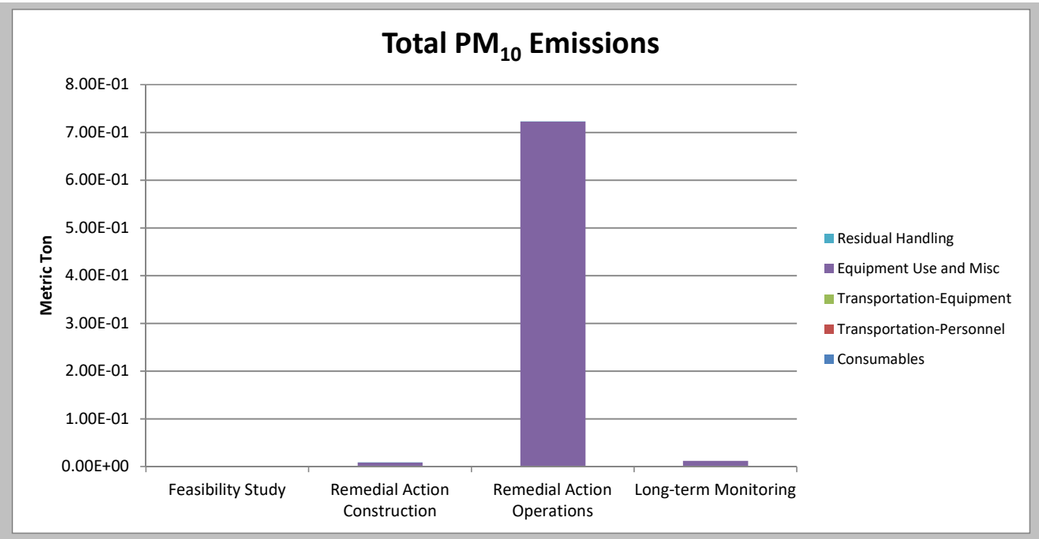

Onsite NOx Emissions
Metric Ton
6.00E-02
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

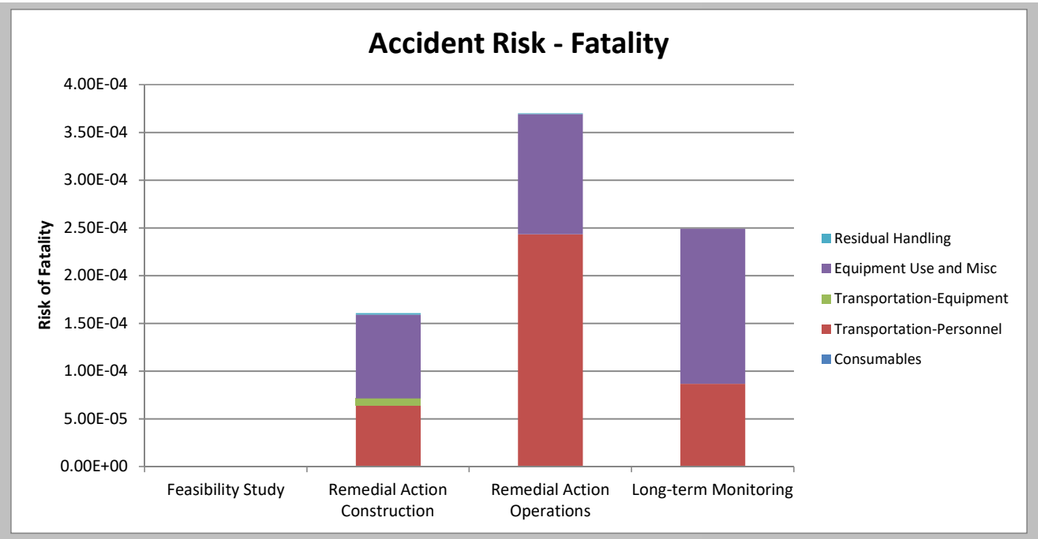

Onsite SOx Emissions
Metric Ton
1.20E-02
1.00E-02
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

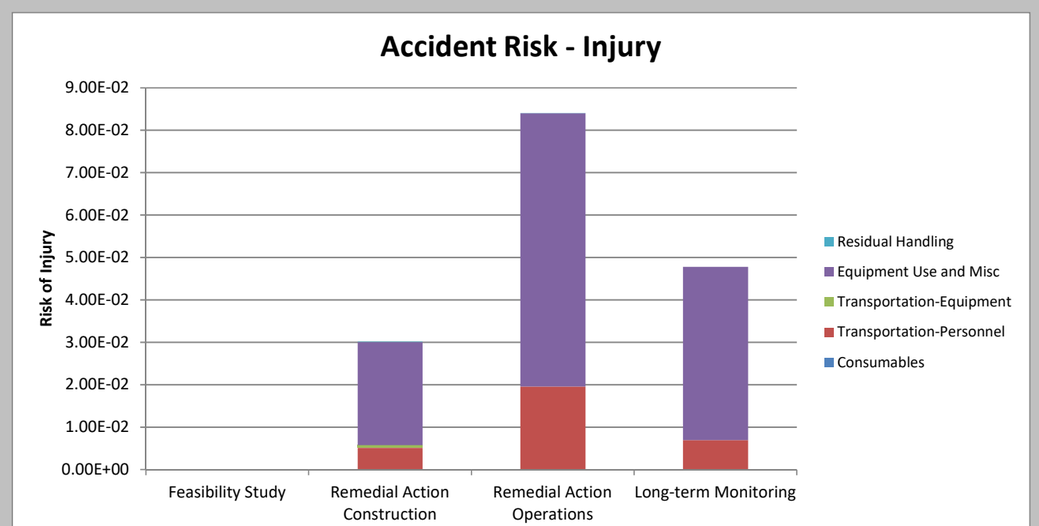

Onsite PM10 Emissions
Metric Ton
8.00E-03
7.00E-03
6.00E-03
5.00E-03
4.00E-03
3.00E-03
2.00E-03
1.00E-03
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

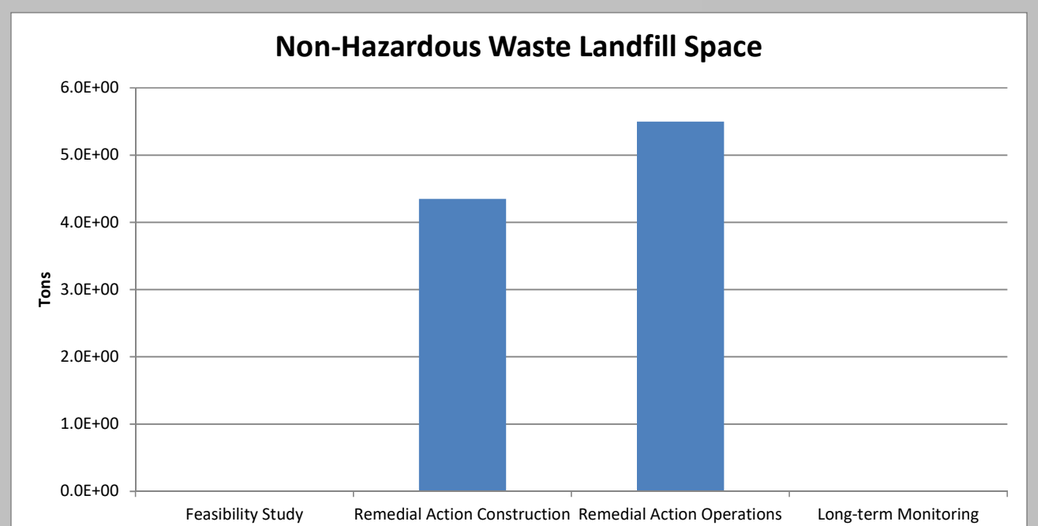

Total NOx Emissions
Metric Ton
1.40E+00
1.20E+00
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Total SOx Emissions
Metric Ton
3.50E+00
3.00E+00
2.50E+00
2.00E+00
1.50E+00
1.00E+00
5.00E-01
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

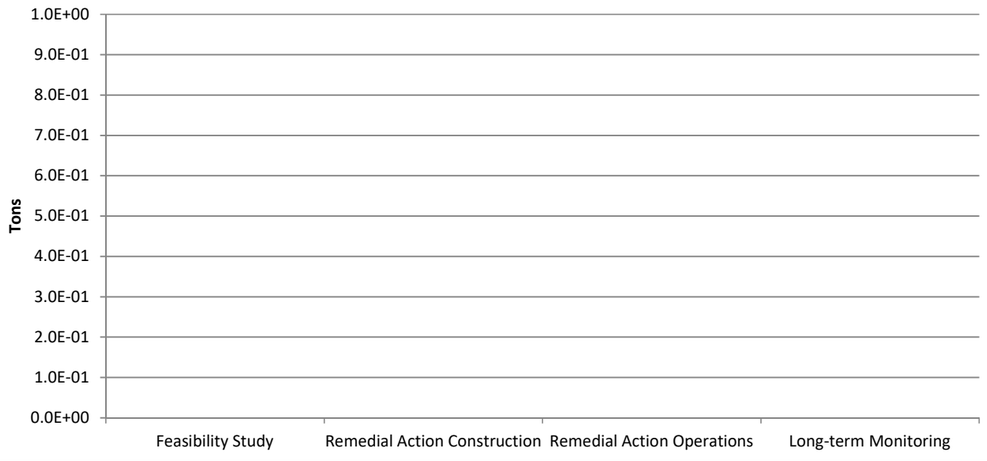

Total PM10 Emissions
Metric Ton
8.00E-01
7.00E-01
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Accident Risk - Fatality
Risk of Fatality
4.00E-04
3.50E-04
3.00E-04
2.50E-04
2.00E-04
1.50E-04
1.00E-04
5.00E-05
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

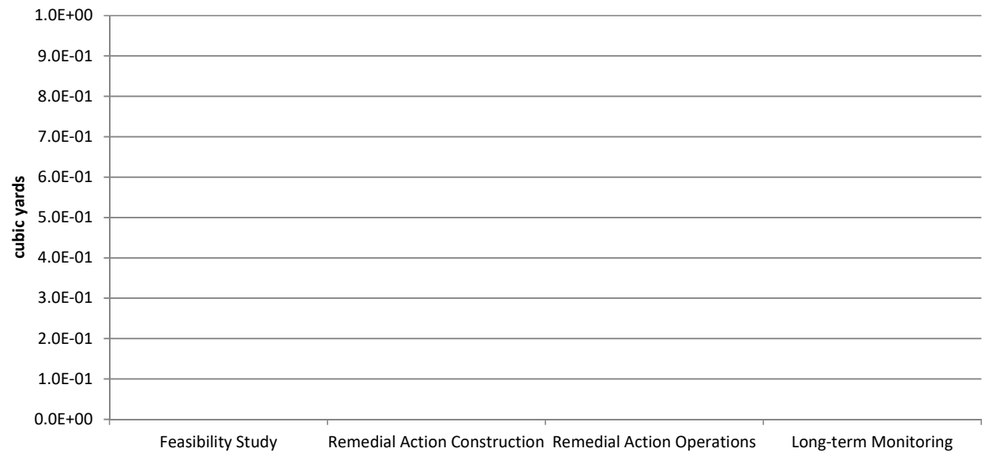

Accident Risk - Injury
Risk of Injury
9.00E-02
8.00E-02
7.00E-02
6.00E-02
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Non-Hazardous Waste Landfill Space
Tons
6.0E+00
5.0E+00
4.0E+00
3.0E+00
2.0E+00
1.0E+00
0.0E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring

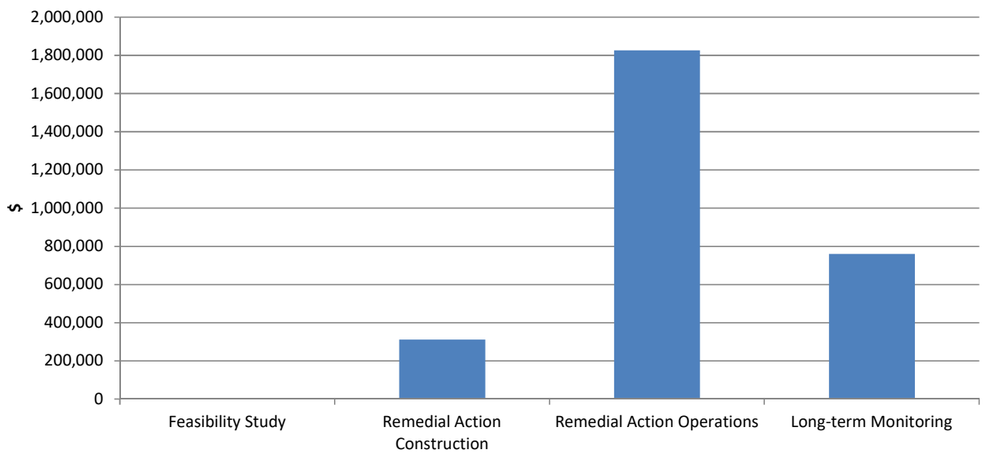
Hazardous Waste Landfill Space



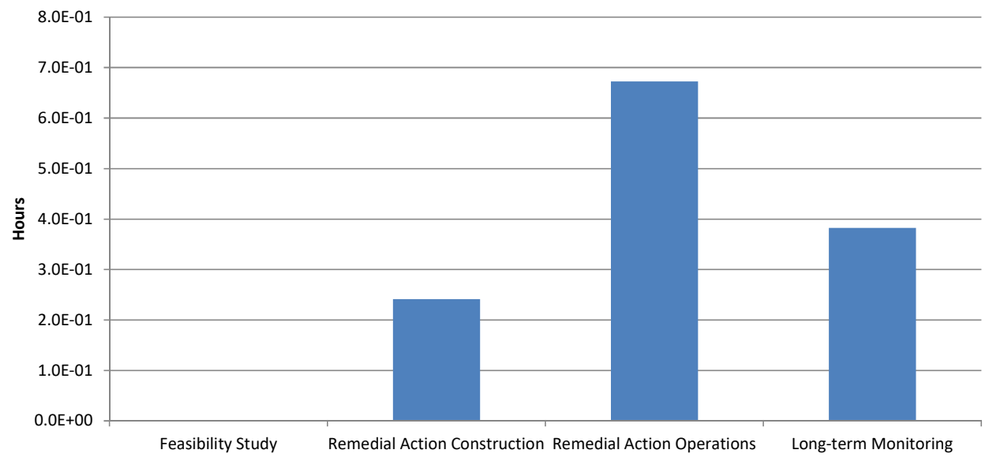
Topsoil Consumption



Costing



Lost Hours - Injury



						Greenhouse Gas Emissions				Criteria Pollutant Emission			Energy Consumption	Water Consumption
	Technology Module / Phase	Module Components	Comments / Assumptions	Quantity	(Units)	CO_2e	CO_2	N_20	CH_4	NO_x	SO_x	PM_{10}		
Stage	Materials								Tonnes				MWhr	gal x 1000
					lft	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lft	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lft	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
					lft	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A
RAC	GW Monitoring Wells	PVC	4 wells 20 feet deep each, 2" Schedule 40	80.00	lft	0.12	0.06	0.00	0.00	0.00	0.00	0.00	2.25	0.14
RAC	Biosparge wells	PVC	15 wells, 2" Schedule 40, 25 feet deep	375.00	lft	0.57	0.29	0.00	0.00	0.00	0.00	0.00	10.54	0.64
RAC	Vent wells	PVC	4 wells 10 feet deep each, 2" Schedule 40	40.00	lft	0.06	0.03	0.00	0.00	0.00	0.00	0.00	1.12	0.07
RAC	Concrete MW pads	General Concrete	4 pads, 2'x2'x6"	900.00	lbs	0.053	0.053	0.000	0.000	0.000	0.000	0.000	0.52	0.000
RAC	Decon pad liner	HDPE	assume HDPE, Assume 25ftx25ft, 6 mm thick, 0.95 g/cm3	729.66	lbs	1.63	0.86	0.00	0.0063	0.00	0.00	0.00	9.55	0.26
RAC	Decon Pad frame		Assume wood, 4x4 in, (25ftx25ft pad) 100 ft of timber, density for pine 530 kg/m3	367.63	lbs	0.0039	0.0039	0.00	0.00	0.00	0.00	0.00	0.0042	0.0025
RAC	Conveyance piping	HDPE	2" PEX pipe, assume HDPE, 900', 0.26 lbs/ft	600.00	lbs	1.34	0.71	0.00	0.01	0.00	0.00	0.00	7.85	0.22
RAC	Vaults for biosparge wells	General Concrete	15 vaults, 1300 lbs each	19,500.00	lbs	1.15	1.15	0.00	0.00	0.00	0.00	0.00	11.35	0.00
RAC	Re-seeding	Fertilizer	fertilizer, 3.06 msf (thousand square feet), 3 lb of seed per 1.2 msf, 300 sy	7.65	lbs	9.54E-03	9.54E-03	1.26E-11	0.00E+00	0.00E+00	3.47E-06	6.97E-09	1.73E-01	3.46E-03
RAC	Re-seeding	Mulch	fertilizer, 3.06 msf (thousand square feet), 3 lb of seed per 1.2 msf, 300 sy	7.65	lbs	2.42E-03	8.47E-04	4.89E-06	2.60E-06	1.44E-09	8.26E-06	6.24E-07	2.74E-02	0.00E+00
RAC	Silt Fence	Medium Impact Material	9 100' rolls, 45lbs/roll	405	lbs	1.84E-01	1.84E-01	0.00E+00	0.00E+00	5.51E-04	9.18E-04	1.84E-04	7.44E+00	0.00E+00
RAC	Temporary Jute Erosion Control Matting	Low Impact Material	300 sy, 90lbs/100sy	306	lbs	6.94E-02	6.94E-02	0.00E+00	0.00E+00	1.39E-04	2.78E-04	5.55E-05	1.87E+00	0.00E+00
					lbs	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A	#N/A

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

BASELINE INFORMATION

COMPONENT 1 DURATION AND COST	Entire Site
Input duration of the component (unit time)	1
Input component cost per unit time ($)	

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Choose specific casing material schedule from drop down menu	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC
Choose well diameter (in) from drop down menu	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
Input total quantity of Sand (kg)												
Input total quantity of Gravel (kg)												
Input total quantity of Bentonite (kg)												
Input total quantity of Typical Cement (kg)												
Input total quantity of General Concrete (kg)												
Input total quantity of Steel (kg)												

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input number of injection points												
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	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												

TREATMENT MEDIA	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input weight of media used (lbs)												
Choose media type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	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	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft2)												
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	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Input well diameter (in)												
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil

SILT CURTAIN MATERIALS	Curtain 1	Curtain 2	Curtain 3	Curtain 4	Curtain 5	Curtain 6	Curtain 7	Curtain 8	Curtain 9	Curtain 10	Curtain 11	Curtain 12
Input length or perimeter of silt curtain (ft)												
Input depth of silt curtain (ft)												

BULK MATERIAL QUANTITIES	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material from drop down menu	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid
Choose units of material quantity from drop down menu	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds
Input material quantity												

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	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 - DEDICATED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Account for an empty return trip?	No	No	No	No	No	No	No	No	No	No	No	No
Input one-way distance traveled (miles) with a given load. If applicable, impact for an empty return trip will be accounted for (no additional input is needed).												
Input weight of equipment transported per truck load (tons)												

EQUIPMENT TRANSPORTATION - SHARED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (miles)												
Input weight of load (tons)												

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (mile)												
Input weight of load (tons)												

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12
Input number of drilling locations												
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)												
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

TRENCHING	Trencher 1	Trencher 2	Trencher 3	Trencher 4	Trencher 5	Trencher 6	Trencher 7	Trencher 8	Trencher 9	Trencher 10	Trencher 11	Trencher 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input operating hours (hr)												

SEDIMENT DREDGING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose dredge equipment type from drop down menu	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Choose dredge fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be dredged (yd3)												
Choose dredge equipment size	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1 C
Suggested dredge equipment size	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose dredge tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	2	2	2	2	2	2	2	2	2	2	2	2
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT MANAGEMENT (STAGING AND DRYING)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Is volume input that of saturated sediment?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Will the sediment be dry when this work is performed?	No	No	No	No	No	No	No	No	No	No	No	No
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT CAPPING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose capping method from drop down menu	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release
Choose capping equipment fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of capping material to be placed (yd3)												
Choose capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Suggested capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Input number of dredge tenders (hr) (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

WATERCRAFT OPERATION	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of vessels												
Input operating time (hours)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

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	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	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	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN												
Input flow rate (gpm)	0	0	0	0	0	0	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Pump efficiency (default already present, user override possible)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN												
Input pump horsepower (hp)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for pump motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Pump load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input pump load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower	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	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	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Equipment load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input equipment load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Equipment motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	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	0	0	0	0	0	0
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6	Generator 7	Generator 8	Generator 9	Generator 10	Generator 11	Generator 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
Input operating hours (hr)												

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6	Tillage Tractor 7	Tillage Tractor 8	Tillage Tractor 9	Tillage Tractor 10	Tillage Tractor 11	Tillage Tractor 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
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	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input area (ft2)												
Input time available (work days)												

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6	Mixer 7	Mixer 8	Mixer 9	Mixer 10	Mixer 11	Mixer 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd3)												
Input production rate (yd3/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)												

INTERNAL COMBUSTION ENGINES	Engine 1	Engine 2	Engine 3	Engine 4	Engine 5	Engine 6	Engine 7	Engine 8	Engine 9	Engine 10	Engine 11	Engine 12
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input fuel consumption rate (gal/hr or scf/hr)												
Input operating hours (hr)												

OTHER FUELED EQUIPMENT	Fuel 1	Fuel 2	Fuel 3	Fuel 4	Fuel 5	Fuel 6	Fuel 7	Fuel 8	Fuel 9	Fuel 10	Fuel 11	Fuel 12
Choose fuel type from drop down menu	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Input volume (scf for Natural gas, gallons for all others)												

DIESEL EQUIPMENT OPERATION (PER HOUR BASIS)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose equipment size for Dozer (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Loader (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Excavator (HP)	150	150	150	150	150	150	150	150	150	150	150	150
Choose equipment size for Scraper (HP)	330	330	330	330	330	330	330	330	330	330	330	330
Choose equipment size for Crawler Crane	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C
Choose equipment size for Tillage Tractor (HP)	16	16	16	16	16	16	16	16	16	16	16	16
Choose equipment size for Paver (HP)	25	25	25	25	25	25	25	25	25	25	25	25
Choose equipment size for Roller (HP)	6	6	6	6	6	6	6	6	6	6	6	6
Choose equipment size for Trencher (HP range)	6 to 11	7 to 11	8 to 11	9 to 11	10 to 11	11 to 11	12 to 11	13 to 11	14 to 11	15 to 11	16 to 11	17 to 11
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating hours (hr)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

OPERATOR LABOR	Occupation 1	Occupation 2	Occupation 3	Occupation 4	Occupation 5	Occupation 6	Occupation 7	Occupation 8	Occupation 9	Occupation 10	Occupation 11	Occupation 12
Choose occupation from drop-down menu	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers
Input total time worked onsite (hours)												

LABORATORY ANALYSIS	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5	Analysis 6	Analysis 7	Analysis 8	Analysis 9	Analysis 10	Analysis 11	Analysis 12
Input dollars spent on laboratory analysis ($)												

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO2 emission (metric ton)	
Input N2O emission (metric ton CO2 e)	
Input CH4 emission (metric ton CO2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM10 emission (metric ton)	
Input fatality risk	
Input injury risk	

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)												
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6
Choose landfill type for waste disposal	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous
Input amount of waste disposed in landfill (tons)												
Input landfill methane emissions (metric tons CH4)												
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	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	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	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	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)

RESOURCE CONSUMPTION

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6
Input total water consumed from potable water treatment facility (gal)												
Input total water disposed to wastewater treatment facility (gal)												

ONSITE LAND AND WATER RESOURCE CONSUMPTION	Entire Site 1	Entire Site 2	Entire Site 3	Entire Site 4	Entire Site 5	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6
Input volume of topsoil brought to site (cubic yards)												
Input volume of groundwater or surface water lost (gal)												

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

BASELINE INFORMATION

COMPONENT 2 DURATION AND COST	Entire Site
Input duration of the component (unit time)	1
Input component cost per unit time ($)	327000

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Choose specific casing material schedule from drop down menu	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC
Choose well diameter (in) from drop down menu	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
Input total quantity of Sand (kg)												
Input total quantity of Gravel (kg)												
Input total quantity of Bentonite (kg)												
Input total quantity of Typical Cement (kg)												
Input total quantity of General Concrete (kg)												
Input total quantity of Steel (kg)												

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input number of injection points												
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	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												

TREATMENT MEDIA	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input weight of media used (lbs)												
Choose media type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	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	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft2)												
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	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Input well diameter (in)												
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil

SILT CURTAIN MATERIALS	Curtain 1	Curtain 2	Curtain 3	Curtain 4	Curtain 5	Curtain 6	Curtain 7	Curtain 8	Curtain 9	Curtain 10	Curtain 11	Curtain 12
Input length or perimeter of silt curtain (ft)												
Input depth of silt curtain (ft)												

BULK MATERIAL QUANTITIES	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material from drop down menu	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid
Choose units of material quantity from drop down menu	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds
Input material quantity												

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	Baseline Sampling	Utility Clearance	MW Install	parge and Vent Well Ir	Well Survey	Trench Install	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Light truck	Light truck	Light truck	Light truck	Light truck	Light truck	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	50	50	50	50	50	50						
Input number of trips taken	6	1	6	6	1	100						
Input number of travelers	1	1	1	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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	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 - DEDICATED LOAD ROAD	HSA Drill Rig	Back Hoe	Skid Steer	Porta John	Misc Equipment	Wells	Concrete	Piping	E&S Materials	Decon Materials	DPT Drill Rig	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose fuel used from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Gasoline
Account for an empty return trip?	No	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	No
Input one-way distance traveled (miles) with a given load. If applicable, impact for an empty return trip will be accounted for (no additional input is needed).	100	100	100	100	100	100	100	100	100	100	100	
Input weight of equipment transported per truck load (tons)	3.05	3.88	3.50	0.13	1.00	0.17	10.20	0.30	0.36	0.56	3.05	

EQUIPMENT TRANSPORTATION - SHARED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (miles)												
Input weight of load (tons)												

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (mile)												
Input weight of load (tons)												

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12
Input number of drilling locations	1											
Choose drilling method from drop down menu	Hollow Stem Auger	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)												
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

TRENCHING	Trencher 1	Trencher 2	Trencher 3	Trencher 4	Trencher 5	Trencher 6	Trencher 7	Trencher 8	Trencher 9	Trencher 10	Trencher 11	Trencher 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input operating hours (hr)												

SEDIMENT DREDGING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose dredge equipment type from drop down menu	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Choose dredge fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be dredged (yd3)												
Choose dredge equipment size	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1 C
Suggested dredge equipment size	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose dredge tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	2	2	2	2	2	2	2	2	2	2	2	2
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT MANAGEMENT (STAGING AND DRYING)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Is volume input that of saturated sediment?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Will the sediment be dry when this work is performed?	No	No	No	No	No	No	No	No	No	No	No	No
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT CAPPING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose capping method from drop down menu	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release
Choose capping equipment fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of capping material to be placed (yd3)												
Choose capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Suggested capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

WATERCRAFT OPERATION	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of vessels												
Input operating time (hours)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

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	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	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	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN												
Input flow rate (gpm)	0	0	0	0	0	0	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Pump efficiency (default already present, user override possible)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN												
Input pump horsepower (hp)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for pump motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Pump load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input pump load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower	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	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	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Equipment load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input equipment load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Equipment motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	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	0	0	0	0	0	0
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6	Generator 7	Generator 8	Generator 9	Generator 10	Generator 11	Generator 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
Input operating hours (hr)												

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6	Tillage Tractor 7	Tillage Tractor 8	Tillage Tractor 9	Tillage Tractor 10	Tillage Tractor 11	Tillage Tractor 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
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	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input area (ft2)												
Input time available (work days)												

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6	Mixer 7	Mixer 8	Mixer 9	Mixer 10	Mixer 11	Mixer 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd3)												
Input production rate (yd3/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)												

INTERNAL COMBUSTION ENGINES	Engine 1	Engine 2	Engine 3	Engine 4	Engine 5	Engine 6	Engine 7	Engine 8	Engine 9	Engine 10	Engine 11	Engine 12
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input fuel consumption rate (gal/hr or scf/hr)												
Input operating hours (hr)												

OTHER FUELED EQUIPMENT	Fuel 1	Fuel 2	Fuel 3	Fuel 4	Fuel 5	Fuel 6	Fuel 7	Fuel 8	Fuel 9	Fuel 10	Fuel 11	Fuel 12
Choose fuel type from drop down menu	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Input volume (scf for Natural gas, gallons for all others)												

DIESEL EQUIPMENT OPERATION (PER HOUR BASIS)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose equipment size for Dozer (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Loader (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Excavator (HP)	150	150	150	150	150	150	150	150	150	150	150	150
Choose equipment size for Scraper (HP)	330	330	330	330	330	330	330	330	330	330	330	330
Choose equipment size for Crawler Crane	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C
Choose equipment size for Tillage Tractor (HP)	16	16	16	16	16	16	16	16	16	16	16	16
Choose equipment size for Paver (HP)	25	25	25	25	25	25	25	25	25	25	25	25
Choose equipment size for Roller (HP)	6	6	6	6	6	6	6	6	6	6	6	6
Choose equipment size for Trencher (HP range)	6 to 11	7 to 11	8 to 11	9 to 11	10 to 11	11 to 11	12 to 11	13 to 11	14 to 11	15 to 11	16 to 11	17 to 11
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating hours (hr)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

OPERATOR LABOR	Drillers	Surveyor	Util. Locator	Oversight	Sampler	Construction	Occupation 7	Occupation 8	Occupation 9	Occupation 10	Occupation 11	Occupation 12
Choose occupation from drop-down menu	Operating engineers	ntific and technical serv	ntific and technical serv	ntific and technical serv	ntific and technical serv	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers
Input total time worked onsite (hours)	64.0	16.0	8.0	192.0	48.0	640.0						

LABORATORY ANALYSIS	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5	Analysis 6	Analysis 7	Analysis 8	Analysis 9	Analysis 10	Analysis 11	Analysis 12
Input dollars spent on laboratory analysis ($)	1,740.00											

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	2.9E+02
Water consumption (gallon)	1.3E+03
Input CO2 emission (metric ton)	7.6E+00
Input N2O emission (metric ton CO2 e)	1.4E+00
Input CH4 emission (metric ton CO2 e)	4.6E-01
Input NOx emission (metric ton)	4.2E-02
Input SOx emission (metric ton)	1.0E-02
Input PM10 emission (metric ton)	7.3E-03
Input fatality risk	
Input injury risk	

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	IDW	Construction Debris	Material Residue	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)	7.2	0.5										
Choose fuel used from drop down menu	Diesel	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input total number of trips	1.0	1.0										
Input number of miles per trip	100.0	100.0										

LANDFILL OPERATIONS	IDW	Construction Debris	Operation 3	Operation 4	Operation 5	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6
Choose landfill type for waste disposal	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous
Input amount of waste disposed in landfill (tons)	7.2	0.5										
Input landfill methane emissions (metric tons CH4)												
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	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	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	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	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)

RESOURCE CONSUMPTION

WATER CONSUMPTION	Development Water	Decon Water	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6
Input total water consumed from potable water treatment facility (gal)	1265	15000										
Input total water disposed to wastewater treatment facility (gal)	1265	15000										

ONSITE LAND AND WATER RESOURCE CONSUMPTION	Entire Site 1	Entire Site 2	Entire Site 3	Entire Site 4	Entire Site 5	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6
Input volume of topsoil brought to site (cubic yards)												
Input volume of groundwater or surface water lost (gal)												

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

BASELINE INFORMATION

COMPONENT 3 DURATION AND COST	Entire Site
Input duration of the component (unit time)	1
Input component cost per unit time ($)	861000

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Choose specific casing material schedule from drop down menu	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC
Choose well diameter (in) from drop down menu	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
Input total quantity of Sand (kg)												
Input total quantity of Gravel (kg)												
Input total quantity of Bentonite (kg)												
Input total quantity of Typical Cement (kg)												
Input total quantity of General Concrete (kg)												
Input total quantity of Steel (kg)												

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input number of injection points												
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	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												

TREATMENT MEDIA	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input weight of media used (lbs)												
Choose media type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	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	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft2)												
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	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Input well diameter (in)												
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil

SILT CURTAIN MATERIALS	Curtain 1	Curtain 2	Curtain 3	Curtain 4	Curtain 5	Curtain 6	Curtain 7	Curtain 8	Curtain 9	Curtain 10	Curtain 11	Curtain 12
Input length or perimeter of silt curtain (ft)												
Input depth of silt curtain (ft)												

BULK MATERIAL QUANTITIES	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material from drop down menu	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid
Choose units of material quantity from drop down menu	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds
Input material quantity												

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	O&M	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Light truck	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	50											
Input number of trips taken	264											
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	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 - DEDICATED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Account for an empty return trip?	No	No	No	No	No	No	No	No	No	No	No	No
Input one-way distance traveled (miles) with a given load. If applicable, impact for an empty return trip will be accounted for (no additional input is needed).												
Input weight of equipment transported per truck load (tons)												

EQUIPMENT TRANSPORTATION - SHARED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (miles)												
Input weight of load (tons)												

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (mile)												
Input weight of load (tons)												

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12
Input number of drilling locations												
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)												
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

TRENCHING	Trencher 1	Trencher 2	Trencher 3	Trencher 4	Trencher 5	Trencher 6	Trencher 7	Trencher 8	Trencher 9	Trencher 10	Trencher 11	Trencher 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input operating hours (hr)												

SEDIMENT DREDGING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose dredge equipment type from drop down menu	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Choose dredge fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be dredged (yd3)												
Choose dredge equipment size	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1 C
Suggested dredge equipment size	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose dredge tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	2	2	2	2	2	2	2	2	2	2	2	2
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT MANAGEMENT (STAGING AND DRYING)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Is volume input that of saturated sediment?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Will the sediment be dry when this work is performed?	No	No	No	No	No	No	No	No	No	No	No	No
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT CAPPING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose capping method from drop down menu	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release
Choose capping equipment fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of capping material to be placed (yd3)												
Choose capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Suggested capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

WATERCRAFT OPERATION	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of vessels												
Input operating time (hours)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

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	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	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	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN												
Input flow rate (gpm)	0	0	0	0	0	0	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Pump efficiency (default already present, user override possible)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN												
Input pump horsepower (hp)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for pump motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Pump load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input pump load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower	Blower	Blower	Blower	Blower	Blower	Blower
Choose method from drop down	Method 2	Method 1	Method 1	Method 1	Method 1	Method 1	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	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Equipment load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input equipment load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Equipment motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	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)	932064	0	0	0	0	0	0	0	0	0	0	0
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6	Generator 7	Generator 8	Generator 9	Generator 10	Generator 11	Generator 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
Input operating hours (hr)												

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6	Tillage Tractor 7	Tillage Tractor 8	Tillage Tractor 9	Tillage Tractor 10	Tillage Tractor 11	Tillage Tractor 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
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	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input area (ft2)												
Input time available (work days)												

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6	Mixer 7	Mixer 8	Mixer 9	Mixer 10	Mixer 11	Mixer 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd3)												
Input production rate (yd3/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)												

INTERNAL COMBUSTION ENGINES	Engine 1	Engine 2	Engine 3	Engine 4	Engine 5	Engine 6	Engine 7	Engine 8	Engine 9	Engine 10	Engine 11	Engine 12
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input fuel consumption rate (gal/hr or scf/hr)												
Input operating hours (hr)												

OTHER FUELED EQUIPMENT	Fuel 1	Fuel 2	Fuel 3	Fuel 4	Fuel 5	Fuel 6	Fuel 7	Fuel 8	Fuel 9	Fuel 10	Fuel 11	Fuel 12
Choose fuel type from drop down menu	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Input volume (scf for Natural gas, gallons for all others)												

DIESEL EQUIPMENT OPERATION (PER HOUR BASIS)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose equipment size for Dozer (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Loader (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Excavator (HP)	150	150	150	150	150	150	150	150	150	150	150	150
Choose equipment size for Scraper (HP)	330	330	330	330	330	330	330	330	330	330	330	330
Choose equipment size for Crawler Crane	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C
Choose equipment size for Tillage Tractor (HP)	16	16	16	16	16	16	16	16	16	16	16	16
Choose equipment size for Paver (HP)	25	25	25	25	25	25	25	25	25	25	25	25
Choose equipment size for Roller (HP)	6	6	6	6	6	6	6	6	6	6	6	6
Choose equipment size for Trencher (HP range)	6 to 11	7 to 11	8 to 11	9 to 11	10 to 11	11 to 11	12 to 11	13 to 11	14 to 11	15 to 11	16 to 11	17 to 11
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating hours (hr)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

OPERATOR LABOR	O&M	Occupation 2	Occupation 3	Occupation 4	Occupation 5	Occupation 6	Occupation 7	Occupation 8	Occupation 9	Occupation 10	Occupation 11	Occupation 12
Choose occupation from drop-down menu	Operating engineers	ntific and technical serv	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers
Input total time worked onsite (hours)	2112.0											

LABORATORY ANALYSIS	Analysis 1	Analysis 2	Analysis 3	Analysis 4	Analysis 5	Analysis 6	Analysis 7	Analysis 8	Analysis 9	Analysis 10	Analysis 11	Analysis 12
Input dollars spent on laboratory analysis ($)												

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO2 emission (metric ton)	
Input N2O emission (metric ton CO2 e)	
Input CH4 emission (metric ton CO2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM10 emission (metric ton)	
Input fatality risk	
Input injury risk	

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	IDW	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)												
Choose fuel used from drop down menu	Diesel	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6
Choose landfill type for waste disposal	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous
Input amount of waste disposed in landfill (tons)												
Input landfill methane emissions (metric tons CH4)												
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	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	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	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	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)

RESOURCE CONSUMPTION

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6
Input total water consumed from potable water treatment facility (gal)												
Input total water disposed to wastewater treatment facility (gal)												

ONSITE LAND AND WATER RESOURCE CONSUMPTION	Entire Site 1	Entire Site 2	Entire Site 3	Entire Site 4	Entire Site 5	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6
Input volume of topsoil brought to site (cubic yards)												
Input volume of groundwater or surface water lost (gal)												

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

BASELINE INFORMATION

COMPONENT 4 DURATION AND COST	Entire Site
Input duration of the component (unit time)	1
Input component cost per unit time ($)	760000

MATERIAL PRODUCTION

WELL MATERIALS	Well Type 1	Well Type 2	Well Type 3	Well Type 4	Well Type 5	Well Type 6	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Choose specific casing material schedule from drop down menu	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC	Sch 40 PVC
Choose well diameter (in) from drop down menu	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8	1/8
Input total quantity of Sand (kg)												
Input total quantity of Gravel (kg)												
Input total quantity of Bentonite (kg)												
Input total quantity of Typical Cement (kg)												
Input total quantity of General Concrete (kg)												
Input total quantity of Steel (kg)												

TREATMENT CHEMICALS & MATERIALS	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input number of injection points												
Choose material type from drop down menu	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	Hydrogen Peroxide	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												

TREATMENT MEDIA	Treatment 1	Treatment 2	Treatment 3	Treatment 4	Treatment 5	Treatment 6	Treatment 7	Treatment 8	Treatment 9	Treatment 10	Treatment 11	Treatment 12
Input weight of media used (lbs)												
Choose media type from drop down menu	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	Virgin GAC	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	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material type from drop down menu	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner	HDPE Liner
Input area of material (ft2)												
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	Well Type 7	Well Type 8	Well Type 9	Well Type 10	Well Type 11	Well Type 12
Input number of wells												
Input depth of wells (ft)												
Input well diameter (in)												
Choose material from drop down menu	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil

SILT CURTAIN MATERIALS	Curtain 1	Curtain 2	Curtain 3	Curtain 4	Curtain 5	Curtain 6	Curtain 7	Curtain 8	Curtain 9	Curtain 10	Curtain 11	Curtain 12
Input length or perimeter of silt curtain (ft)												
Input depth of silt curtain (ft)												

BULK MATERIAL QUANTITIES	Material 1	Material 2	Material 3	Material 4	Material 5	Material 6	Material 7	Material 8	Material 9	Material 10	Material 11	Material 12
Choose material from drop down menu	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid	Acetic Acid
Choose units of material quantity from drop down menu	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds	pounds
Input material quantity												

TRANSPORTATION

PERSONNEL TRANSPORTATION - ROAD	MNA	Post Treatment Samp.	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose vehicle type from drop down menu*	Light truck	Light truck	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars	Cars
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input distance traveled per trip (miles)	50	50										
Input number of trips taken	198	24										
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Choose vehicle type from drop down menu	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	Intercity rail	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 - DEDICATED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Account for an empty return trip?	No	No	No	No	No	No	No	No	No	No	No	No
Input one-way distance traveled (miles) with a given load. If applicable, impact for an empty return trip will be accounted for (no additional input is needed).												
Input weight of equipment transported per truck load (tons)												

EQUIPMENT TRANSPORTATION - SHARED LOAD ROAD	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
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	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (miles)												
Input weight of load (tons)												

EQUIPMENT TRANSPORTATION - WATER	Trip 1	Trip 2	Trip 3	Trip 4	Trip 5	Trip 6	Trip 7	Trip 8	Trip 9	Trip 10	Trip 11	Trip 12
Input distance traveled (mile)												
Input weight of load (tons)												

EQUIPMENT USE

EARTHWORK	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

DRILLING	Event 1	Event 2	Event 3	Event 4	Event 5	Event 6	Event 7	Event 8	Event 9	Event 10	Event 11	Event 12
Input number of drilling locations												
Choose drilling method from drop down menu	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push	Direct Push
Input time spent drilling at each location (hr)												
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel

TRENCHING	Trencher 1	Trencher 2	Trencher 3	Trencher 4	Trencher 5	Trencher 6	Trencher 7	Trencher 8	Trencher 9	Trencher 10	Trencher 11	Trencher 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input operating hours (hr)												

SEDIMENT DREDGING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose dredge equipment type from drop down menu	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical	Mechanical
Choose dredge fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be dredged (yd3)												
Choose dredge equipment size	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1	awler Crane, 25 ton, 1 C
Suggested dredge equipment size	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1	wler Crane, 25 ton, 1
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose dredge tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	2	2	2	2	2	2	2	2	2	2	2	2
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT MANAGEMENT (STAGING AND DRYING)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose earthwork equipment type from drop down menu	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane	Crawler Crane
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of material to be removed (yd3)												
Is volume input that of saturated sediment?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Will the sediment be dry when this work is performed?	No	No	No	No	No	No	No	No	No	No	No	No
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

SEDIMENT CAPPING	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose capping method from drop down menu	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release	Surface Release
Choose capping equipment fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input volume of capping material to be placed (yd3)												
Choose capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Suggested capping equipment size/type	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge	Hopper Barge
Input number of dredge tenders (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Choose tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for dredge tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of scow tenders (default already present, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose scow tender fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating time for scow tenders (hr) (default calculated value, user override possible)	0	0	0	0	0	0	0	0	0	0	0	0
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of research vessels (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Input operating time for research vessels (hr) (default calculated value, user override possible	0	0	0	0	0	0	0	0	0	0	0	0
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

WATERCRAFT OPERATION	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose size of research vessel from drop down menu	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large	Research Vessel (large)
Choose research vessel fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input number of vessels												
Input operating time (hours)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

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	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose method from drop down	Method 1	Method 1	Method 1	Method 1	Method 1	Method 1	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	0	0	0	0	0	0
Method 2 - PUMP HEAD IS KNOWN												
Input flow rate (gpm)	0	0	0	0	0	0	0	0	0	0	0	0
Input total head (ft)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Pump efficiency (default already present, user override possible)	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Input specific gravity (default already present, user override possible)	1	1	1	1	1	1	1	1	1	1	1	1
Method 3 - NAME PLATE SPECIFICATIONS ARE KNOWN												
Input pump horsepower (hp)	0	0	0	0	0	0	0	0	0	0	0	0
Input number of pumps operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each pump (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for pump motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Pump load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input pump load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Pump motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

DIESEL AND GASOLINE PUMPS	Pump 1	Pump 2	Pump 3	Pump 4	Pump 5	Pump 6	Pump 7	Pump 8	Pump 9	Pump 10	Pump 11	Pump 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose type of equipment from drop down	Blower	Blower	Blower	Blower	Blower	Blower	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	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	0	0	0	0	0	0
Input number of equipments operating	0	0	0	0	0	0	0	0	0	0	0	0
Input operating time for each equipment (hrs)	0	0	0	0	0	0	0	0	0	0	0	0
Percent of max speed for motor (Optional input for variable speed motor)	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%
Equipment load if max motor speed draws full nameplate horsepower	1	1	1	1	1	1	1	1	1	1	1	1
Input equipment load (default already present, user override possible, consider above value)	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85	0.85
Equipment motor efficiency (default already present, user override possible)	0.85	0.85	0.85	0.85	0.85	0.85	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	0	0	0	0	0	0
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

GENERATORS	Generator 1	Generator 2	Generator 3	Generator 4	Generator 5	Generator 6	Generator 7	Generator 8	Generator 9	Generator 10	Generator 11	Generator 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Choose horsepower range from drop down menu	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1	0 to 1
Input operating hours (hr)												

AGRICULTURAL EQUIPMENT	Tillage Tractor 1	Tillage Tractor 2	Tillage Tractor 3	Tillage Tractor 4	Tillage Tractor 5	Tillage Tractor 6	Tillage Tractor 7	Tillage Tractor 8	Tillage Tractor 9	Tillage Tractor 10	Tillage Tractor 11	Tillage Tractor 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
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	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	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	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose stabilization equipment type from drop down menu	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller	Roller
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline
Input area (ft2)												
Input time available (work days)												

MIXING EQUIPMENT	Mixer 1	Mixer 2	Mixer 3	Mixer 4	Mixer 5	Mixer 6	Mixer 7	Mixer 8	Mixer 9	Mixer 10	Mixer 11	Mixer 12
Choose fuel type from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3	1 to 3
Input volume (yd3)												
Input production rate (yd3/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)												

INTERNAL COMBUSTION ENGINES	Engine 1	Engine 2	Engine 3	Engine 4	Engine 5	Engine 6	Engine 7	Engine 8	Engine 9	Engine 10	Engine 11	Engine 12
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input fuel consumption rate (gal/hr or scf/hr)												
Input operating hours (hr)												

OTHER FUELED EQUIPMENT	Fuel 1	Fuel 2	Fuel 3	Fuel 4	Fuel 5	Fuel 6	Fuel 7	Fuel 8	Fuel 9	Fuel 10	Fuel 11	Fuel 12
Choose fuel type from drop down menu	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas
Input volume (scf for Natural gas, gallons for all others)												

DIESEL EQUIPMENT OPERATION (PER HOUR BASIS)	Equipment 1	Equipment 2	Equipment 3	Equipment 4	Equipment 5	Equipment 6	Equipment 7	Equipment 8	Equipment 9	Equipment 10	Equipment 11	Equipment 12
Choose equipment type from drop down menu	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer	Dozer
Choose equipment size for Dozer (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Loader (HP)	65	65	65	65	65	65	65	65	65	65	65	65
Choose equipment size for Excavator (HP)	150	150	150	150	150	150	150	150	150	150	150	150
Choose equipment size for Scraper (HP)	330	330	330	330	330	330	330	330	330	330	330	330
Choose equipment size for Crawler Crane	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C	awler Crane, 25 ton, 1 C
Choose equipment size for Tillage Tractor (HP)	16	16	16	16	16	16	16	16	16	16	16	16
Choose equipment size for Paver (HP)	25	25	25	25	25	25	25	25	25	25	25	25
Choose equipment size for Roller (HP)	6	6	6	6	6	6	6	6	6	6	6	6
Choose equipment size for Trencher (HP range)	6 to 11	7 to 11	8 to 11	9 to 11	10 to 11	11 to 11	12 to 11	13 to 11	14 to 11	15 to 11	16 to 11	17 to 11
Choose fuel type from drop down menu	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel	Diesel
Input operating hours (hr)												
Will DIESEL-run equipment be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No

OPERATOR LABOR	Sampler	Occupation 2	Occupation 3	Occupation 4	Occupation 5	Occupation 6	Occupation 7	Occupation 8	Occupation 9	Occupation 10	Occupation 11	Occupation 12
Choose occupation from drop-down menu	ntific and technical serv	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers	Construction laborers
Input total time worked onsite (hours)	1776.0											

LABORATORY ANALYSIS	MNA	Post Treatment	Analysis 3	Analysis 4	Analysis 5	Analysis 6	Analysis 7	Analysis 8	Analysis 9	Analysis 10	Analysis 11	Analysis 12
Input dollars spent on laboratory analysis ($)	57,420.00	6,960.00										

OTHER KNOWN ONSITE ACTIVITIES	Entire Site
Input energy usage (MMBTU)	
Water consumption (gallon)	
Input CO2 emission (metric ton)	
Input N2O emission (metric ton CO2 e)	
Input CH4 emission (metric ton CO2 e)	
Input NOx emission (metric ton)	
Input SOx emission (metric ton)	
Input PM10 emission (metric ton)	
Input fatality risk	
Input injury risk	

RESIDUAL HANDLING

RESIDUE DISPOSAL/RECYCLING	Soil Residue	Residual Water	Material Residue	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals	Other Residuals
Will DIESEL-run vehicles be retrofitted with a particulate reduction technology?	No	No	No	No	No	No	No	No	No	No	No	No
Input weight of the waste transported to landfill or recycling per trip (tons)												
Choose fuel used from drop down menu	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	Gasoline	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	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6	Operation 6
Choose landfill type for waste disposal	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous	Non-Hazardous
Input amount of waste disposed in landfill (tons)												
Input landfill methane emissions (metric tons CH4)												
Region												
Electricity Region	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD	MD

THERMAL/CATALYTIC OXIDIZERS*	Oxidizer 1	Oxidizer 2	Oxidizer 3	Oxidizer 4	Oxidizer 5	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	Oxidizer 6	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	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	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	Natural gas	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)

RESOURCE CONSUMPTION

WATER CONSUMPTION	Treatment System 1	Treatment System 2	Treatment System 3	Treatment System 4	Treatment System 5	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6	Treatment System 6
Input total water consumed from potable water treatment facility (gal)												
Input total water disposed to wastewater treatment facility (gal)												

ONSITE LAND AND WATER RESOURCE CONSUMPTION	Entire Site 1	Entire Site 2	Entire Site 3	Entire Site 4	Entire Site 5	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6	Entire Site 6
Input volume of topsoil brought to site (cubic yards)												
Input volume of groundwater or surface water lost (gal)												

Sustainable Remediation Summary - Feasibility Study

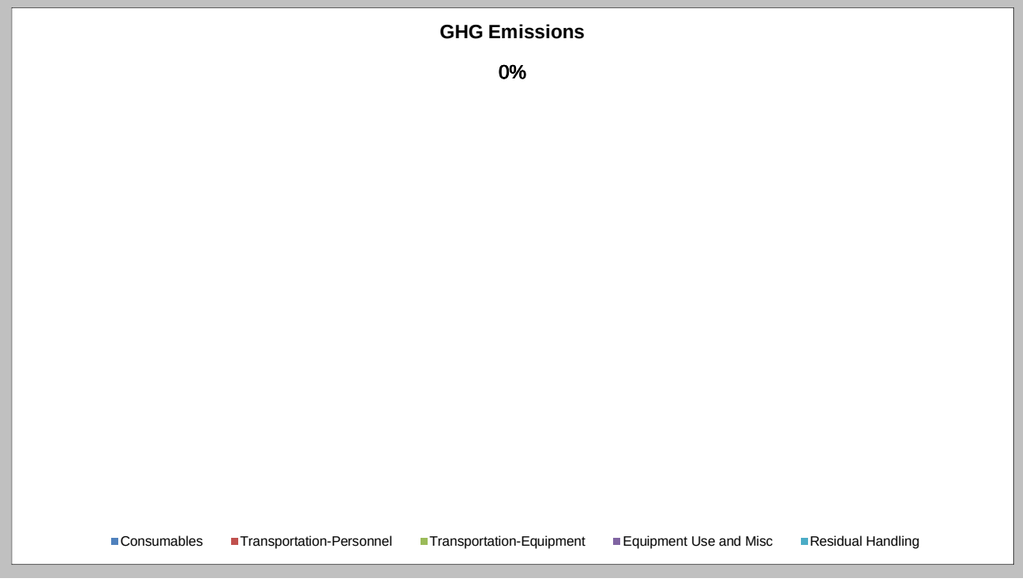
Activities	GHG Emissions	Percent Total	Total Energy Used	Percent Total	Water Consumption	Percent Total	Electricity Usage	Percent Total	Onsite NOx Emissions	Percent Total	Onsite SOx Emissions	Percent Total	Onsite PM10 Emissions	Percent Total	Total NOx Emissions	Percent Total	Total SOx Emissions	Percent Total	Total PM10 Emissions	Percent Total	Accident Risk Fatality	Percent Total	Accident Risk Injury	Percent Total
	metric ton	%	MMBTU	%	gallons	%	MWH	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%		%		%
Consumables	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	NA	NA	NA	NA
Transportation-Personnel	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Transportation-Equipment	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	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	0.0	0.0E+00	0.0	0.0E+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	NA	NA	NA	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Total	0.00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0

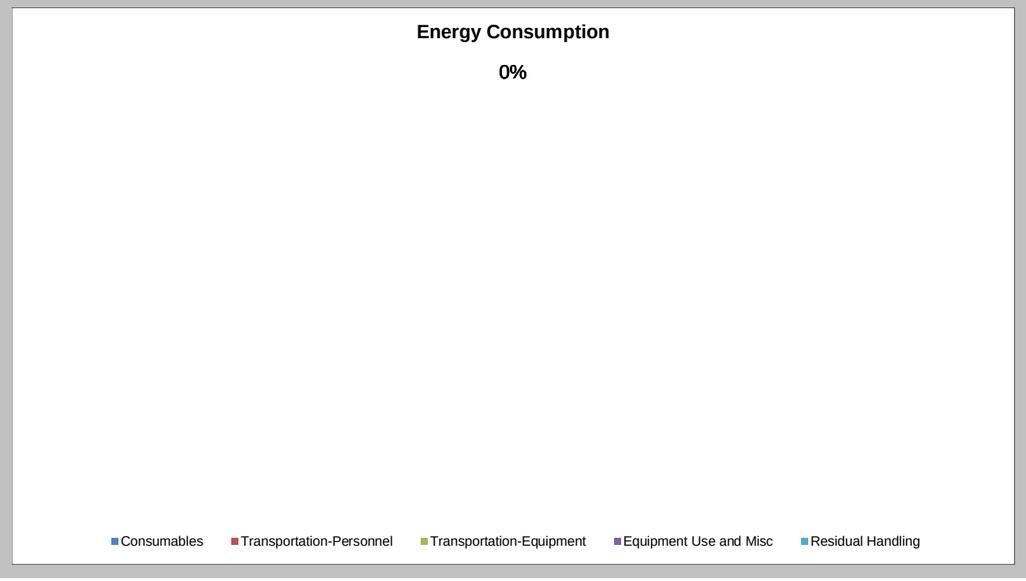
Additional Sustainability Metrics

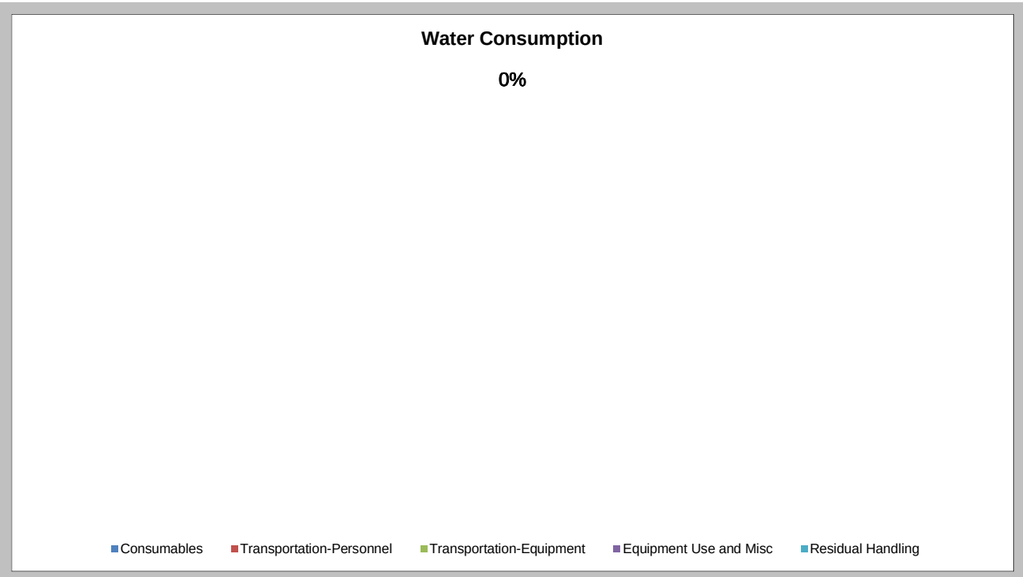
Non-Hazardous Waste Landfill Space (tons)	0.0
Hazardous Waste Landfill Space (tons)	0.0
Topsoil Consumption (yd^3)	0.0
Cost of Phase ($)	0.0
Lost Hours - Injury	0.0

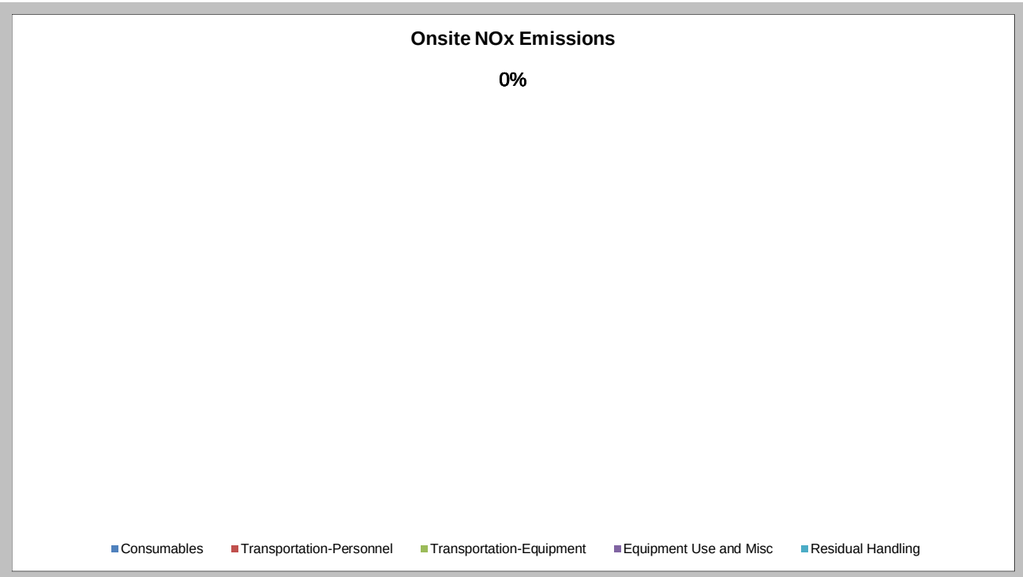
Footprint Reduction

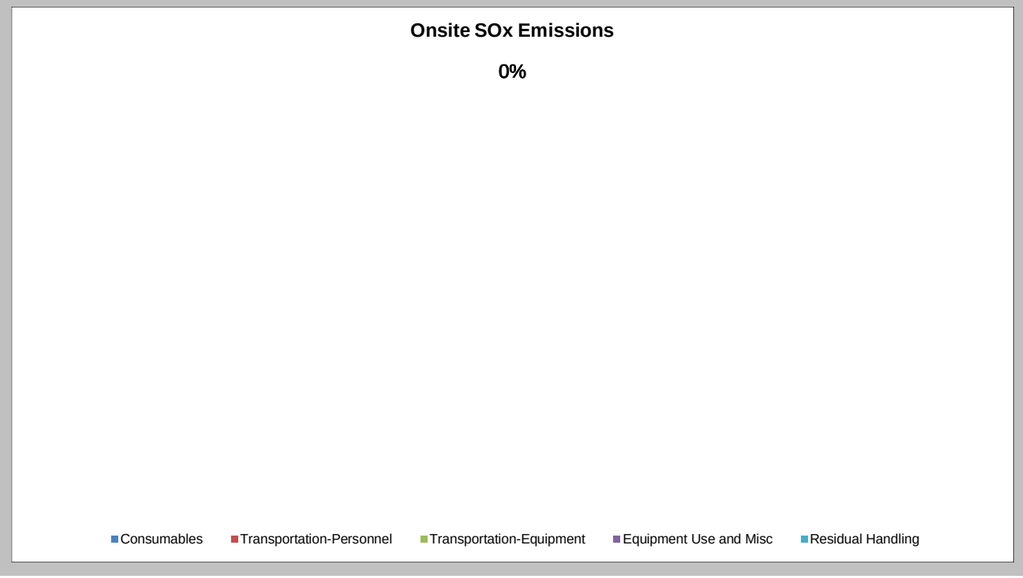
Total electricity replacement (MWh)	0.00E+00
Total electricity replacement (mmBtu)	0.00E+00
Percent electricity from renewable sources (%)	0.0%
Landfill gas reduction (metric ton CO_2 e)	0.00E+00
GHG emissions (metric ton CO2 e)	0.00E+00
NOx emissions (metric ton)	0.00E+00
SOx emissions (metric ton)	0.00E+00
PM10 emissions (metric ton)	0.00E+00

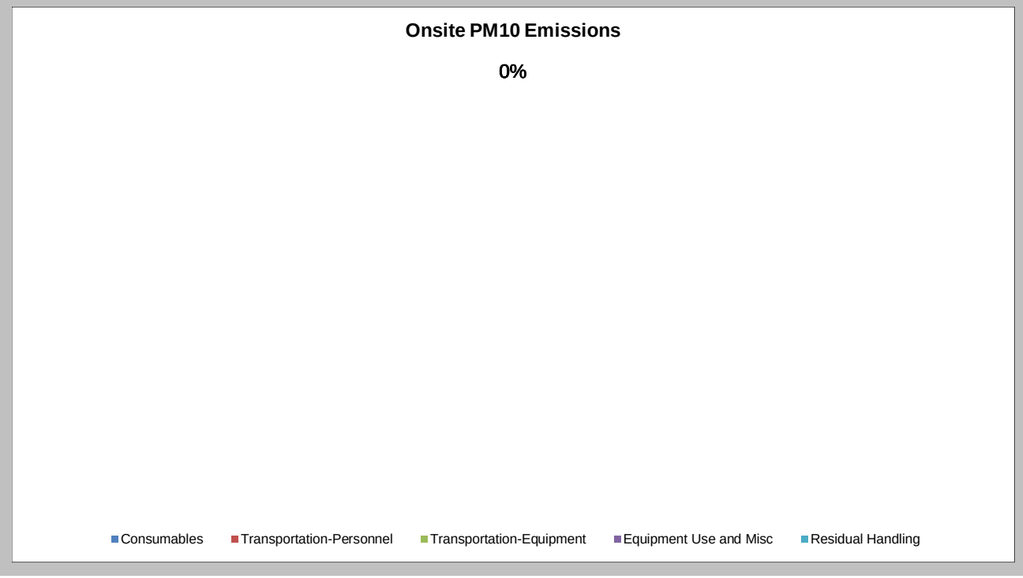


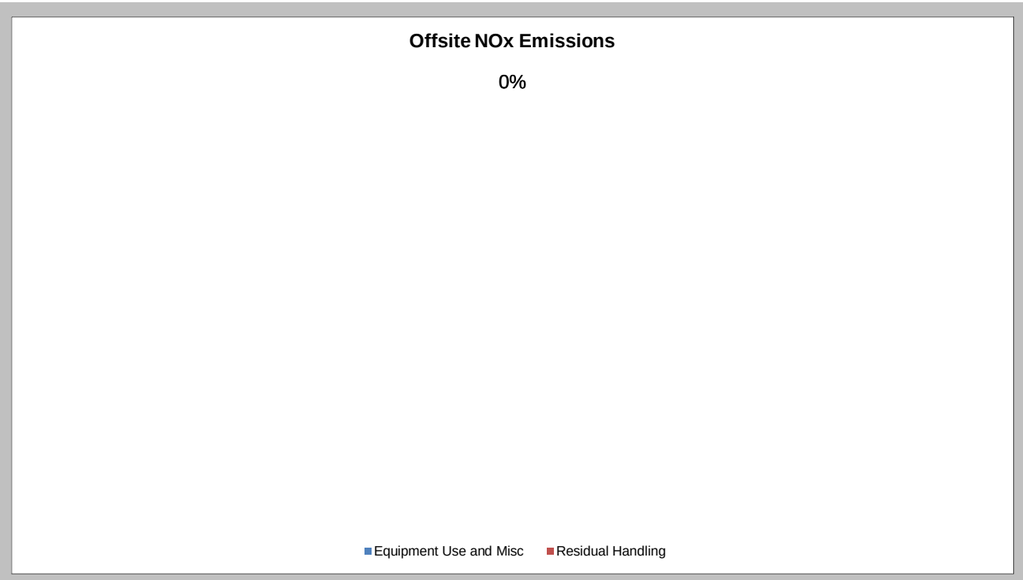


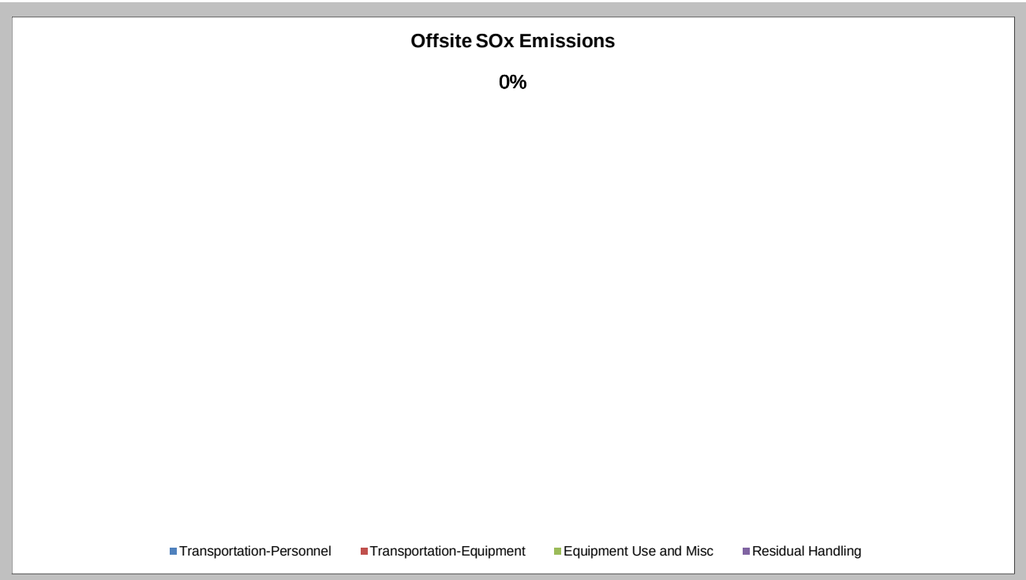

Water Consumption
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

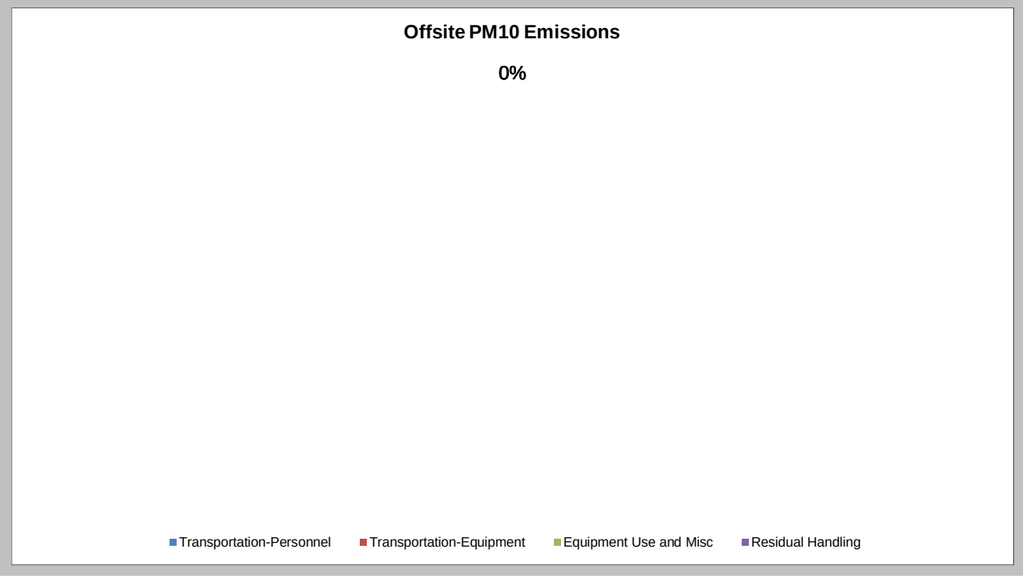

Onsite NOx Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Onsite SOx Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

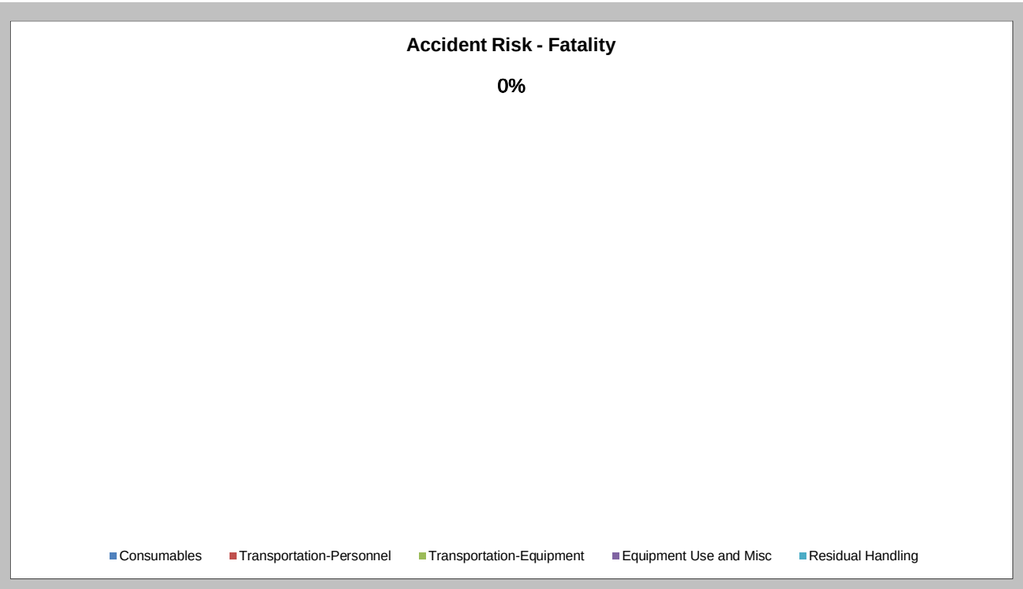

Onsite PM10 Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite NOx Emissions
0%
Equipment Use and Misc
Residual Handling


Offsite SOx Emissions
0%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite PM10 Emissions
0%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Injury
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

Sustainable Remediation Summary - Remedial Action Construction

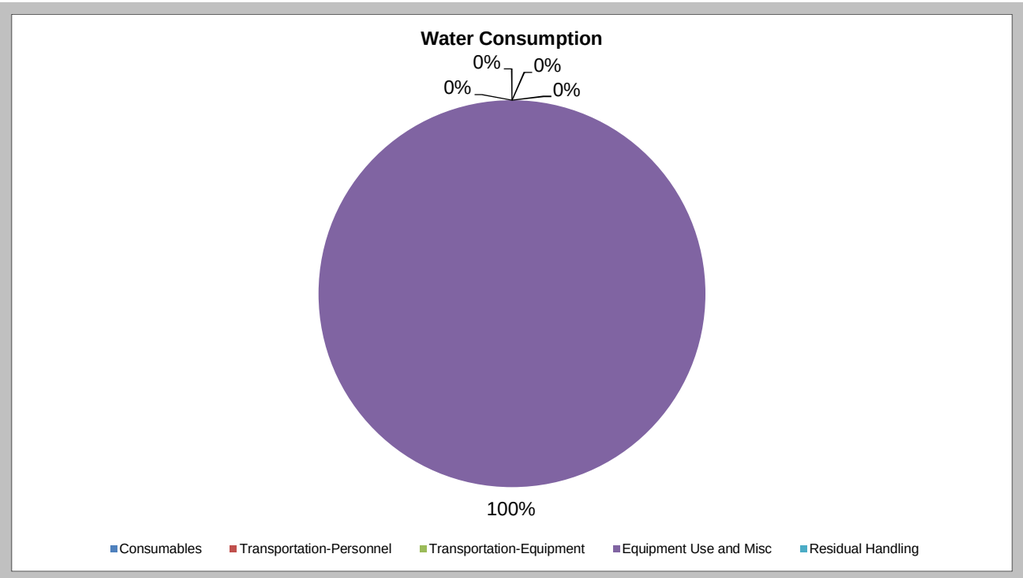
Activities	GHG Emissions	Percent Total	Total Energy Used	Percent Total	Water Consumption	Percent Total	Electricity Usage	Percent Total	Onsite NOx Emissions	Percent Total	Onsite SOx Emissions	Percent Total	Onsite PM10 Emissions	Percent Total	Total NOx Emissions	Percent Total	Total SOx Emissions	Percent Total	Total PM10 Emissions	Percent Total	Accident Risk Fatality	Percent Total	Accident Risk Injury	Percent Total
	metric ton	%	MMBTU	%	gallons	%	MWH	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%		%		%
Consumables	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	NA	NA	NA	NA
Transportation-Personnel	3.30	19.6	4.2E+01	10.7	NA	NA	NA	NA	NA	-	NA	-	NA	-	1.4E-03	2.8	4.3E-05	0.3	2.0E-04	2.1	4.7E-05	39.0	3.8E-03	16.9
Transportation-Equipment	2.87	17.0	3.7E+01	9.6	NA	NA	NA	NA	NA	-	NA	-	NA	-	9.0E-04	1.9	1.6E-05	0.1	8.0E-05	0.9	8.6E-06	7.1	6.9E-04	3.1
Equipment Use and Misc	10.34	61.2	3.0E+02	78.2	1.8E+04	100.0	0.0E+00	0.0	4.2E-02	100.0	1.0E-02	100.0	7.3E-03	100.0	4.6E-02	94.1	1.3E-02	97.6	7.7E-03	82.1	6.3E-05	52.6	1.8E-02	79.4
Residual Handling	0.39	2.3	5.6E+00	1.4	NA	NA	NA	NA	0.0E+00	-	0.0E+00	-	0.0E+00	-	5.8E-04	1.2	2.6E-04	1.9	1.4E-03	15.0	1.6E-06	1.3	1.3E-04	0.6
Total	16.90	100.0	3.89E+02	100.0	1.76E+04	100.0	0.00E+00	0.0	4.16E-02	100.0	1.02E-02	100.0	7.25E-03	100.0	4.84E-02	100.0	1.35E-02	100.0	9.38E-03	100.0	1.20E-04	100.0	2.22E-02	100.0

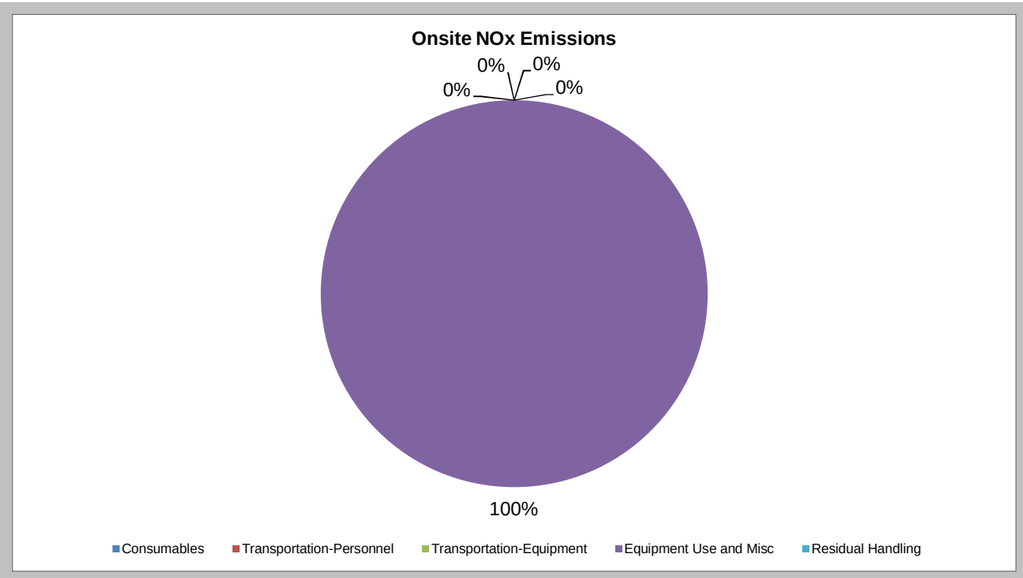
Additional Sustainability Metrics

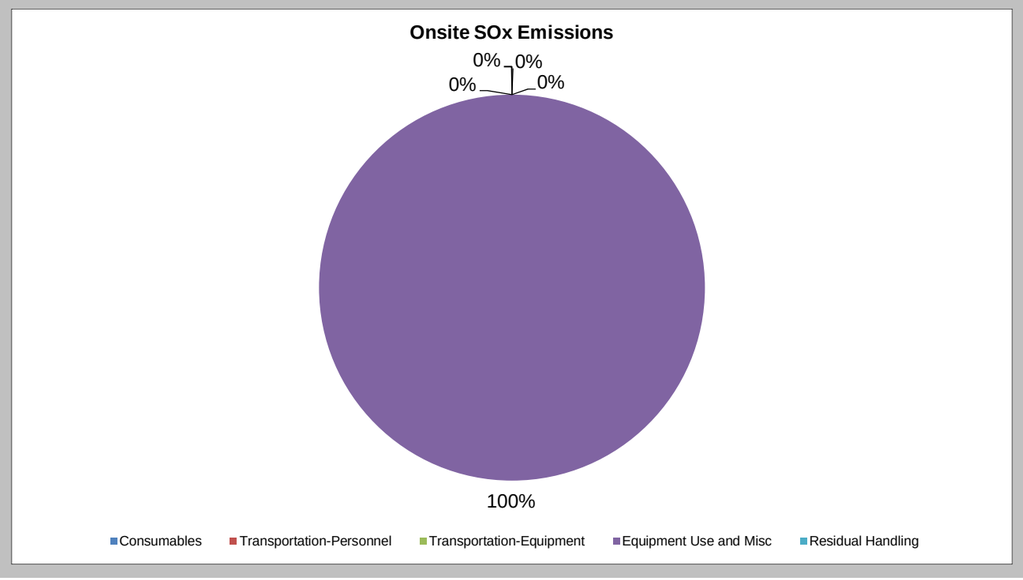
Non-Hazardous Waste Landfill Space (tons)	7.7
Hazardous Waste Landfill Space (tons)	0.0
Topsoil Consumption (yd^3)	0.0
Cost of Phase ($)	327000.0
Lost Hours - Injury	0.2

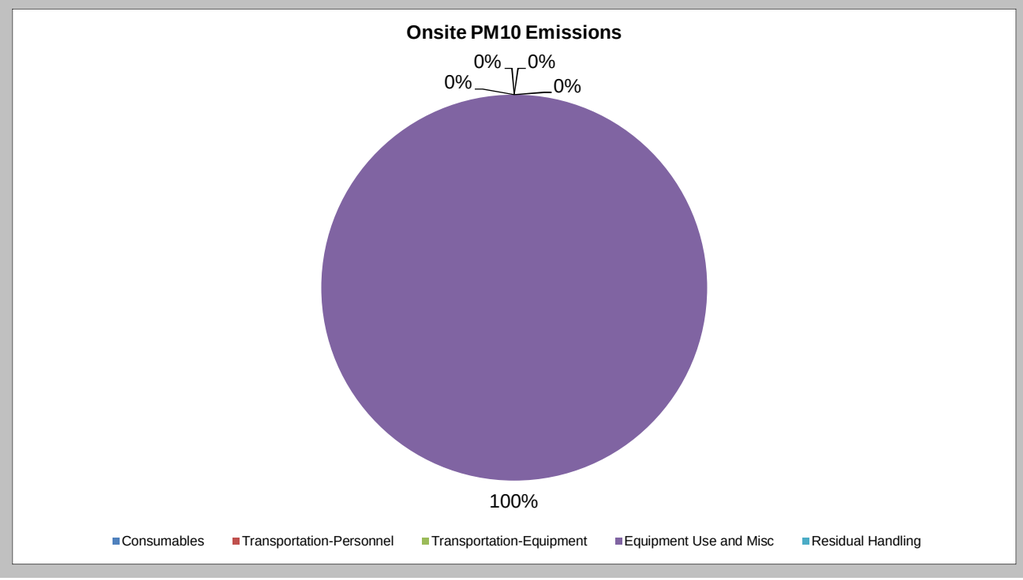
Footprint Reduction

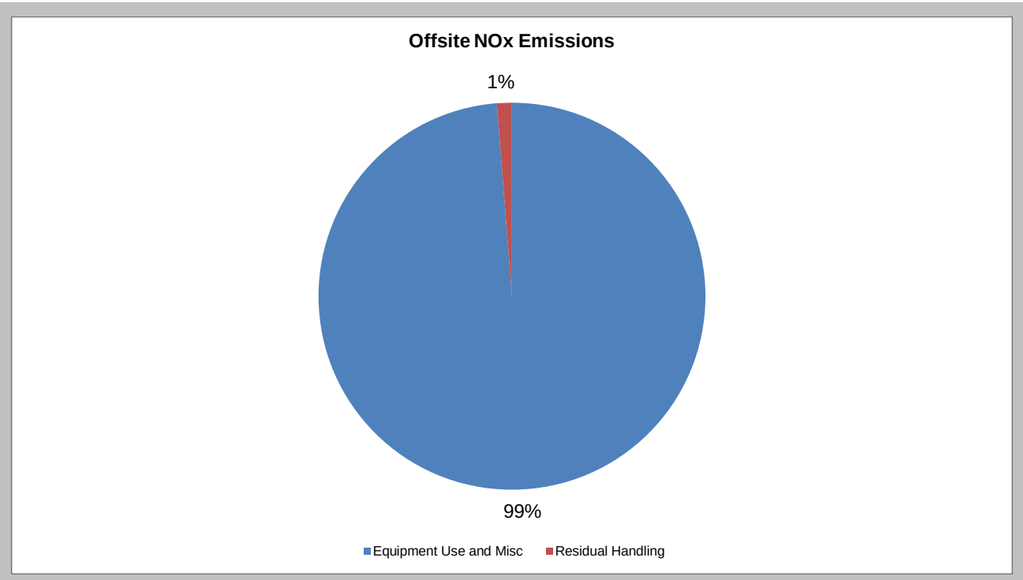
Total electricity replacement (MWh)	0.00E+00
Total electricity replacement (mmBtu)	0.00E+00
Percent electricity from renewable sources (%)	0.0%
Landfill gas reduction (metric ton CO_2 e)	0.00E+00
GHG emissions (metric ton CO2 e)	0.00E+00
NOx emissions (metric ton)	0.00E+00
SOx emissions (metric ton)	0.00E+00
PM10 emissions (metric ton)	0.00E+00

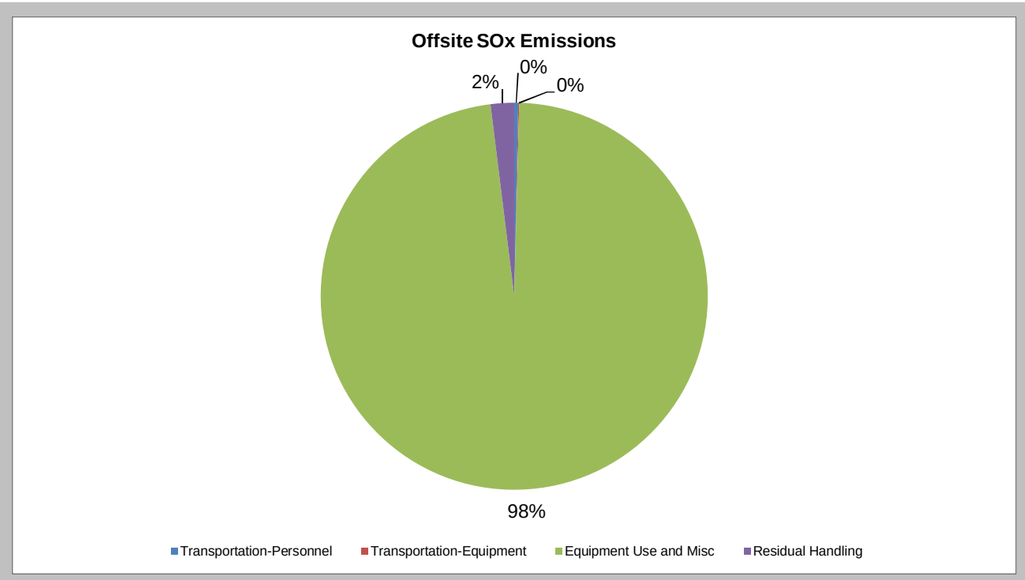

Water Consumption
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

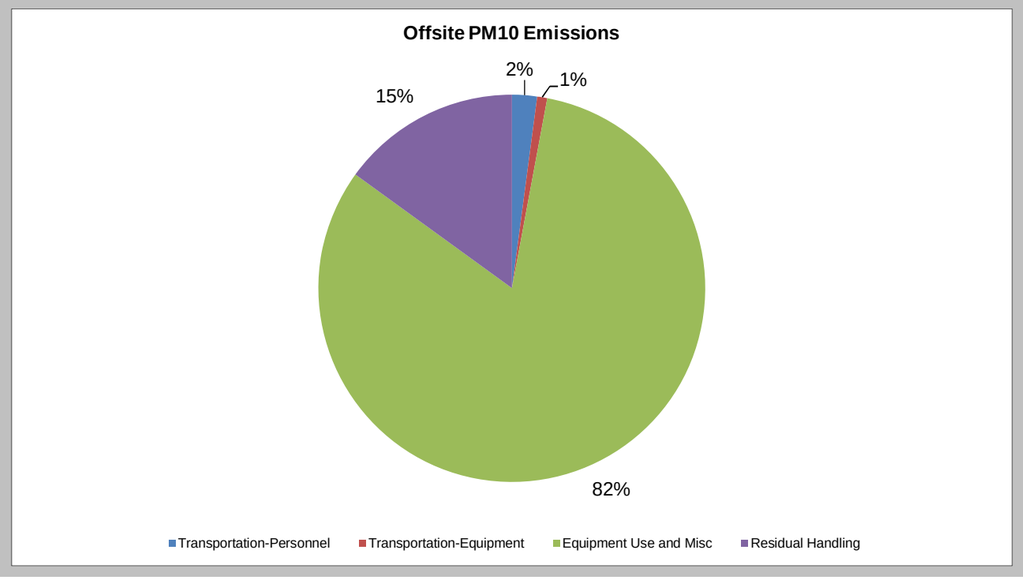

Onsite NOx Emissions
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

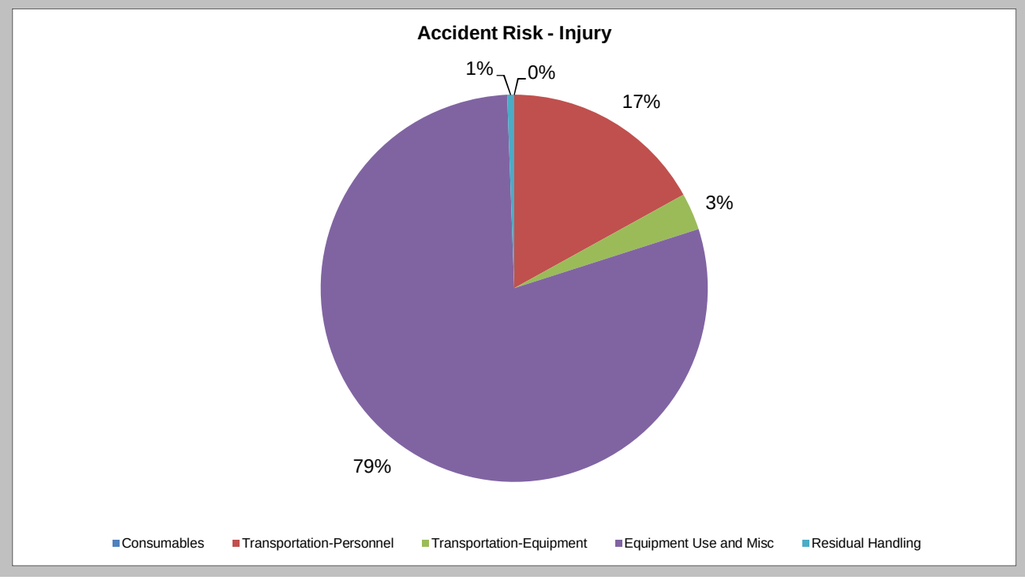

Onsite SOx Emissions
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

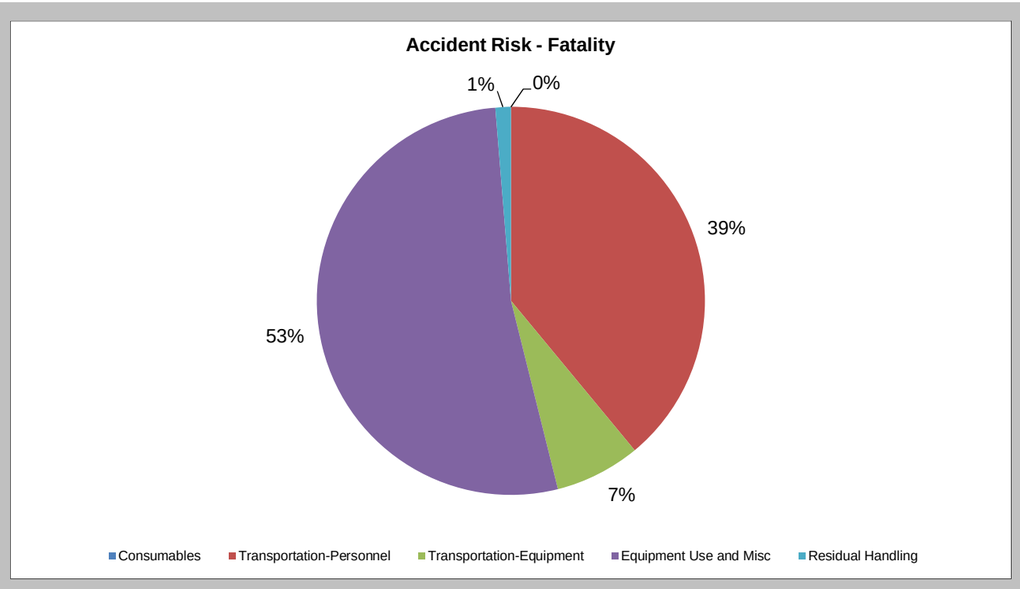

Onsite PM10 Emissions
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite NOx Emissions
1%
99%
Equipment Use and Misc
Residual Handling


Offsite SOx Emissions
2%
0%
0%
98%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite PM10 Emissions
2%
1%
15%
82%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Injury
1%
0%
17%
3%
79%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
1%
0%
39%
53%
7%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

Sustainable Remediation Summary - Remedial Action Operations

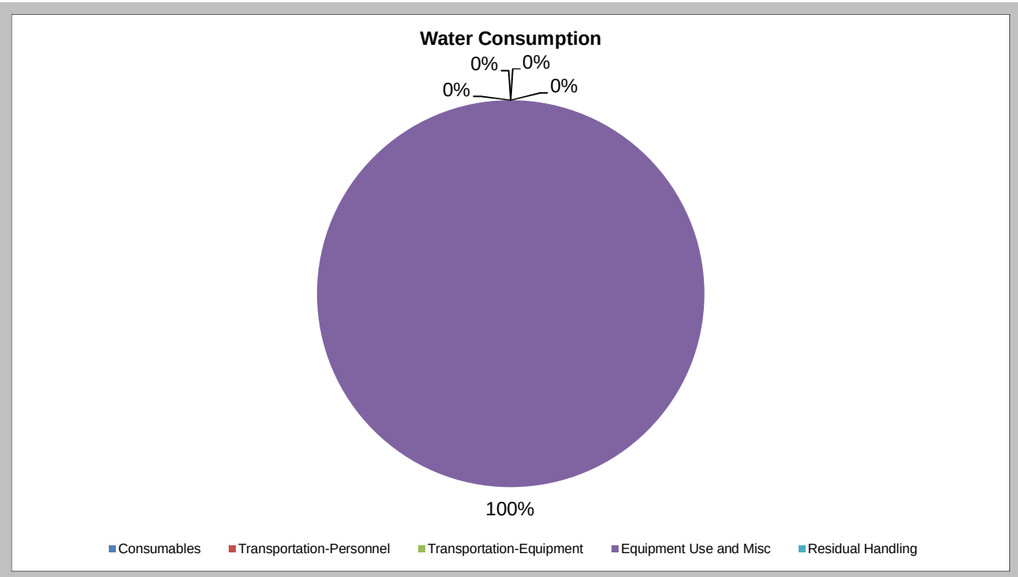
Activities	GHG Emissions	Percent Total	Total Energy Used	Percent Total	Water Consumption	Percent Total	Electricity Usage	Percent Total	Onsite NOx Emissions	Percent Total	Onsite SOx Emissions	Percent Total	Onsite PM10 Emissions	Percent Total	Total NOx Emissions	Percent Total	Total SOx Emissions	Percent Total	Total PM10 Emissions	Percent Total	Accident Risk Fatality	Percent Total	Accident Risk Injury	Percent Total
	metric ton	%	MMBTU	%	gallons	%	MWH	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%		%		%
Consumables	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	NA	NA	NA	NA
Transportation-Personnel	7.27	1.2	9.2E+01	1.1	NA	NA	NA	NA	NA	-	NA	-	NA	-	3.0E-03	0.6	9.5E-05	0.0	4.3E-04	0.0	1.0E-04	47.7	8.3E-03	14.6
Transportation-Equipment	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Equipment Use and Misc	588.49	98.8	8.2E+03	98.9	4.8E+05	100.0	9.3E+02	100.0	0.0E+00	-	0.0E+00	-	0.0E+00	-	5.0E-01	99.4	4.2E+00	100.0	1.2E+00	100.0	1.1E-04	52.3	4.9E-02	85.4
Residual Handling	0.00	-	0.0E+00	-	NA	NA	NA	NA	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Total	595.76	100.0	8.29E+03	100.0	4.75E+05	100.0	9.32E+02	100.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	5.05E-01	100.0	4.23E+00	100.0	1.17E+00	100.0	2.16E-04	100.0	5.69E-02	100.0

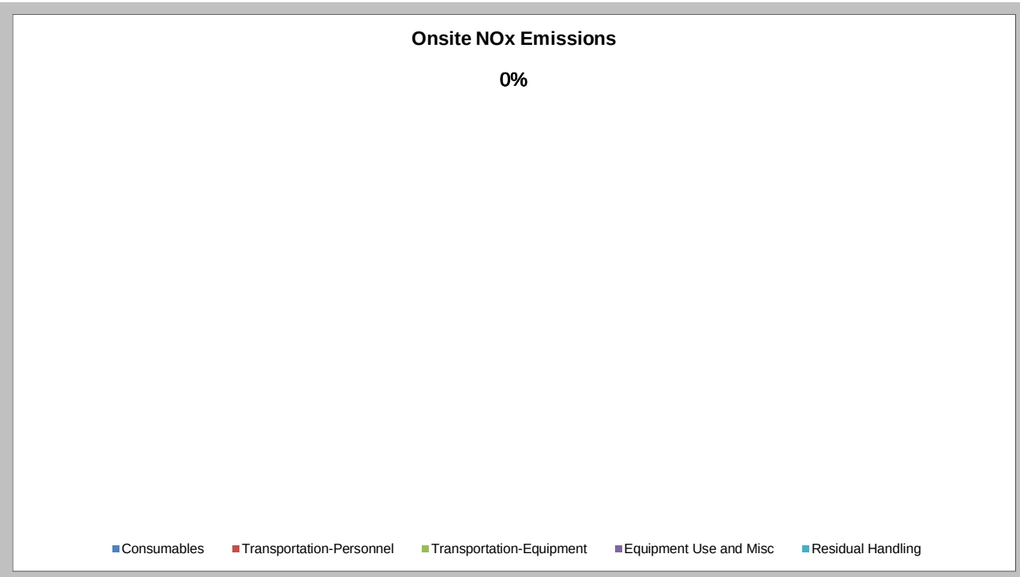
Additional Sustainability Metrics

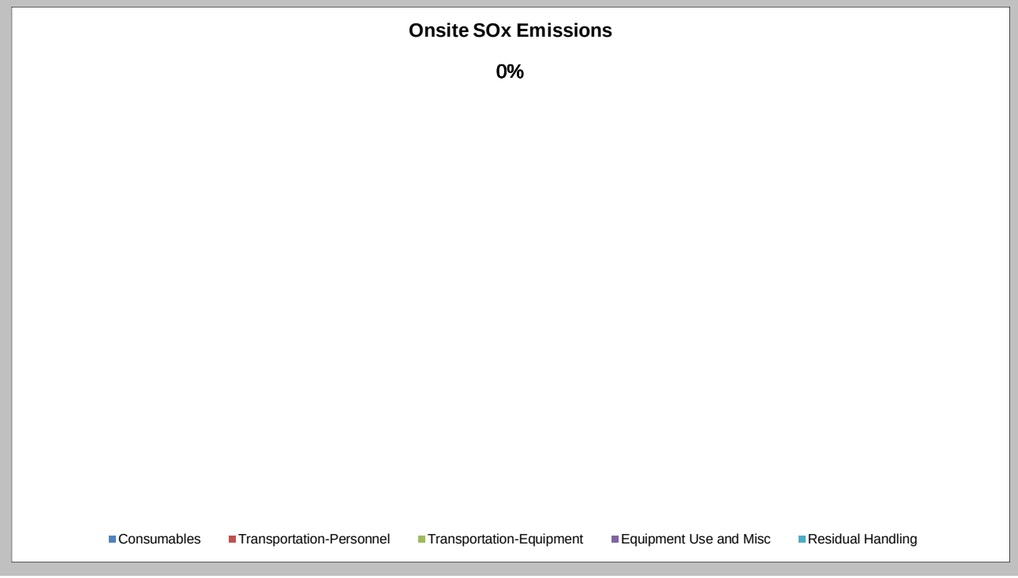
Non-Hazardous Waste Landfill Space (tons)	0.0
Hazardous Waste Landfill Space (tons)	0.0
Topsoil Consumption (yd^3)	0.0
Cost of Phase ($)	861000.0
Lost Hours - Injury	0.5

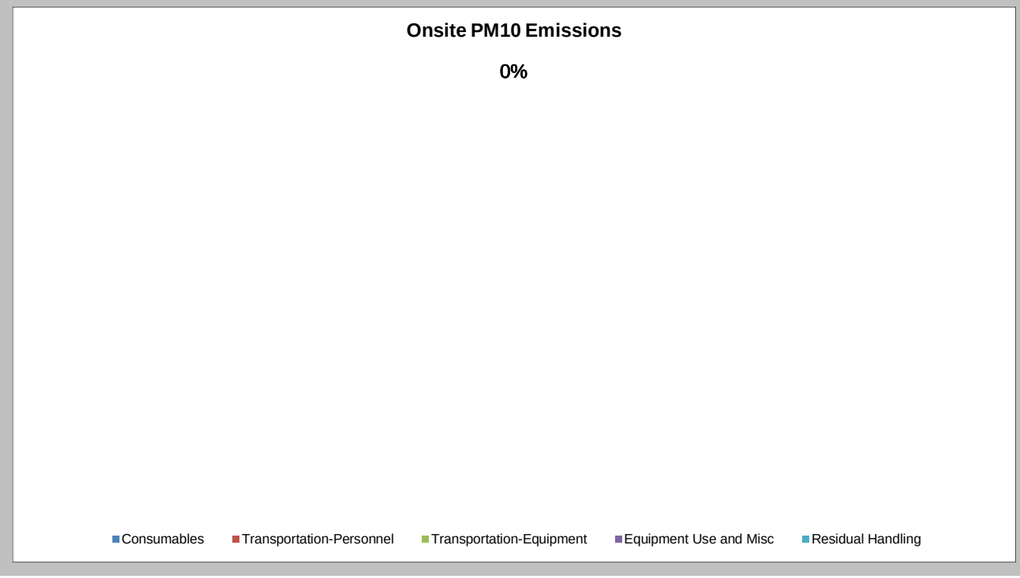
Footprint Reduction

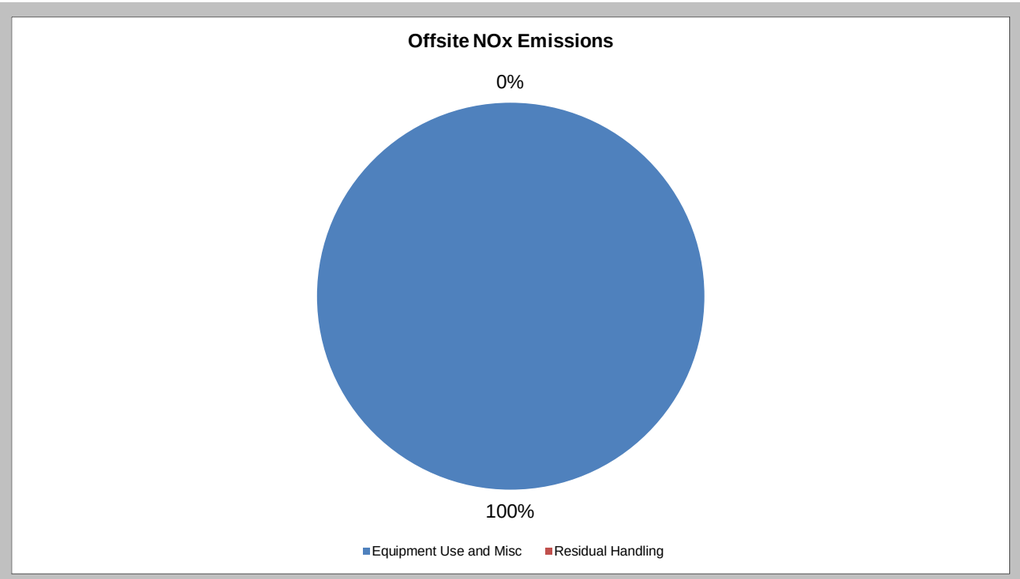
Total electricity replacement (MWh)	0.00E+00
Total electricity replacement (mmBtu)	0.00E+00
Percent electricity from renewable sources (%)	5.3%
Landfill gas reduction (metric ton CO_2 e)	0.00E+00
GHG emissions (metric ton CO2 e)	0.00E+00
NOx emissions (metric ton)	0.00E+00
SOx emissions (metric ton)	0.00E+00
PM10 emissions (metric ton)	0.00E+00

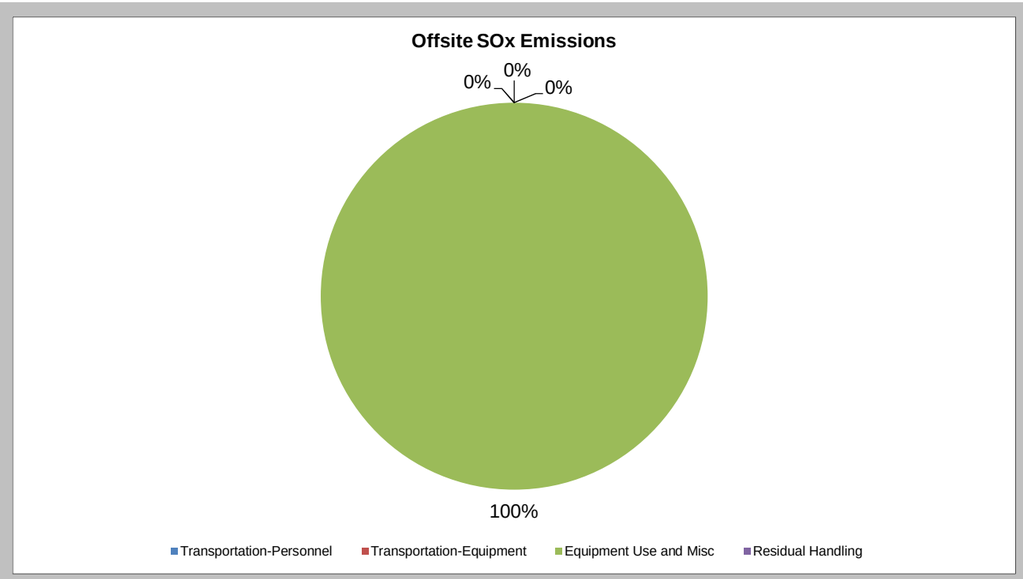

Water Consumption
0%
0%
0%
0%
100%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

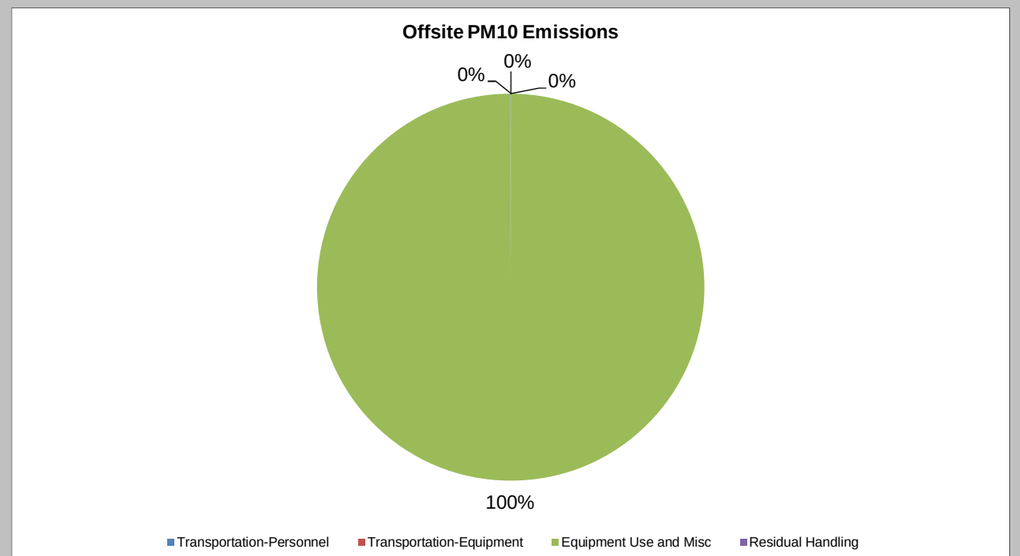

Onsite NOx Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

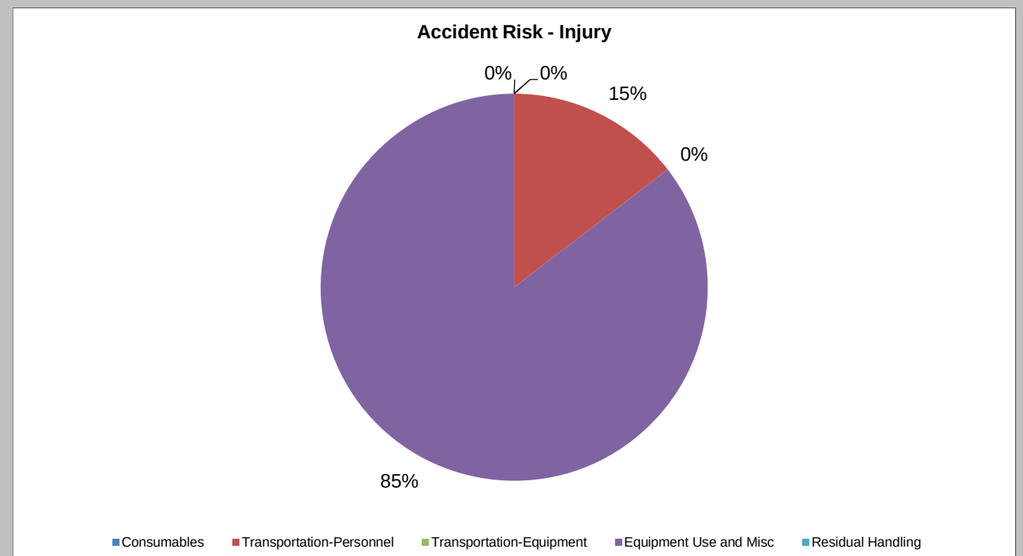

Onsite SOx Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

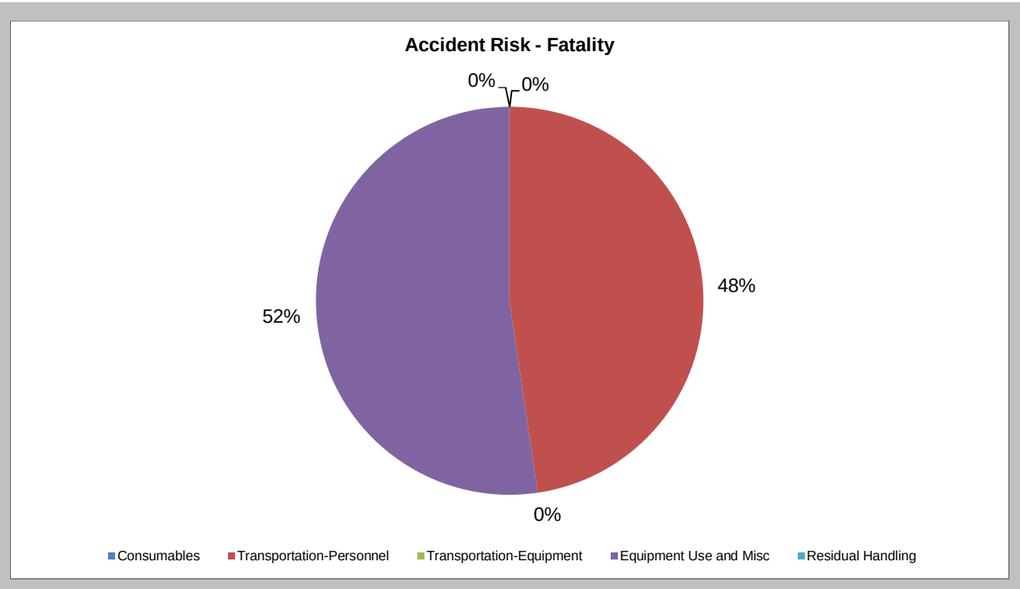

Onsite PM10 Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite NOx Emissions
0%
100%
Equipment Use and Misc
Residual Handling


Offsite SOx Emissions
0%
0%
0%
100%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite PM10 Emissions
0%
0%
0%
100%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Injury
0%
0%
15%
0%
85%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Accident Risk - Fatality
0%
0%
48%
52%
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

Sustainable Remediation Summary - Long-term Monitoring

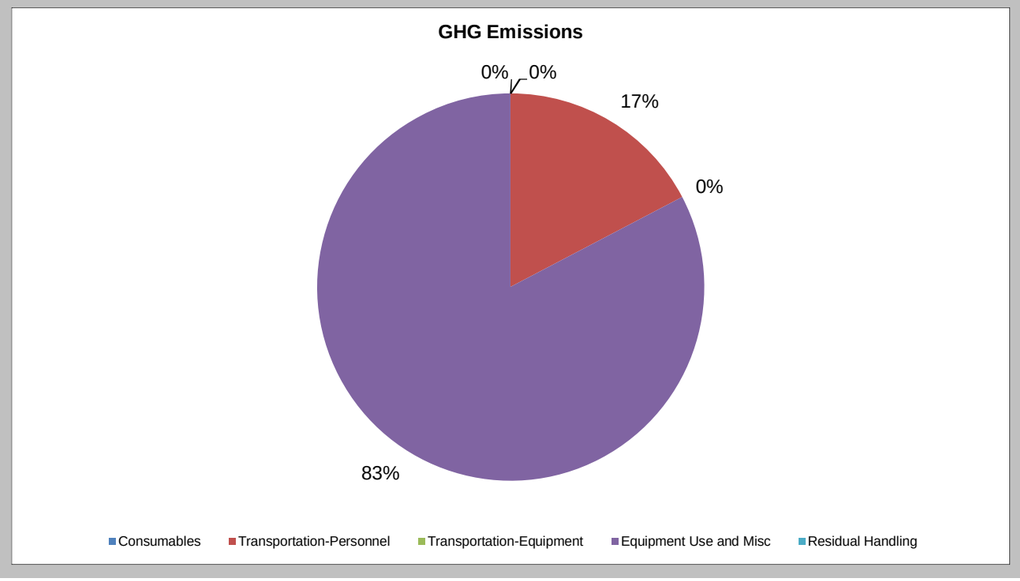
Activities	GHG Emissions	Percent Total	Total Energy Used	Percent Total	Water Consumption	Percent Total	Electricity Usage	Percent Total	Onsite NOx Emissions	Percent Total	Onsite SOx Emissions	Percent Total	Onsite PM10 Emissions	Percent Total	Total NOx Emissions	Percent Total	Total SOx Emissions	Percent Total	Total PM10 Emissions	Percent Total	Accident Risk Fatality	Percent Total	Accident Risk Injury	Percent Total
	metric ton	%	MMBTU	%	gallons	%	MWH	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%	metric ton	%		%		%
Consumables	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	NA	NA	NA	NA
Transportation-Personnel	6.11	17.3	7.7E+01	15.6	NA	NA	NA	NA	NA	-	NA	-	NA	-	2.5E-03	1.8	8.0E-05	0.1	3.6E-04	3.0	8.7E-05	91.5	7.0E-03	41.6
Transportation-Equipment	0.00	-	0.0E+00	-	NA	NA	NA	NA	NA	-	NA	-	NA	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Equipment Use and Misc	29.20	82.7	4.2E+02	84.4	0.0E+00	0.0	0.0E+00	0.0	0.0E+00	-	0.0E+00	-	0.0E+00	-	1.4E-01	98.2	1.1E-01	99.9	1.2E-02	97.0	8.0E-06	8.5	9.8E-03	58.4
Residual Handling	0.00	-	0.0E+00	-	NA	NA	NA	NA	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-	0.0E+00	-
Total	35.32	100.0	4.95E+02	100.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	0.00E+00	0.0	1.43E-01	100.0	1.05E-01	100.0	1.20E-02	100.0	9.46E-05	100.0	1.67E-02	100.0

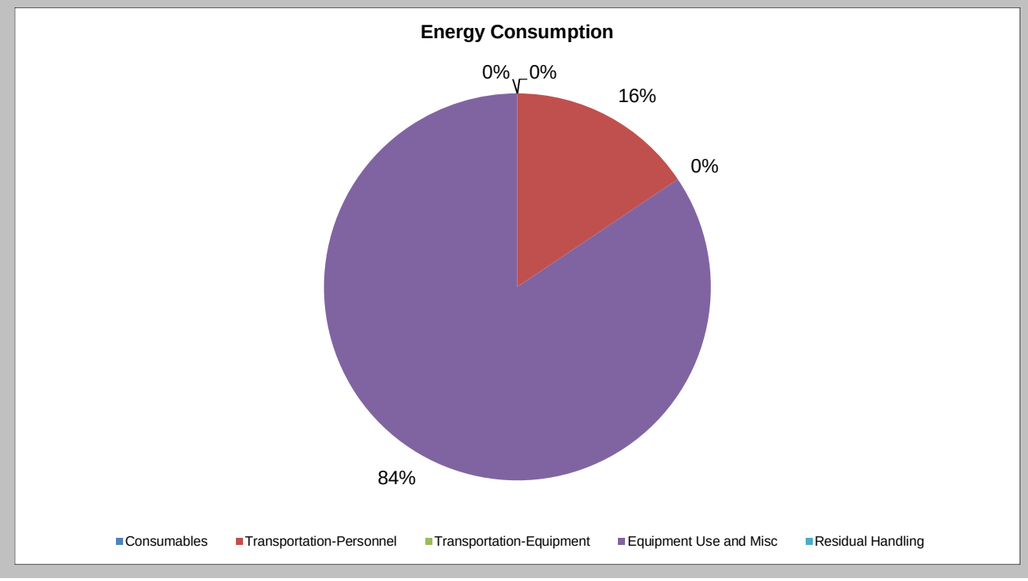
Additional Sustainability Metrics

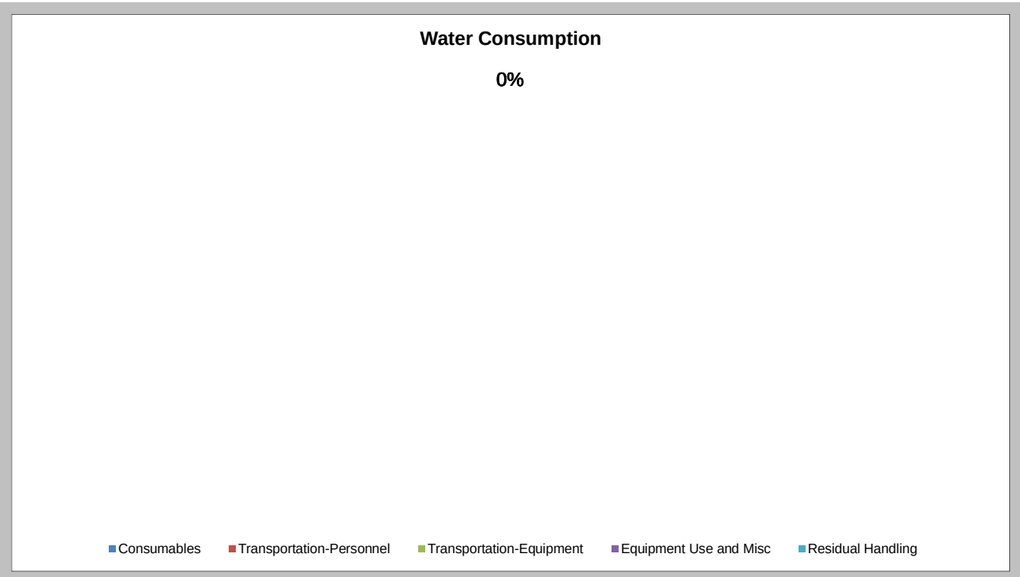
Non-Hazardous Waste Landfill Space (tons)	0.0
Hazardous Waste Landfill Space (tons)	0.0
Topsoil Consumption (yd^3)	0.0
Cost of Phase ($)	760000.0
Lost Hours - Injury	0.1

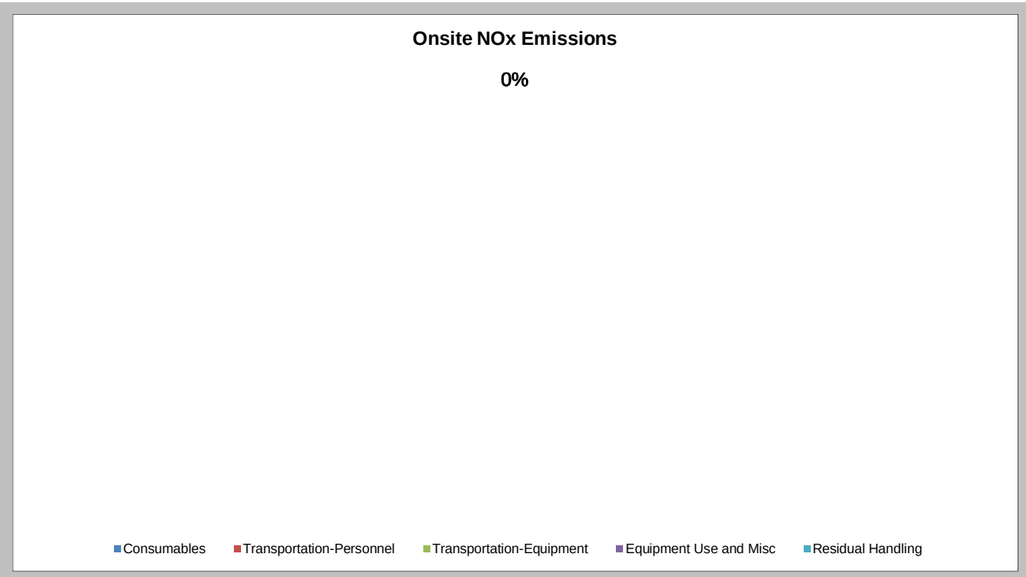
Footprint Reduction

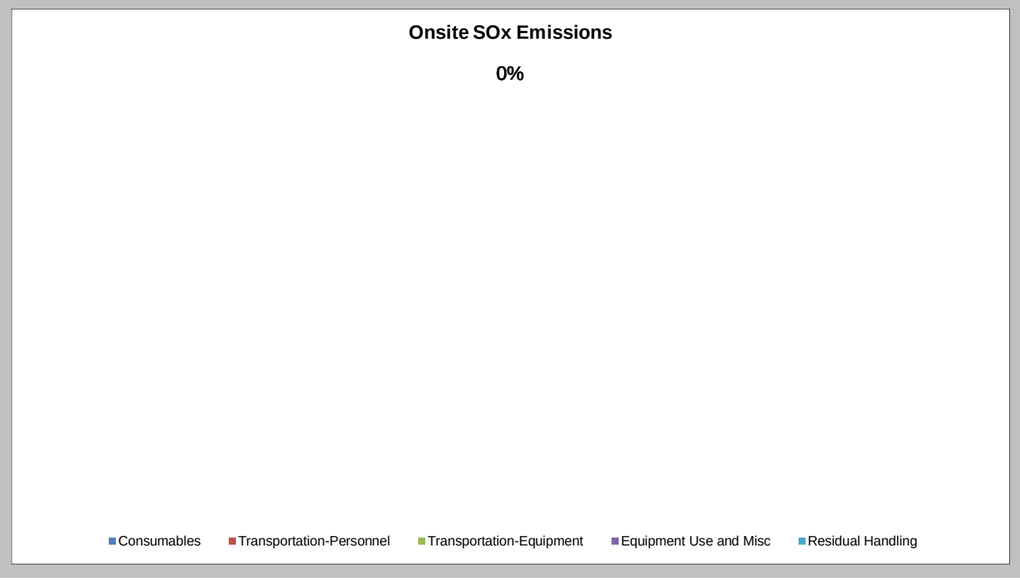
Total electricity replacement (MWh)	0.00E+00
Total electricity replacement (mmBtu)	0.00E+00
Percent electricity from renewable sources (%)	0.0%
Landfill gas reduction (metric ton CO_2 e)	0.00E+00
GHG emissions (metric ton CO2 e)	0.00E+00
NOx emissions (metric ton)	0.00E+00
SOx emissions (metric ton)	0.00E+00
PM10 emissions (metric ton)	0.00E+00

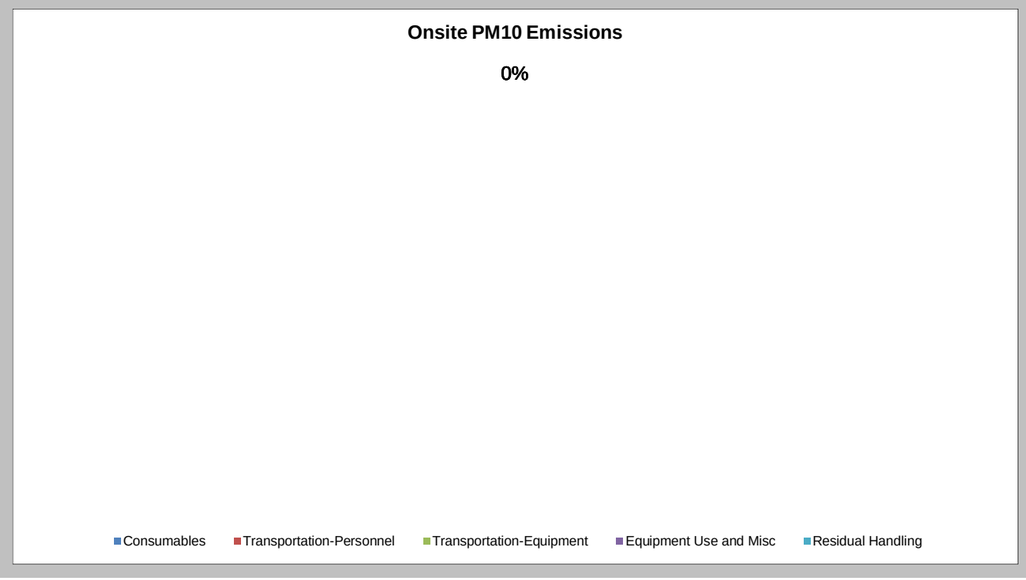


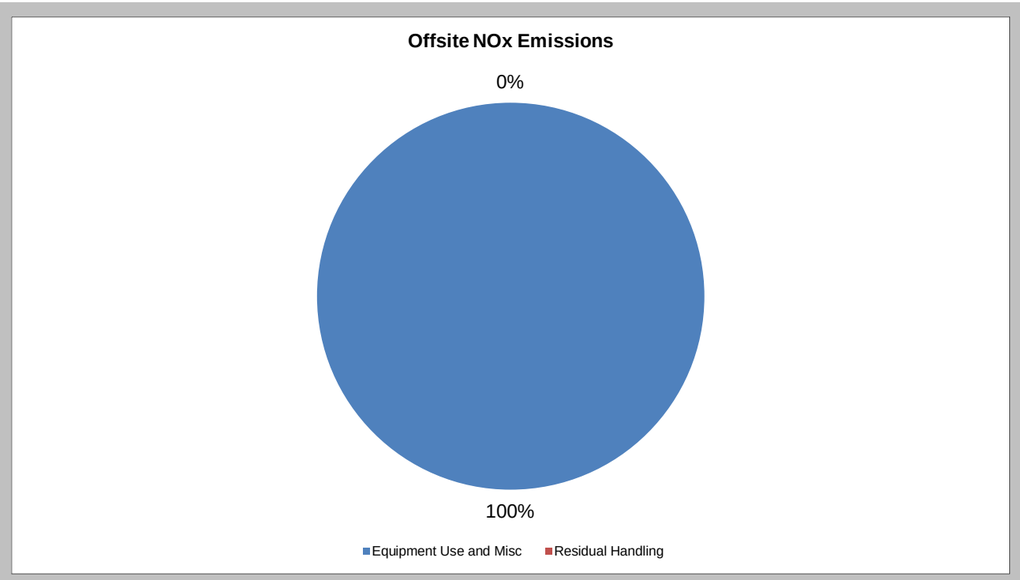


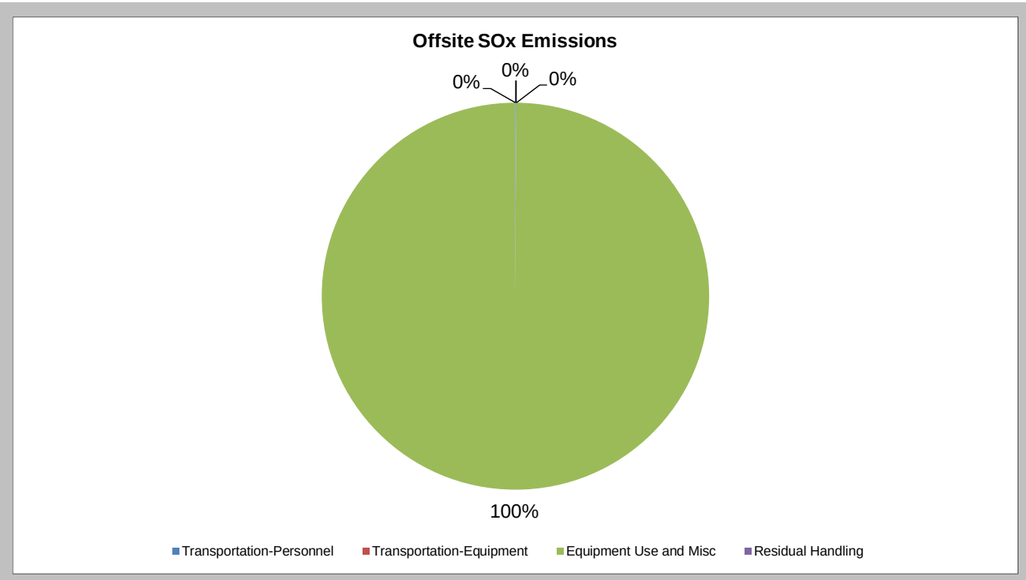

Water Consumption
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

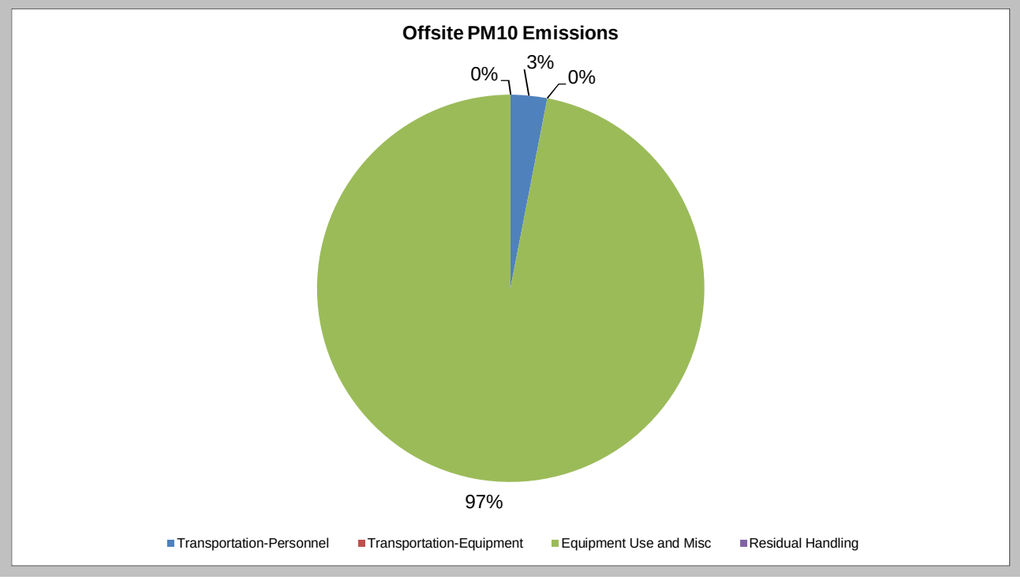

Onsite NOx Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

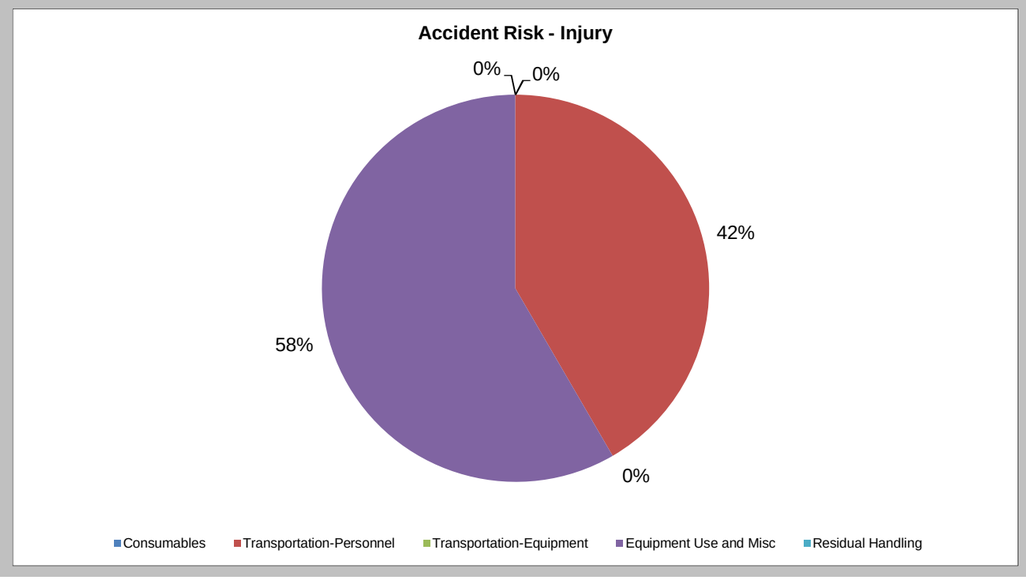

Onsite SOx Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

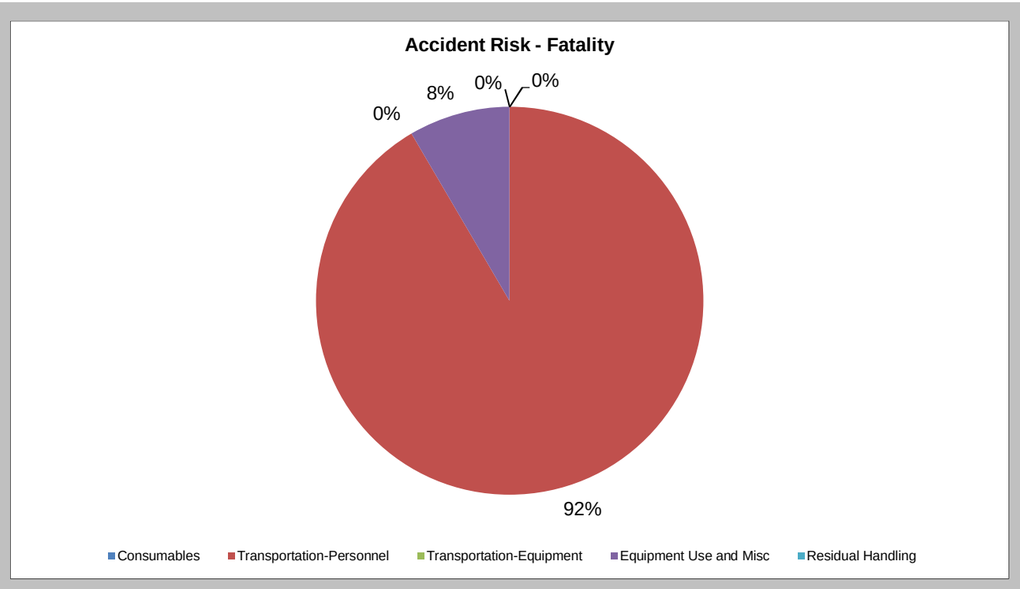

Onsite PM10 Emissions
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite NOx Emissions
0%
100%
Equipment Use and Misc
Residual Handling


Offsite SOx Emissions
0%
0%
0%
100%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling


Offsite PM10 Emissions
0%
3%
0%
97%
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

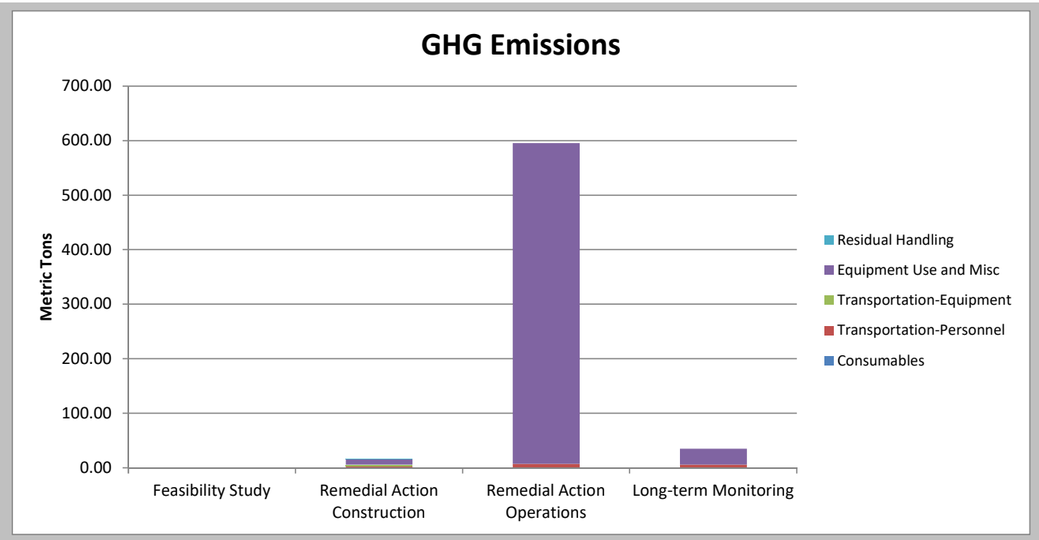

Accident Risk - Injury
0%
0%
42%
58%
0%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

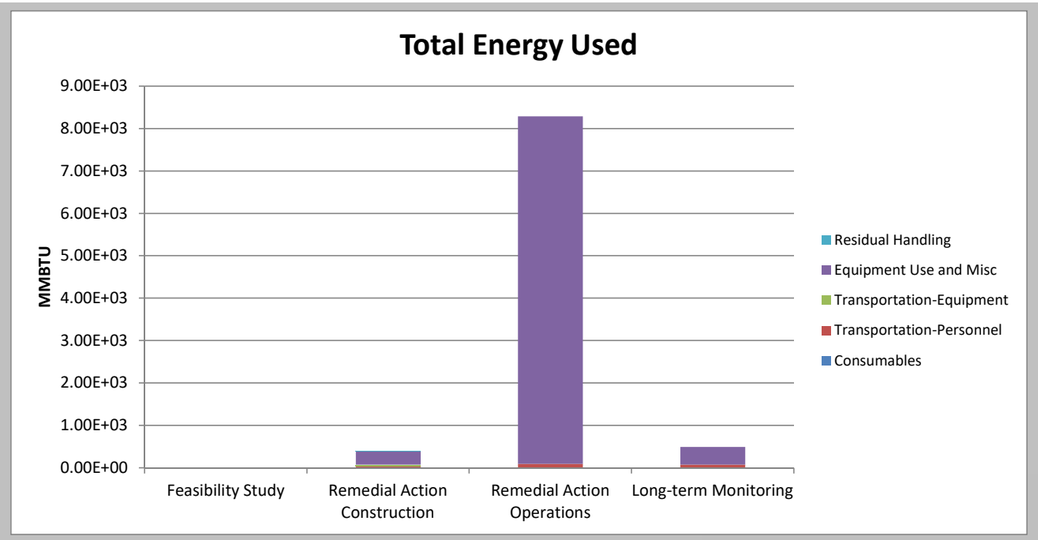

Accident Risk - Fatality
0%
0%
8%
0%
92%
Consumables
Transportation-Personnel
Transportation-Equipment
Equipment Use and Misc
Residual Handling

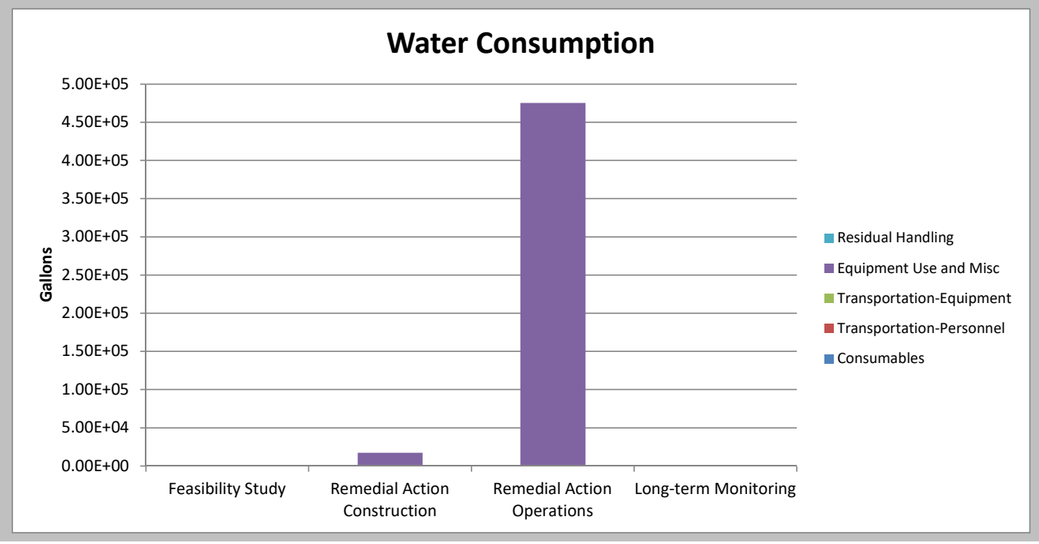
Sustainable Remediation - Environmental Footprint Summary
Alt 4

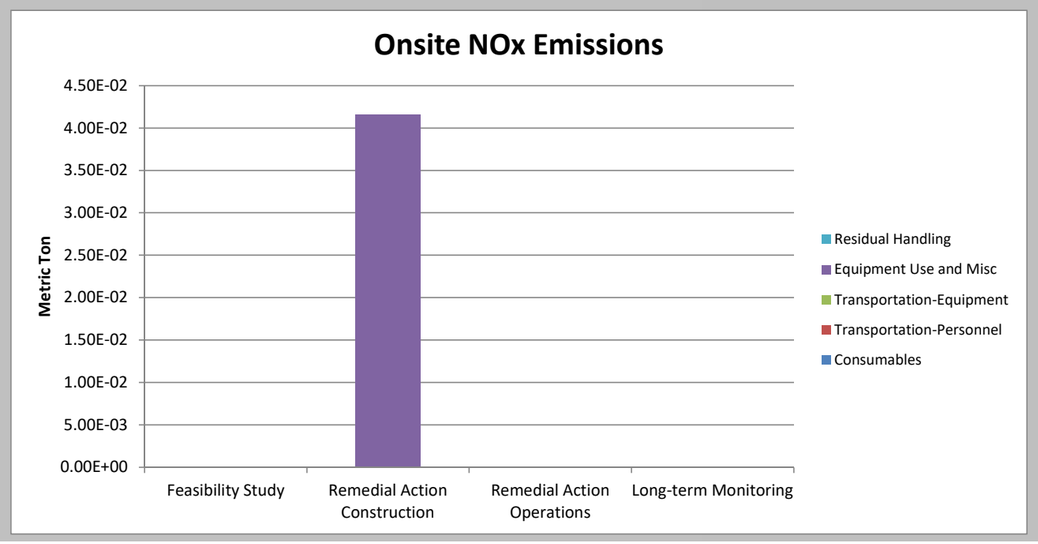
Phase	Activities	GHG Emissions	Total Energy Used	Water Consumption	Electricity Usage	Onsite NOx Emissions	Onsite SOx Emissions	Onsite PM10 Emissions	Total NOx Emissions	Total SOx Emissions	Total PM10 Emissions	Accident Risk Fatality	Accident Risk Injury
		metric ton	MMBTU	gallons	MWH	metric ton	metric ton	metric ton	metric ton	metric ton	metric ton		
Feasibility Study	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Transportation-Equipment	0.00	0.0E+00	NA	NA	NA	NA	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	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Residual Handling	0.00	0.0E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	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	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Remedial Action Construction	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	3.30	4.2E+01	NA	NA	NA	NA	NA	1.4E-03	4.3E-05	2.0E-04	4.7E-05	3.8E-03
	Transportation-Equipment	2.87	3.7E+01	NA	NA	NA	NA	NA	9.0E-04	1.6E-05	8.0E-05	8.6E-06	6.9E-04
	Equipment Use and Misc	10.34	3.0E+02	1.8E+04	0.0E+00	4.2E-02	1.0E-02	7.3E-03	4.6E-02	1.3E-02	7.7E-03	6.3E-05	1.8E-02
	Residual Handling	0.39	5.6E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	5.8E-04	2.6E-04	1.4E-03	1.6E-06	1.3E-04
	Sub-Total	16.90	3.89E+02	1.76E+04	0.00E+00	4.16E-02	1.02E-02	7.25E-03	4.84E-02	1.35E-02	9.38E-03	1.20E-04	2.22E-02
Remedial Action Operations	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	7.27	9.2E+01	NA	NA	NA	NA	NA	3.0E-03	9.5E-05	4.3E-04	1.0E-04	8.3E-03
	Transportation-Equipment	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	588.49	8.2E+03	4.8E+05	9.3E+02	0.0E+00	0.0E+00	0.0E+00	5.0E-01	4.2E+00	1.2E+00	1.1E-04	4.9E-02
	Residual Handling	0.00	0.0E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	595.76	8.29E+03	4.75E+05	9.32E+02	0.00E+00	0.00E+00	0.00E+00	5.05E-01	4.23E+00	1.17E+00	2.16E-04	5.69E-02
Long-term Monitoring	Consumables	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	NA	NA
	Transportation-Personnel	6.11	7.7E+01	NA	NA	NA	NA	NA	2.5E-03	8.0E-05	3.6E-04	8.7E-05	7.0E-03
	Transportation-Equipment	0.00	0.0E+00	NA	NA	NA	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Equipment Use and Misc	29.20	4.2E+02	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	1.4E-01	1.1E-01	1.2E-02	8.0E-06	9.8E-03
	Residual Handling	0.00	0.0E+00	NA	NA	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00	0.0E+00
	Sub-Total	35.32	4.95E+02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.43E-01	1.05E-01	1.20E-02	9.46E-05	1.67E-02
Total		**6.5E+02**	**9.2E+03**	**4.9E+05**	**9.3E+02**	**4.2E-02**	**1.0E-02**	**7.3E-03**	**7.0E-01**	**4.4E+00**	**1.2E+00**	**4.3E-04**	**9.6E-02**

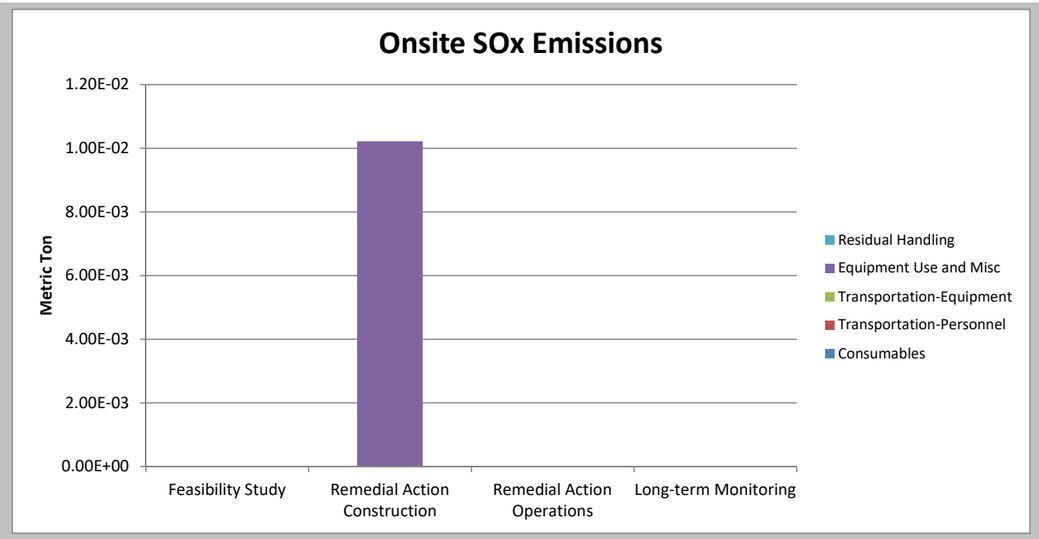
Remedial Alternative Phase	Non-Hazardous Waste Landfill Space	Hazardous Waste Landfill Space	Topsoil Consumption	Costing	Lost Hours - Injury	Percent electricity from renewable sources	Total Cost with Footprint Reduction
	tons	tons	cubic yards	$		%	
Feasibility Study	0.0E+00	0.0E+00	0.0E+00	0	0.0E+00	0.0%	$1,948,000
Remedial Action Construction	7.7E+00	0.0E+00	0.0E+00	327,000	1.8E-01	0.0%	
Remedial Action Operations	0.0E+00	0.0E+00	0.0E+00	861,000	4.5E-01	5.3%	
Long-term Monitoring	0.0E+00	0.0E+00	0.0E+00	760,000	1.3E-01	0.0%	
Total	7.7E+00	0.0E+00	0.0E+00	$1,948,000	7.7E-01	1.3%	

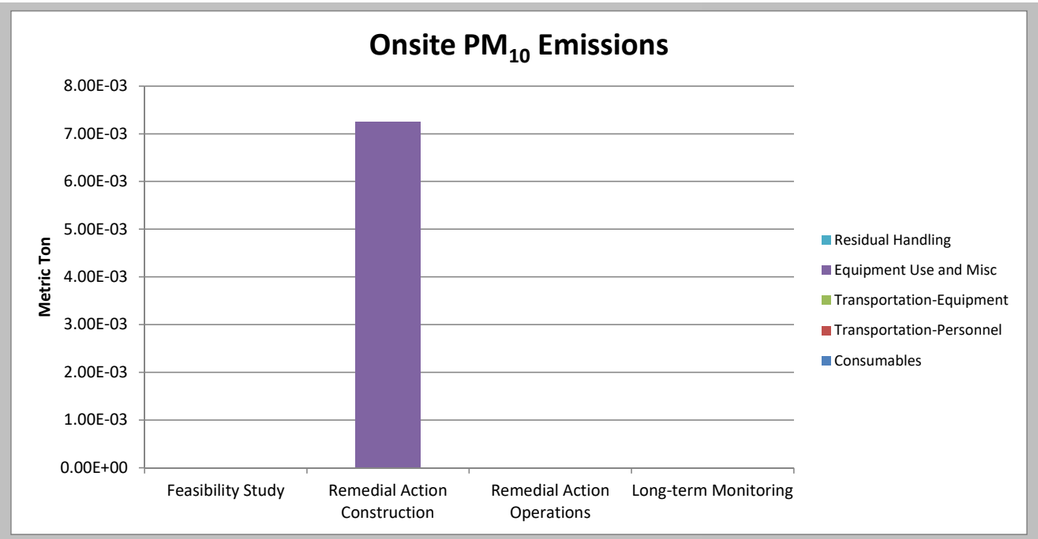

GHG Emissions
Metric Tons
700.00
600.00
500.00
400.00
300.00
200.00
100.00
0.00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

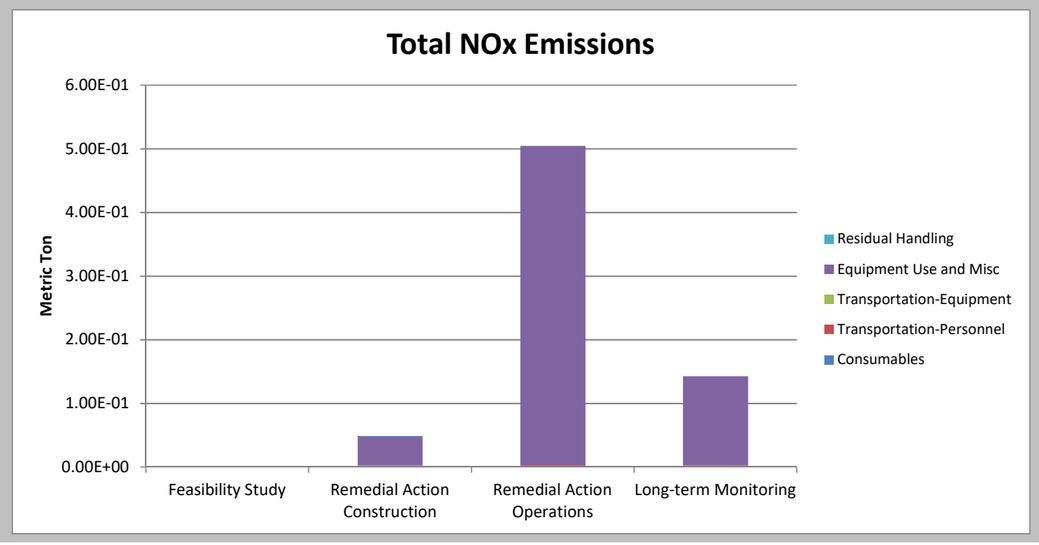

Total Energy Used
MMBTU
9.00E+03
8.00E+03
7.00E+03
6.00E+03
5.00E+03
4.00E+03
3.00E+03
2.00E+03
1.00E+03
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

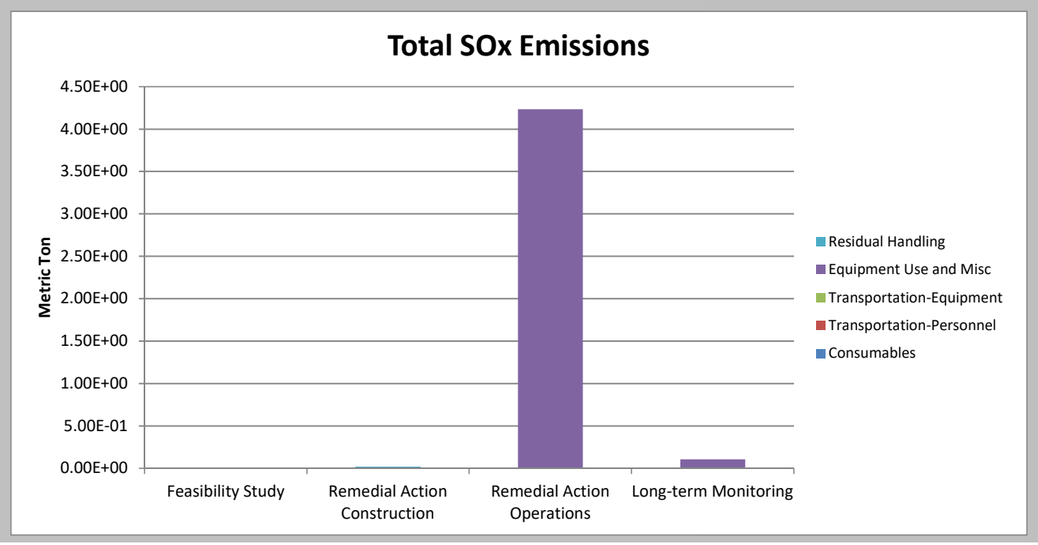

Water Consumption
Gallons
5.00E+05
4.50E+05
4.00E+05
3.50E+05
3.00E+05
2.50E+05
2.00E+05
1.50E+05
1.00E+05
5.00E+04
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel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

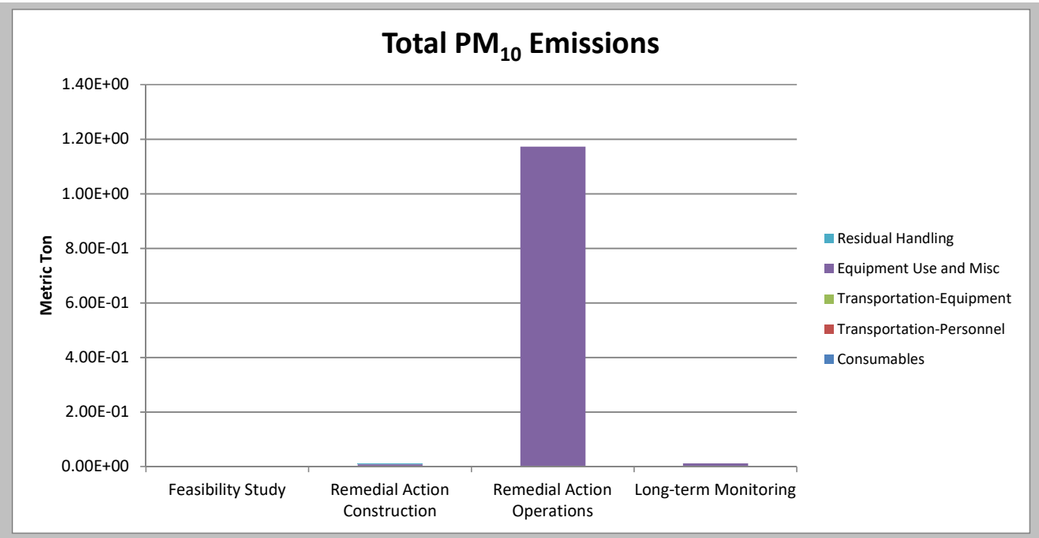

Onsite NOx Emissions
Metric Ton
4.50E-02
4.00E-02
3.50E-02
3.00E-02
2.50E-02
2.00E-02
1.50E-02
1.00E-02
5.00E-03
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

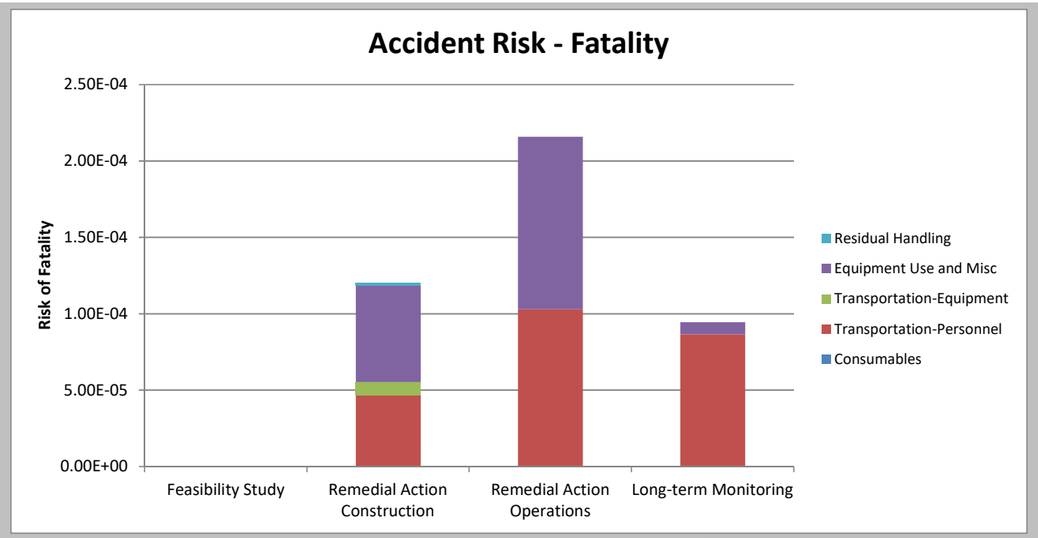

Onsite SOx Emissions
1.20E-02
1.00E-02
8.00E-03
6.00E-03
4.00E-03
2.00E-03
0.00E+00
Metric Ton
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

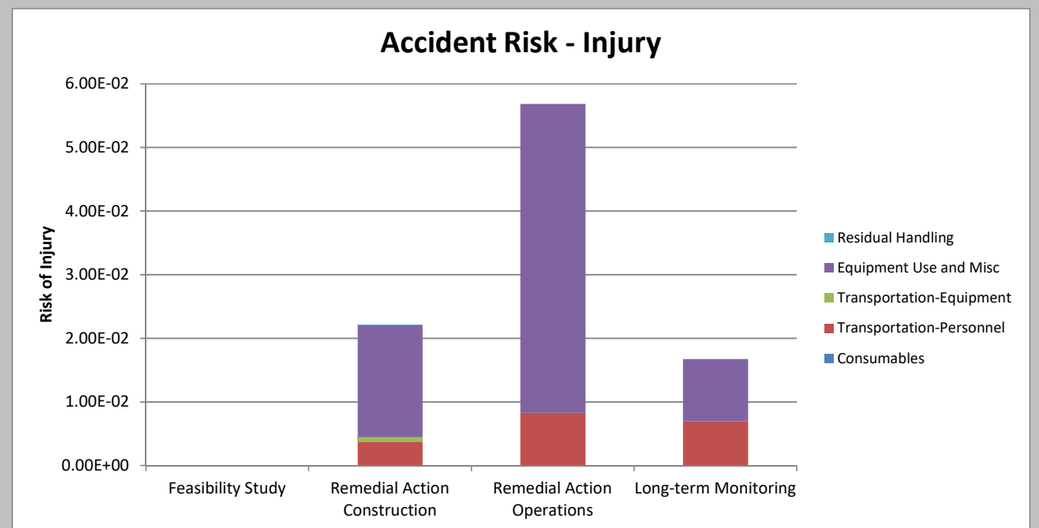

Onsite PM10 Emissions
8.00E-03
7.00E-03
6.00E-03
5.00E-03
4.00E-03
3.00E-03
2.00E-03
1.00E-03
0.00E+00
Metric Ton
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

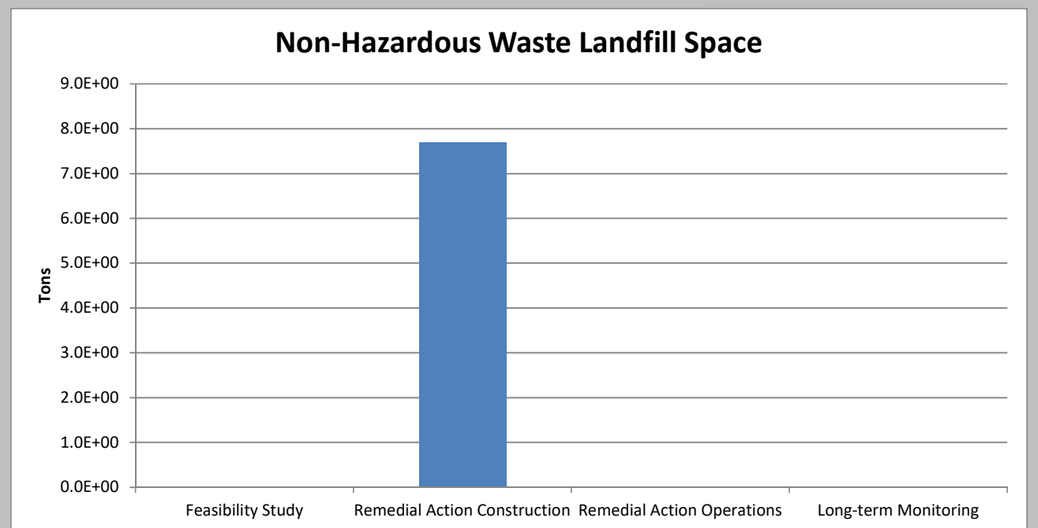

Total NOx Emissions
6.00E-01
5.00E-01
4.00E-01
3.00E-01
2.00E-01
1.00E-01
0.00E+00
Metric Ton
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Total SOx Emissions
4.50E+00
4.00E+00
3.50E+00
3.00E+00
2.50E+00
2.00E+00
1.50E+00
1.00E+00
5.00E-01
0.00E+00
Metric Ton
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

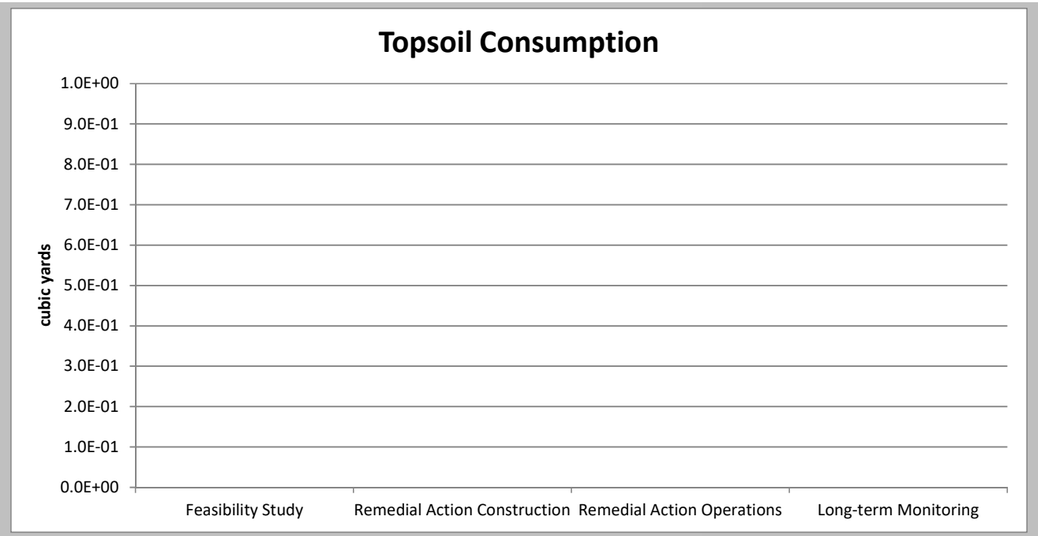

Total PM10 Emissions
Metric Ton
1.40E+00
1.20E+00
1.00E+00
8.00E-01
6.00E-01
4.00E-01
2.00E-01
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

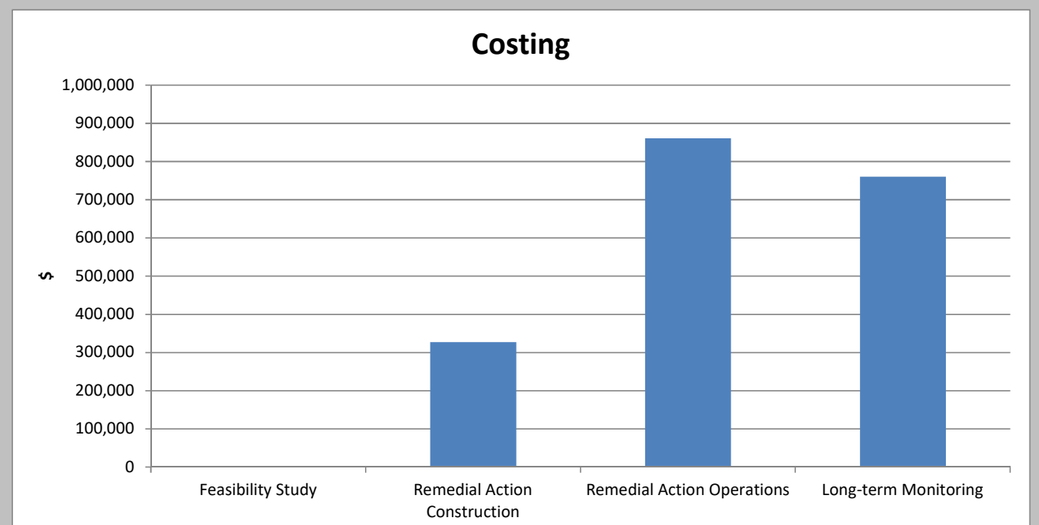

Accident Risk - Fatality
Risk of Fatality
2.50E-04
2.00E-04
1.50E-04
1.00E-04
5.00E-05
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables

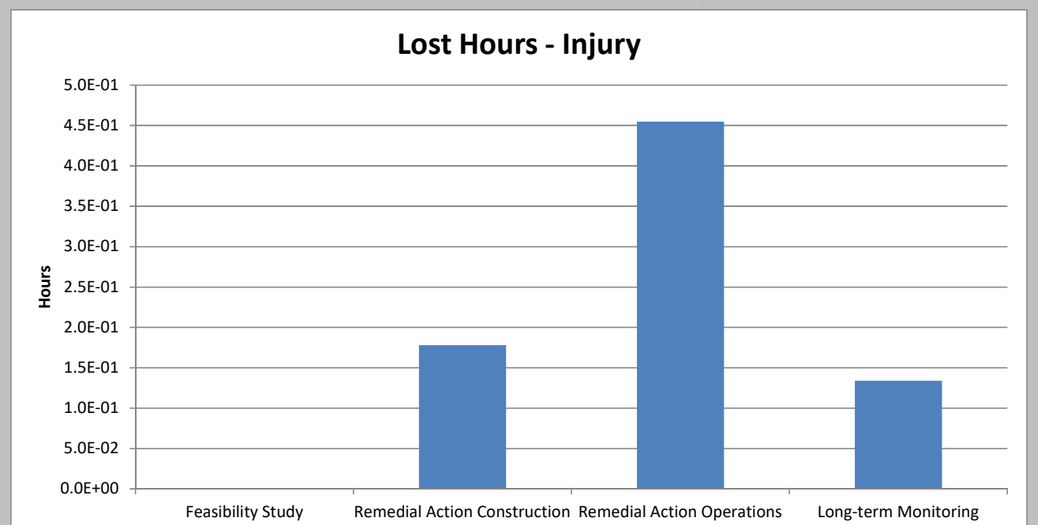

Accident Risk - Injury
Risk of Injury
6.00E-02
5.00E-02
4.00E-02
3.00E-02
2.00E-02
1.00E-02
0.00E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring
Residual Handling
Equipment Use and Misc
Transportation-Equipment
Transportation-Personnel
Consumables


Non-Hazardous Waste Landfill Space
Tons
9.0E+00
8.0E+00
7.0E+00
6.0E+00
5.0E+00
4.0E+00
3.0E+00
2.0E+00
1.0E+00
0.0E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring


Hazardous Waste Landfill Space
Tons
1.0E+00
9.0E-01
8.0E-01
7.0E-01
6.0E-01
5.0E-01
4.0E-01
3.0E-01
2.0E-01
1.0E-01
0.0E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring


Topsoil Consumption
cubic yards
1.0E+00
9.0E-01
8.0E-01
7.0E-01
6.0E-01
5.0E-01
4.0E-01
3.0E-01
2.0E-01
1.0E-01
0.0E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring


Costing
$
1,000,000
900,000
800,000
700,000
600,000
500,000
400,000
300,000
200,000
100,000
0
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring


Lost Hours - Injury
Hours
5.0E-01
4.5E-01
4.0E-01
3.5E-01
3.0E-01
2.5E-01
2.0E-01
1.5E-01
1.0E-01
5.0E-02
0.0E+00
Feasibility Study
Remedial Action Construction
Remedial Action Operations
Long-term Monitoring

APPENDIX C—REMEDIAL ALTERNATIVE COST ESTIMATES

Cost Estimate for Alternative 1 - MNA/LUCs
TCB Plumes - RAP Addendum 5

Capital Costs

Monitoring Well Installation and Baseline Sampling

Item	Description	Qty	Units	$/Unit	Cost
Monitoring Wells	Replace monitoring well that were abandoned for excavations. TO BE DONE AS PART OF SOIL REMEDY	0	-	$0	$0
Monitoring Wells	New wells near shore, two at 25', one at 15', one at 20', 2" diameter, protective casing	4	ea	$2,000	$8,000
Baseline Sampling	Collect one round of samples from 17 MWs and 8 SW samples	5	day	$2,500	$12,500
Laboratory Analysis	28 samples (includes QA/QC) for VOCs and MNA parameters	28	ea	$155	$4,340
Laboratory Analysis (MBT)	6 samples for MI QuantArray Chlor	6	ea	$750	$4,500
Preliminary Report	Summarize Field activities and laboratory results	1	ls	$10,000	$10,000
Total					**$39,340**

Annual Costs

Long Term Monitoring (Years 1, 2, and 3)

Item	Description	Qty	Units	$/Unit	Cost
Sampling (labor and analytical)	Semi-annual - 17 MWs, 8 surface water, and 3 QA/QC samples (VOCs and MNA parameters)	2	ea	$16,840	$33,680
Management/coordination	Semi-annual	2	ea	$1,000	$2,000
Reporting	Semi-annual	2	ea	$10,000	$20,000
Total					**$55,680**

Long Term Monitoring (Years 4 and after)

Item	Description	Qty	Units	$/Unit	Cost
Sampling (labor and analytical)	Annual - 17 MWs, 8 surface water, and 3 QA/QC samples (VOCs and MNA parameters)	1	ea	$16,840	$16,840
Management/coordination	Annual	1	ea	$1,000	$1,000
Reporting	Annual	1	ea	$10,000	$10,000
Total					**$27,840**

Cost Estimate for Alternative 2 - Extraction and Treatment - Complete capture; MNA/LUCs
TCB Plumes - RAP Addendum 5

Capital Costs

Groundwater extraction subsurface components

Item	Description	Qty	Units	$/Unit	Cost
Conveyance piping to treatment system installation					
Trenching subcontractor, materials	2" PEX line to treatment plant, 1" conduits	900	feet	$60	$54,000
Trench installation oversight (engineer)	50' of conveyance piping per day	18	days	$1,500	$27,000
Extraction wells and pumps installation					
Extraction wells	25' deep each, 4" diameter	7	ea	$2,000	$14,000
Vaults for extraction wells (labor, materials)	2'x2' vaults, 5'x5' concrete pads	7	ea	$1,500	$10,500
Pumps and level sensors for extraction wells (equipment, installation)	0.5 hp pumps, local level switches	7	ls	$2,500	$17,500
Management/planning	Documentation, planning, management, permitting	1	ls	$40,000	$40,000
Contingency (20% of total)		20%	ls		$24,600
Design/Engineering		1	ls	$20,000	$20,000
Subtotal					**$207,600**

Aboveground treatment plant components

Item	Description	Qty	Units	$/Unit	Cost
Electric Service	Panels/Motor Controls	1	ls	$10,000	$10,000
Control Panel/Programming	SCADA, touch-screen panel	1	ls	$5,000	$5,000
Piping and instrumentation	Various	1	ls	$5,000	$5,000
Oversight cost (engineer)	10 field days assumed for construction	10	days	$2,000	$20,000
Management/planning	Documentation, planning, management	5	days	$2,500	$12,500
Discharge permit	Modify POTW permit	5	days	$2,500	$12,500
Other permitting	grading, E&S	1	ls	$30,000	$30,000
Report	Summary Construction Completion Report	1	ls	$25,000	$25,000
Contingency (20% of total)		20%	ls		$10,500
Design/Engineering		1	ls	$20,000	$20,000
Subtotal					**$150,500**

Monitoring Well Installation and Baseline Sampling

Item	Description	Qty	Units	$/Unit	Cost
Monitoring Wells	Replace monitoring well that were abandoned for excavations. TO BE DONE AS PART OF SOIL REMEDY	0	-	$0	$0
Monitoring Wells	New wells near shore, two at 25', one at 15', one at 20', 2" diameter, protective casing	4	ea	$2,000	$8,000
Baseline Sampling	Collect one round of samples from 17 MWs and 8 SW samples	5	day	$2,500	$12,500
Laboratory Analysis	28 samples (includes QA/QC) for VOCs	28	ea	$60	$1,680
Laboratory Analysis (MBT)	6 samples for MI QuantArray Chlor	6	ea	$750	$4,500
Preliminary Report	Summarize Field activities and laboratory results	1	ls	$10,000	$10,000
Subtotal					**$36,680**

TOTAL					**$394,780**

Annual Costs

Years 1 to 5 Treatment System Annual O&M

Item	Description	Qty	Units	$/Unit	Cost
Periodic system O&M	Every 2 weeks (part of TCE system)	0	visits	$1,500	$0
Management/coordination	12 hours/month (part of TCE system)	0	hours	$150	$0
Reporting	POTW, system status (increment to TCE system)	1	ls	$7,500	$7,500
Analytical sampling	Monthly sampling (increment to TCE system)	12	mo	$500	$6,000
VGAC changeout costs	15% VGAC loading capacity (increment to TCE system)	100	lb	$5	$500
Electric power	1.9 KW constant load (increment to TCE system)	16644	kwh	$0.12	$1,997
POTW discharge	Fee, based on 5 gpm, 24 hours per day, 365 days/year	351.3	1000 ft3	$69.62	$24,457
Equipment maintenance	pumps	1	ls	$2,000	$2,000
Spare parts	Pumps	1	ls	$500	$500
IDW transport and disposal	Filter bags, etc (part of TCE system)	0	lb	$1.00	$0
Contingency (10% of total)		10%	ls		$4,295
Annual O&M cost					**$47,249**

Years 6 to 8 Treatment System Annual O&M (50 % lower concentrations in plumes)

Item	Description	Qty	Units	$/Unit	Cost
Periodic system O&M	Every 2 weeks (part of TCE system)	0	visits	$1,500	$0
Management/coordination	12 hours/month (part of TCE system)	0	hours	$150	$0
Reporting	POTW, system status (increment to TCE system)	1	ls	$7,500	$7,500
Analytical sampling	Monthly sampling (increment to TCE system)	12	mo	$500	$6,000
VGAC changeout costs	15% VGAC loading capacity (increment to TCE system)	50	lb	$5	$250
Electric power	1.9 KW constant load (increment to TCE system)	16644	kwh	$0.12	$1,997
POTW discharge	Fee, based on 5 gpm, 24 hours per day, 365 days/year	351.3	1000 ft3	$69.62	$24,457
Equipment maintenance	pumps	1	ls	$2,000	$2,000
Spare parts	Pumps	1	ls	$500	$500
IDW transport and disposal	Filter bags, etc (part of TCE system)	0	lb	$1.00	$0
Contingency (10% of total)		10%	ls		$4,270
Annual O&M cost					**$46,974**

Years 9 to 30 Treatment System Annual O&M (50% lower concentrations in plumes) (TCE plume treatment complete)

Item	Description	Qty	Units	$/Unit	Cost
Periodic system O&M	Every 4 weeks	12	visits	$1,500	$18,000
Management/coordination	12 hours/month	144	hours	$150	$21,600
Reporting	POTW, system status	1	ls	$15,000	$15,000
Analytical sampling	Monthly sampling (Influent and effluent)	24	mo	$500	$12,000
VGAC changeout costs	15% VGAC loading capacity	25	lb	$5	$125
Electric power	1.9 KW constant load	16644	kwh	$0.12	$1,997
POTW discharge	Fee, based on 5 gpm, 24 hours per day, 365 days/year	351.3	1000 ft3	$69.62	$24,457
Equipment maintenance	pumps	1	ls	$2,000	$2,000
Spare parts	Pumps	1	ls	$500	$500
IDW transport and disposal	Filter bags, etc	500	lb	$1.00	$500
Contingency (10% of total)		10%	ls		$9,618
Annual O&M cost					**$105,797**

Mechanical Equipment Replacement (Year 20)

Pumps	Extraction and discharge pumps	8	ea	$2,000	$16,000
Air Stripper Blower	350 cfm blower	1	ea	$750	$750
Total					**$16,750**

Annual Long Term Monitoring (Years 1, 2, and 3)

Item	Description	Qty	Units	$/Unit	Cost
Sampling (labor and analytical)	Semi-annual - 17 MWs, 8 surface water, and 3 QA/QC samples (VOCs)	2	ea	$14,180	$28,360
Management/coordination	Semi-annual	2	ea	$1,000	$2,000
Reporting	Semi-annual	2	ea	$10,000	$20,000
Total					**$50,360**

Long Term Monitoring (Years 4 and after)

Item	Description	Qty	Units	$/Unit	Cost
Sampling (labor and analytical)	Annual - 17 MWs, 8 surface water, and 3 QA/QC samples (VOCs)	1	ea	$14,180	$14,180
Management/coordination	Annual	1	ea	$1,000	$1,000
Reporting	Annual	1	ea	$10,000	$10,000
Total					**$25,180**

Annual Post-Active Treatment Monitoring
Long Term Monitoring (first year)

Item	Description	Qty	Units	$/Unit	Cost
Sampling (labor and analytical)	Semi-annual (VOCs)	2	ea	$14,180	$28,360
Management/coordination	Semi-annual	2	ea	$1,000	$2,000
Reporting	Semi-annual	2	ea	$10,000	$20,000
Annual post-active treatment cost					**$50,360**

Long Term Monitoring (second year)

	Description	Qty	Units	$/Unit	Cost
Sampling (labor and analytical)	Semi-annual (VOCs)	2	ea	$14,180	$28,360
Management/coordination	Semi-annual	2	ea	$1,000	$2,000
Reporting	Semi-annual	2	ea	$10,000	$20,000
Remedial Action Completion Report		1	ea	$25,000	$25,000
Annual post-active treatment cost					**$75,360**

Cost Estimate for Alternative 4 - Aerobic PRB; MNA/LUCs
TCB Plumes - RAP Addendum 5

Capital Costs
Biosparging Components

Item	Description	Qty	Units	$/Unit	Cost
Trenching subcontractor, materials	2" PEX line to treatment plant, 1" PEX to wells	1000	feet	$60	$60,000
Trench installation oversight (engineer)	50' of conveyance piping per day	20	days	$1,500	$30,000
Biosparging wells wells	25' deep each, 2" diameter	15	ea	$2,000	$30,000
Vaults for injection wells (labor, materials)	2'x2' vaults, 5'x5' concrete pads	15	ea	$1,500	$22,500
Distribution manifolds	Panels to house flow meters, control valves, and shut-off valves for each well.	2	ls	$9,500	$19,000
Air Compressor	50 cfm rotary screw compressor, 15 hp; installed	1	ls	$18,000	$18,000
Electric Service	Panels/Motor Controls	1	ls	$10,000	$10,000
Piping and instrumentation	Various	1	ls	$5,000	$5,000
Other permitting	grading, E&S	5	days	$2,500	$12,500
Report	Summary Construction Completion Report	1	ls	$25,000	$25,000
Management/planning	Documentation, planning, management, permitting	1	ls	$60,000	$60,000
Contingency (20% of total)		20%	ls		$38,900
Design/Engineering		1	ls	$50,000	$50,000
Subtotal					**$380,900**

Monitoring Well Installation and Baseline Sampling

Item	Description	Qty	Units	$/Unit	Cost
Monitoring Wells	Replace monitoring well that were abandoned for excavations. TO BE DONE AS PART OF SOIL REMEDY	0	-	$0	$0
Monitoring Wells	New wells near shore, two at 25', one at 15', one at 20', 2" diameter, protective casing	4	ea	$2,000	$8,000
Baseline Sampling	Collect one round of samples from 17 MWs and 8 SW samples	5	day	$2,500	$12,500
Laboratory Analysis	28 samples (includes QA/QC) for VOCs	28	ea	$60	$1,680
Laboratory Analysis (MBT)	6 samples for MI QuantArray Chlor	6	ea	$750	$4,500
Preliminary Report	Summarize Field activities and laboratory results	1	ls	$10,000	$10,000
Subtotal					**$36,680**

TOTAL					**$417,580**

Cost Estimate for Alternative 4 - Aerobic PRB; MNA/LUCs
TCB Plumes - RAP Addendum 5
Annual costs

Treatment System Annual O&M - First half of operation - Years 1 - 8

Item	Description	Qty	Units	$/Unit	Cost
Periodic system O&M	Every 2 weeks (part of TCE system)	0	visits	$1,500	$0
Management/coordination	12 hours/month (part of TCE system)	0	hours	$150	$0
Reporting	System status (increment to TCE system)	1	ls	$7,500	$7,500
Electric power	5.6 KW constant load (increment to TCE system)	49056	kwh	$0.12	$5,887
Equipment maintenance	Compressor	1	ls	$2,000	$2,000
Spare parts	Compressor	1	ls	$500	$500
IDW transport and disposal	Filter bags, etc (part of TCE system)	0	lb	$1.00	$0
Contingency (10% of total)		10%	ls		$1,589
Annual O&M cost					**$17,475**

Treatment System Annual O&M - second half of operation. Assume lower concentrations so less frequent operation (50% of above) - Years 9 to 30 (TCE Plume treatment complete)

Item	Description	Qty	Units	$/Unit	Cost
Periodic system O&M	Every 4 weeks	12	visits	$1,500	$18,000
Management/coordination	12 hours/month	144	hours	$150	$21,600
Reporting	System status	1	ls	$10,000	$10,000
Electric power	2.8 KW constant load	24528	kwh	$0.12	$2,943
Equipment maintenance	Compressor	1	ls	$2,000	$2,000
Spare parts	Compressor	1	ls	$500	$500
IDW transport and disposal	Filter bags, etc	0	lb	$1.00	$0
Contingency (10% of total)		10%	ls		$5,504
Annual O&M cost					**$60,548**

Mechanical Equipment Replacement (Year 20)

Compressor	Compressor	1	ea	$18,000	$18,000
Total					**$18,000**

Annual Long Term Monitoring (Years 1, 2, and 3)

Item	Description	Qty	Units	$/Unit	Cost
Sampling (labor and analytical)	Semi-annual - 17 MWs, 8 surface water, and 3 QA/QC samples (VOCs)	2	ea	$14,180	$28,360
Management/coordination	Semi-annual	2	ea	$1,000	$2,000
Reporting	Semi-annual	2	ea	$10,000	$20,000
Total					**$50,360**

Long Term Monitoring (Years 4 and after)

Item	Description	Qty	Units	$/Unit	Cost
Sampling (labor and analytical)	Annual - 17 MWs, 8 surface water, and 3 QA/QC samples (VOCs)	1	ea	$14,180	$14,180
Management/coordination	Annual	1	ea	$1,000	$1,000
Reporting	Annual	1	ea	$10,000	$10,000
Total					**$25,180**

Cost Estimate for Alternative 4 - Aerobic PRB; MNA/LUCs
TCB Plumes - RAP Addendum 5
Annual Post-Active Treatment Monitoring
Long Term Monitoring (first year)

Item	Description	Qty	Units	$/Unit	Cost
Sampling (labor and analytical)	Semi-annual (VOCs)	2	ea	$14,180	$28,360
Management/coordination	Semi-annual	2	ea	$1,000	$2,000
Reporting	Semi-annual	2	ea	$10,000	$20,000
Annual post-active treatment cost					**$50,360**

Long Term Monitoring (second year)

	Description	Qty	Units	$/Unit	Cost
Sampling (labor and analytical)	Semi-annual (VOCs)	2	ea	$14,180	$28,360
Management/coordination	Semi-annual	2	ea	$1,000	$2,000
Reporting	Semi-annual	2	ea	$10,000	$20,000
Remedial Action Completion Report		1	ea	$25,000	$25,000
Annual post-active treatment cost					**$75,360**

Cost Estimate Totals and Summaries
TCB Plumes - RAP Addendum 5

	Alternative 1				Alternative 2				Alternative 4			
	Capital Cost	O&M	Monitoring	Total	Capital Cost	O&M	Monitoring	Total	Capital Cost	O&M	Monitoring	Total
Cost												
Capital	$39,340			$39,340	$394,780			$394,780	$417,580			$417,580
Annual												
1			$55,680	$55,680		$47,249	$50,360	$97,609		$17,475	$50,360	$67,835
2			$55,680	$55,680		$47,249	$50,360	$97,609		$17,475	$50,360	$67,835
3			$55,680	$55,680		$47,249	$50,360	$97,609		$17,475	$50,360	$67,835
4			$27,840	$27,840		$47,249	$25,180	$72,429		$17,475	$25,180	$42,655
5			$27,840	$27,840		$47,249	$25,180	$72,429		$17,475	$25,180	$42,655
6			$27,840	$27,840		$46,974	$25,180	$72,154		$17,475	$25,180	$42,655
7			$27,840	$27,840		$46,974	$25,180	$72,154		$17,475	$25,180	$42,655
8			$27,840	$27,840		$46,974	$25,180	$72,154		$17,475	$25,180	$42,655
9			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
10			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
11			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
12			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
13			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
14			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
15			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
16			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
17			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
18			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
19			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
20			$27,840	$27,840		$122,547	$25,180	$147,727		$78,548	$25,180	$103,728
21			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
22			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
23			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
24			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
25			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
26			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
27			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
28			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
29			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
30			$27,840	$27,840		$105,797	$25,180	$130,977		$60,548	$25,180	$85,728
Post-Active 1							$50,360	$50,360			$50,360	$50,360
Post-Active 2							$75,360	$75,360			$75,360	$75,360
Total Project	$39,340	$0	$918,720	$958,060	$394,780	$2,721,455	$956,660	$4,072,895	$417,580	$1,489,852	$956,660	$2,864,092
ROUNDED	**$40,000**	**$0**	**$919,000**	**$959,000**	**$395,000**	**$2,722,000**	**$957,000**	**$4,073,000**	**$418,000**	**$1,490,000**	**$957,000**	**$2,865,000**
rounded annual			**$919,000**				**$3,679,000**				**$2,447,000**	

APPENDIX D—GROUNDWATER MODELING

GROUNDWATER FLOW AND SOLUTE TRANSPORT MODEL ANALYSIS OF POTENTIAL REMEDIAL ALTERNATIVES FOR CONTAMINATED GROUNDWATER IN BLOCKS E AND F, MIDDLE RIVER COMPLEX

Prepared for:
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Prepared by:
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July 2020

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ACRONYMS AND ABBREVIATIONS

DHC	Dark Head Cove
ft/day	feet per day
GM	geometric mean
Lockheed Martin	Lockheed Martin Corporation
MRC	Middle River Complex
MSL	mean sea level
µg/L	micrograms per liter
VOC	volatile organic compounds

SECTION 1
INTRODUCTION

This report summarizes the development, calibration, and predictive use of a groundwater flow and transport model of the Lockheed Martin Middle River Complex (MRC) site, located in Middle River, Maryland (Figure 1-1). The original version of this model was developed in 2010 in support of a remediation conceptual design for addressing volatile organic compounds (VOCs) and 1,4-dioxane groundwater plumes. The 2010 model and model evaluation are summarized in *Development and Calibration of a Groundwater Flow and Solute Transport Model for the Middle River Site, Middle River, MD* which is Appendix G of the *Groundwater Response Action Plan* (Tetra Tech, 2012).

1.1 GOALS AND OBJECTIVES

The groundwater modeling summarized herein has been performed to predict and compare the effects of two remedial alternatives on the 1,2,4-trichlorobenzene (1,2,4-TCB) and chlorobenzene plumes present in Blocks E and F. Of specific interest are (1) the potential length of time the groundwater contamination in excess of 100 ug/L will remain in the saturated zone, (2) how much 1,2,4-TCB and chlorobenzene might discharge to Dark Head Cove (DHC) during the period of remediation under the two alternatives, and (3) how long it takes for 1,2,4 TCB and chlorobenzene discharging to DHC to decline to below 8 ug/L and 30 ug/L, respectively.

SECTION 2
CONCEPTUAL MODEL

The conceptual model of a hydrogeologic system is a working description of the characteristics and dynamics of the system. Its purpose is to consolidate site and regional hydrologic data into a set of assumptions and concepts that can be evaluated quantitatively (ASTM, 1996). The conceptual model is subsequently translated into a numerical representation in the groundwater model.

2.1 GEOLOGY

The MRC is underlain by the Potomac group, a lower Cretaceous-age inter-bedded gravel, sand, silt, and clay unit ranging in thickness from zero to 800 feet. The Potomac group at the site consists of three units (from the top down): the Patapsco formation, the Arundel clay, and the Patuxent formation. The sediments of the Potomac Group were deposited in a river-delta environment (Hansen, 1969). The deposits of the Patapsco formation constitute fine to medium sand and silt beds characteristic of back swamps and flood-plain deposits (Clark and others, 1918). The Patapsco formation, which is the primary formation of interest in this investigation, is composed primarily of silty sands, fine-grained to medium-grained sands, silty clays, clayey silts, and plastic clay. The Arundel clay is composed of dark gray and maroon lignitic clays and ranges between 25 and 200 feet thick beneath the site. Based on deep borings at the site, the top of the Arundel clay is found at between -65 and -75 ft mean sea level (MSL).

Investigations at the site indicate that the subsurface is characterized by a complex arrangement of predominantly clay, silty clay, silt, and clayey silt, with smaller, more permeable zones of silty sand and sand. Thick sequences of low-permeability clay, silty clay, clayey silt and silt are present in the northern two-thirds of the Middle River Complex (MRC) site. Interbedded sands, silty sands, sandy silts, and silts are encountered south of Buildings A, B, and C.

2.2 HYDROLOGY

The hydrogeologic system beneath the site consists of multiple, laterally- and vertically discontinuous relatively permeable units that provide the primary pathways for groundwater flow and contamination. Water enters these units via natural infiltration of precipitation (recharge) and collected and redirected stormwater and snowmelt and discharges to the surface waters that bound the site to the southwest (Cow Pen Creek) and the southeast (Dark Head Cove). These relatively shallow permeable zones, part of the Patapsco formation, are underlain at depths of 70 to 100 feet by the Arundel formation, a regionally extensive, thick, dense clay confining unit. The top of the Arundel formation forms the base of the groundwater flow system that was modeled in this program.

The more permeable units beneath the site are laterally and vertically discontinuous, making it difficult/impossible to delineate distinct aquifer layers and confining units across the MRC. However detailed study in the Block E and F area has indicated that the more permeable sands are continuous along the axis of the paleochannel that is present in this area (Tetra Tech, 2020). Recent documents evaluating the target area of Blocks E and F refer to hydrologic units 1 and 2 with hydrologic unit 1 having an upper surficial and a lower surficial aquifer. However, wells historically have been completed at the site according to general depth intervals: A – shallow (typically <25 feet), B – intermediate (typically <35 feet), and C – deep (55 to 75 feet deep).

2.3 AQUIFER CHARACTERISTICS

Based on slug tests conducted by Tetra Tech at 28 wells on site (Table 2-1), the hydraulic conductivity of the more permeable deposits increases with depth at the site (Tetra Tech, 2012). The average hydraulic conductivity of the shallow wells is 0.22 feet per day (ft/d) (geometric mean, GM = 0.07 ft/d); average of the intermediate wells was 0.48 ft/d (GM = 0.22 f/d); and average of deep wells was 3.82 ft/d (GM = 0.89 f/d). In general, the deeper the well completion interval, the more sand (SM) is present in the interval and the higher the hydraulic conductivity. With respect to the "A" zone, wells completed near the center of the MRC (potentiometric high) monitor a substantially lower permeability layer than do those elsewhere at the site.

2.4 INFLUENCE OF SURFACE WATERS

Water levels in the shallow and intermediate zones form a potentiometric high near the center of the MRC, with groundwater flowing away to the southwest and southeast to discharge to Cow Pen Creek and Dark Head Cove, respectively (Figure 1-1). Although water level data from the deep "C" zone are limited, water levels and associated groundwater flow in the deep zone appear to not be influenced by Cow Pen Creek and flow appears to be principally toward the southeast and Dark Head Cove.

2.5 WATER BUDGET

2.5.1 Evapotranspiration

Much of the MRC is paved or covered by buildings; the remainder of the site is primarily covered by grass. As such, evapotranspiration is expected to be a very minimal factor on site and was not explicitly represented in the groundwater model.

2.5.2 Runoff

The topography of MRC, which is gently sloping from Eastern Boulevard to the southwest and south, towards Cow Pen Creek and Dark Head Cove, and the nature of the ground surface (much is paved or covered by buildings) create a significant potential for runoff from precipitation. At the same time, runoff from the buildings and some or all of the paved areas is captured and conveyed through a storm sewer system.

2.5.3 Recharge

Areal variations in recharge rates are influenced by topography and surficial geology, including the presence or absence of paved surfaces. Precipitation in the area is approximately 44 inches per year (Tenbus and Fleck, 2001). Recharge is expected to occur primarily in the late winter and early spring months when precipitation is relatively high and evapotranspiration minimal. Tenbus and Fleck (2001) estimated recharge rates of between 0 and 9 inches per year at the nearby Graces Quarters site, which is located in the Edgewood Area of Aberdeen Proving Ground. Rates applied in the associated groundwater model were varied based on topography, the presence of fine-

grained sediment within or above the surficial aquifer, the presence of wetlands, and field observations of overland flow.

Recharge to the groundwater system in locations where the ground surface is not covered by buildings or pavement at MRC is expected to be at the low end of the 0 to 9 inch per year range referred to by Tenbus and Fleck (2001) due to the generally low permeability of the surface soil.

SECTION 3
NUMERICAL FLOW MODEL

Development of a numerical groundwater flow model is the process of transforming the conceptual model into a mathematical form. Fundamental components of the groundwater flow model include dimensionality, discretization, boundary and initial conditions, and hydraulic properties (ASTM, 1996).

The original groundwater flow and transport model of the Middle River Complex was completed in 2010 (Tetra Tech, 2012). Updating the model for purposes of evaluating potential groundwater remedial alternatives in Block E and Block F of the MRC consisted primarily of refining the spatial distribution of hydraulic conductivity values sitewide using data from an additional 131 wells that have been installed since 2010 and refining the model grid spacing in the Block E and F area. Water levels measured at these additional wells were subsequently included as part of the flow model calibration. A brief description of the current model is presented below.

3.1 CODE SELECTION

The groundwater flow model was developed using MODFLOW-2000, a well-documented, widely used and accepted code developed by the U.S. Geological Survey (USGS) (McDonald and Harbaugh, 1988; Harbaugh et al., 2000A; Harbaugh et al., 2000B).

3.2 MODEL GRID AND LAYERING

A total of nine model layers were used to represent the shallow groundwater system beneath MRC. The base of the model corresponds to approximately the top of the Arundel clay, which is treated as a no-flow boundary in the model. Table 3-1 summarizes information on the model layering.

The model grid, which is shown in Figure 3-1, is oriented approximately 30 degrees off of a north-south orientation. The grid is aligned so that it is approximately consistent with the alignment of the model for the adjacent Martin State Airport site.

3.3 BOUNDARY CONDITIONS

The lateral model boundary conditions are also shown in Figure 3-1. In model layer one, Dark Head Cove and Cow Pen Creek are represented using the MODFLOW river package. The water level in both was set to 0 feet above sea level. These surface waters form natural hydraulic discharge boundaries for groundwater in the shallow zone. No flow boundaries are specified in all model layers at cells along the far shore of these surface waters. As previously noted, the base of model layer nine is generally coincident with the top of the Arundel clay and is assumed to be impermeable.

3.4 HYDRAULIC PROPERTIES

At the start of the 2010 modeling program, Tetra Tech utilized geologic interpretations to define the lateral and vertical distribution of the various geologic materials. Tetra Tech had characterized the stratigraphy at each monitoring well according to whether it is (a) sand; (b) silty sand or sandy silt; (3) silt or clayey silt; (4) clay or silty clay; (5) gravel; or (6) concrete/asphalt. Kriging was used to assign the appropriate material to each cell in the model domain. In the 2020 program, data on site stratigraphy from a total of 131 wells that have been constructed over the past ten years were used to revise the site stratigraphy.

Hydraulic conductivity values of unconsolidated deposits through which monitoring wells are screened range from 0.0005 to 9.2 ft/d, based on slug tests conducted at these wells (see Table 2-1). The lowest values are from wells completed primarily in clay, silty clay, and clayey silt; the highest values are from "C" interval deep wells completed in fine sand. Based on the results of these tests, an initial value of hydraulic conductivity was assigned to each of the geologic materials present. They were modified as appropriate during the model calibration program, which is described in the following section.

SECTION 4
FLOW MODEL CALIBRATION

4.1 INTRODUCTION

Calibration of the groundwater flow model is the process of adjusting hydraulic parameters, boundary conditions, and initial conditions within reasonable ranges to obtain a match between measured and simulated potentials, flow rates, or other calibration targets (ASTM, 1996). The groundwater flow model was calibrated to a synoptic set of sitewide water level measurements taken at the monitoring wells in March 2019 (AECOM, 2019). This was the most recent comprehensive monitoring episode complete prior to the start of the model update program. Groundwater levels were assumed to be under approximate steady-state conditions for purposes of calibration. The quality of the calibration was assessed and quantified through statistical analysis of residuals. Both first- and second-order statistics were utilized.

4.2 STEADY-STATE FLOW

Groundwater levels measured at MRC in March 2019 were used for the steady-state calibration targets. In the process of calibrating the model, the hydraulic conductivities of the different materials were modified within reasonable ranges. The final distribution of hydraulic conductivity by model layer is presented in Figure 4-1a through Figure 4-1c. In addition, groundwater recharge was varied as part of the calibration process (Figure 4-2).

Table 4-1A and 4-1B presents a statistical summary of the match between measured and simulated groundwater levels for the calibrated model, both for all wells and for the wells in layers 1 through 4 in Blocks E and F (focus area), respectively. Ideally, the average error should be equal to zero, indicating that positive and negative residuals balance out and that there is no trend in the error (Anderson and Woessner, 1992). In addition, the absolute error should be equal to or less than 10% of the measured range in water levels across the spatial extent of the monitoring points providing the target water levels.

Review of Table 4-1A reveals that these criteria are met for the model-wide area. Model-wide the average error is effectively zero (0.07 ft), and the absolute average error (1.49 ft) is well below 10% of the measured range (2.94 ft). It is noted that approximately half of the wells (112 of 228, or 49%) are completed in model layer 1. Simulated water levels in model layer 1 are, on average, slightly lower than the measured water levels, while those in layers 2 and 3 are slightly higher. The other two layers representing the intermediate zone (layers 4 and 5) are approximately 1.5 feet higher than measured, but this represents only 25 wells (only 10% of all wells) and most of these wells are outside the focus area.

Review of Table 4-1B reveals that these criteria are also met for the focus area wells. The average error for these wells is effectively zero (0.01 ft), and the absolute average error (1.09 ft) is below ten percent of the measured range (1.36 ft). On a layer by layer basis the average error is close to zero, and the absolute error is close to 10% at the focus area wells.

4.3 PLUME FLOW VIA PARTICLE TRACKING

With the flow model updated and re-calibrated, the second part of the calibration program was undertaken, which consisted of simulating the advective path of 1,2,4-TCB from the primary sources of contamination, former transformer rooms 2 and 3 (eastern plume) and former transformer room 4 (western plume), to confirm the model's ability to simulate the observed pathway of the plumes over the time period that they are believed to have developed. Particle tracking analysis with the calibrated flow model produced horizontal plume trajectories that were consistent with the distribution of 1,2,4-TCB in the eastern and, to a lesser degree, of the western plumes as measured in 2019.

SECTION 5
HYDRAULIC CONTAINMENT

The calibrated groundwater flow model was used to identify potential groundwater extraction programs that would successfully contain and capture contaminated groundwater. For the eastern plume, the extent of 1,2,4-TCB contamination in excess of 100 ug/L was the target capture zone. For the western plume, the target capture zone included that necessary to capture 1,2,4-TCB in excess of 10 ug/L. Tetra Tech personnel defined the locations for potential extraction wells near the downgradient end of the eastern and western plumes (see Figure 5-1). Based on model analysis, it was determined that the western plume could be contained using two wells, each pumping at 0.5 gpm (1.0 gpm combined); the eastern plume by five wells pumping a combined 4.0 gpm.

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SECTION 6
TRANSPORT MODEL DEVELOPMENT

6.1 CODE SELECTION

Contaminant mass fate and transport modeling was conducted using the finite difference code, MT3D v. 5.2 (Zheng, 1998; Zheng, 2006). MT3D utilizes MODFLOW-2000 to simulate the advective transport of dissolved constituents. MT3D accounts directly for other fate and transport mechanisms including hydrodynamic dispersion, diffusion, sorption and sequential biodegradation.

6.2 CONTAMINANTS OF CONCERN

The fate and transport modeling considered 1,2,4-TCB and chlorobenzene as the only contaminants driving the RAP approach. Both compounds are components of the eastern plume while chlorobenzene is only detected at relatively low concentrations at three disparate locations in the western plume. The distributions of each of these compounds, based on concentrations measured in 2019, were initialized in the model, are shown in Figure 6-1 (1,2,4-TCB) and Figure 6-2 (chlorobenzene). Table 6-1 summarizes the transport parameters used to represent the two compounds.

6.3 INITIALIZING MASS IN PLACE

All transport simulations were conducted by predicting the change in contaminant distribution over time, beginning with "current" conditions. Current conditions were equated to concentrations measured in 2019 (Tetra Tech, 2020).

SECTION 7
FATE AND TRANSPORT MODEL SIMULATIONS

7.1 INTRODUCTION

The groundwater flow and solute transport models were used to predict the change in the 1,2,4-TCB and chlorobenzene plumes, and the associated discharge of mass into Dark Head Cove, over a 50-year period under two alternative scenarios. One scenario focused on pumping at the extraction wells discussed in Section 5.1; the other scenario assumed that there was no pumping, and the plumes were allowed to discharge to the cove or otherwise attenuate. Under both alternatives it was assumed that the three primary sources (former transformer rooms 2, 3, and 4) were removed and encircled by sheet pile walls left in place after site remediation (projected to occur in 2021).

In reviewing model predictions about plume behavior over time in the following sections, it is important to keep in mind that the predicted distributions of contamination, as reflected in the defined morphology of the plumes, are subject to varying degrees of uncertainty. Considerable portions of the defined plumes extend into areas in which no data (in the form of monitoring wells) is available to confirm or deny the presence of contamination. At the same time, some of these areas coincide with model-predicted zones of relatively low hydraulic conductivity. This apparent contradiction is most evident in the defined western 1,2,4-TCB plume. (See Section 7.3 for further discussion of this.) Contamination initialized in zones of low hydraulic conductivity will be more intransigent than contamination in zones of relatively high conductivity. This fact may be the reason, at least in part, for why some of the plumes are predicted to still remain at the end of the 50-year simulation period.

7.2 EASTERN AND WESTERN 1,2,4-TCB PLUMES

The predicted distribution of 1,2,4-TCB in model layers 1 through 4 after 25, 50, 75, and 100 years in the absence of pumping is presented in Figure 7-1 through 7-4, respectively. The predicted

distribution of 1,2,4-TCB after 25, 50, 75, and 100 years in model layers 1 through 4 under the pumping alternative (4.0 gpm) is presented in Figures 7-5 through 7-8. The predicted mass discharge of 1,2,4-TCB to the cove over the 100-year simulation period under each alternative is presented in Figure 7-9.

The model predicts that there will be substantial 1,2,4-TCB contamination still in place in the eastern plume after 100 years, both under the non-pumping and the pumping alternatives. The maximum concentration of 1,2,4-TCB in the eastern plume at the end of the 100 years is 663 ug/L (non-pumping alternative) and 582 ug/L (pumping alternative). This lingering contamination is due, in part, to the very high retardation coefficient associated with 1,2,4-TCB, which in these simulations ranges between 11 and 13 in most of the model domain.

The model also predicts discharge of a total of 6.2 pounds of 1,2,4-TCB to the cove from the combined plumes under the non-pumping alternative over the 100-year simulation period; a total of 1.8E-2 pounds of 1,2,4-TCB under the pumping alternative. Mass discharge without active pumping is predicted to be relatively steady over years seven to fifty at about 6.0E-2 pound of 1,2,4-TCB per year, gradually increasing to about 7.2E-2 pounds per year after 100 years. Predicted mass discharge to the cove under the pumping alternative increases each year after about year 20; the maximum discharge is about 6.0E-4 pounds per year of 1,2,4-TCB in year 100.

Under neither remediation scenario does the concentration of 1,2,4 TCB discharging to DHC decline to below 8 ug/L.

The reliability of model predictions for transport of the western 1,2,4-TCB plume is uncertain. Little change is predicted to the morphology of the plume after the first year or so of pumping. Under both alternatives, the model predicts the presence of an apparently stagnant zone of 1,2,4-TCB in the area of former transformer room 4. The model-developed distribution of hydraulic conductivity in the area of the western plume (see Figure 4-1) is inconsistent with the proposed shape of the western plume. Much of the defined plume is in model-defined zones with very low hydraulic conductivity. It is also noted that there is no data in the defined plume between the area very near the source (e.g., MRC-MW-113) and wells MRC-MW-134A/B. It may well be that the

proposed removal of source material at former transformer room 4 will be enough to eliminate any long-term issue with 1,2,4-TCB in this area.

7.3 EASTERN AND WESTERN CHLOROBENZENE PLUME

The predicted distribution of chlorobenzene after 25, 50, 75, and 100 years in model layers 1 through 4 in the absence of pumping is presented in Figures 7-10 through 7-13. The predicted distribution of chlorobenzene after 25, 50, 75, and 100 years in model layers 1 through 4 under the pumping alternative (1.0 gpm) is presented in Figures 7-14 through 7-17. The predicted mass discharge of chlorobenzene to the cove over the period under each alternative is presented in Figure 7-18.

The model predicts that there will be very little chlorobenzene still in place in the subsurface after 100 years, both under the non-pumping and the pumping alternatives. The maximum concentration of chlorobenzene in the eastern plume at the end of the 100 years is 17 ug/L (non-pumping alternative) and 10 ug/L (pumping alternative). Most of the remaining eastern plume mass in place is present upgradient of, and separate from, the extraction wells. This condition is likely related to the distribution of hydraulic conductivity within the defined plume.

The model predicts a combined discharge to the cove of a total of 1.3 pounds of chlorobenzene under the non-pumping alternative; a total of 3.5E-2 pounds of chlorobenzene under the pumping alternative. Mass discharge without active pumping steadily increases through the first 70 to 80 years; then begins to level off at about 1.7E-2 pounds per year. Under the pumping scenario, mass increases gradually over the first 70 to 80 years, then begins to decline. The predicted mass discharge at year 100 is approximately 4.5E-4 pounds per year.

Under neither remediation scenario does the concentration of chlorobenzene discharging to DHC exceed 30 ug/L.

SECTION 8
SUMMARY AND CONCLUSIONS

This report summarizes the revision, re-calibration, and predictive use of a groundwater flow and contaminant fate and transport model of a designated area within the Lockheed Martin Middle River Complex (MRC), located in Middle River, Maryland. The groundwater modeling was performed in support of a remediation conceptual design for addressing 1,2,4-TCB and chlorobenzene groundwater plumes located in Blocks E and F.

Two alternative scenarios were evaluated: a no-pumping alternative and an alternative in which the minimum pumping rate needed to contain the existing plumes was applied. Under both alternatives it was assumed that the estimated sources of soil contamination, located at former transformer rooms 2, 3, and 4, had been removed and the areas encircled by sheet pile walls extending part way into the subsurface.

The model predicts that there will still be substantial 1,2,4-TCB contamination in place in the subsurface after 100 years, both under the non-pumping and the pumping alternatives. This lingering contamination is due, in part, to the very high retardation coefficient associated with 1,2,4-TCB. The model also predicts discharge of a total of 6.2 pounds per year of 1,2,4-TCB to the river under the non-pumping alternative; a total of 1.8E-2 pounds per year under the pumping alternative. Under neither remediation scenario does the concentration of 1,2,4 TCB discharging to DHC decline to below 8 ug/L.

The reliability of model predictions for transport of the western 1,2,4-TCB plume is uncertain, as the model-developed distribution of hydraulic conductivity in the area of the western plume is inconsistent with the proposed shape of the western plume. Much of the plume is in zones with very low hydraulic conductivity. However, there is no data in the defined plume between the area very near the source and wells MRC-MW-134A/B.

The model predicts that there will be very little chlorobenzene still in place in the subsurface after 100 years, both under the non-pumping and the pumping alternatives. The model predicts a combined discharge to the cove of a total of 1.3 pounds of chlorobenzene under the non-pumping alternative; a total of 3.5E-2 pounds of chlorobenzene under the pumping alternative. Under neither remediation scenario does the concentration of chlorobenzene discharging to DHC exceed 30 ug/L.

SECTION 9
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FIGURES

Figure 1-1 Site Location

Figure 3-1 Model Grid and Boundary Conditions

Figure 4-1 Hydraulic Conductivity (ft/d) Distribution in the Calibrated Model

Figure 4-2 Estimated Distribution of Groundwater Recharge in the Calibrated Model

Figure 5-1 Specified Locations for Plume Extraction Wells.

Figure 6-1 Initial Distribution of 1,2,4 TCB in Model Layers 1 through 4

Figure 6-2 Initial Distribution of Chlorobenzene in Model Layers 1 through 4

Figure 7-1 Predicted Distribution of 1,2,4 TCB in the East and West Plumes After 25 Years Under the No Pumping Alternative in Model Layers 1 Through 4

Figure 7-2 Predicted Distribution of 1,2,4 TCB in the East and West Plumes After 50 Years Under the No Pumping Alternative in Model Layers 1 Through 4

Figure 7-3 Predicted Distribution of 1,2,4 TCB in the East and West Plumes After 75 Years Under the No Pumping Alternative in Model Layers 1 Through 4

Figure 7-4 Predicted Distribution of 1,2,4 TCB in the East and West Plumes After 100 Years Under the No Pumping Alternative in Model Layers 1 Through 4

Figure 7-5 Predicted Distribution of 1,2,4 TCB in the East and West Plumes After 25 Years Under the Pumping Alternative in Model Layers 1 Through 4

Figure 7-6 Predicted Distribution of 1,2,4 TCB in the East and West Plumes After 50 Years Under the Pumping Alternative in Model Layers 1 Through 4

Figure 7-7 Predicted Distribution of 1,2,4 TCB in the East and West Plumes After 75 Years Under the Pumping Alternative in Model Layers 1 Through 4

Figure 7-8 Predicted Distribution of 1,2,4 TCB in the East and West Plumes After 100 Years Under the Pumping Alternative in Model Layers 1 Through 4

Figure 7-9 Predicted Mass Discharge of 1,2,4 TCB to Dark Head Cove Over 100 Years Under (A) the No Pumping Alternative and (B) the Pumping Alternative

Figure 7-10 Predicted Distribution of Chlorobenzene in the East and West Plumes After 25 Years Under the No Pumping Alternative in Model Layers 1 Through 4

Figure 7-11 Predicted Distribution of Chlorobenzene in the East and West Plumes After 50 Years Under the No Pumping Alternative in Model Layers 1 Through 4

Figure 7-12 Predicted Distribution of Chlorobenzene in the East and West Plumes After 75 Years Under the No Pumping Alternative in Model Layers 1 Through 4

Figure 7-13 Predicted Distribution of Chlorobenzene in the East and West Plumes After 100 Years Under the No Pumping Alternative in Model Layers 1 Through 4

Figure 7-14 Predicted Distribution of Chlorobenzene in the East and West Plumes After 25 Years Under the Pumping Alternative in Model Layers 1 Through 4

Figure 7-15 Predicted Distribution of Chlorobenzene in the East and West Plumes After 50 Years Under the Pumping Alternative in Model Layers 1 Through 4

Figure 7-16 Predicted Distribution of Chlorobenzene in the East and West Plumes After 75 Years Under the Pumping Alternative in Model Layers 1 Through 4

Figure 7-17 Predicted Distribution of Chlorobenzene in the East and West Plumes After 100 Years Under the Pumping Alternative in Model Layers 1 Through 4

Figure 7-18 Predicted Mass Discharge of Chlorobenzene to Dark Head Cove Over 100 Years Under (A) the No Pumping Alternative and (B) the Pumping Alternative

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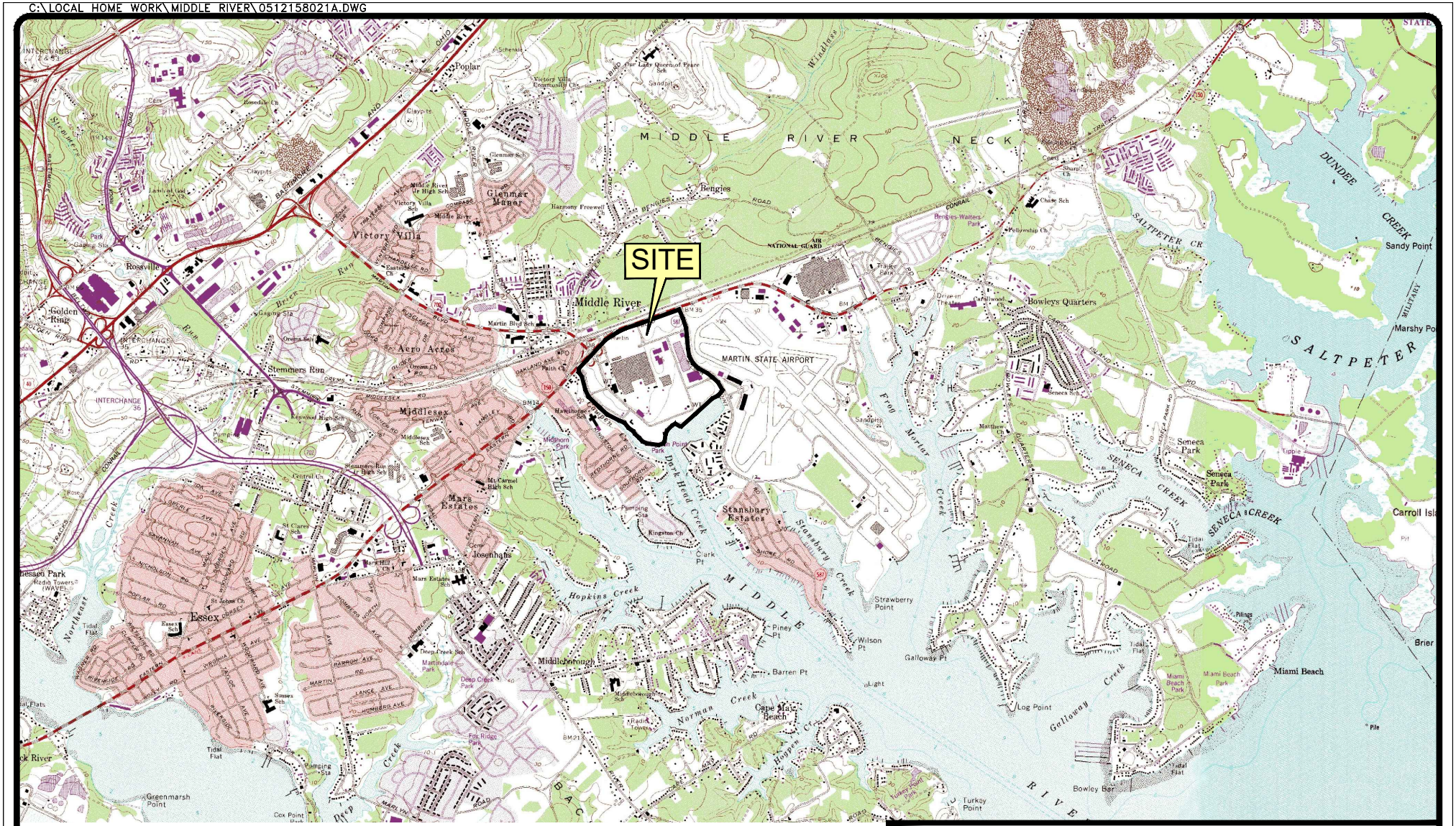

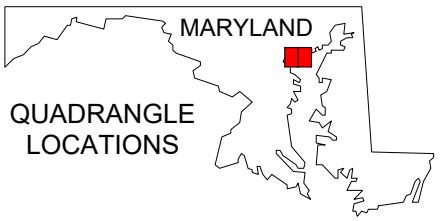

SOURCE:
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TITLE: SITE LOCATION MAP

LOCATION: Middle River Complex, Middle River, Maryland

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PROJECT#	117-0512158
DATE	4-17-20

FIGURE 1-1

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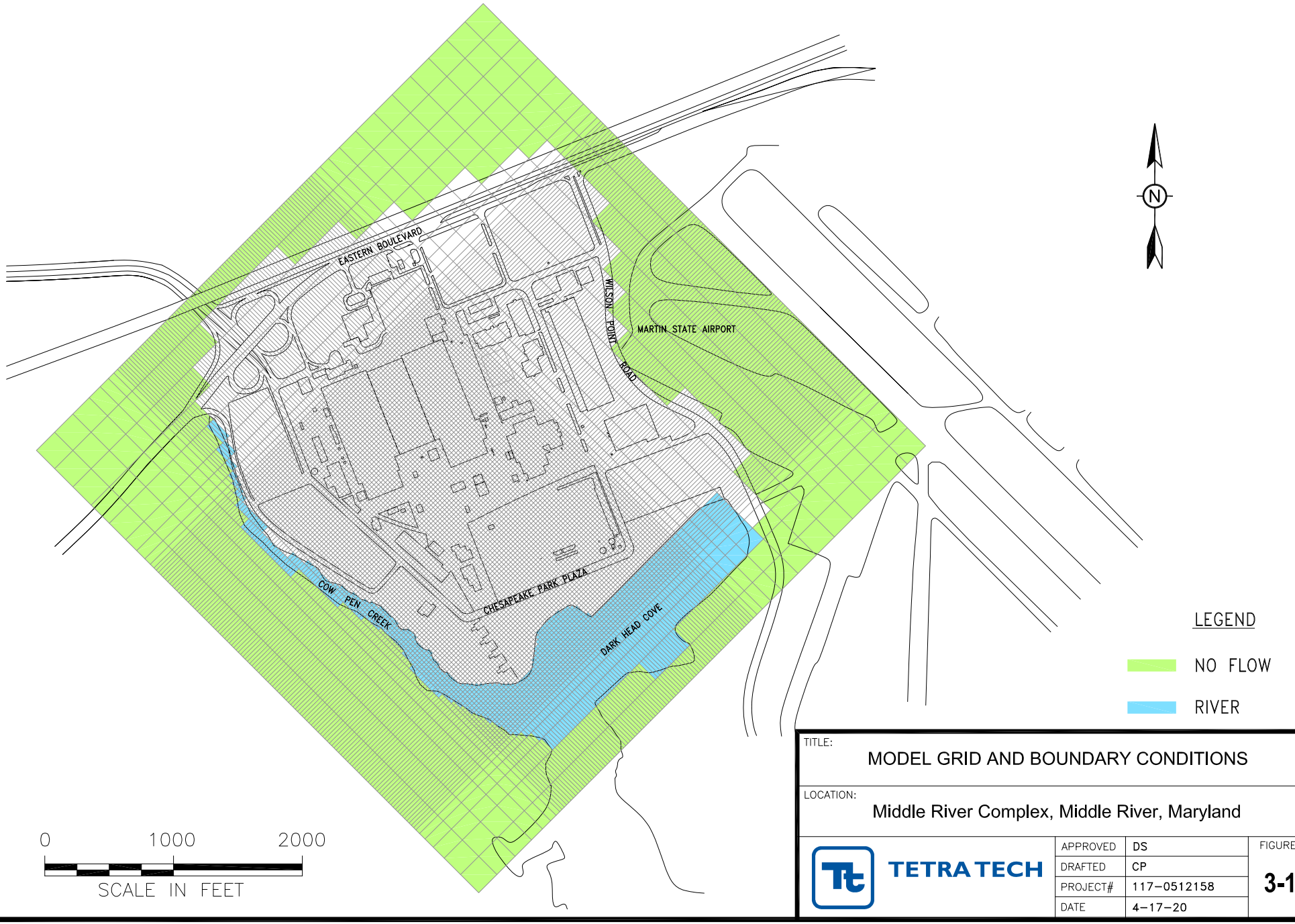

TITLE:
MODEL GRID AND BOUNDARY CONDITIONS

LOCATION:
Middle River Complex, Middle River, Maryland

TETRA TECH

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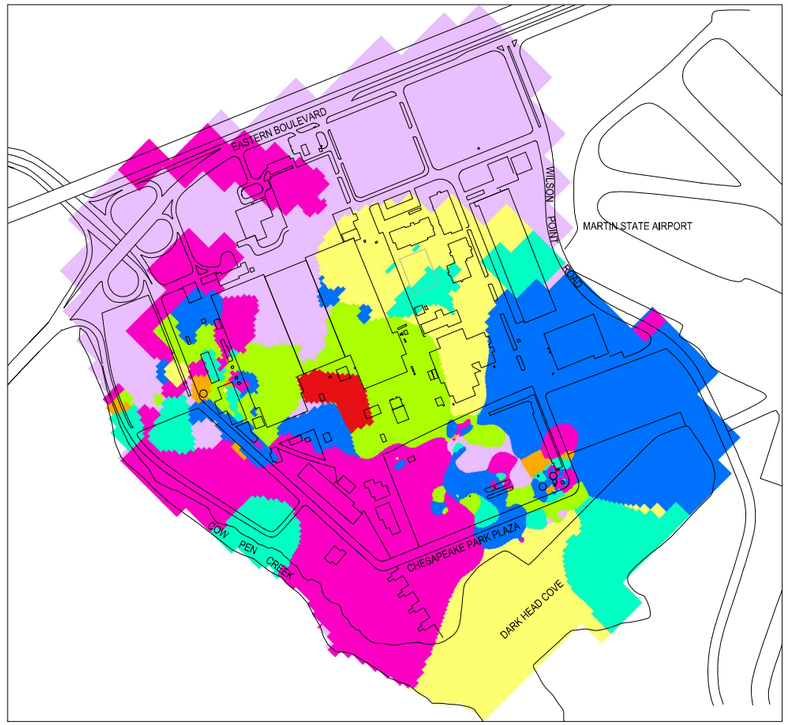
PROJECT#	117-0512158
DATE	4-17-20

FIGURE
3-1



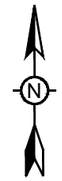
LAYER 1



LAYER 2



LAYER 3



Hydraulic Conductivity (ft/d)

- 0.02
- 0.021
- 0.10
- 0.34
- 0.50
- 0.66
- 1.□5
- 1.92

0 1000 2000

SCALE IN FEET

TITLE: HYDRAULIC CONDUCTIVITY (FT/D) DISTRIBUTION IN THE CALIBRATED MODEL IN LAYERS 1 THROUGH 3

LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

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PROJECT#	117-0512158
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FIGURE 4-1A

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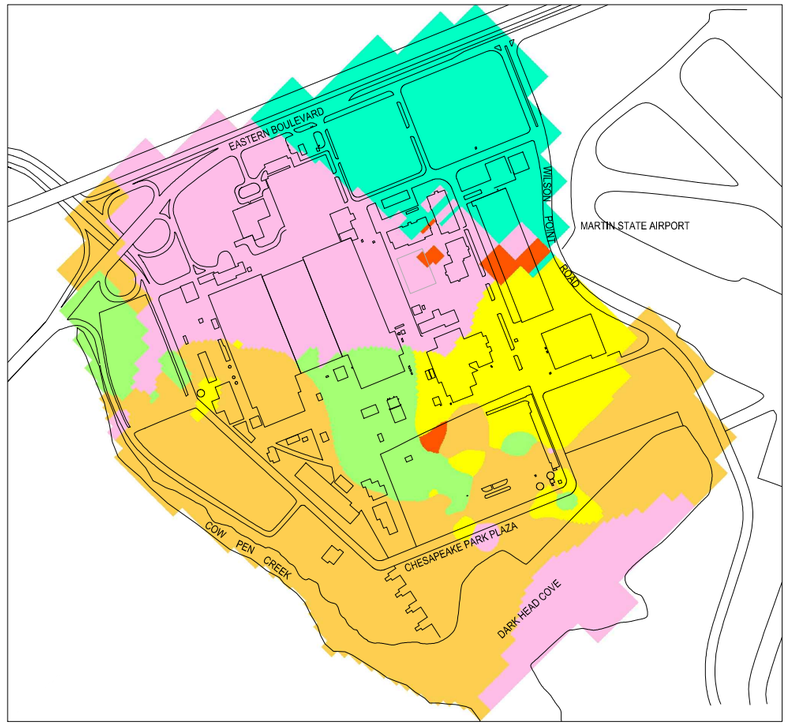


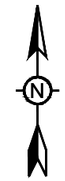
LAYER 4



LAYER 5



LAYER 6



Hydraulic Conductivity (ft/d)

- 0.03
- 0.10
- 0.13
- 0.23
- 0.44
- 2.17
- 50

0 1000 2000

SCALE IN FEET

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TITLE: HYDRAULIC CONDUCTIVITY (FT/D) DISTRIBUTION IN THE CALIBRATED MODEL IN LAYERS 4 THROUGH 6

LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

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FIGURE 4-1B



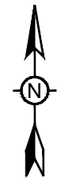
LAYER 7



LAYER 8



LAYER 9



Hydraulic Conductivity (ft/d)

- 0.01
- 0.10
- 1.00
- 2.40
- 3.1□
- 33

0 1000 2000

SCALE IN FEET

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TITLE: HYDRAULIC CONDUCTIVITY (FT/D) DISTRIBUTION IN THE CALIBRATED MODEL IN LAYERS 7 THROUGH 9

LOCATION: Middle River Complex, Middle River, Maryland

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DATE	4-17-20

FIGURE 4-1C

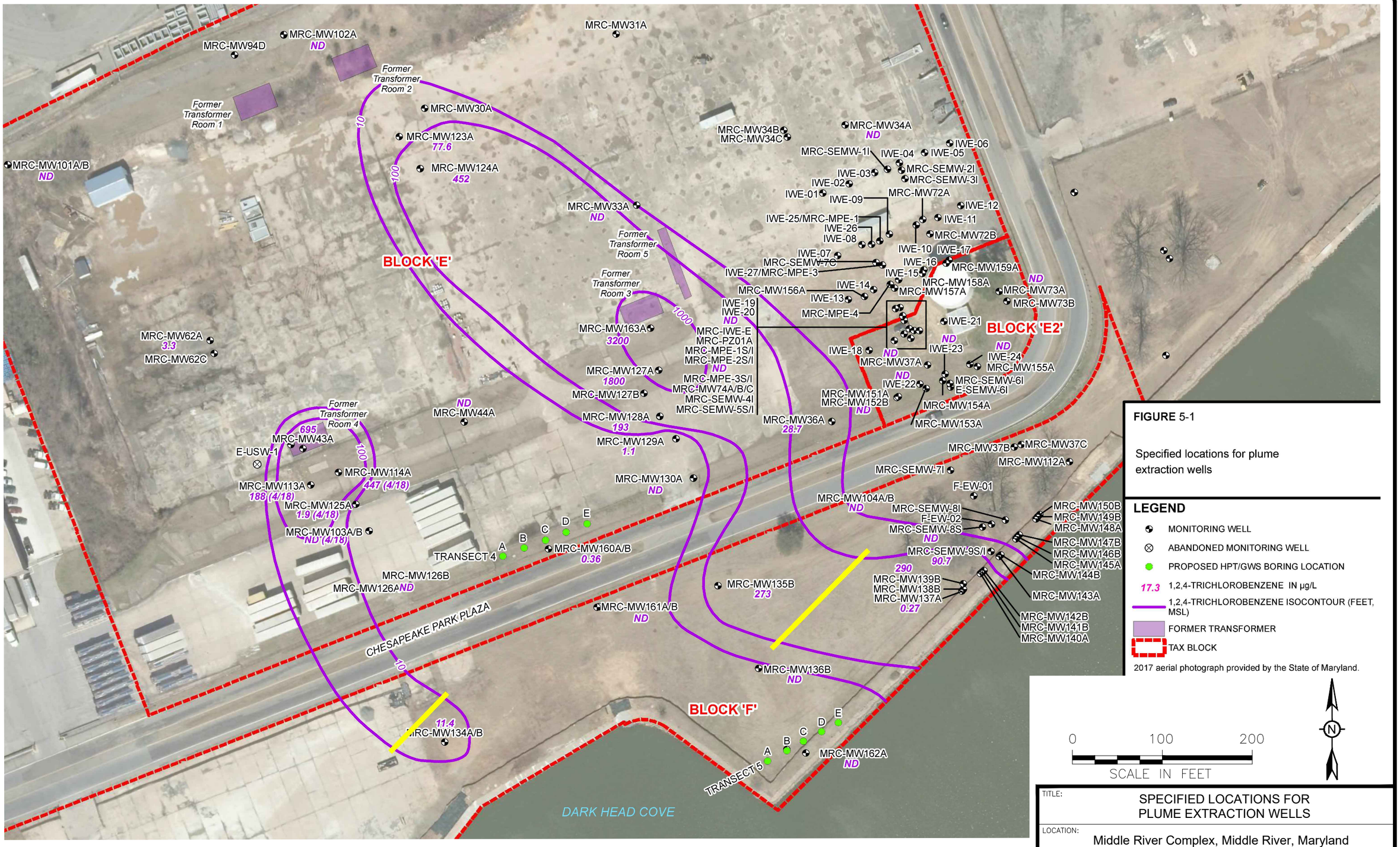

FIGURE 5-1

Specified locations for plume extraction wells

LEGEND

- MONITORING WELL
- ABANDONED MONITORING WELL
- PROPOSED HPT/GWS BORING LOCATION
- 17.3 1,2,4-TRICHLOROBENZENE IN µg/L
- 1,2,4-TRICHLOROBENZENE ISOCONTOUR (FEET, MSL)
- FORMER TRANSFORMER
- TAX BLOCK

2017 aerial photograph provided by the State of Maryland.

0 100 200

SCALE IN FEET

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TITLE: SPECIFIED LOCATIONS FOR PLUME EXTRACTION WELLS

LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

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PROJECT#	117-0512158
DATE	4-17-20

FIGURE 5-1

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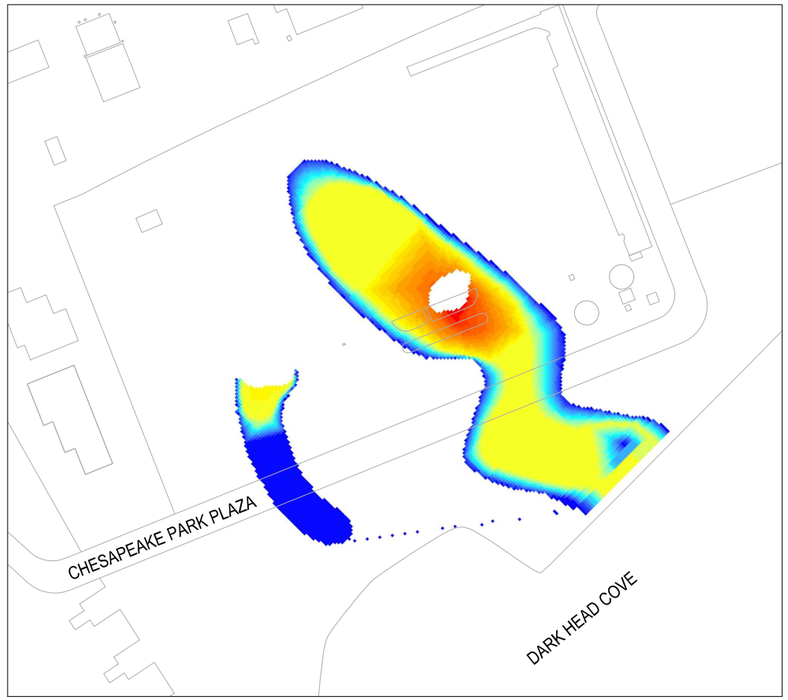
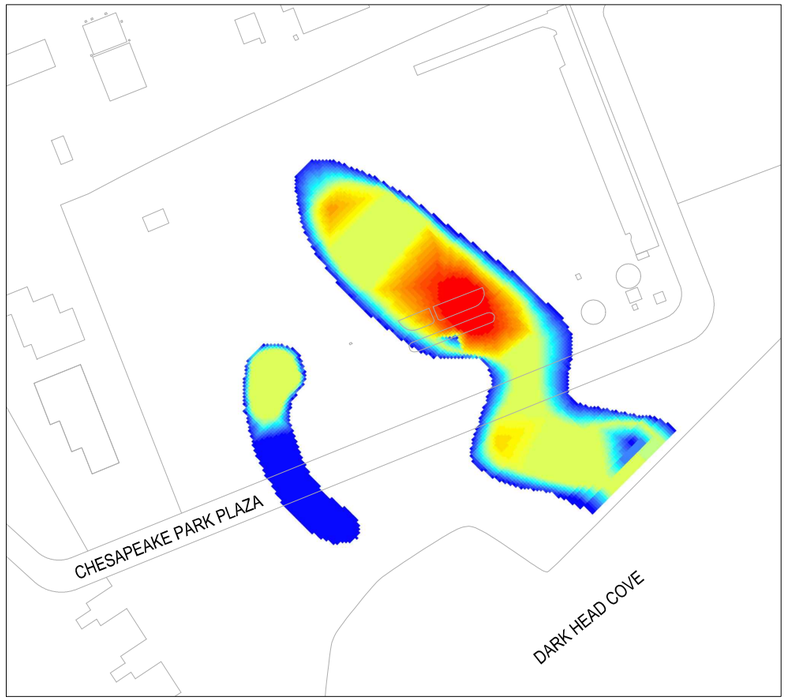
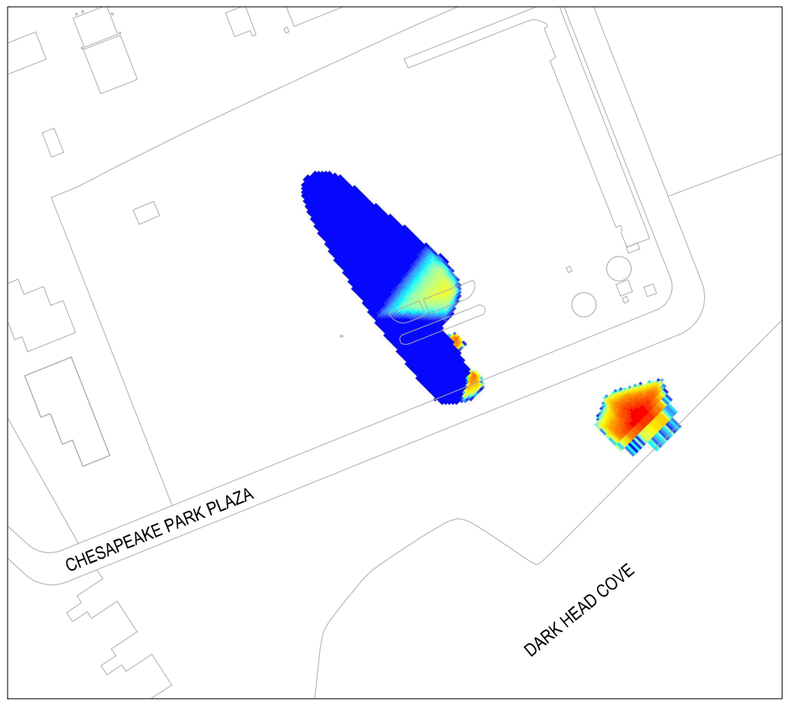


LAYER 1



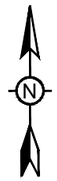
LAYER 2



LAYER 3



LAYER 4



1,2,4-TCB Concentration (μg/L)

- 10.00 - 11.96
- 11.97 - 15.48
- 15.49 - 19.01
- 19.02 - 22.64
- 22.65 - 26.63
- 26.64 - 31.09
- 31.10 - 35.85
- 35.86 - 40.83
- 40.84 - 46.09
- 46.10 - 51.22
- 51.23 - 56.40
- 56.41 - 61.35
- 61.36 - 65.92
- 65.93 - 70.88
- 70.89 - 76.08
- 76.09 - 80.94
- 80.95 - 85.55
- 85.56 - 89.92
- 89.93 - 94.22
- 94.23 - 98.87
- 98.88 - 137.57
- 137.58 - 219.70
- 219.71 - 312.48
- 312.49 - 409.97
- 409.98 - 516.36
- 516.37 - 640.71
- 640.72 - 775.19
- 775.20 - 925.88
- 925.89 - 1145.74
- 1145.75 - 1441.63
- 1441.64 - 1786.23
- 1786.24 - 2423.50

0 300 600

SCALE IN FEET

TITLE: INITIAL DISTRIBUTION OF 1,2,4-TCB IN MODEL LAYERS 1 THROUGH 4

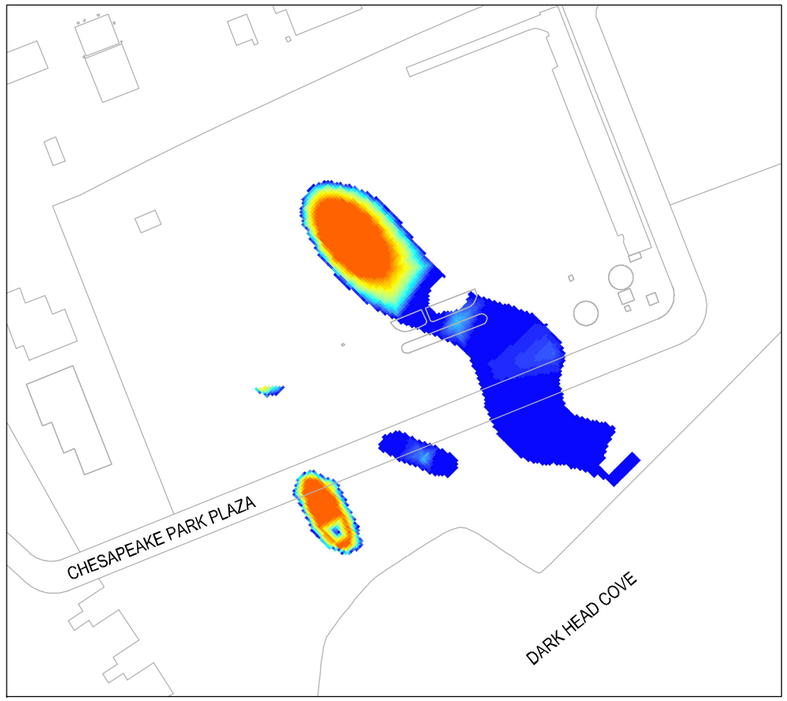
LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

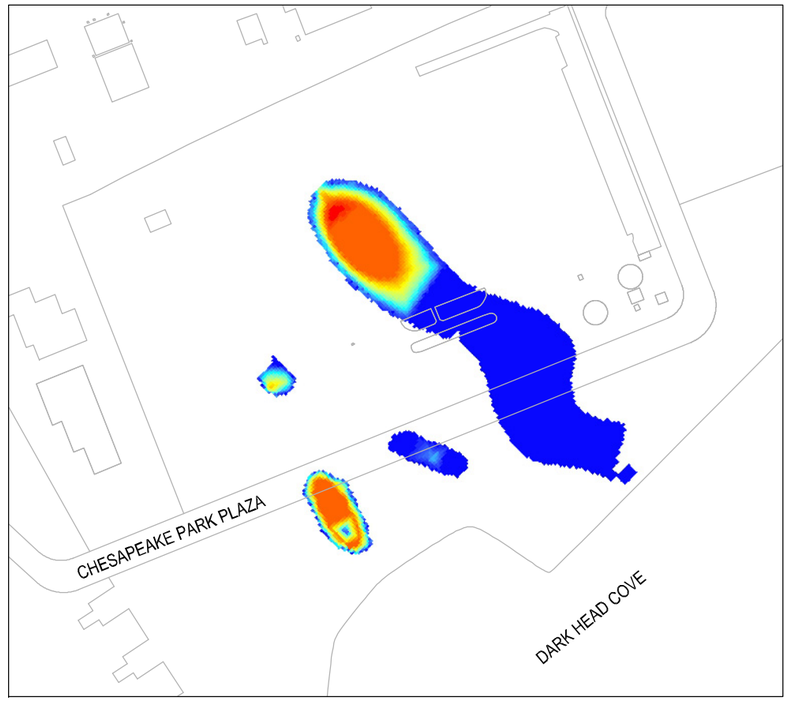
APPROVED	DS
DRAFTED	CP
PROJECT#	117-0512158
DATE	4-14-20

FIGURE 6-1

C:\LOCAL_HOME\WORK\MIDDLE_RIVER\0512158029A.DWG



LAYER 1



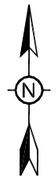
LAYER 2



LAYER 3



LAYER 4



Chlorobenzene Concentration (μg/L)

- 10.00 - 11.36
- 11.37 - 13.72
- 13.73 - 15.38
- 15.39 - 17.14
- 17.15 - 18.97
- 18.98 - 20.65
- 20.66 - 22.64
- 22.65 - 24.98
- 24.99 - 27.20
- 27.21 - 29.91
- 29.92 - 32.83
- 32.84 - 36.05
- 36.06 - 38.97
- 38.98 - 42.09
- 42.10 - 45.13
- 45.14 - 48.72
- 48.73 - 52.18
- 52.19 - 55.75
- 55.76 - 59.92
- 59.93 - 63.92
- 63.93 - 67.64
- 67.65 - 72.02
- 72.03 - 76.02
- 76.03 - 79.89
- 79.90 - 84.69
- 84.70 - 89.18
- 89.19 - 93.48
- 93.49 - 98.05
- 98.06 - 120.11
- 120.12 - 167.39
- 167.40 - 217.46
- 217.47 - 299.07

0 300 600

SCALE IN FEET

TITLE: INITIAL DISTRIBUTION OF CHLOROBENZENE IN MODEL LAYERS 1 THROUGH 4

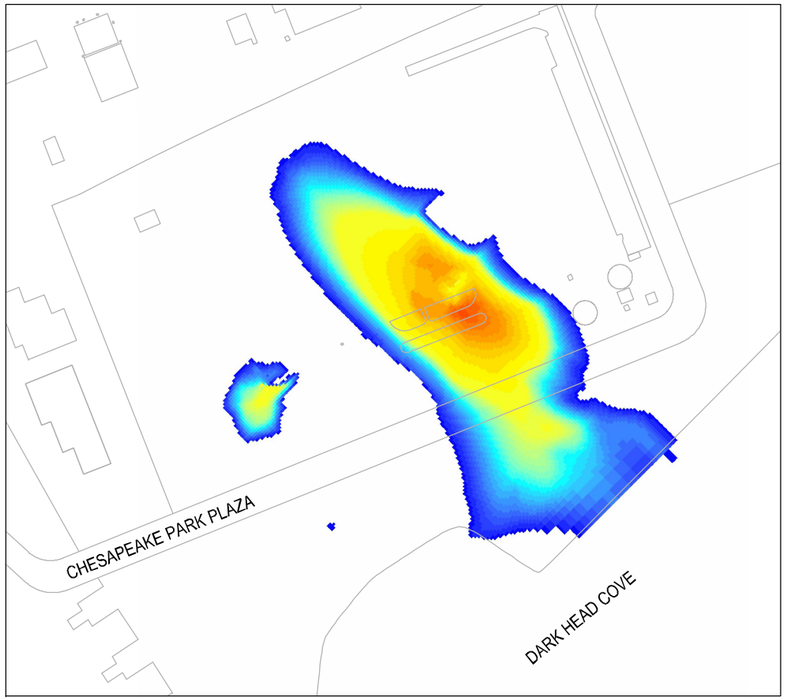
LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

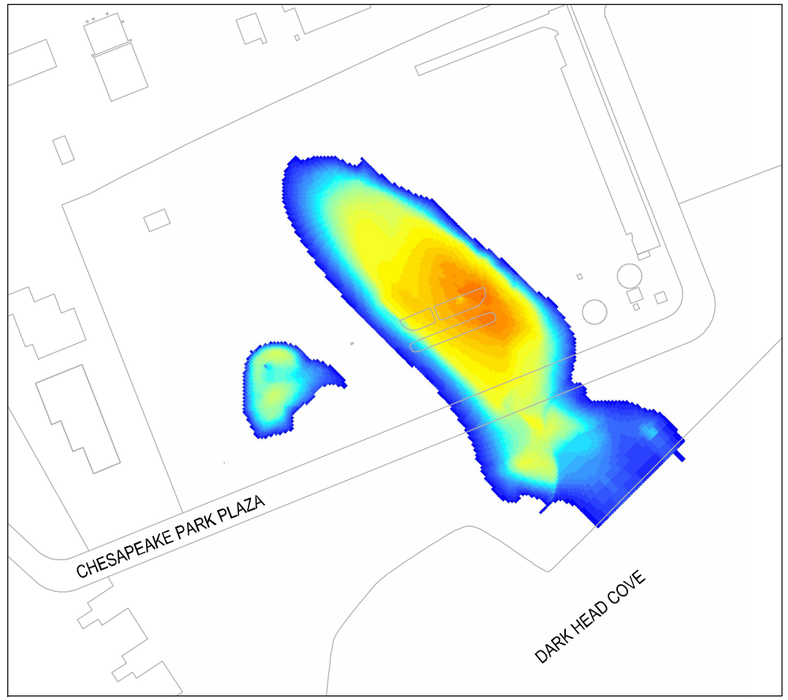
APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 6-2

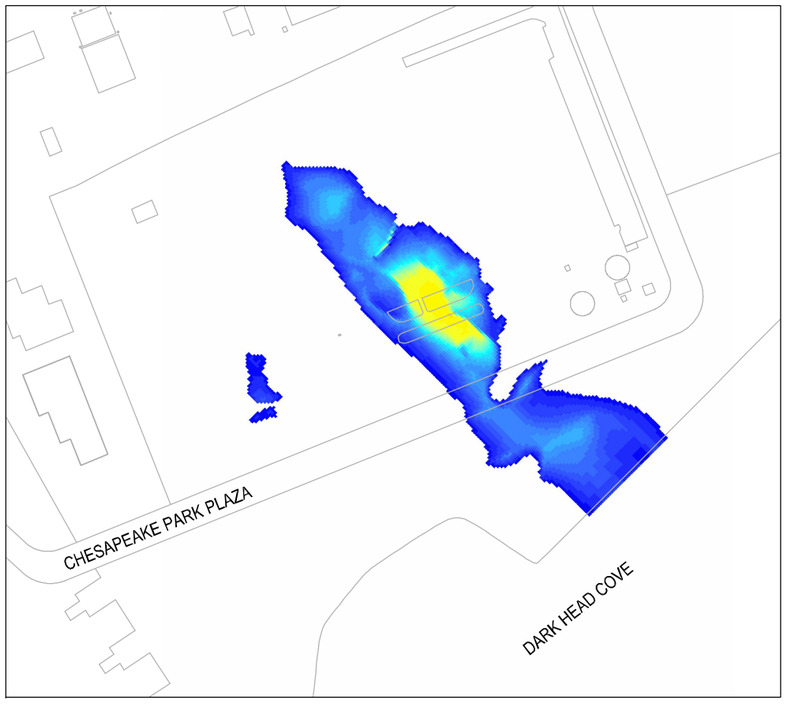
P:\ACAD\0512-158-MRIV\0512158059A.DWG



LAYER 1



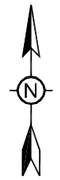
LAYER 2



LAYER 3



LAYER 4



1,2,4-TCB Concentration (μg/L)

- 10.00 - 11.96
- 11.97 - 15.48
- 15.49 - 19.01
- 19.02 - 22.64
- 22.65 - 26.63
- 26.64 - 31.09
- 31.10 - 35.85
- 35.86 - 40.83
- 40.84 - 46.09
- 46.10 - 51.22
- 51.23 - 56.40
- 56.41 - 61.35
- 61.36 - 65.92
- 65.93 - 70.88
- 70.89 - 76.08
- 76.09 - 80.94
- 80.95 - 85.55
- 85.56 - 89.92
- 89.93 - 94.22
- 94.23 - 98.87
- 98.88 - 137.57
- 137.58 - 219.70
- 219.71 - 312.48
- 312.49 - 409.97
- 409.98 - 516.36
- 516.37 - 640.71
- 640.72 - 775.19
- 775.20 - 925.88
- 925.89 - 1145.74
- 1145.75 - 1441.63
- 1441.64 - 1786.23
- 1786.24 - 2423.50

0 300 600

SCALE IN FEET

TITLE: PREDICTED DISTRIBUTION OF 1,2,4-TCB IN THE EAST AND WEST PLUMES AFTER 25 YEARS UNDER THE NO PUMPING ALTERNATIVE IN MODEL LAYERS 1 THROUGH 4

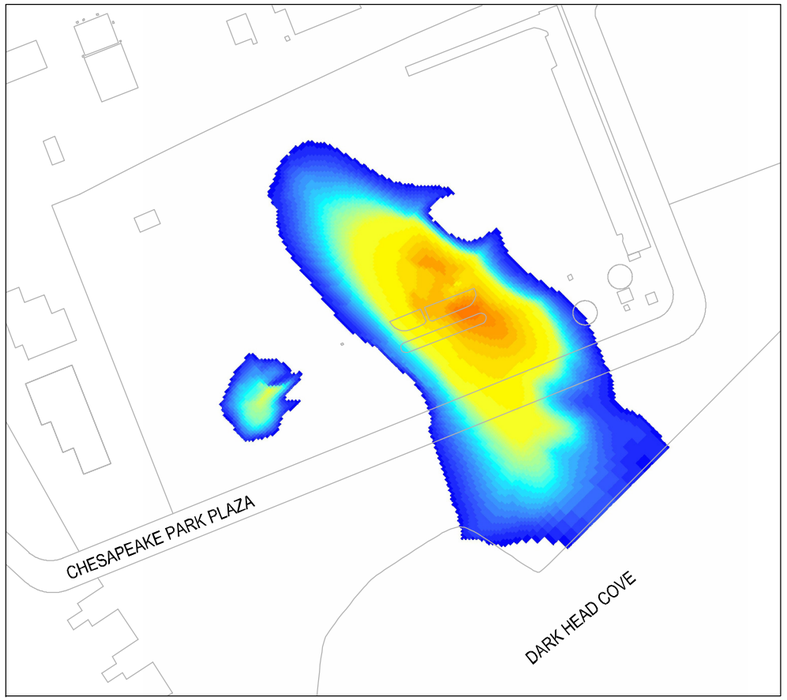
LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

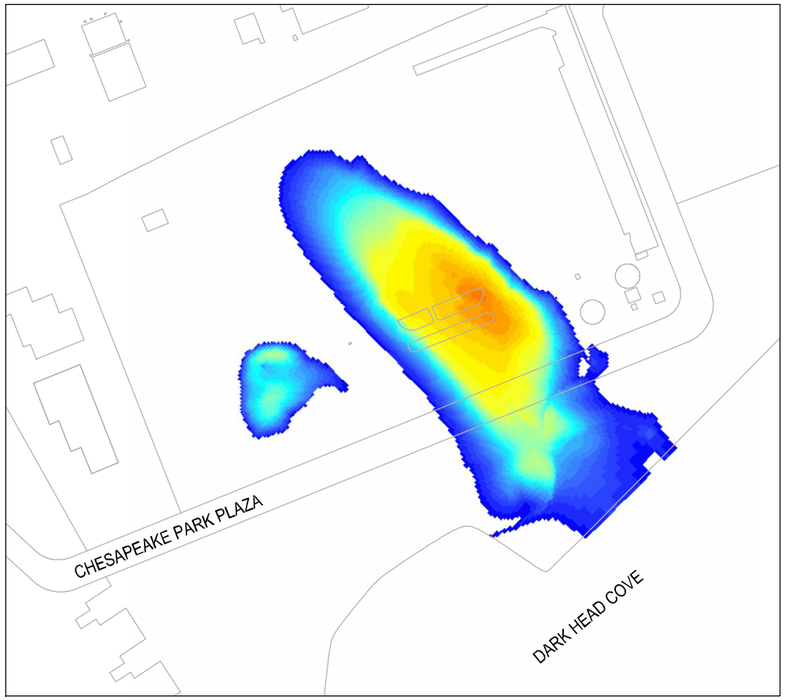
APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-1

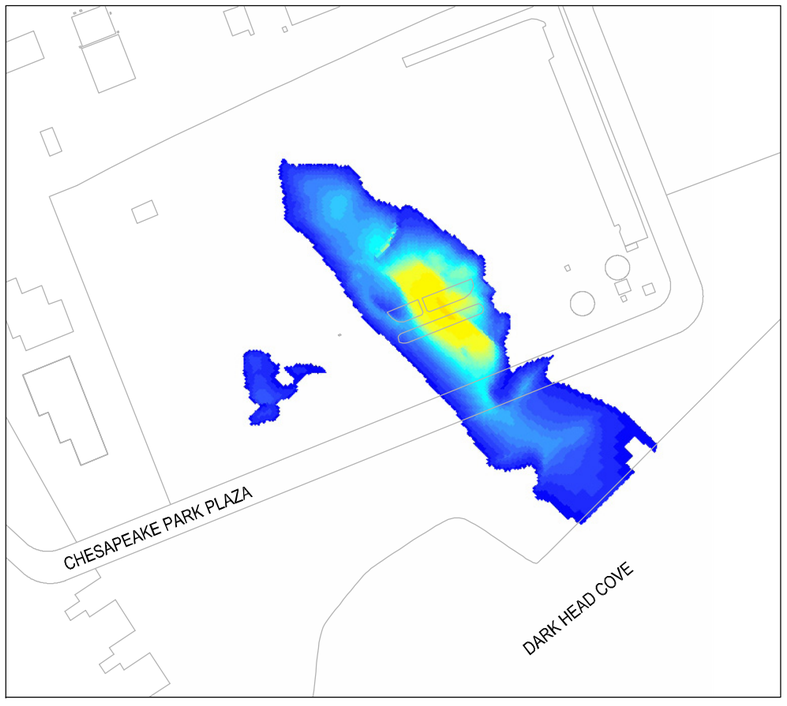
P:\ACAD\0512-158-MRIV\0512158043A.DWG



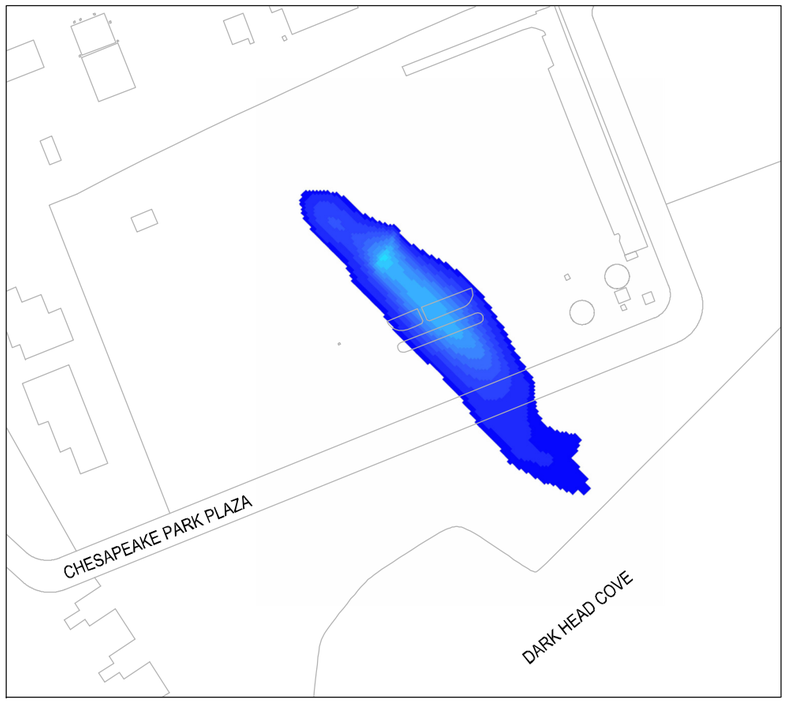
LAYER 1



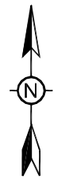
LAYER 2



LAYER 3



LAYER 4



1,2,4-TCB Concentration (μg/L)

- 10.00 - 11.96
- 11.97 - 15.48
- 15.49 - 19.01
- 19.02 - 22.64
- 22.65 - 26.63
- 26.64 - 31.09
- 31.10 - 35.85
- 35.86 - 40.83
- 40.84 - 46.09
- 46.10 - 51.22
- 51.23 - 56.40
- 56.41 - 61.35
- 61.36 - 65.92
- 65.93 - 70.88
- 70.89 - 76.08
- 76.09 - 80.94
- 80.95 - 85.55
- 85.56 - 89.92
- 89.93 - 94.22
- 94.23 - 98.87
- 98.88 - 137.57
- 137.58 - 219.70
- 219.71 - 312.48
- 312.49 - 409.97
- 409.98 - 516.36
- 516.37 - 640.71
- 640.72 - 775.19
- 775.20 - 925.88
- 925.89 - 1145.74
- 1145.75 - 1441.63
- 1441.64 - 1786.23
- 1786.24 - 2423.50

0 300 600

SCALE IN FEET

TITLE: PREDICTED DISTRIBUTION OF 1,2,4-TCB IN THE EAST AND WEST PLUMES AFTER 50 YEARS UNDER THE NO PUMPING ALTERNATIVE IN MODEL LAYERS 1 THROUGH 4

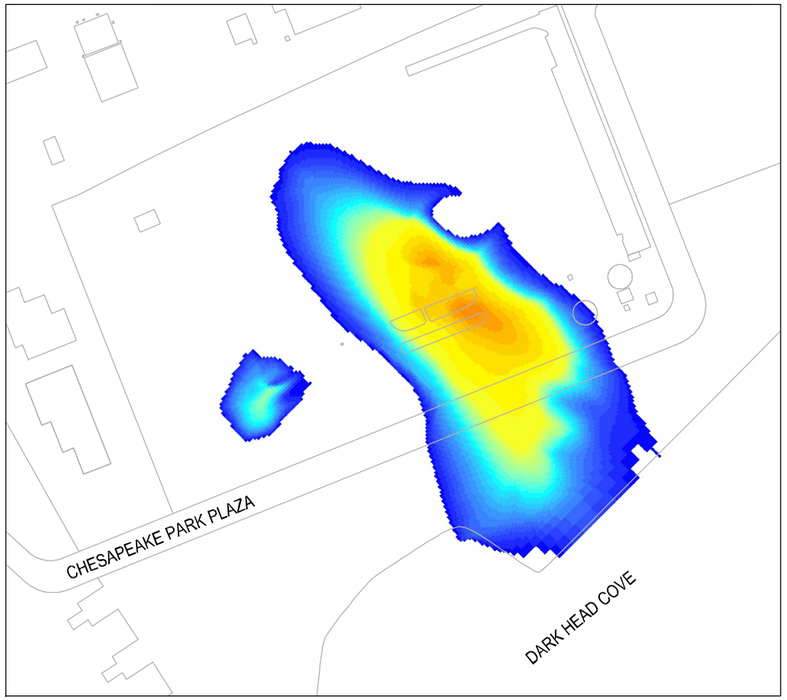
LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

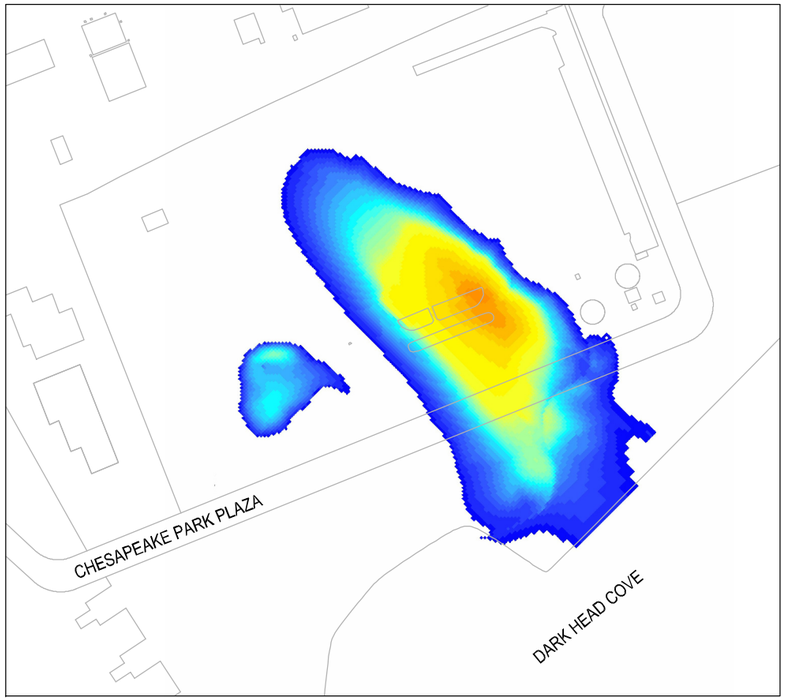
APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-2

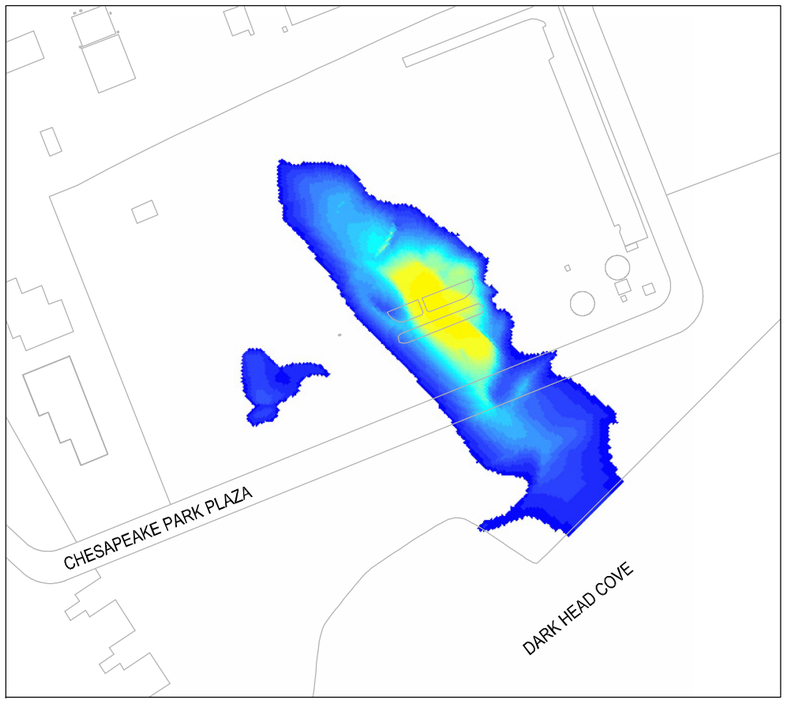
P:\ACAD\0512-158-MRIV\0512158044A.DWG



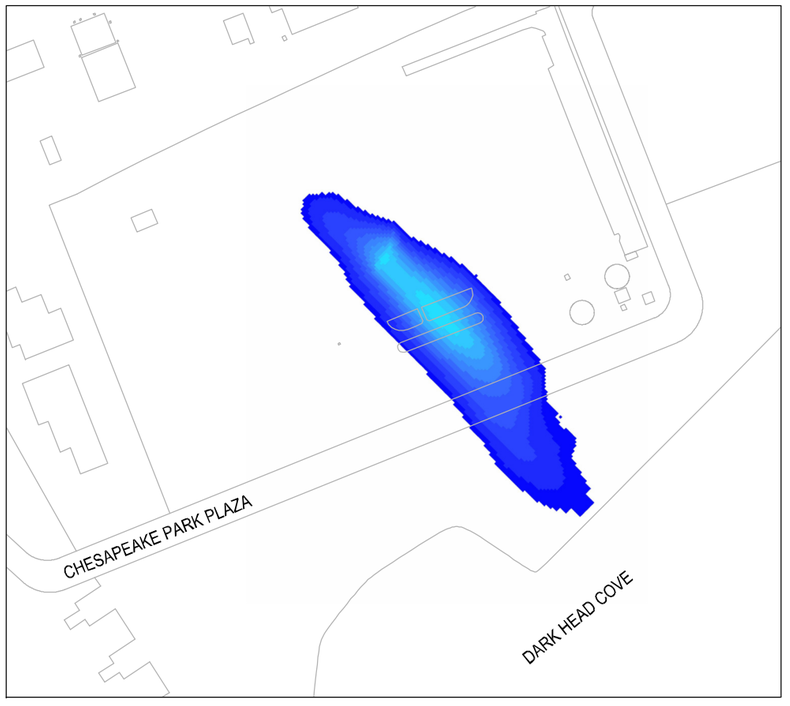
LAYER 1



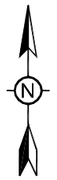
LAYER 2



LAYER 3



LAYER 4



1,2,4-TCB Concentration (μg/L)

- 10.00 - 11.96
- 11.97 - 15.48
- 15.49 - 19.01
- 19.02 - 22.64
- 22.65 - 26.63
- 26.64 - 31.09
- 31.10 - 35.85
- 35.86 - 40.83
- 40.84 - 46.09
- 46.10 - 51.22
- 51.23 - 56.40
- 56.41 - 61.35
- 61.36 - 65.92
- 65.93 - 70.88
- 70.89 - 76.08
- 76.09 - 80.94
- 80.95 - 85.55
- 85.56 - 89.92
- 89.93 - 94.22
- 94.23 - 98.87
- 98.88 - 137.57
- 137.58 - 219.70
- 219.71 - 312.48
- 312.49 - 409.97
- 409.98 - 516.36
- 516.37 - 640.71
- 640.72 - 775.19
- 775.20 - 925.88
- 925.89 - 1145.74
- 1145.75 - 1441.63
- 1441.64 - 1786.23
- 1786.24 - 2423.50

0 300 600

SCALE IN FEET

TITLE: PREDICTED DISTRIBUTION OF 1,2,4-TCB IN THE EAST AND WEST PLUMES AFTER 75 YEARS UNDER THE NO PUMPING ALTERNATIVE IN MODEL LAYERS 1 THROUGH 4

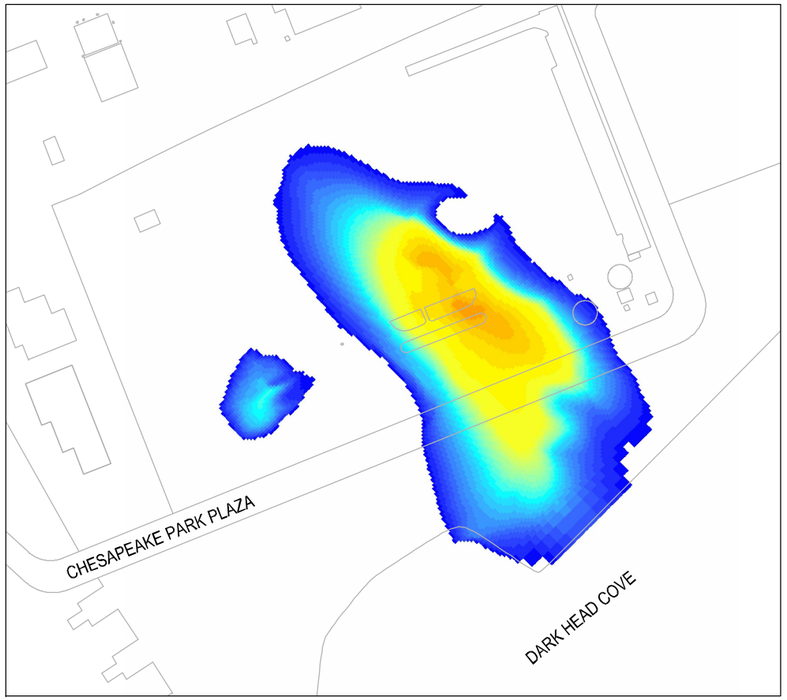
LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

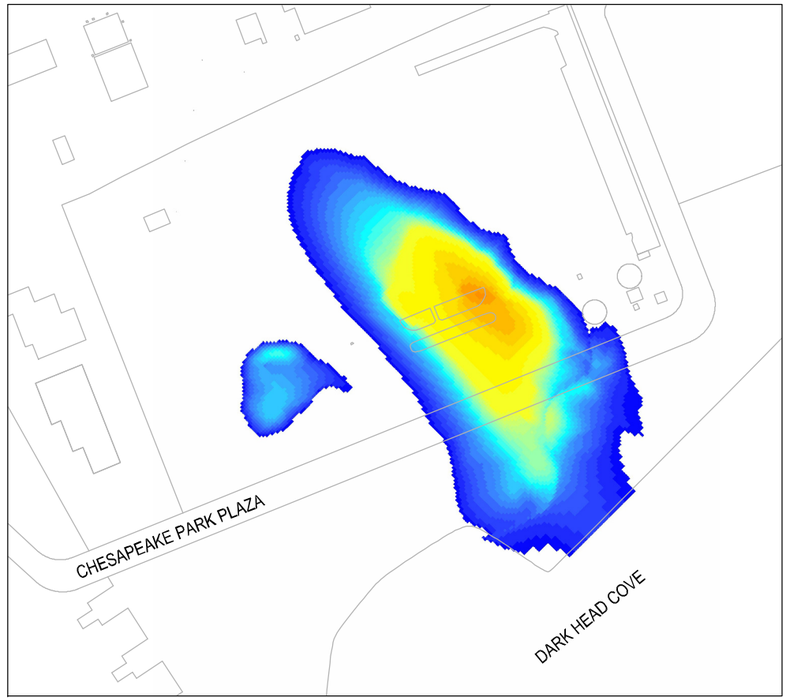
APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-3

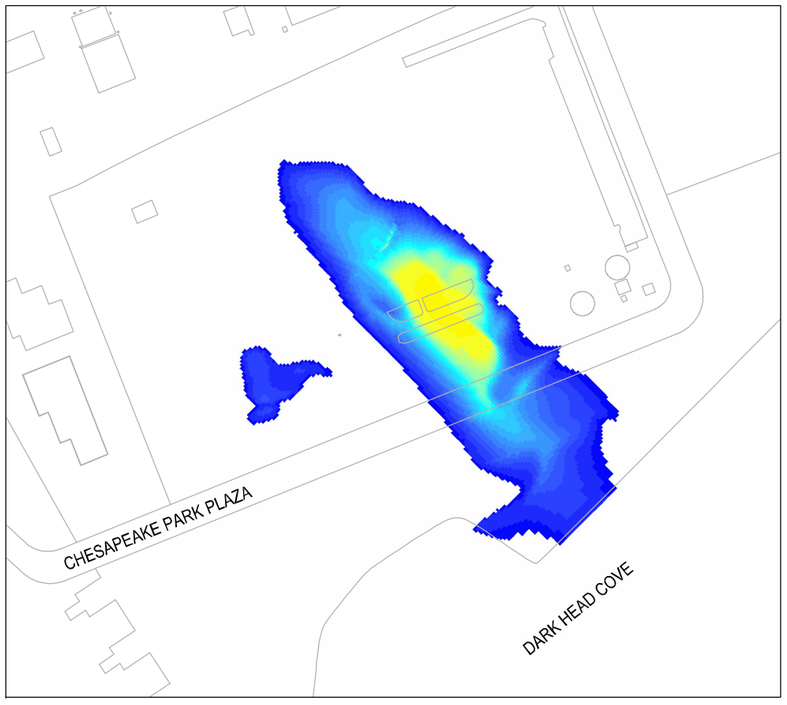
P:\ACAD\0512-158-MRIV\0512158045A.DWG



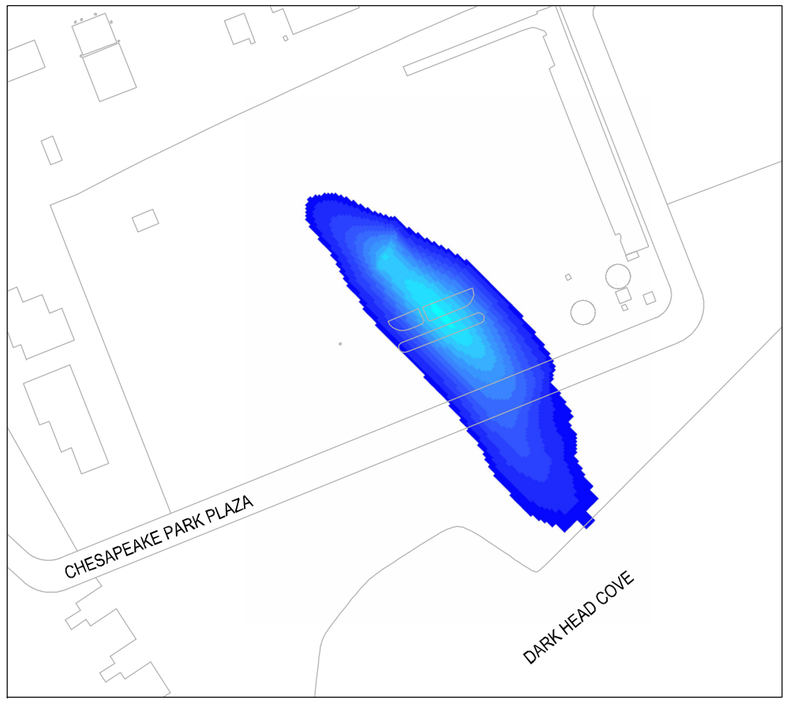
LAYER 1



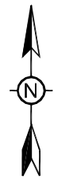
LAYER 2



LAYER 3



LAYER 4



1,2,4-TCB Concentration (μg/L)

- 10.00 - 11.96
- 11.97 - 15.48
- 15.49 - 19.01
- 19.02 - 22.64
- 22.65 - 26.63
- 26.64 - 31.09
- 31.10 - 35.85
- 35.86 - 40.83
- 40.84 - 46.09
- 46.10 - 51.22
- 51.23 - 56.40
- 56.41 - 61.35
- 61.36 - 65.92
- 65.93 - 70.88
- 70.89 - 76.08
- 76.09 - 80.94
- 80.95 - 85.55
- 85.56 - 89.92
- 89.93 - 94.22
- 94.23 - 98.87
- 98.88 - 137.57
- 137.58 - 219.70
- 219.71 - 312.48
- 312.49 - 409.97
- 409.98 - 516.36
- 516.37 - 640.71
- 640.72 - 775.19
- 775.20 - 925.88
- 925.89 - 1145.74
- 1145.75 - 1441.63
- 1441.64 - 1786.23
- 1786.24 - 2423.50

0 300 600

SCALE IN FEET

TITLE: PREDICTED DISTRIBUTION OF 1,2,4-TCB IN THE EAST AND WEST PLUMES AFTER 100 YEARS UNDER THE NO PUMPING ALTERNATIVE IN MODEL LAYERS 1 THROUGH 4

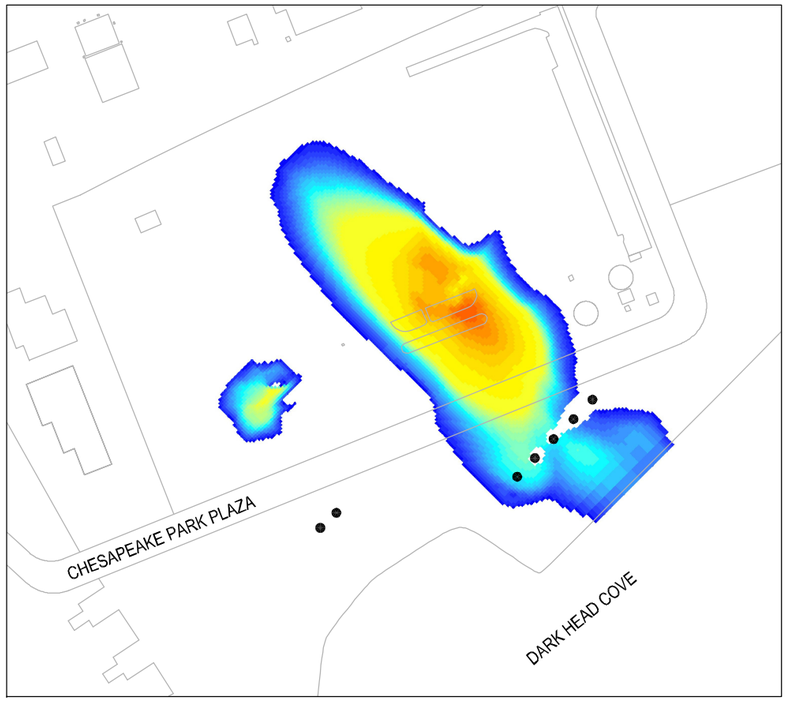
LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

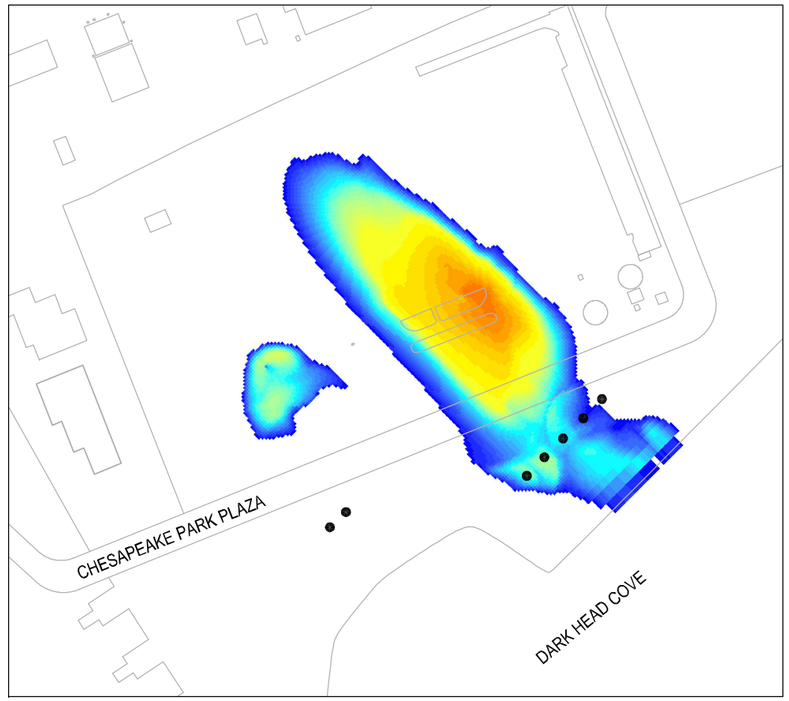
APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-4

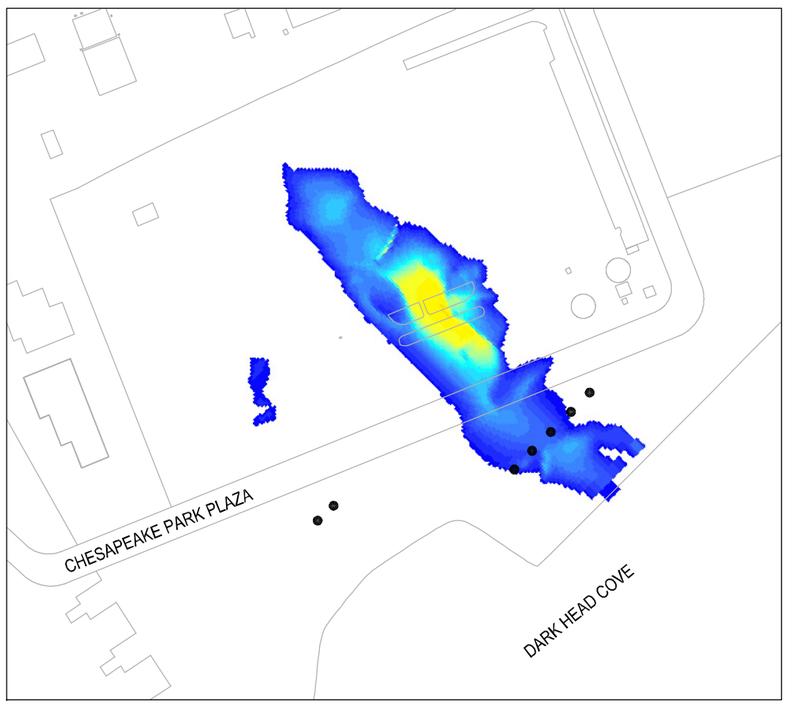
P:\ACAD\0512-158-MRIV\0512158046A.DWG



LAYER 1



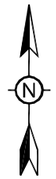
LAYER 2



LAYER 3



LAYER 4



1,2,4-TCB Concentration (μg/L)

- 10.00 - 11.96
- 11.97 - 15.48
- 15.49 - 19.01
- 19.02 - 22.64
- 22.65 - 26.63
- 26.64 - 31.09
- 31.10 - 35.85
- 35.86 - 40.83
- 40.84 - 46.09
- 46.10 - 51.22
- 51.23 - 56.40
- 56.41 - 61.35
- 61.36 - 65.92
- 65.93 - 70.88
- 70.89 - 76.08
- 76.09 - 80.94
- 80.95 - 85.55
- 85.56 - 89.92
- 89.93 - 94.22
- 94.23 - 98.87
- 98.88 - 137.57
- 137.58 - 219.70
- 219.71 - 312.48
- 312.49 - 409.97
- 409.98 - 516.36
- 516.37 - 640.71
- 640.72 - 775.19
- 775.20 - 925.88
- 925.89 - 1145.74
- 1145.75 - 1441.63
- 1441.64 - 1786.23
- 1786.24 - 2423.50

LEGEND

- PROPOSED EXTRACTION WELL

0 300 600

SCALE IN FEET

TITLE: PREDICTED DISTRIBUTION OF 1,2,4-TCB IN THE AND WEST PLUMES AFTER 25 YEARS UNDER THE PUMPING ALTERNATIVE (4.0 GPM) IN MODEL LAYERS 1 THROUGH 4

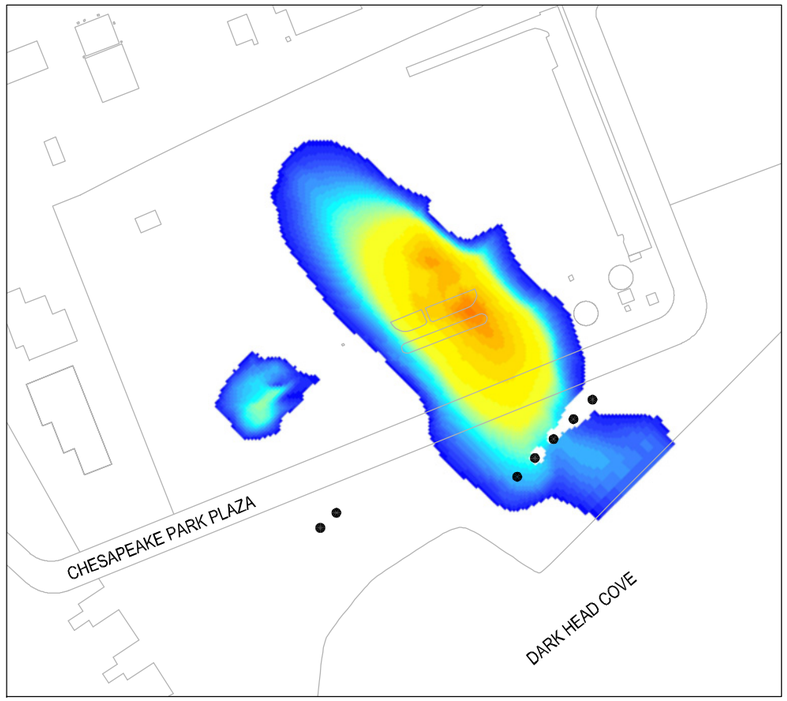
LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

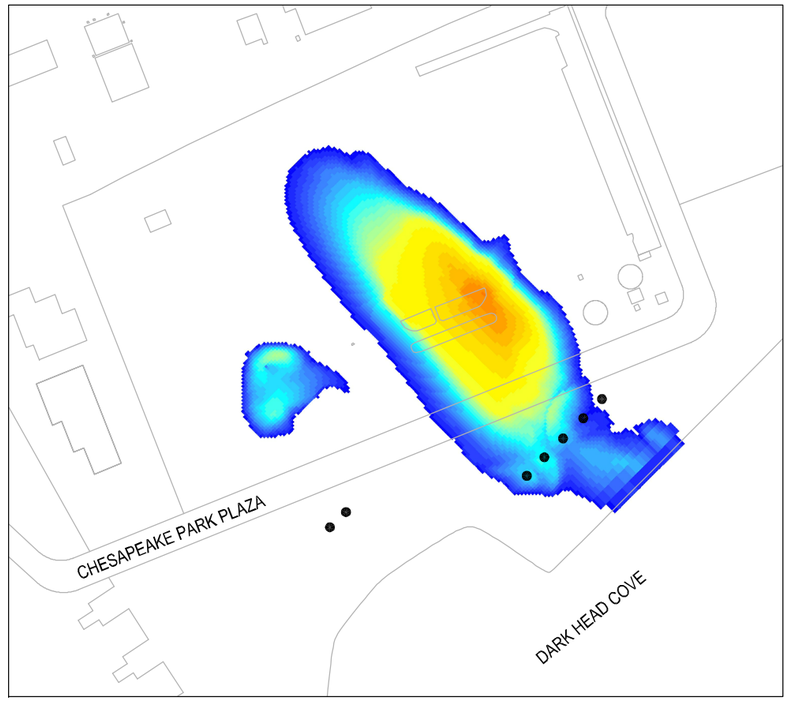
APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-5

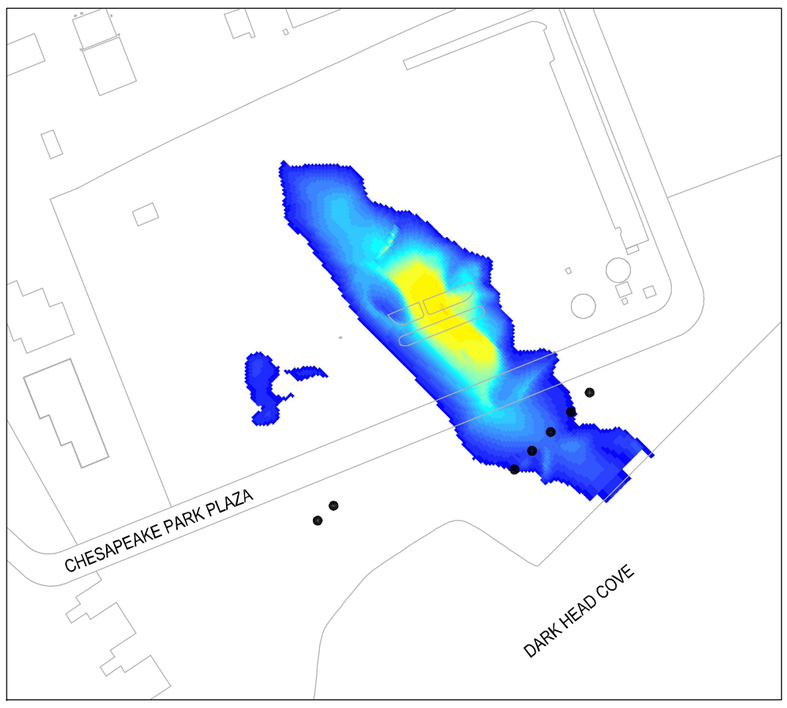
P:\ACAD\0512-158-MRIV\0512158047A.DWG



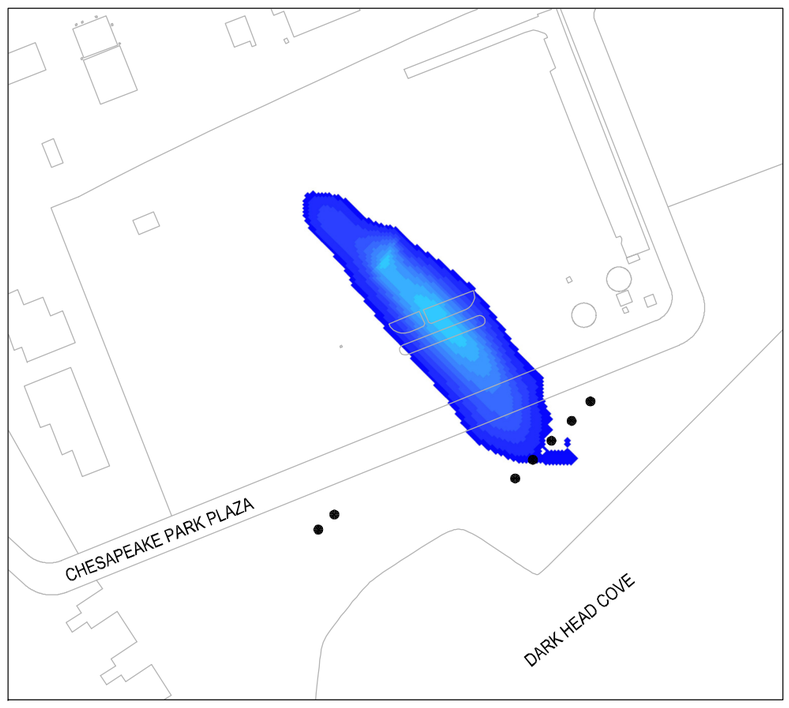
LAYER 1



LAYER 2



LAYER 3



LAYER 4

N

1,2,4-TCB Concentration (μg/L)

- 10.00 - 11.96
- 11.97 - 15.48
- 15.49 - 19.01
- 19.02 - 22.64
- 22.65 - 26.63
- 26.64 - 31.09
- 31.10 - 35.85
- 35.86 - 40.83
- 40.84 - 46.09
- 46.10 - 51.22
- 51.23 - 56.40
- 56.41 - 61.35
- 61.36 - 65.92
- 65.93 - 70.88
- 70.89 - 76.08
- 76.09 - 80.94
- 80.95 - 85.55
- 85.56 - 89.92
- 89.93 - 94.22
- 94.23 - 98.87
- 98.88 - 137.57
- 137.58 - 219.70
- 219.71 - 312.48
- 312.49 - 409.97
- 409.98 - 516.36
- 516.37 - 640.71
- 640.72 - 775.19
- 775.20 - 925.88
- 925.89 - 1145.74
- 1145.75 - 1441.63
- 1441.64 - 1786.23
- 1786.24 - 2423.50

LEGEND

● PROPOSED EXTRACTION WELL

0 300 600

SCALE IN FEET

TITLE: PREDICTED DISTRIBUTION OF 1,2,4-TCB IN THE AND WEST PLUMES AFTER 50 YEARS UNDER THE PUMPING ALTERNATIVE (4.0 GPM) IN MODEL LAYERS 1 THROUGH 4

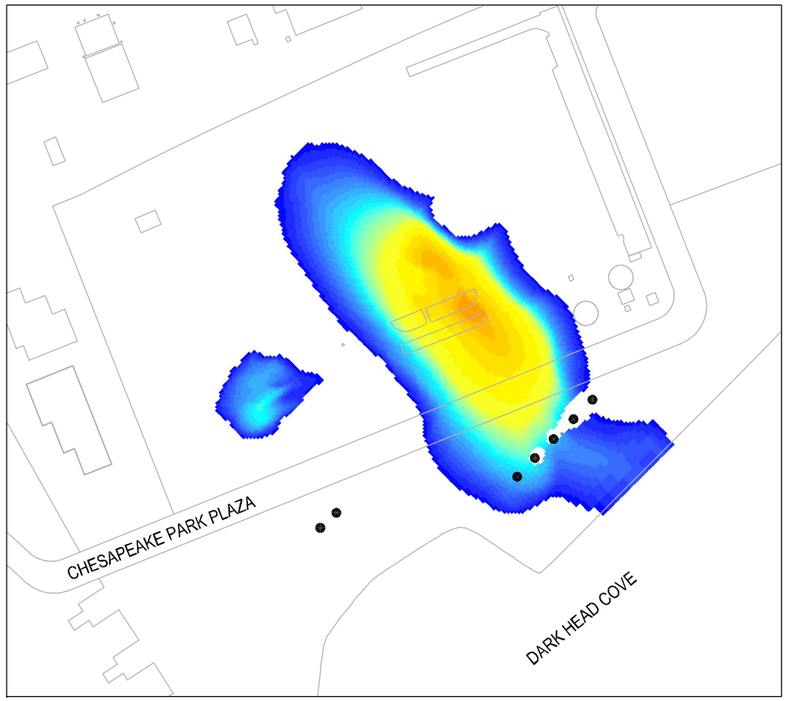
LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

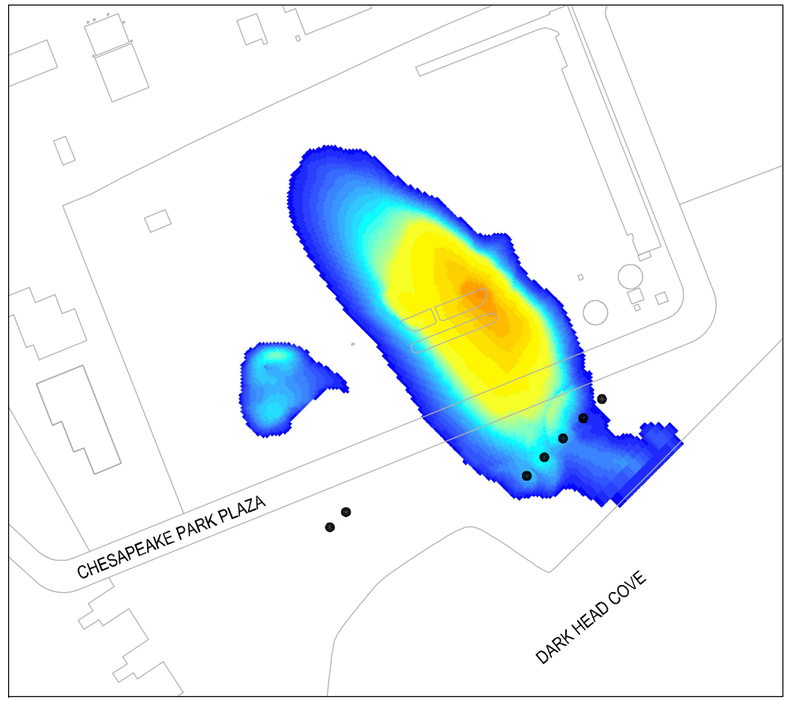
APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-6

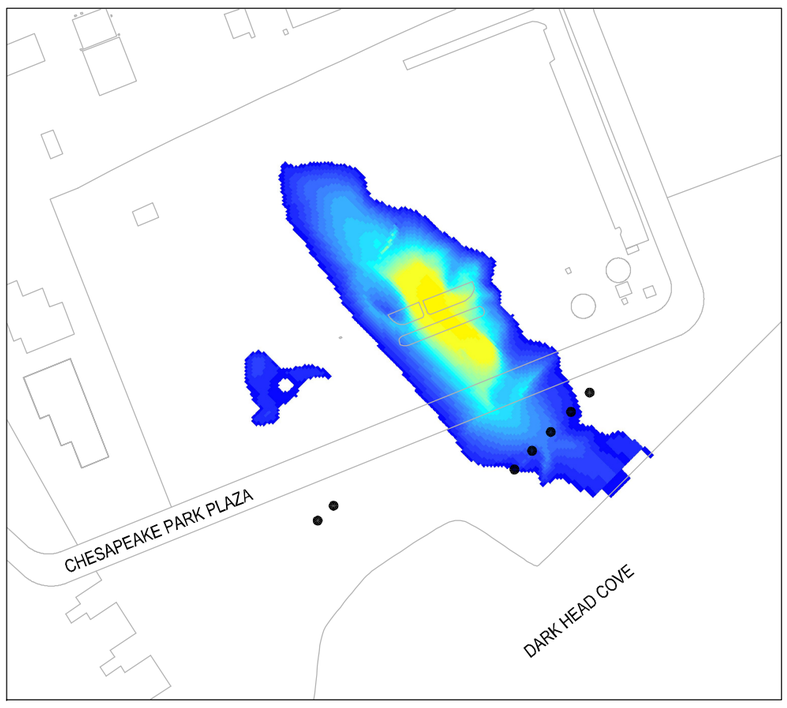
P:\ACAD\0512-158-MRIV\0512158048A.DWG



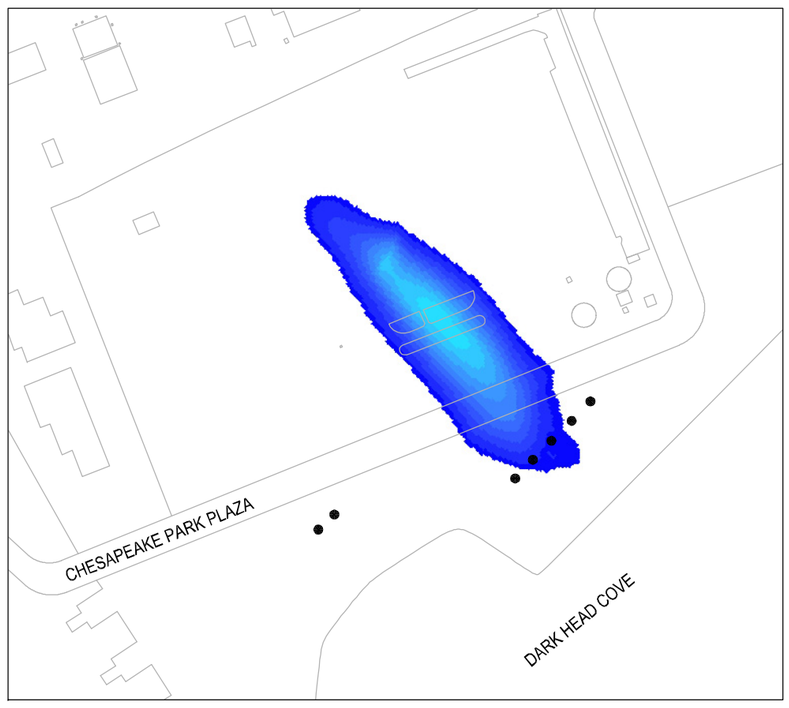
LAYER 1



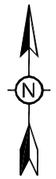
LAYER 2



LAYER 3



LAYER 4



1,2,4-TCB Concentration (μg/L)

- 10.00 - 11.96
- 11.97 - 15.48
- 15.49 - 19.01
- 19.02 - 22.64
- 22.65 - 26.63
- 26.64 - 31.09
- 31.10 - 35.85
- 35.86 - 40.83
- 40.84 - 46.09
- 46.10 - 51.22
- 51.23 - 56.40
- 56.41 - 61.35
- 61.36 - 65.92
- 65.93 - 70.88
- 70.89 - 76.08
- 76.09 - 80.94
- 80.95 - 85.55
- 85.56 - 89.92
- 89.93 - 94.22
- 94.23 - 98.87
- 98.88 - 137.57
- 137.58 - 219.70
- 219.71 - 312.48
- 312.49 - 409.97
- 409.98 - 516.36
- 516.37 - 640.71
- 640.72 - 775.19
- 775.20 - 925.88
- 925.89 - 1145.74
- 1145.75 - 1441.63
- 1441.64 - 1786.23
- 1786.24 - 2423.50

LEGEND

● PROPOSED EXTRACTION WELL

0 300 600

SCALE IN FEET

TITLE: PREDICTED DISTRIBUTION OF 1,2,4-TCB IN THE AND WEST PLUMES AFTER 75 YEARS UNDER THE PUMPING ALTERNATIVE (4.0 GPM) IN MODEL LAYERS 1 THROUGH 4

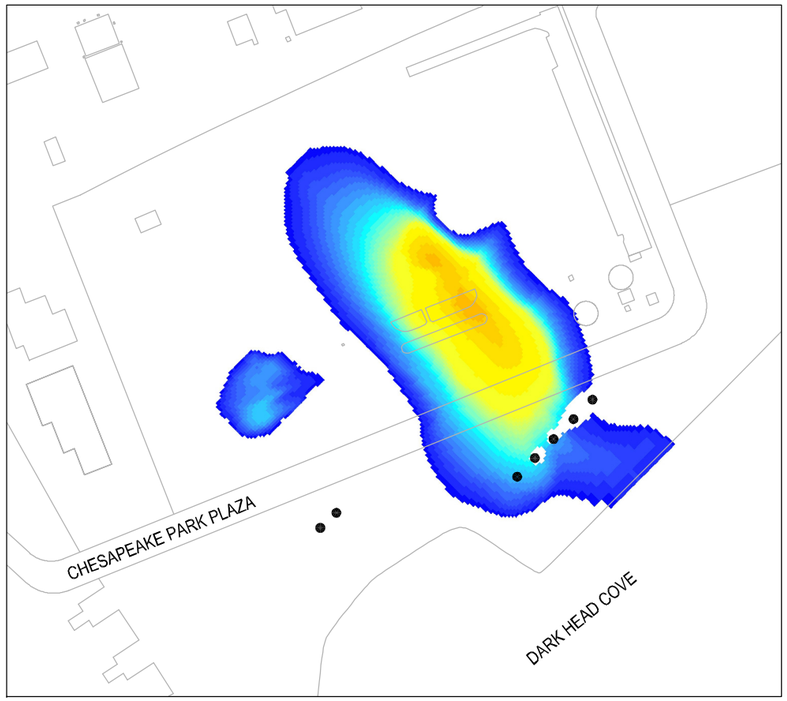
LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

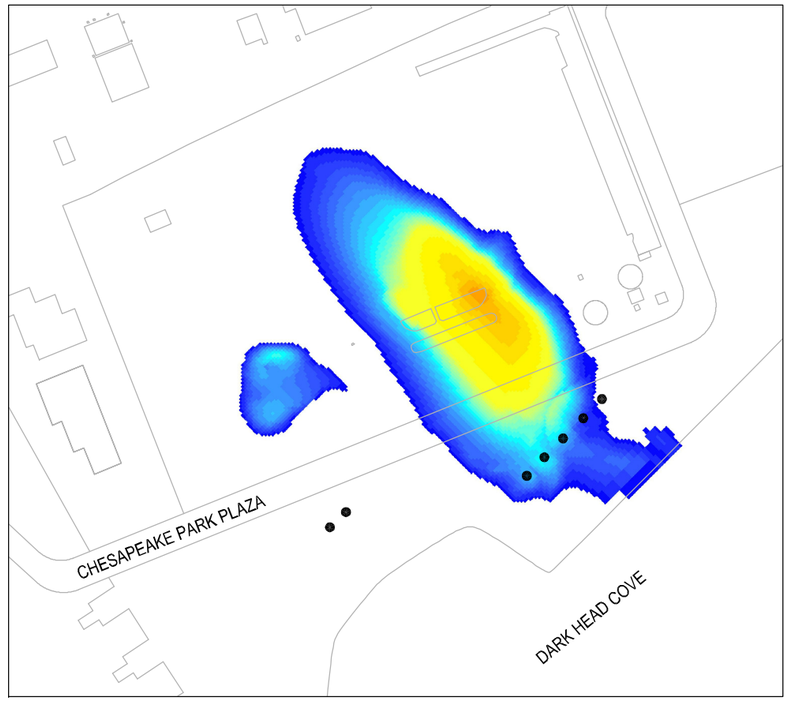
APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-7

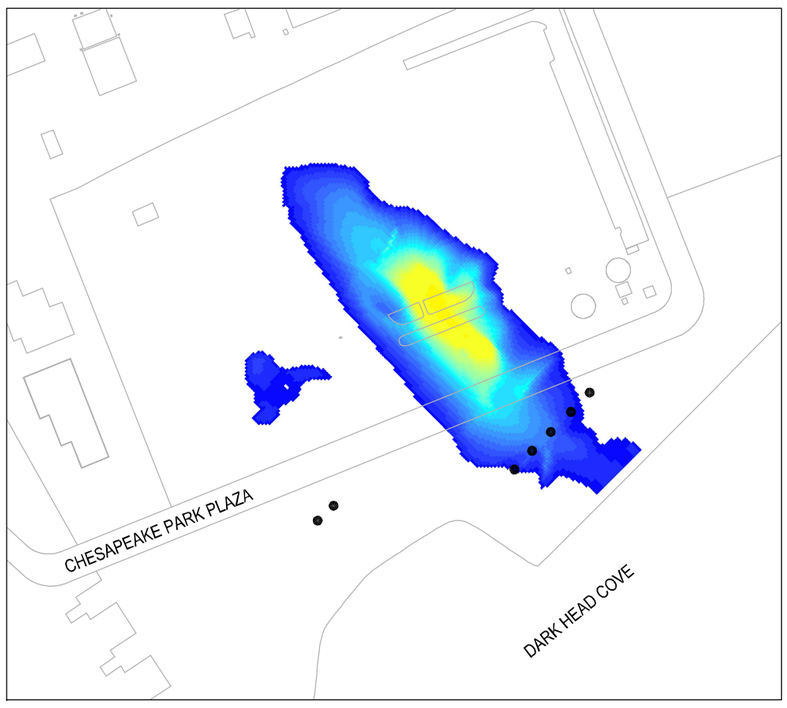
P:\ACAD\0512-158-MRIV\0512158049A.DWG



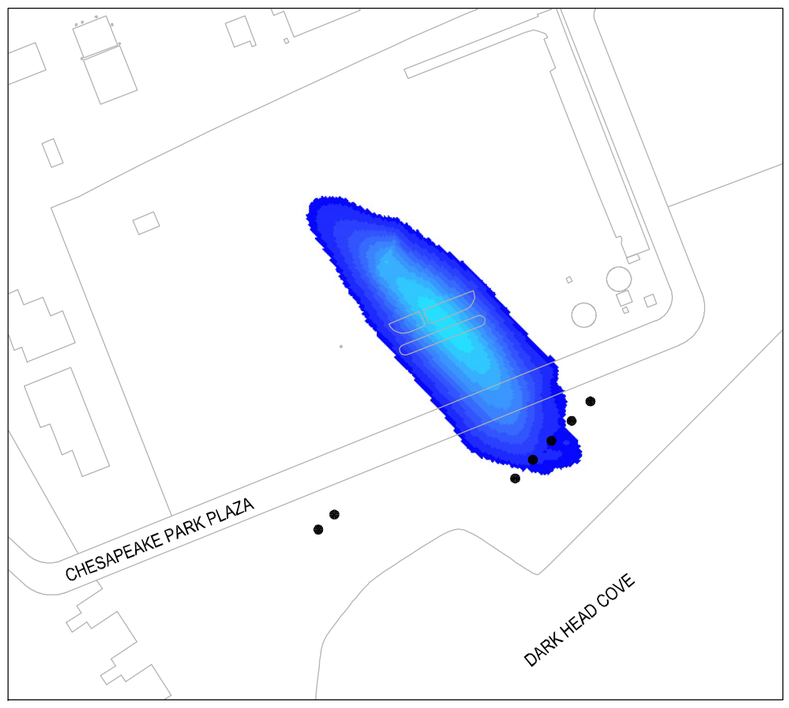
LAYER 1



LAYER 2



LAYER 3



LAYER 4

N

1,2,4-TCB Concentration (μg/L)

- 10.00 - 11.96
- 11.97 - 15.48
- 15.49 - 19.01
- 19.02 - 22.64
- 22.65 - 26.63
- 26.64 - 31.09
- 31.10 - 35.85
- 35.86 - 40.83
- 40.84 - 46.09
- 46.10 - 51.22
- 51.23 - 56.40
- 56.41 - 61.35
- 61.36 - 65.92
- 65.93 - 70.88
- 70.89 - 76.08
- 76.09 - 80.94
- 80.95 - 85.55
- 85.56 - 89.92
- 89.93 - 94.22
- 94.23 - 98.87
- 98.88 - 137.57
- 137.58 - 219.70
- 219.71 - 312.48
- 312.49 - 409.97
- 409.98 - 516.36
- 516.37 - 640.71
- 640.72 - 775.19
- 775.20 - 925.88
- 925.89 - 1145.74
- 1145.75 - 1441.63
- 1441.64 - 1786.23
- 1786.24 - 2423.50

LEGEND

● PROPOSED EXTRACTION WELL

0 300 600

SCALE IN FEET

TITLE: PREDICTED DISTRIBUTION OF 1,2,4-TCB IN THE AND WEST PLUMES AFTER 100 YEARS UNDER THE PUMPING ALTERNATIVE (4.0 GPM) IN MODEL LAYERS 1 THROUGH 4

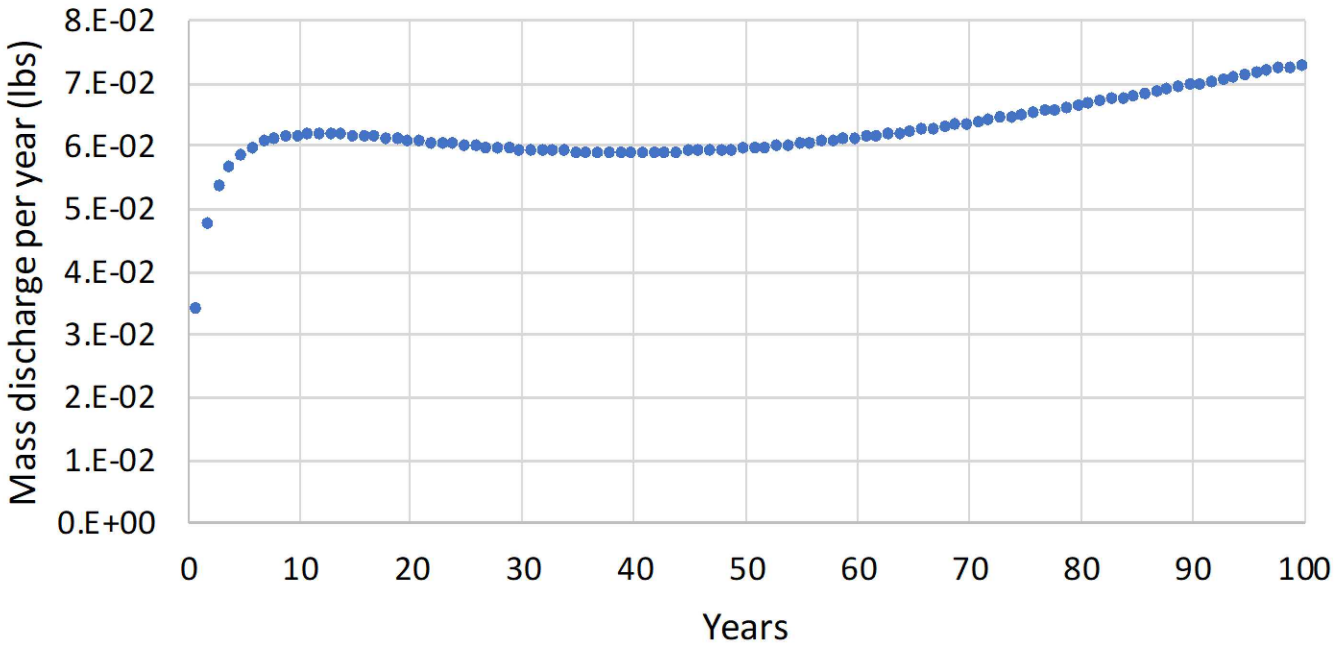
LOCATION: Middle River Complex, Middle River, Maryland

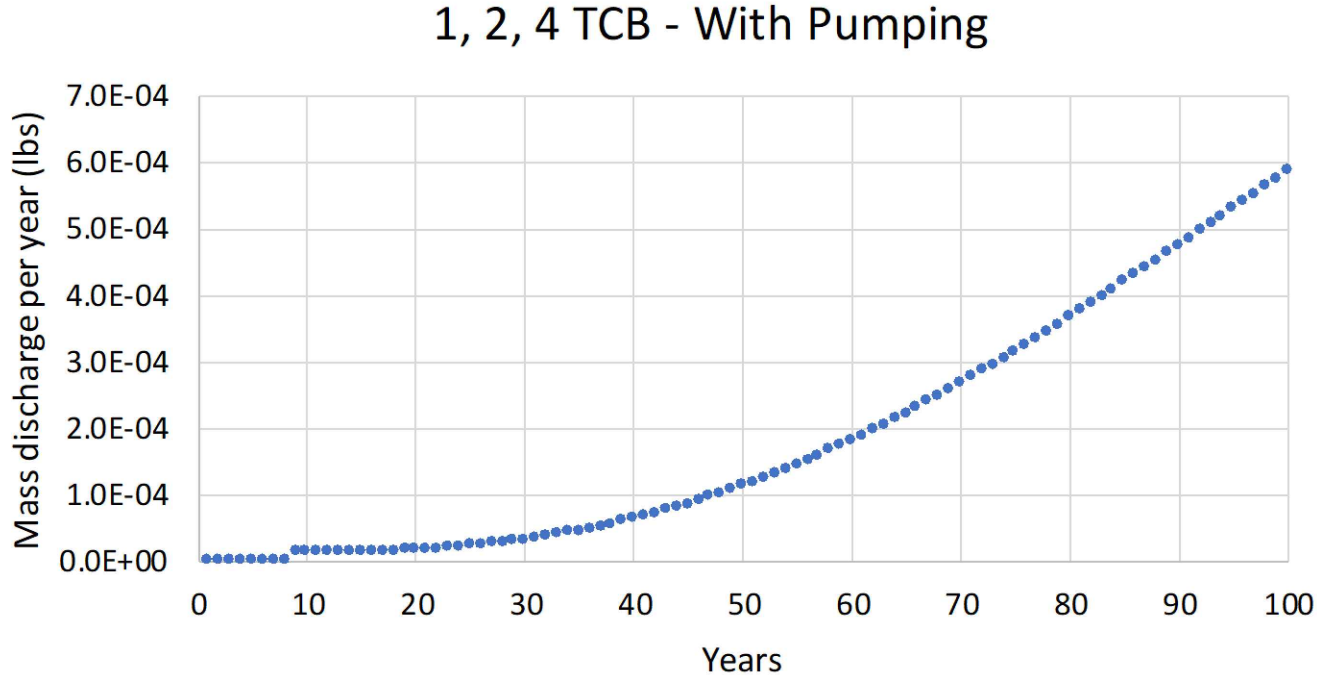
TETRA TECH

APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-8

P:\ACAD\0512-158-MRIV\0512158050A.DWG





TITLE: PREDICTED MASS DISCHARGE OF 1,2,4-TCB TO DAR□ HEAD COVE OVER 100 YEARS UNDER THE (A) THE NO PUMPING ALTERNATIVE AND (B) PUMPING ALTERNATIVE

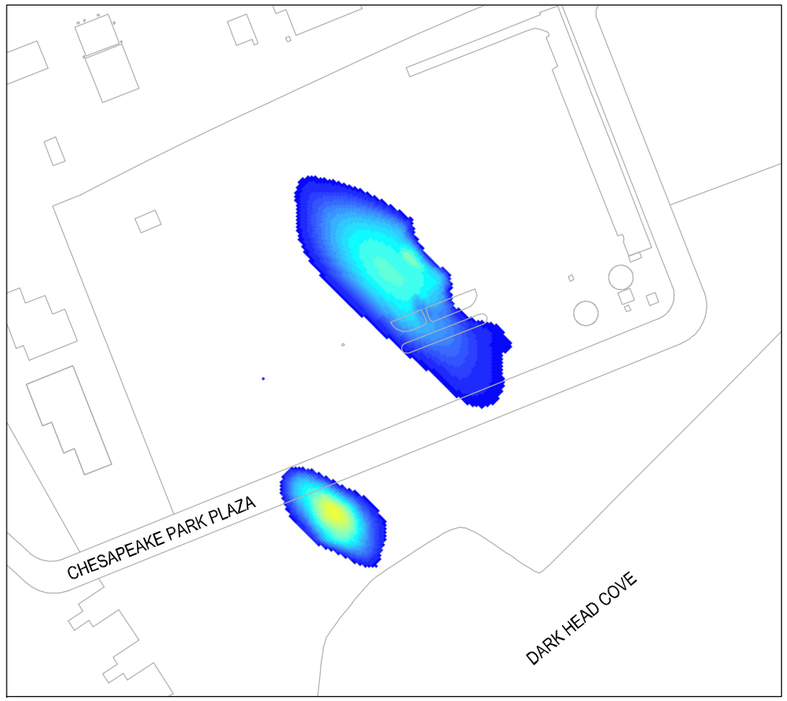
LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

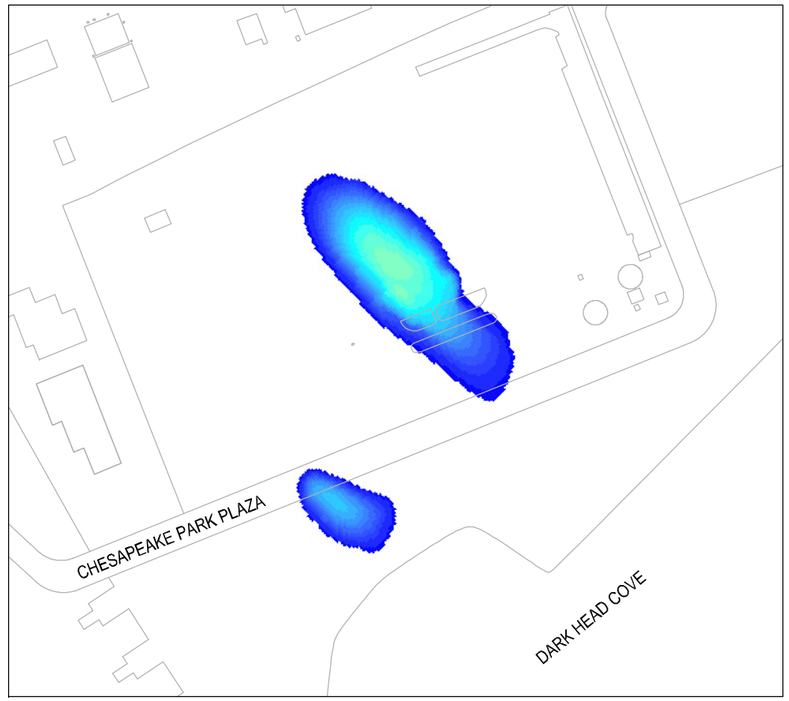
APPROVED	DS
DRAFTED	CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-9

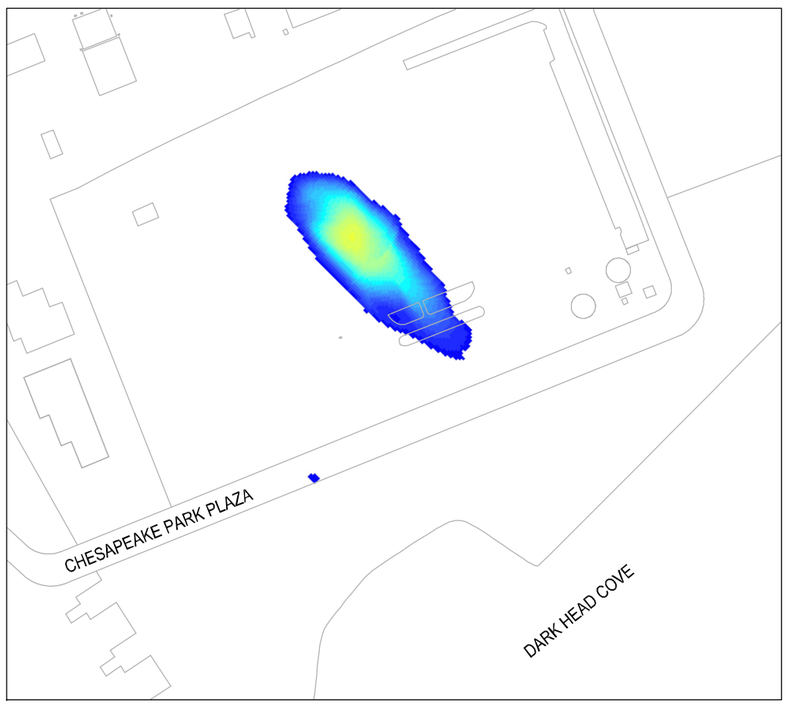
P:\ACAD\0512-158-MRIV\0512158041A.DWG



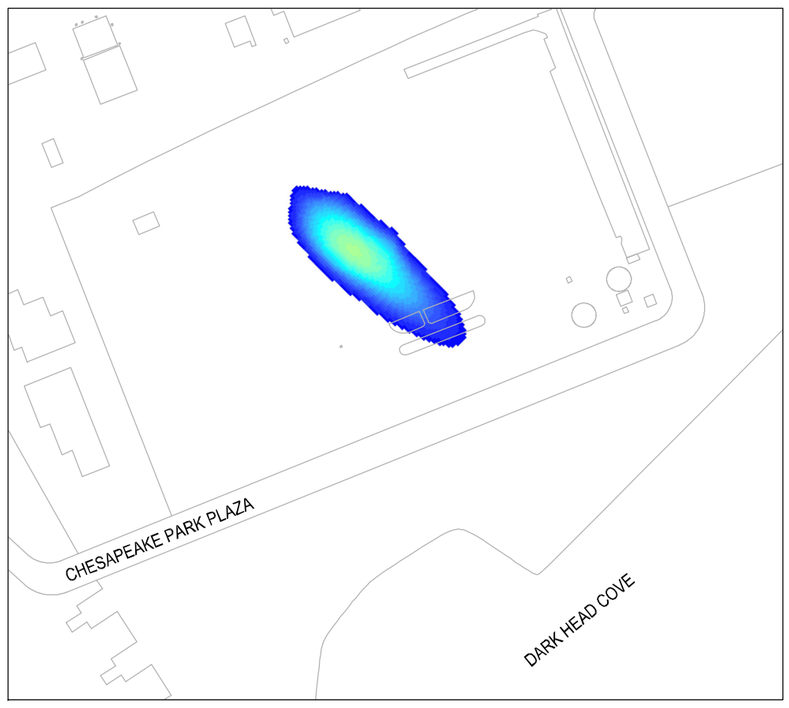
LAYER 1



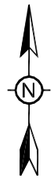
LAYER 2



LAYER 3



LAYER 4



Chlorobenzene Concentration (μg/L)

- 10.00 - 11.36
- 11.37 - 13.72
- 13.73 - 15.38
- 15.39 - 17.14
- 17.15 - 18.97
- 18.98 - 20.65
- 20.66 - 22.64
- 22.65 - 24.98
- 24.99 - 27.20
- 27.21 - 29.91
- 29.92 - 32.83
- 32.84 - 36.05
- 36.06 - 38.97
- 38.98 - 42.09
- 42.10 - 45.13
- 45.14 - 48.72
- 48.73 - 52.18
- 52.19 - 55.75
- 55.76 - 59.92
- 59.93 - 63.92
- 63.93 - 67.64
- 67.65 - 72.02
- 72.03 - 76.02
- 76.03 - 79.89
- 79.90 - 84.69
- 84.70 - 89.18
- 89.19 - 93.48
- 93.49 - 98.05
- 98.06 - 120.11
- 120.12 - 167.39
- 167.40 - 217.46
- 217.47 - 299.07

0 300 600

SCALE IN FEET

TITLE: PREDICTED DISTRIBUTION OF CHLOROBENZENE IN THE EAST AND WEST PLUMES AFTER 25 YEARS UNDER NO PUMPING ALTERNATIVE IN MODEL LAYERS 1 THROUGH 4

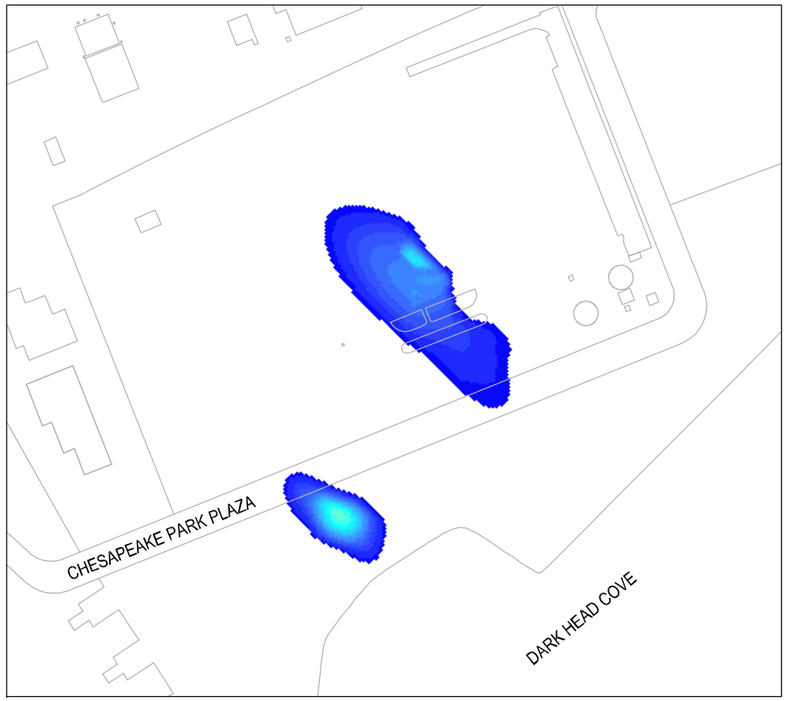
LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

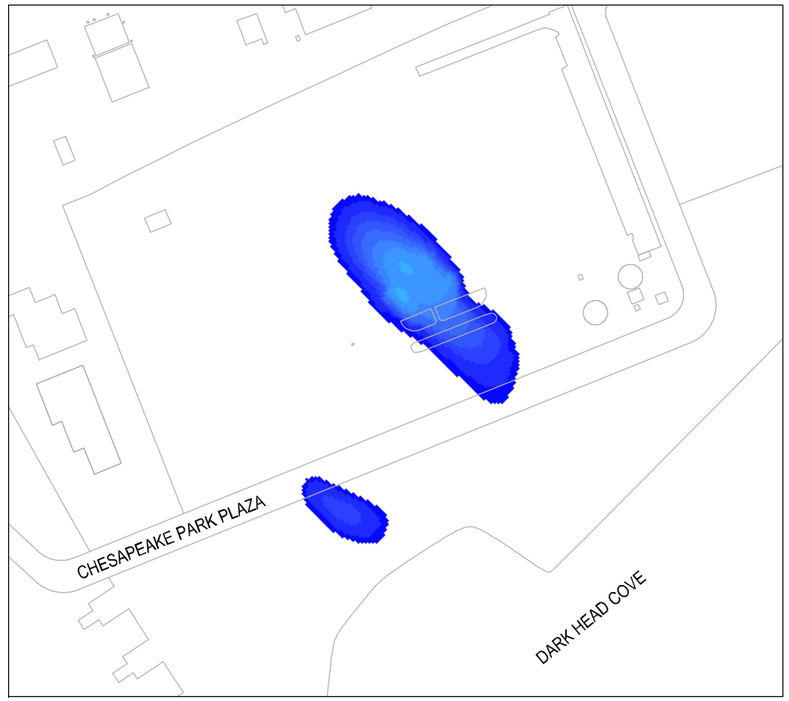
APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-10

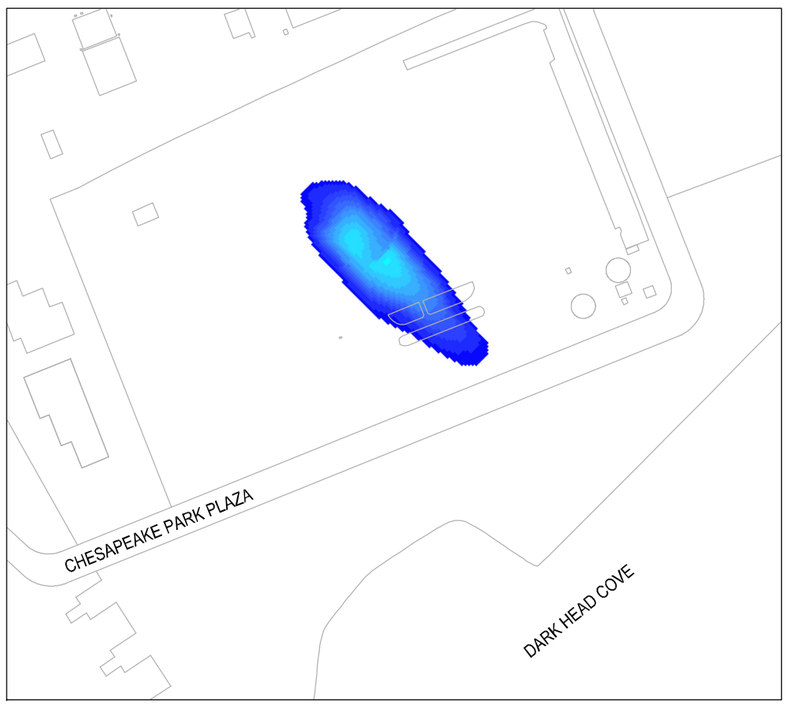
P:\ACAD\0512-158-MRIV\0512158051A.DWG



LAYER 1



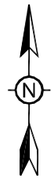
LAYER 2



LAYER 3



LAYER 4



Chlorobenzene Concentration (μg/L)

- 10.00 - 11.36
- 11.37 - 13.72
- 13.73 - 15.38
- 15.39 - 17.14
- 17.15 - 18.97
- 18.98 - 20.65
- 20.66 - 22.64
- 22.65 - 24.98
- 24.99 - 27.20
- 27.21 - 29.91
- 29.92 - 32.83
- 32.84 - 36.05
- 36.06 - 38.97
- 38.98 - 42.09
- 42.10 - 45.13
- 45.14 - 48.72
- 48.73 - 52.18
- 52.19 - 55.75
- 55.76 - 59.92
- 59.93 - 63.92
- 63.93 - 67.64
- 67.65 - 72.02
- 72.03 - 76.02
- 76.03 - 79.89
- 79.90 - 84.69
- 84.70 - 89.18
- 89.19 - 93.48
- 93.49 - 98.05
- 98.06 - 120.11
- 120.12 - 167.39
- 167.40 - 217.46
- 217.47 - 299.07

0 300 600

SCALE IN FEET

TITLE: PREDICTED DISTRIBUTION OF CHLOROBENZENE IN THE EAST AND WEST PLUMES AFTER 50 YEARS UNDER NO PUMPING ALTERNATIVE IN MODEL LAYERS 1 THROUGH 4

LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-11

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LAYER 1



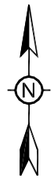
LAYER 2



LAYER 3



LAYER 4



Chlorobenzene Concentration (μg/L)

- 10.00 - 11.36
- 11.37 - 13.72
- 13.73 - 15.38
- 15.39 - 17.14
- 17.15 - 18.97
- 18.98 - 20.65
- 20.66 - 22.64
- 22.65 - 24.98
- 24.99 - 27.20
- 27.21 - 29.91
- 29.92 - 32.83
- 32.84 - 36.05
- 36.06 - 38.97
- 38.98 - 42.09
- 42.10 - 45.13
- 45.14 - 48.72
- 48.73 - 52.18
- 52.19 - 55.75
- 55.76 - 59.92
- 59.93 - 63.92
- 63.93 - 67.64
- 67.65 - 72.02
- 72.03 - 76.02
- 76.03 - 79.89
- 79.90 - 84.69
- 84.70 - 89.18
- 89.19 - 93.48
- 93.49 - 98.05
- 98.06 - 120.11
- 120.12 - 167.39
- 167.40 - 217.46
- 217.47 - 299.07

0 300 600

SCALE IN FEET

TITLE: PREDICTED DISTRIBUTION OF CHLOROBENZENE IN THE EAST AND WEST PLUMES AFTER 75 YEARS UNDER NO PUMPING ALTERNATIVE IN MODEL LAYERS 1 THROUGH 4

LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

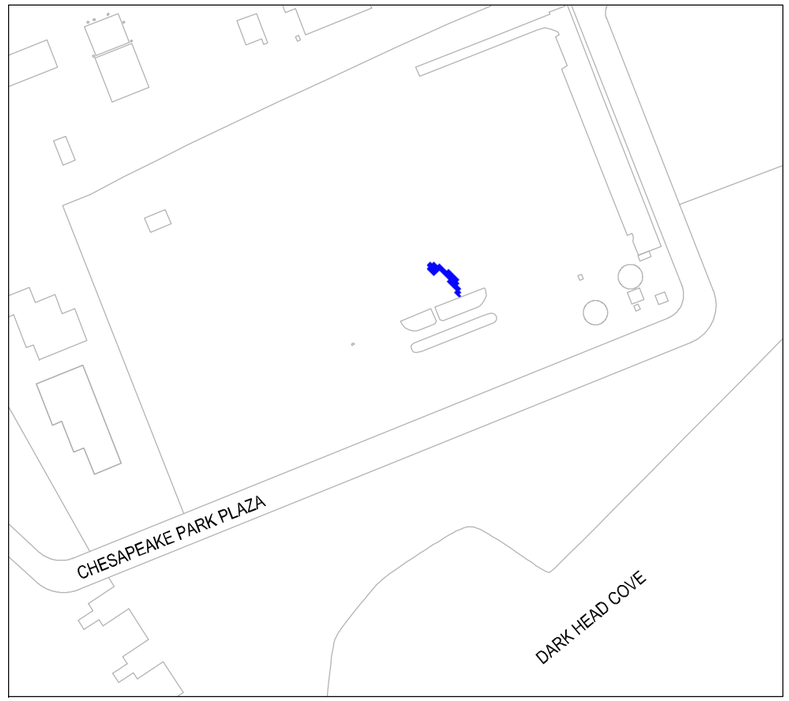
APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-12

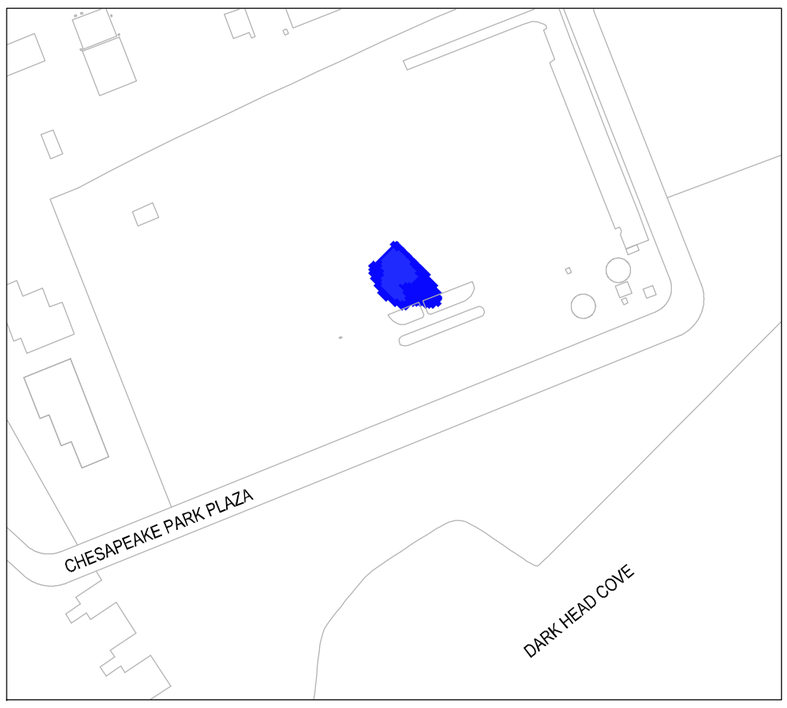
P:\ACAD\0512-158-MRIV\0512158053A.DWG



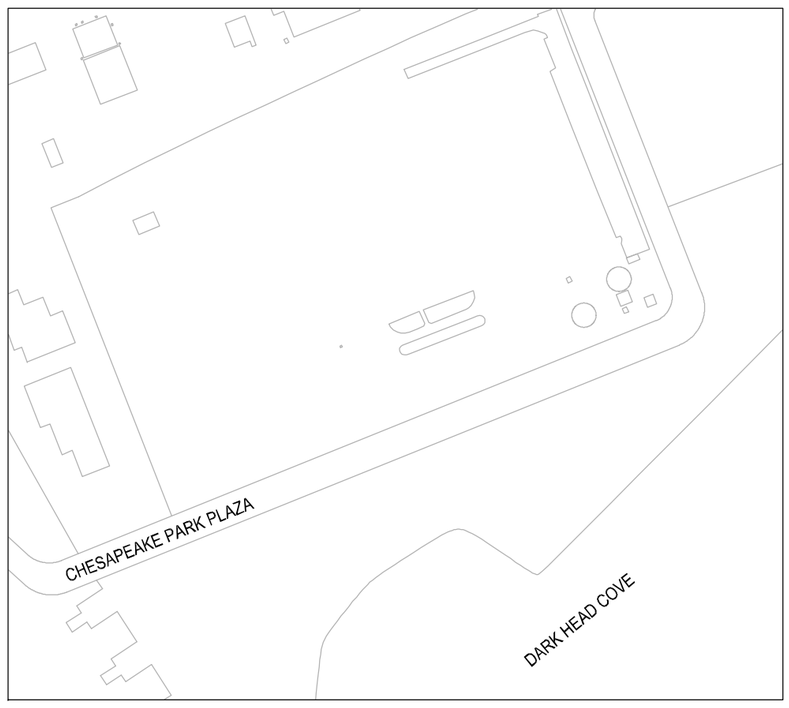
LAYER 1



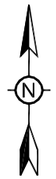
LAYER 2



LAYER 3



LAYER 4



Chlorobenzene Concentration (μg/L)

- 10.00 - 11.36
- 11.37 - 13.72
- 13.73 - 15.38
- 15.39 - 17.14
- 17.15 - 18.97
- 18.98 - 20.65
- 20.66 - 22.64
- 22.65 - 24.98
- 24.99 - 27.20
- 27.21 - 29.91
- 29.92 - 32.83
- 32.84 - 36.05
- 36.06 - 38.97
- 38.98 - 42.09
- 42.10 - 45.13
- 45.14 - 48.72
- 48.73 - 52.18
- 52.19 - 55.75
- 55.76 - 59.92
- 59.93 - 63.92
- 63.93 - 67.64
- 67.65 - 72.02
- 72.03 - 76.02
- 76.03 - 79.89
- 79.90 - 84.69
- 84.70 - 89.18
- 89.19 - 93.48
- 93.49 - 98.05
- 98.06 - 120.11
- 120.12 - 167.39
- 167.40 - 217.46
- 217.47 - 299.07

0 300 600

SCALE IN FEET

TITLE: PREDICTED DISTRIBUTION OF CHLOROBENZENE IN THE EAST AND WEST PLUMES AFTER 100 YEARS UNDER NO PUMPING ALTERNATIVE IN MODEL LAYERS 1 THROUGH 4

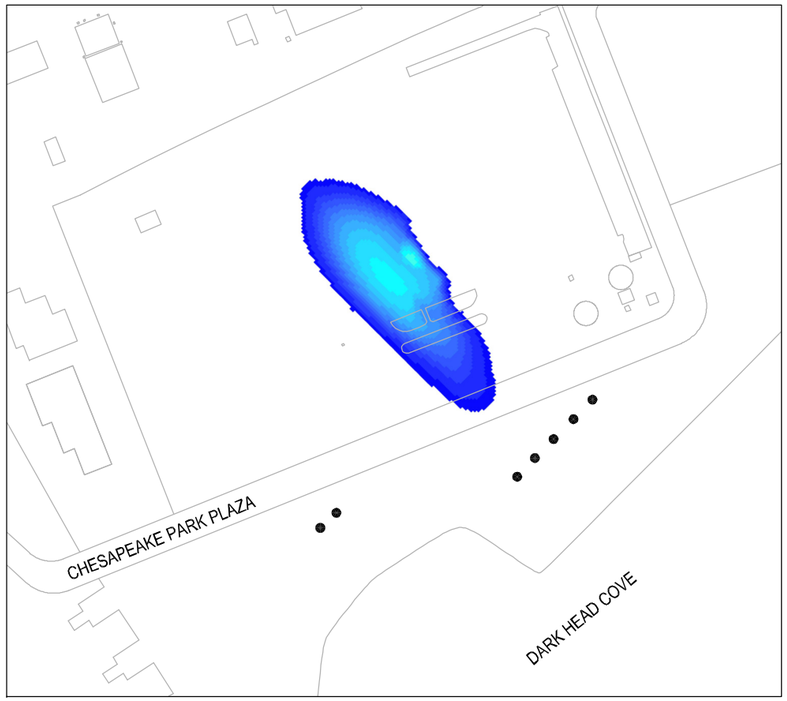
LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

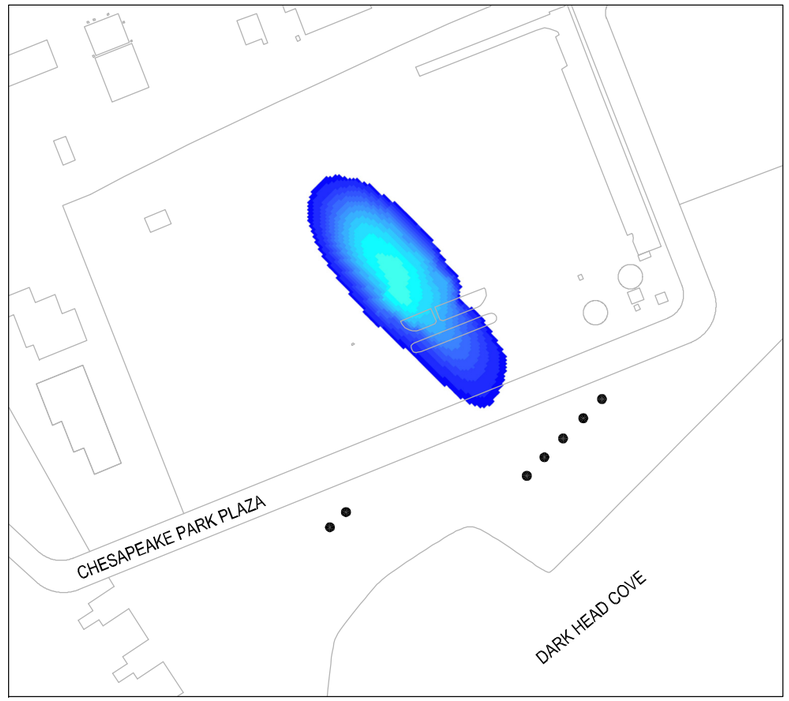
APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-13

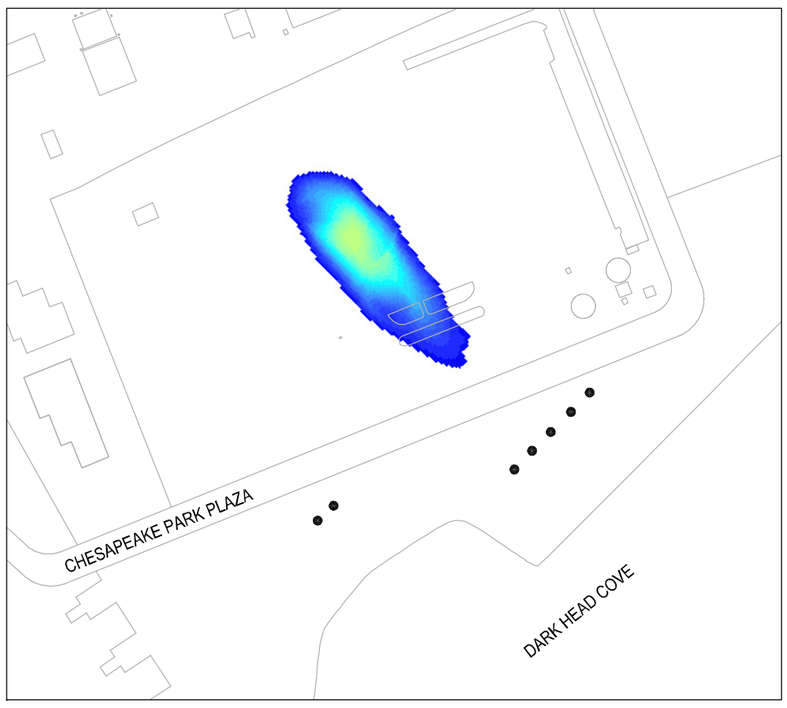
P:\ACAD\0512-158-MRIV\0512158054A.DWG



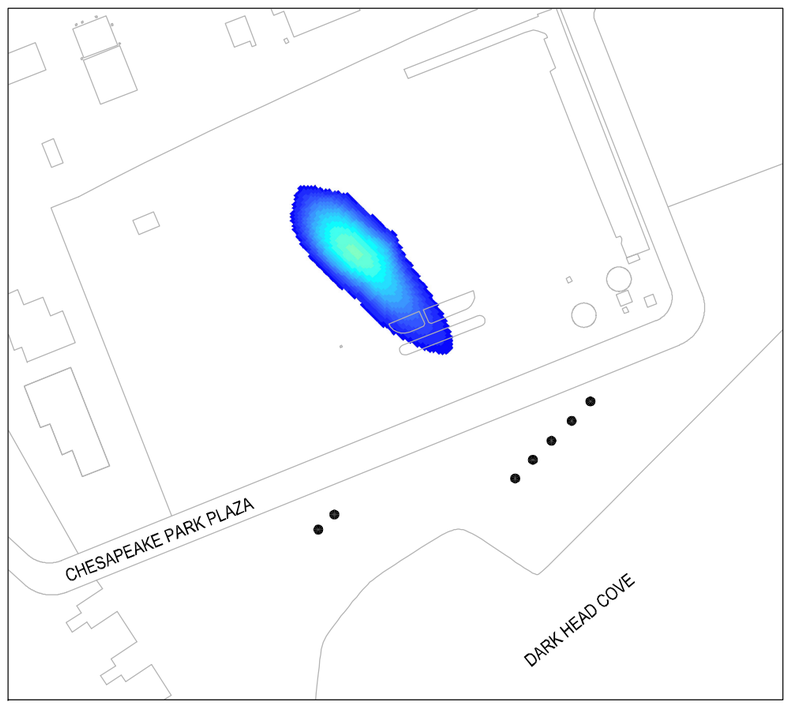
LAYER 1



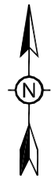
LAYER 2



LAYER 3



LAYER 4



Chlorobenzene Concentration (μg/L)

- 10.00 - 11.36
- 11.37 - 13.72
- 13.73 - 15.38
- 15.39 - 17.14
- 17.15 - 18.97
- 18.98 - 20.65
- 20.66 - 22.64
- 22.65 - 24.98
- 24.99 - 27.20
- 27.21 - 29.91
- 29.92 - 32.83
- 32.84 - 36.05
- 36.06 - 38.97
- 38.98 - 42.09
- 42.10 - 45.13
- 45.14 - 48.72
- 48.73 - 52.18
- 52.19 - 55.75
- 55.76 - 59.92
- 59.93 - 63.92
- 63.93 - 67.64
- 67.65 - 72.02
- 72.03 - 76.02
- 76.03 - 79.89
- 79.90 - 84.69
- 84.70 - 89.18
- 89.19 - 93.48
- 93.49 - 98.05
- 98.06 - 120.11
- 120.12 - 167.39
- 167.40 - 217.46
- 217.47 - 299.07

LEGEND

● PROPOSED EXTRACTION WELL

0 300 600

SCALE IN FEET

TITLE: PREDICTED DISTRIBUTION OF CHLOROBENZENE IN THE EAST AND WEST PLUMES AFTER 25 YEARS UNDER THE PUMPING ALTERNATIVE IN MODEL LAYERS 1 THROUGH 4

LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-14

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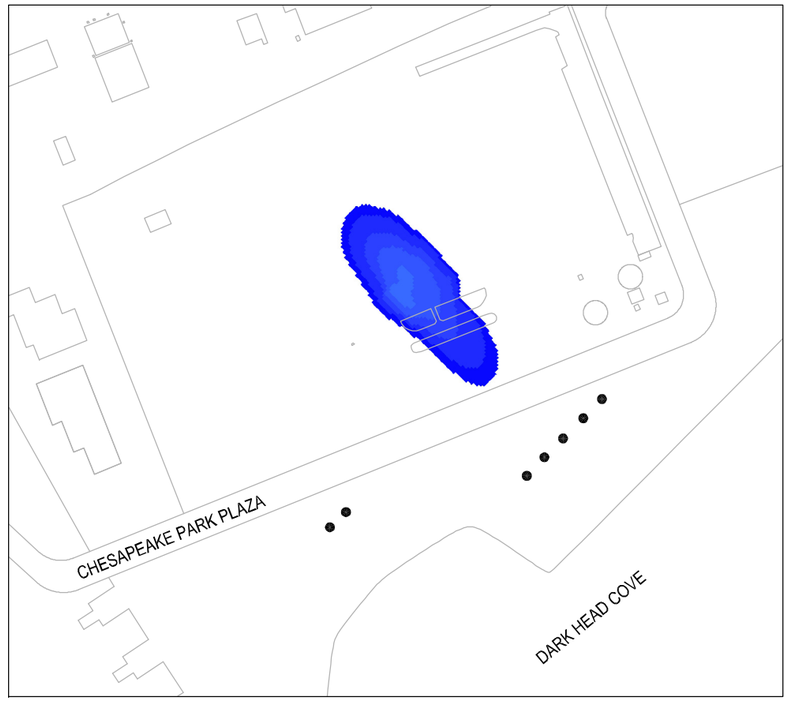
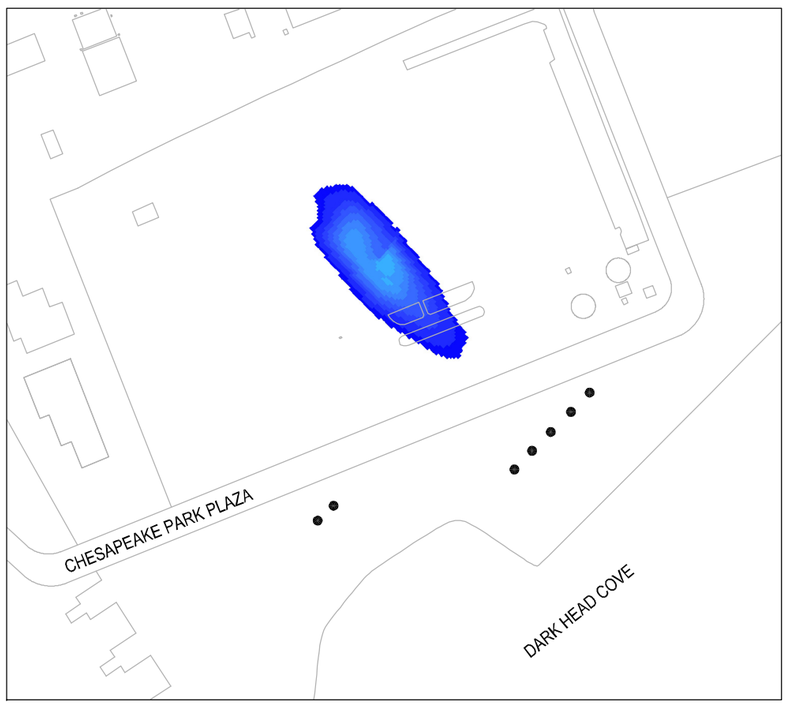
LAYER 1



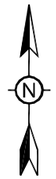
LAYER 2



LAYER 3



LAYER 4



Chlorobenzene Concentration (μg/L)

- 10.00 - 11.36
- 11.37 - 13.72
- 13.73 - 15.38
- 15.39 - 17.14
- 17.15 - 18.97
- 18.98 - 20.65
- 20.66 - 22.64
- 22.65 - 24.98
- 24.99 - 27.20
- 27.21 - 29.91
- 29.92 - 32.83
- 32.84 - 36.05
- 36.06 - 38.97
- 38.98 - 42.09
- 42.10 - 45.13
- 45.14 - 48.72
- 48.73 - 52.18
- 52.19 - 55.75
- 55.76 - 59.92
- 59.93 - 63.92
- 63.93 - 67.64
- 67.65 - 72.02
- 72.03 - 76.02
- 76.03 - 79.89
- 79.90 - 84.69
- 84.70 - 89.18
- 89.19 - 93.48
- 93.49 - 98.05
- 98.06 - 120.11
- 120.12 - 167.39
- 167.40 - 217.46
- 217.47 - 299.07

LEGEND

● PROPOSED EXTRACTION WELL

0 300 600

SCALE IN FEET

TITLE: PREDICTED DISTRIBUTION OF CHLOROBENZENE IN THE EAST AND WEST PLUMES AFTER 50 YEARS UNDER THE PUMPING ALTERNATIVE IN MODEL LAYERS 1 THROUGH 4

LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-15

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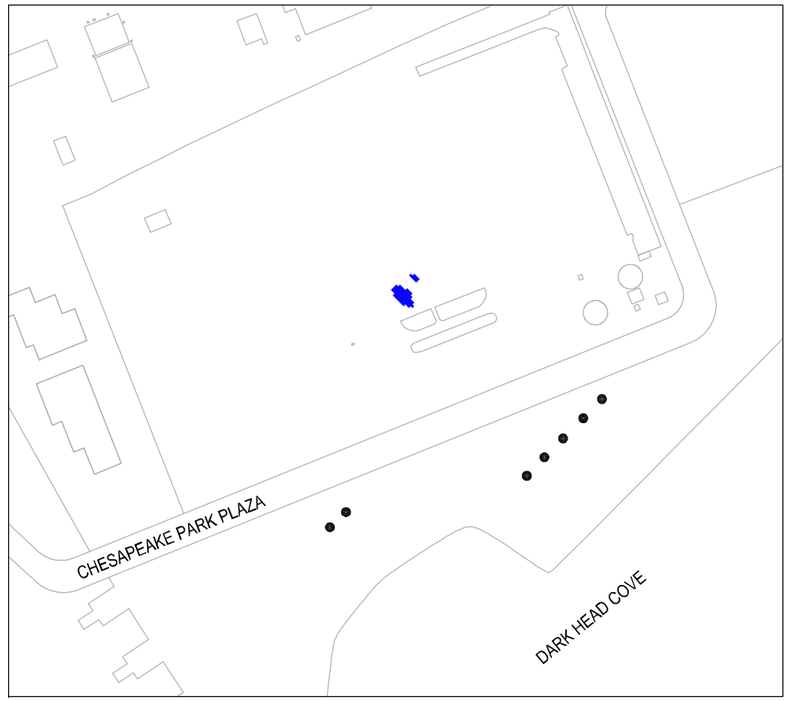
LAYER 1



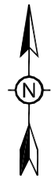
LAYER 2



LAYER 3



LAYER 4



Chlorobenzene Concentration (μg/L)

- 10.00 - 11.36
- 11.37 - 13.72
- 13.73 - 15.38
- 15.39 - 17.14
- 17.15 - 18.97
- 18.98 - 20.65
- 20.66 - 22.64
- 22.65 - 24.98
- 24.99 - 27.20
- 27.21 - 29.91
- 29.92 - 32.83
- 32.84 - 36.05
- 36.06 - 38.97
- 38.98 - 42.09
- 42.10 - 45.13
- 45.14 - 48.72
- 48.73 - 52.18
- 52.19 - 55.75
- 55.76 - 59.92
- 59.93 - 63.92
- 63.93 - 67.64
- 67.65 - 72.02
- 72.03 - 76.02
- 76.03 - 79.89
- 79.90 - 84.69
- 84.70 - 89.18
- 89.19 - 93.48
- 93.49 - 98.05
- 98.06 - 120.11
- 120.12 - 167.39
- 167.40 - 217.46
- 217.47 - 299.07

LEGEND

● PROPOSED EXTRACTION WELL

0 300 600

SCALE IN FEET

TITLE: PREDICTED DISTRIBUTION OF CHLOROBENZENE IN THE EAST AND WEST PLUMES AFTER 75 YEARS UNDER THE PUMPING ALTERNATIVE IN MODEL LAYERS 1 THROUGH 4

LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-16

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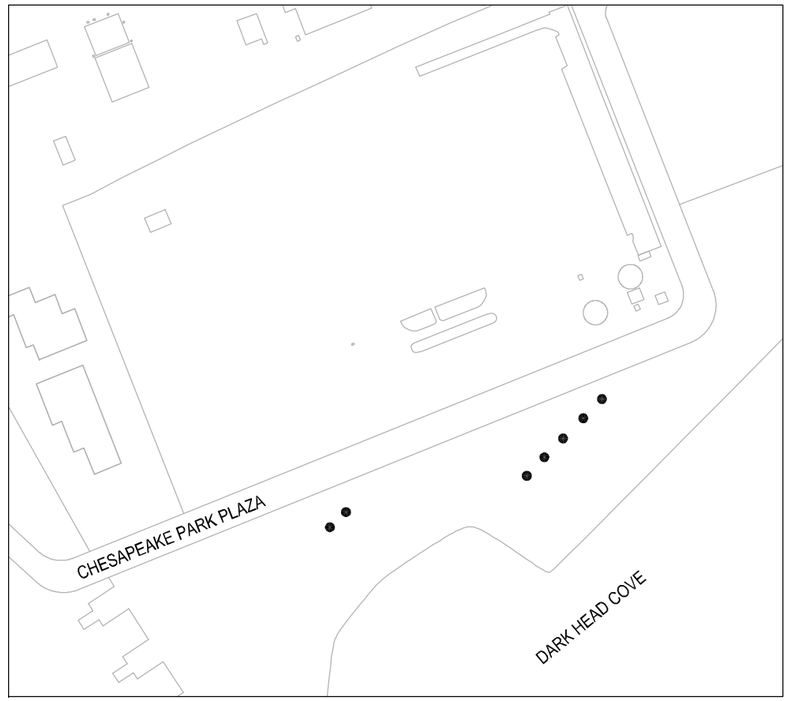
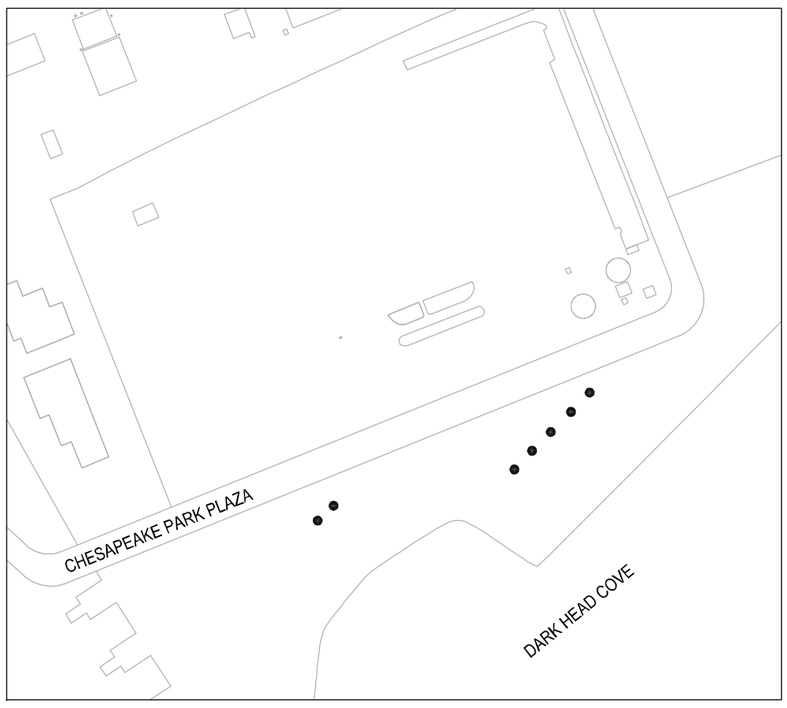
LAYER 1



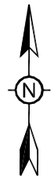
LAYER 2



LAYER 3



LAYER 4



Chlorobenzene Concentration (μg/L)

- 10.00 - 11.36
- 11.37 - 13.72
- 13.73 - 15.38
- 15.39 - 17.14
- 17.15 - 18.97
- 18.98 - 20.65
- 20.66 - 22.64
- 22.65 - 24.98
- 24.99 - 27.20
- 27.21 - 29.91
- 29.92 - 32.83
- 32.84 - 36.05
- 36.06 - 38.97
- 38.98 - 42.09
- 42.10 - 45.13
- 45.14 - 48.72
- 48.73 - 52.18
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- 63.93 - 67.64
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- 76.03 - 79.89
- 79.90 - 84.69
- 84.70 - 89.18
- 89.19 - 93.48
- 93.49 - 98.05
- 98.06 - 120.11
- 120.12 - 167.39
- 167.40 - 217.46
- 217.47 - 299.07

LEGEND

● PROPOSED EXTRACTION WELL

0 300 600

SCALE IN FEET

TITLE: PREDICTED DISTRIBUTION OF CHLOROBENZENE IN THE EAST AND WEST PLUMES AFTER 100 YEARS UNDER THE PUMPING ALTERNATIVE IN MODEL LAYERS 1 THROUGH 4

LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

APPROVED	DS
DRAFTED	JC/CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-17

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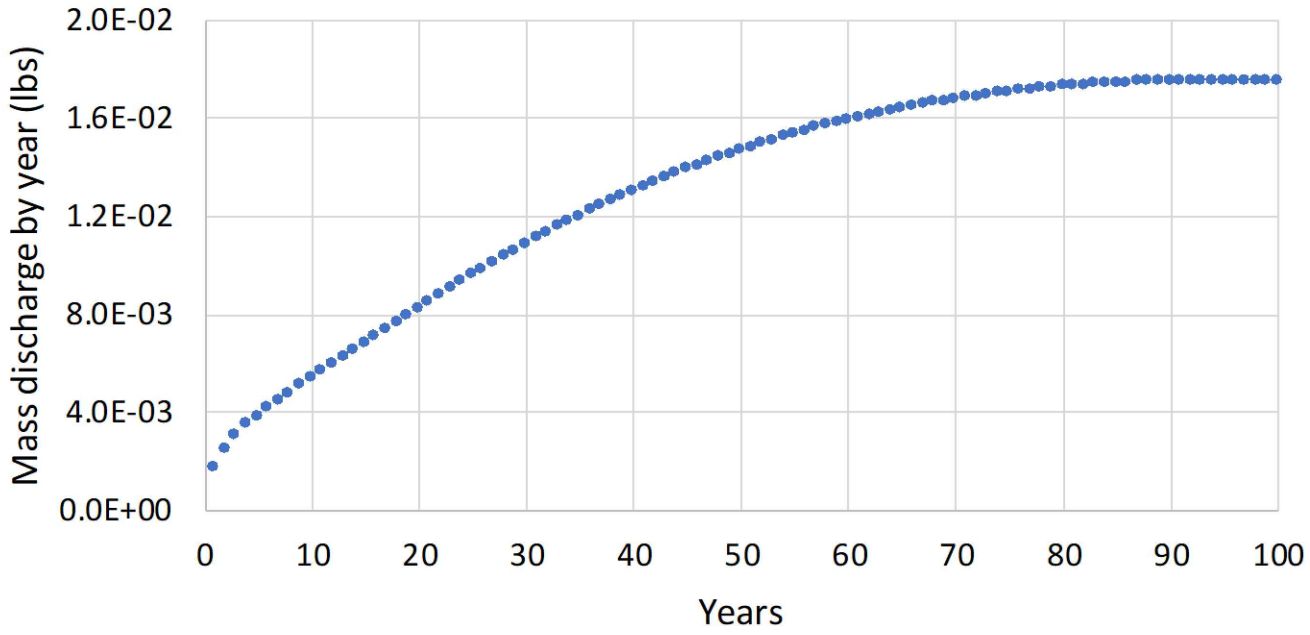

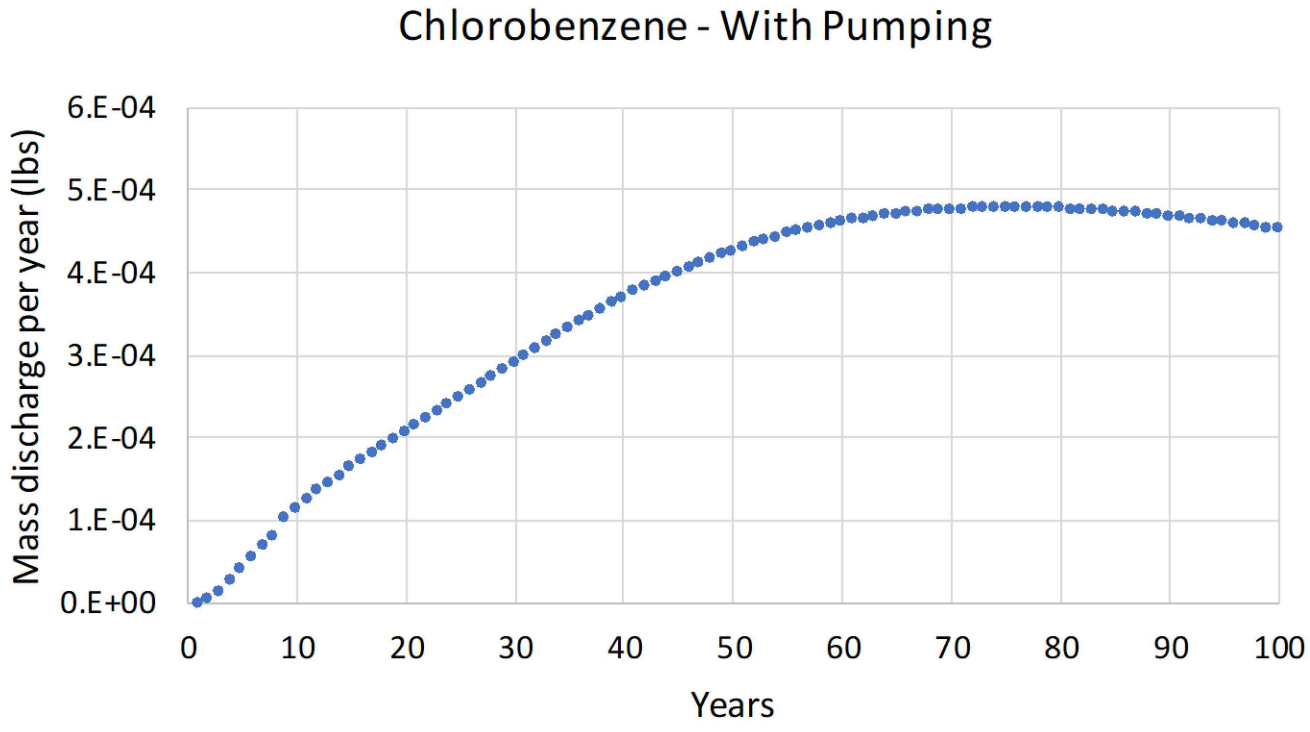

TITLE: PREDICTED MASS DISCHARGE OF CHLOROBENZEZE TO DAR□ HEAD COVE OVER 100 YEARS UNDER THE (A) THE NO PUMPING ALTERNATIVE AND (B) PUMPING ALTERNATIVE

LOCATION: Middle River Complex, Middle River, Maryland

TETRA TECH

APPROVED	DS
DRAFTED	CP
PROJECT#	117-0512158
DATE	7-10-20

FIGURE 7-18

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TABLES

Table 2-1 Results of Slug Tests at Selected Wells

Table 3-1 Summary of Model Layering

Table 4-1 Summary of Statistics for Flow Calibration (A) model-wide and (B) in Blocks E and F

Table 6-1 Input Parameters for Transport Model

Table 2-1. Results of slug tests at selected wells (Tetra Tech, 2008).

Name	Hydraulic conductivity (feet/day)	Completion Depth (feet below ground)	Description	Name	Hydraulic conductivity (feet/day)	Completion Depth (feet below ground)	Description	Name	Hydraulic conductivity (feet/day)	Completion Depth (feet below ground)	Description
MW66A	1.25	19	SM	MW34B	0.92	30	SM, SC, CL	MW12C	9.16	75	SM
MW65A	0.99	18	SM	MW14B	0.71	30	SM, ML	MW27C	6.3	78	SM
MW50A	0.30	26	ML,SM,ML	MW37B	0.56	34	SM, ML, SM	MW11C	5.14	73	SM
MW60A	0.22	22	CL, ML	MW21B	0.23	34	SM, ML	MW62C	3.57	65	SP
MW54A	0.17	13	SC	MW27B	0.006	50	SM	MW34C	2.22	55	SM
MW52A	0.10	13	ML, SC, CL					MW14C	0.35	75	SM, ML
MW53A	0.10	13	CL, SC, CL					MW37C	0.00053	70	SM, ML
MW56A	0.10	13	SM, CL								
MW62A	0.06	13	CL, SM								
MW63A	0.06	14	SP, ML								
MW61A	0.049	14	SM, CL								
MW59A	0.046	12	ML, CL								
MW64A	0.03	16	SM, CL, SP, ML								
MW58A	0.006	18	SM, CL, SP								
MW55A2	0.0049	22	CL								
MW57A	0.0027	12	ML, SM								

SP *fine sand*
SM *sand; silty sand*
SC *sand with clay*
ML *silt; sandy silt; clayey silt*
CL *clay; silty clay*

Table 3-1. Summary of model layering

Layer	Elevation of Top [1]		Elevation of Bottom [1]		Average thickness (feet)
	Minimum	Maximum	Minimum	Maximum	
1	0.0	36.8	-15.0	14.4	19.1
2	-15.0	14.4	-21.0	5.5	7.6
3	-21.0	5.5	-28.5	-5.7	9.5
4	-28.5	-5.7	-36.0	-16.9	9.5
5	-36.0	-16.9	-43.5	-28.0	9.5
6	-43.5	-28.0	-51.0	-39.2	9.5
7	-51.0	-39.2	-58.5	-50.4	9.5
8	-58.5	-50.4	-66.0	-61.6	9.6
9	-66.0	-61.6	-75.0	-75.0	11.4

[1] feet mean sea level

Table 4-1. Summary of statistics for flow calibration (a) model-wide, and (b) in blocks E and F

Table 4-1A. Simulation March 2019 WLs - Model-Wide Statistics					
Layer	Avg. residual	Abs avg. residual	AAR/obs range WLs	No. Of wells	
1	-0.34	1.60	5%	112	**Upper**
2	0.14	1.35	5%	28	
3	0.30	1.11	5%	54	**Inter-mediate**
4	1.60	2.03	16%	16	
5	1.52	1.57	15%	9	
6	-0.88	2.15	15%	5	**Deep**
7	0.65	0.65	20%	4	
model	**0.07**	**1.49**	**5.1%**		

Table 4-1B. Simulation March 2019 WLs - Block E & F Statistics				
Layer	Avg. residual	Abs avg. residual	AAR/obs range WLs	No. Of wells
1	-0.17	1.22	9%	51
2	-0.35	1.33	11%	12
3	0.40	0.76	6%	31
4	-0.22	0.86	14%	5
model	**0.01**	**1.09**	**8%**	**99**

Upper Unit (layers 1 & 2)				
Residual	Abs. Avg.		Obs	Sim
-0.24	**1.55**	**Max**	29.30	30.00
Abs Resid/Range:	**5.3%**	**Min**	0.05	0.91
		Range	29.3	29.1

Intermediate (Layers 3, 4, & 5)				
Residual	Abs. Avg.		Obs	Sim
0.70	**1.34**	**Max**	22.10	24.94
Abs Resid/Range:	**6.2%**	**Min**	0.55	0.04
		Range	21.6	24.9

Deep (Layers 6, 7, 8, & 9)				
Residual	Abs. Avg.		Obs	Sim
-0.33	**1.66**	**Max**	21.52	23.25
Abs Resid/Range:	**8.0%**	**Min**	0.78	0.20
		Range	20.7	23.0

Avg. resid.	average residual = simulated - observed (feet)
Abs avg.	absolute average residual (feet)
msl	mean sea level
Obs	observed level (feet msl)
Sim	simulated level (feet msl)
Max	maximum level (feet msl)
Min	minimum level (feet msl)
Range	range of levels (feet)
Values	number of observations
WL	water level

Table 6-1. Input parameter values for the transport model

	Units	Sand	Silty sand	Silty clayey sand	Clayey silty sand	Gravel	Source
f_{oc}	%	0.07%	0.07%	0.07%	0.07%	0.07%	MRC field values
Chlorobenzene: K_{oc}	L/Kg	224	224	224	224	224	USEPA
1,2,4-Trichlorobenzene: K_{oc}	L/Kg	1356	1356	1356	1356	1356	MI DEQ
bulk density	g/cm^3	2.5	2.5	2.5	2.5	2.5	MRC field values
porosity	--	0.40	0.40	0.48	0.45	0.32	best estimate
effective porosity	--	0.20	0.20	0.24	0.23	0.16	best estimate
Chlorobenzene							
distribution coefficient, Kd	L/Kg	1.6E-01	1.6E-01	1.6E-01	1.6E-01	1.6E-01	NA
retardation, R	--	3.0	3.0	2.7	2.8	3.51	NA
1,2,4-Trichlorobenzene							
distribution coefficient, Kd	L/Kg	9.72E-01	9.7E-01	9.7E-01	9.7E-01	9.7E-01	NA
retardation coefficient, R	--	13	13	11	12	16	NA

f_{oc} fraction of organic carbon
K_{oc} partition coefficient
g grams
Kg kilogram
cm^3 cubic centimeter
L litre