FOCUSED FEASIBILITY STUDY

ROSENDALE CLEANERS
1090-1094 ROUTE 32
ROSENDALE, ULSTER COUNTY, NEW YORK 12472

NYSDEC SITE NO. 356050

Prepared for:

NEW YORK STATE OF OPPORTUNITY | Department of Environmental Conservation

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CERTIFICATION

I, Phillip J. Castellano, certify that I am currently a NYS registered professional engineer and that this Feasibility Study Report was prepared in accordance with all applicable statutes and regulations and in substantial conformance with the DER Technical Guidance for Site investigation and Remediation (DER-10) and that all activities were performed in full accordance with the DER-approved work plan and any DER-approved modifications.

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9/15/22
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Signature

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1.0 INTRODUCTION

1.1 Purpose and Organization

This Focused Feasibility Study (FFS) Report has been prepared for the Rosendale Cleaners Inactive Hazardous Waste Disposal Site (Site No. 356050), located at 1090-1094 Route 32, Rosendale, New York. A Site Location Map is presented in **Figure 1**. A Site Plan is presented in **Figure 2**. The FFS Report was completed in accordance with New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation (DER) Work Assignment (WA) Amendment No. D009812-09.1, 6 NYCRR Part 375, and DER-10, Technical Guidance for Site Investigation and Remediation (DER-10).

Between September 2012 and October 2021, a Remedial Investigation (RI) was completed for NYSDEC by TRC Engineers, Inc. (TRC) to investigate the nature and extent of contamination associated with the Site. The findings of the investigation are presented in a March 2022 RI Report (TRC).

This FFS Report describes remedial alternatives that may be implemented to address soil and groundwater impacts identified by the RI. The FFS Report has been organized into eight sections as follows:

- Section 1 – Site background and summary of environmental setting.
- Section 2 – Identification of applicable Standards, Criteria and Guidance (SCGs) that are used to screen remedial technologies and assist in the selection process for potential remedial alternatives.
- Section 3 – Identification and screening of technologies and process options.
- Section 4 – Identification and descriptions of selected remedial alternatives.
- Section 5 – Detailed analysis of each proposed remedial alternative including supporting methodology information and preliminary cost estimates for each alternative.
- Section 6 – Comparative analysis of remedial alternatives.
- Section 7 – Recommended remedial alternative.
- Section 8 – A listing of references used for preparation of this report.

1.2 Site Location and Setting

The approximately 1.93-acre Site is located at 1090-1094 Route 32 near the intersection of Route 32 and Madeline Lane in Rosendale, Ulster County, New York. The Site is an irregularly shaped parcel of land identified on the Ulster County Tax Map as Section 62.83, Block 2, Lot 43. According to information obtained from Ulster County, the Site is zoned for business (B-2 Business) and is currently owned by Aero Star Realty, LLC. The Site is improved with a one-story vacant building and an asphalt paved parking lot and has been used for a variety of commercial purposes. The foundation walls and concrete floor slab of the former Rosendale Cleaners building (burned down in 1981), remain at the Site adjacent to and south of the existing vacant building. The one-story vacant building was formerly occupied by a hardware store, and later a diner until approximately 2009. The Site is in a mixed commercial and residential area and is bordered to the north by a car wash; to the east by Joleyn Lane, residential properties, an unnamed creek, and a wooded area; to the south by the unnamed creek, a wooded area, and a bicycle shop; and to the west by Route 32, the Rosendale Citgo Station, and a doctor's office. Rondout Creek, a "protected stream" designated as Class B waters, is approximately 800 feet north and west of the Site. Rondout Creek flows from west to east towards the Hudson River. A United States Geological Survey (USGS) 7.5-minute topographic map showing the Site location and surrounding land features is provided on **Figure 1**. A figure showing the Site layout is provided on **Figure 2**.

1.3 Current and Historic Uses

As noted above in Section 1.2, the Site is currently improved with a one-story vacant building, with an asphalt paved parking lot. Adjacent to and south of the one-story building is the concrete masonry unit (CMU) foundation wall and concrete floor slab of the former Rosendale Cleaners building, which burned down in 1981. The combined footprint of the former Rosendale Cleaners building and existing one-story building, is approximately 15,000 square feet. Based on TRC's observations, the paved parking lot is occasionally used as a truck stop by drivers visiting the Rosendale Citgo Station. In addition, the lower part of the Site, covered by the concrete floor slab of the former Rosendale Cleaners building, is utilized for equipment storage (dispensers, piping, tanks, building materials, drums, etc.) for the Rosendale Citgo Station.

According to information provided by the NYSDEC, available online information from Ulster County, and the *January 2009 Site Characterization (SC) Investigation Report*, prepared by EA Engineering, P.C. of Syracuse, New York (EA) for the NYSDEC, the vacant one-story building, adjacent to the former one-story building occupied by Rosendale Cleaners, was occupied by commercial tenants. The Rosendale Cleaners building burned down in 1981, while the adjacent commercial building remained, though it is currently vacant. The former occupants of the existing one-story commercial building were a hardware store and a diner, until approximately 2009. Additional information regarding the date of construction of the buildings, or specific information regarding the building occupants, was not available.

1.4 Geology and Hydrogeology

As noted in the *January 2009 SC Investigation Report*, Site soils includes sand, silt, and clay. Soil in the area is mapped as Limerick silty loam, described as having soils impeding downward movement of water and having moderately fine or fine textures. Based on soil borings advanced during the RI, unconsolidated units in and around the Site consist of silty sand to sand and gravel at least 25 feet thick that grades to a gray silty clay at approximately 48 feet below ground surface (bgs) which extends to depths greater than 70 feet bgs. In addition, clay was encountered north of the Site between 17 feet bgs (MW-18) and 23 feet bgs (MW-17R). According to the Surficial Geology Map of New York – Lower Hudson Sheet (1989), the material underlying the area is classified as Lacustrine delta, described as: coarse to fine gravel and sand, stratified, generally well sorted, deposited at a lake shoreline, thickness variable (3 to 15 meters). Cross-sections A-A' and B-B' (**Figures 3A and 3B**) show the geology in the southern part of the Site based on borings completed for the RI.

Bedrock was not encountered during the RI; however, bedrock in the form of outcrops was noted east of the Site. A review of the geologic map of New York, Lower Hudson Sheet published by the University of the State of New York, the State Education Department, dated 1970, indicates that the Site is located on undifferentiated lower Devonian and Silurian bedrock consisting of Port Ewan through Manlius Limestones, Rondout Limestone, Binnewater Sandstone, and High Falls Shale. According to the Bedrock Geology Map of New York State – Lower Hudson (1970, reprinted 1995), bedrock underlying the Site and surrounding area is classified as Austin Glen Formation of the Ordovician period.

Depth to groundwater is typically between 5 to 15 feet below bgs. Groundwater in the area generally flows north-northwest towards Rondout Creek. Groundwater surface elevation measurements and inferred groundwater surface elevation contours, based on measurements in October 2021, are shown on **Figure 4**.

During a June 2018 groundwater sampling event, groundwater surface elevations ranged from approximately 50.76 feet in monitoring well MW-10 (located west of the former Rosendale Cleaners building) to 55.96 feet in monitoring well MW-13 (located south of the former Rosendale Cleaners building). The apparent predominant groundwater flow direction was to the northwest toward Roundout Creek. During an October 2021 groundwater sampling event, groundwater surface elevations ranged from approximately 53.30 feet (MW-10) to 59.40 feet (MW-13). The inferred predominant groundwater flow direction was again to the northwest toward Roundout Creek, consistent with the results of the June 2018 groundwater sampling event.

1.5 Remedial Investigation and Remedial Action History

The Site is a Class 2 Inactive Hazardous Waste Disposal Site (IHWDS) and has been assigned Site No. 356050. The primary contaminants of concern (COCs) associated with the Site are the chlorinated volatile organic compounds (CVOCs) cis-1,2-dichloroethene (cis-1,2-DCE), trans-1,2-dichloroethene (trans-1,2-DCE), tetrachloroethene (PCE), trichloroethene (TCE), and vinyl chloride (VC). Presented below are brief summaries of information presented in prior reports.

NYSDEC Spill No. 90-08718

In November 1990, a spill was reported to the NYSDEC, which included the detection of petroleum compounds in groundwater samples collected from monitoring wells on the Rosendale Citgo Station property. As a result, Spill No. 90-08718 was assigned to the Citgo property. Historic groundwater sampling completed at the Rosendale Citgo Station in connection with the spill also identified a number of CVOCs. Due to the presence of these compounds, the Rosendale Citgo Station was referred to the NYSDEC DER. As of the date of this Report, NYSDEC Spill No. 90-08718 remains open.

January 2009 Site Characterization Investigation Report – EA Engineering, P.C.

In 2008, EA was retained by the NYSDEC to complete a SC to characterize subsurface conditions and determine the source of CVOCs detected in groundwater at the Rosendale Citgo Station and Rosendale Cleaners Site. Based on data presented in the *January 2009 SC Investigation Report*, it was concluded that CVOCs were originating from a source located hydraulically upgradient of the former Rosendale Cleaners building. Additional investigations of upgradient areas and the Rosendale Citgo Station were recommended to further delineate regional groundwater impacts and to determine the groundwater contamination source.

Remedial Investigation – TRC

The RI field activities described below were completed by TRC for NYSDEC between September 2012 and October 2021. The RI field activities were completed in general accordance with NYSDEC Division of Environmental Remediation (DER)-10, Technical Guidance for Site Investigation and Remediation. In addition, the RI activities were completed in accordance with the following Work Assignment (WA) documentation:

- D007620-03 – Notice to Proceed (NTP) dated May 23, 2012 and NYSDEC-approved Scope of Work (SOW) dated August 17, 2012;
- D007621-03.1 – WA Amendment Approval letter and NYSDEC-approved SOW dated October 15, 2013;
- D007621-35 – NTP dated April 20, 2017 and NYSDEC-approved SOW dated November 15, 2017;
- D009812-09 – NTP dated June 29, 2020 and NYSDEC-approved SOW dated November 2, 2020; and,
- D009812-09.1 – WA Amendment Approval letter and NYSDEC-approved SOW dated August 3, 2021.

The *July 2014 RI Report* for the Site, prepared by TRC, concluded that the source of soil and groundwater CVOCs was likely attributable to a buried debris pile located directly south of the former Rosendale Cleaners building.

In April 2017, the NYSDEC issued a RI/Feasibility Study (FS) WA to TRC to further assess soil and groundwater on-Site and implement an Interim Remedial Measure (IRM) to address suspected source area impacts following completion of additional RI field activities. The additional RI field activities were completed between December 2017 and June 2018 and verified that the buried debris pile was a potential source area and was likely contributing to soil and groundwater contamination at the Site.

As a result of the additional RI investigation activities, four IRM alternatives were evaluated to address the potential source area at the Site. The IRM alternatives included excavation focused on the removal and off-site disposal of buried debris and soil impacted above 6 New York Codes, Rules, and Regulations (NYCRR) Part 375

Commercial Use Soil Cleanup Objectives (CUSCOs) and application of an In-Situ Chemical Reduction (ISCR) reagent to the bottom of the excavation prior to backfilling. Based on the results of the evaluation, potential future use of the Site, and cost, IRM Alternative No. 4 was selected. IRM Alternative No. 4 consisted primarily of excavation and off-site disposal of approximately 280 cubic yards of debris and soil and application of an ISCR reagent to the bottom of the excavation area. The proposed IRM activities were described in the *August 2019 Remedial Action Work Plan (RAWP)*, prepared by TRC.

To further characterize and define soil impacts in support of the proposed IRM excavation, TRC completed a Supplemental RI in November 2020. The results of the investigation indicated that the limit of impacts to soil exceeded the proposed IRM excavation area. Specifically, elevated concentrations of tetrachloroethene (PCE) were detected beyond the limits of the proposed IRM excavation as well as in underlying native soil, at concentrations potentially subject to both Universal Treatment Standards (UTS) and Land Disposal Restrictions (LDR). As a result, the NYSDEC cancelled the IRM and authorized completion of additional RI activities, update of the July 2014 RI Report, and preparation of an FFS.

As summarized above, multiple investigations to determine the presence, nature, and extent of CVOCs have been completed both on and off-Site. Petroleum compounds detected in multiple soil and groundwater samples collected during the investigations, have been attributed to the Rosendale Citgo Station. Since the monitoring/remediation of petroleum impacts is being implemented under the NYSDEC Spills Program, the focus of this FFS Report is CVOCs related to the Rosendale Cleaners Site.

Additional details regarding the results of the RI are presented below. Refer to the March 2022 RI Report for a comprehensive presentation of the results of the RI.

Soil and Sediment Sampling Results

Based on soil borings advanced during the RI, unconsolidated units in the Site investigation area consist of silty sand to sand and gravel at least 25 feet thick that grades to a gray silty clay at approximately 48 feet below ground surface and extends to depths greater than 70 feet bgs. In addition, clay was encountered north of the Site between 17 feet bgs (MW-18) and 23 feet bgs (MW-17R).

The buried debris pile in the southern part of the Site rises to approximately 3 feet above surrounding ground surface, is approximately 30 feet in diameter, and is limited to approximately the upper 10 feet of the overburden. Buried debris observed during the RI included metal, lumber, concrete, brick, and textiles, all of which are likely associated with the former dry cleaner. Two underground septic tanks that were identified and investigation did not indicate apparent impacts.

The investigations completed between September 2012 and September 2021 identified elevated concentrations of CVOCs at depths ranging from 4 to 15 feet bgs in soil within and surrounding the buried debris pile. The highest CVOC concentrations were detected in soil during the November 2020 Supplemental RI, with results indicating that subsurface CVOC impacts are present in soil east of the apparent debris pile, and north and east of the previously proposed IRM excavation area.

PCE is the CVOC detected at the highest concentration in soil, at a maximum concentration of 90,000 mg/kg, detected at a depth of 6 to 6.5 feet bgs (ROS-RB-302) in November 2020. PCE breakdown products (TCE, cis-1,2-DCE, trans-1,2-DCE, and VC) have also been detected in multiple soil samples at concentrations above 6 NYCRR Unrestricted Use Soil Cleanup Objectives (UUSCOs). Petroleum-related compounds were detected above applicable SCGs in samples collected during September 2012 activities, however the samples were collected on the Rosendale Citgo Station property and are likely attributable to the associated spill.

VOCs were not detected at concentrations above applicable SCGs in sediment samples collected in November 2012 in the unnamed creek east and south of the Site. This indicates that the elevated CVOCs detected on-Site have not migrated to the shallow sediment interval sampled during the investigation.

Groundwater Sampling Results

Between September 2012 and October 2021, two direct push grab and four Site-wide groundwater monitoring events were completed. Elevated concentrations of CVOCs have been detected in grab groundwater samples collected within and around the buried debris pile and in monitoring wells both on- and off-Site. The CVOCs PCE, TCE, and their breakdown products have been detected in groundwater at the highest concentrations within and surrounding the buried debris pile. During the RI January 2013, April 2013, June 2018, and October 2021 Site-wide groundwater monitoring events, PCE and TCE were not detected above Class GA Values in any off-Site monitoring wells. However, PCE/TCE breakdown compounds, most notably cis-1,2-DCE, have consistently been detected above the Class GA Values in off-Site monitoring wells. Based on the multiple rounds of groundwater sampling, CVOC impacts extend off-Site to the west and northwest (inferred direction of groundwater flow) and to the furthest downgradient sampling point prior to the Rondout Creek (MW-17R, located approximately 90 to 100 feet south of the Rondout Creek). In addition, CVOCs have not been detected in the deepest screened Site monitoring well (MW-12, screen set at a depth of 40 to 70 feet bgs) since the April 2013 monitoring event. A summary of CVOC concentrations detected in groundwater during the October 2021 sampling event can be found on **Figure 5A**.

The highest measured CVOC concentration in groundwater has been PCE, at a concentration of 9,700 µg/L (in ROS-SB-201 [directly north of the buried debris pile] at a depth of 14 to 16 feet bgs, collected in December 2017). Petroleum compounds (i.e., BTEX and/or MTBE) have been detected at concentrations above applicable criteria in samples collected during the RI, however, the petroleum impacts are likely attributable to the open spill at the Rosendale Citgo Station. PFOA and PFOS were detected both on and off-Site at concentrations above SCGs in groundwater in five of the six samples analyzed. Based on the data collected to date, the source of PFOA/PFOS exceedances is unknown.

Soil Vapor Intrusion Sampling Results

In March 2013, SVI samples were collected from seven structures (designated Structure A through Structure G) and analyzed for VOCs. The results of SVI sampling in Structures A, B, C, D, E, and F (downgradient of the Rosendale Cleaners Site) did not exceed applicable criteria. In Structure G, carbon tetrachloride was detected in the sub-slab vapor and indoor air samples at concentrations indicating that "mitigation" was the recommended action. Carbon tetrachloride was not detected in the ambient air sample associated with Structure G. There were no potential sources of VOCs identified in Structure G at the time of the vapor intrusion sampling. Structure G was vacant at the time of sampling and the basement level where the indoor air sample was collected contained two open sump pits. No standing water was observed in the sump pits at the time of the sampling. Carbon tetrachloride was not detected in the January 2013 or March 2013 groundwater samples collected from the nearest upgradient well, MW-14. In addition, similar elevated concentrations of carbon tetrachloride were not detected in the vapor intrusion samples collected in the other structures.

The sub-slab soil vapor, indoor air and ambient air analytical results were submitted to the NYSDOH on April 5, 2013. The NYSDOH indicated that no additional action was required related to the Site investigation area and that the results would be communicated to the property owners of the sampled structures, as appropriate.

Fish and Wildlife Impact Assessment Results

A FWIA for the Site was completed in accordance with NYSDEC DER-10, Technical Guidance for Site Investigation and Remediation and the NYSDEC Guidance Document "Fish and Wildlife Impact Analysis for Inactive Hazardous Waste Sites." The FWIA included components associated with Step 1 of the FWIA process. The results of the FWIA are summarized below:

- A total of five terrestrial ecological communities were identified at the Site including mowed lawn, successional old field, successional shrubland, urban structure exterior, and urban vacant lot.
- In addition to the five terrestrial ecological community types above, 8 ecological cover types were documented within 0.5 mile of the Site, including Appalachian oak-hickory forest, Maple-basswood rich mesic forest, confined river, shallow emergent marsh, shrub swamp, eutrophic pond, intermittent stream, and unranked cultural including mowed roadside/pathway, paved road/path, riprap/erosion control roadside, urban structure exterior, and mowed lawn.
- According to the National Wetlands Inventory (NWI) mapping, there are no Federally mapped wetlands or waterbodies within the Site boundary. During an additional review of the NYSDEC Environmental Resource Mapper (ERM) no State mapped wetlands or waterbodies were identified on Site. Within 0.5 mile of the Site there are a total of 16 Federally mapped wetlands and waterbodies, totaling approximately 47.5 acres. Further review of the ERM indicates there are no NYSDEC mapped wetlands located within 0.5 miles of the Site.

- There were no wetlands or waterbodies delineated on-Site. Two intermittent, unmapped, streams were identified off-Site, adjacent to the eastern and southern Site boundaries. These two streams have a presumed off-Site connection to the NWI and NYSDEC regulated stream, Rondout Creek, north of the Site.
- Considering that the majority of the Site (approximately 48%) consists of developed impervious areas (i.e., urban exterior structure and urban vacant lot), the Site appears to provide little value to wildlife. The undeveloped portions of the Site include fragmented areas of mowed lawn, successional old field, and successional shrubland found adjacent to developed areas that are periodically mowed, limiting their potential value to provide wildlife with nesting or foraging opportunities. There are presently no open water communities or streams which reside within the Site boundary, however two intermittent, unmapped, streams located adjacent to the Site did support habitat for amphibians and benthic macro-invertebrates.
- No endangered, threatened, rare, or special concern species or habitats were identified at the Site during the FWIA; however, results in consultation with the New York Natural Heritage Program (NYNHP) identified the State and federally endangered Indiana bat (Myotis sodalis) as being documented within one mile of the Site as well as their hibernacula within 2.5 miles of the Site. In addition, the NYNHP identified the State and federally threatened northern long eared bat (Myotis septentrionalis) as being documented within approximately one mile of the Site, as well as hibernacula within 2.5 miles. Additionally, the United States Fish and Wildlife Service (USFWS) Information for Planning and Conservation (IPaC) did identify two federally listed threatened or endangered species known to occur in the vicinity of the Site. These species were the northern longeared bat a State and federally threatened bat species and the Indiana bat a State and federally endangered bat species. Monarch Butterfly (Danaus plexippus) was also identified as a candidate species that could occur on the Site.
- There were no obvious signs of significant environmental stress attributed to the disposal sites within the Site and there were no signs of contaminant-induced vegetation or wildlife mortality found at the time of the FWIA. The greatest level of stress apparent on the Site originates from continued use for waste storage or other anthropogenic disturbances.
- The vegetated areas on-Site are not accessible to the public and their view is obstructed from the roadside by wooden fencing and existing structures. The Site lacks provision as a resource to any visual quality or aesthetics as it does not provide a clear viewshed to vegetated communities on-Site. Likewise, there is little uniqueness or heritage value documented at the Site as there is limited context of cultural features located within or adjacent to the Site. There is a NYSDEC significant natural community (Limestone woodland) located within two miles of the Site, however due to topography there is no clear viewshed to this community from the Site. As such, the Site does not provide educational or scientific value, as it is

located on private land without available or safe public access, parking, or facilities and lacks any critical area of specific research interest

1.6 Conceptual Site Model

The following conceptual site model describes the nature and extent of the contaminants known to be present at the Site, the dominant fate and transport characteristics, potential exposure pathways, and potential impacts to receptors.

Based on the result of the RI and prior investigations, the primary Site COCs are CVOCs in soil and groundwater. Additionally, PFOA and/or PFOS have been detected above screening criteria in soil within and surrounding the buried debris pile and in groundwater both on- and off-Site. Petroleum compounds (i.e., BTEX and MTBE) were detected in soil and groundwater but are attributable to the Rosendale Citgo Station spill. Since the monitoring/remediation of petroleum impacts is currently being addressed under the NYSDEC Spills Program, the focus of this Conceptual Site Model (CSM) is CVOCs related to the Rosendale Cleaners Site.

Physical evidence of contamination and elevated CVOC concentrations (CVOCs exceeding UUSCOs or Commercial Use Soil Cleanup Objectives [CUSCOs]) have been detected in subsurface soil, both within and surrounding the buried debris pile. PCE in particular has been detected above the CUSCO (150 mg/kg) in soil at concentrations of up to 90,000 mg/kg (ROS-SB-302 at a depth of 6 to 6.5 feet bgs). In addition, PCE has been detected above UUSCOs beneath the water table at depths of 10 to 15 feet bgs (ROS-SB-311). Due to the presence of significant CVOC concentrations within the buried debris pile, it is likely this area is an ongoing source of contamination to groundwater. Cross-sections of the area, including PCE concentrations and PID readings, can be found on **Figures 3A** and **3B**. Under current conditions, exposure to subsurface soil in the vicinity of the buried debris pile is not likely since the parcel is vacant. Potential exposure could occur during a soil disturbance (e.g., during future redevelopment), depending on the proximity to the buried debris pile; however, appropriate health and safety procedures can be used to mitigate exposure.

CVOCs have been detected above applicable SCGs in groundwater samples collected both on and off-Site. The apparent source of the CVOCs is the Site buried debris pile and surrounding soil. Specifically, PCE has been detected at concentrations of up to 9,700 µg/L (September 2012 grab groundwater sample location ROS-GW-201 at a depth of 14 to 16 feet bgs, located directly north of the buried debris pile). With respect to monitoring well groundwater sampling events, MW-15 (located within the buried debris pile) contained elevated concentrations of several CVOCs (notably cis-1,2-DCE at a maximum concentration of 8,000 µg/L in April 2013).

Based on groundwater surface elevation measurements, the predominant direction of groundwater flow is inferred to be to the north/northwest, towards Rondout Creek. In addition, during two groundwater monitoring events (January 2013 and April 2013) an apparent component of flow in the direction of MW-10 (located west of the former

Rosendale Cleaners building) was identified, based on a localized groundwater depression. Elevated concentrations of CVOCs in groundwater within and surrounding the buried debris pile decrease downgradient (north/northwest). The CVOC groundwater plume appears to be migrating in the direction of the Rondout Creek, as evidenced by the October 2021 groundwater sample collected from MW-17R (the furthest downgradient investigation point). CVOCs at concentrations exceeding Class GA Value in monitoring well MW-17R included cis-1,2-DCE (detected at a concentration of 48 µg/L, Class GA Value of 5 µg/L) and VC (detected at a concentration of 3 µg/L, Class GA Value of 2 µg/L). The presence of PCE breakdown products in the most downgradient well indicates that natural biodegradation of PCE is occurring in the investigation area. Based on the groundwater sampling to date, CVOC impacts within and surrounding the buried debris pile do not extend south past the unnamed creek. Of the four groundwater samples collected from MW-13 (south of the unnamed creek), CVOCs have either not been detected above laboratory quantification limits or have been detected at concentrations below Class GA Values.

Additionally, PFOA and PFOS have been detected in groundwater at concentrations above applicable SCGs; however, there is a limited data set for PFAS. Further investigation would be required to determine if PFAS impacts are representative of Site background conditions. PFAS impacts are not included in this Focused Feasibility Study.

Groundwater has been encountered at depths ranging from 5 to 15 feet bgs in the area, therefore contact with groundwater is generally unlikely, minimizing the potential for exposure. Groundwater at the Site is not utilized for potable or non-potable purposes as the area is on public water, so ingestion/absorption of this media does not represent a significant exposure pathway. There is a potential for exposure to contaminated groundwater during redevelopment and associated dewatering activities. Higher levels of exposure to CVOC contaminants in groundwater would be encountered during redevelopment work below the water table in the vicinity of the buried debris mound and adjacent site soils. Appropriate health and safety procedures can be used to mitigate exposure and would differ depending on the nature and location of the work.

The results of SVI sampling in Structures A, B, C, D, E, and F (downgradient of the Rosendale Cleaners Site) did not exceed applicable criteria. For Structure G, comparison of sub-slab vapor and indoor air concentrations of carbon tetrachloride indicated that “mitigation” was the recommended action. No potential sources of VOCs were identified in Structure G at the time of vapor intrusion sampling. Structure G was reportedly vacant for approximately one year at the time of sample collection. In addition, carbon tetrachloride was not detected in the January 2013 groundwater sample from the nearest upgradient well, MW-14. Therefore, the carbon tetrachloride in sub-slab vapor at Structure G does not appear to be related to the Site. Similar elevated concentrations of carbon tetrachloride were not detected in any of the vapor intrusion samples collected in the other structures. With the exception of the carbon tetrachloride detected in Structure G, there are no potentially complete exposure pathways via vapor intrusion with respect to Site-related contaminants.

VOCs were not detected at concentrations above applicable criteria in sediment samples collected in November 2012 in the unnamed creek east and south of the Site. This indicates that the elevated CVOCs detected on-Site have not migrated to the shallow sediment interval sampled.

1.7 Qualitative Exposure Assessment

An exposure pathway consists of five elements: (1) a contaminant source, (2) a contaminant release, and transport mechanism, (3) a point of exposure, (4) a route of exposure, and (5) a receptor population. An exposure pathway is complete when all five elements of an exposure pathway are complete.

Based on the findings of the RI and prior investigations by others, the principal COCs associated with the Site have been identified as CVOCs, particularly PCE, TCE, and associated breakdown products, in soil and groundwater. The source of CVOC impacts in soil and groundwater is most likely the buried debris pile, believed to consist of materials from the former Rosendale Cleaners building. Results from SVI and sediment sampling indicate that Site CVOCs are not impacting these media. A qualitative assessment was prepared to evaluate and document the potential for exposure to Site-related contaminants.

Dermal contact, ingestion of soil or groundwater, or inhalation of vapors or dust represent the potential routes of exposure. Potential receptors include construction workers during demolition and redevelopment, future on-Site occupants and visitors, future on-Site maintenance workers, and off-Site residents.

Considering the current conditions at the Site, the following exposure pathways are considered incomplete:

- **Groundwater ingestion:** Groundwater in the area of the Site is not used as a source of potable water; therefore, this exposure pathway is not complete for potential on-Site and off-Site visitors, building occupants and residents. **Inhalation of vapors by Site visitors, building occupants and off-Site residents:** There are no current occupants at the Site and no on-Site buildings are in use. Additionally, vapor intrusion was not identified as a concern in offsite buildings sampled during the RI.

The following exposure pathways are considered potentially complete:

- **Dermal contact with soil by construction workers and maintenance workers:** Potential future construction activities (e.g., redevelopment) could result in contact with Site impacted soil (i.e., soil sampling results showed CVOCs above UUSCOs and CUSCOs).
- **Soil dermal contact by Site visitors, building occupants and off-Site residents:** There are no current occupants at the Site and no on-Site buildings are in use. However, the debris pile and majority of Site surface soils surrounding the debris pile are accessible and therefore a potential exposure pathway for visitors.

- **Soil ingestion:** There are no current occupants at the Site and no on-Site buildings are in use. However, the debris pile and majority of Site surface soils surrounding the debris pile are accessible and therefore a potential exposure pathway for visitors.
- **Dermal contact with groundwater by construction workers and maintenance workers:** The groundwater table is at depths between 5 and 15 feet bgs in the area. The potential for exposure of workers to contaminated groundwater via contact exists if soil excavation is required at depths below the water table.
- **Inhalation of dust by construction workers and maintenance workers:** Potential future construction and maintenance activities (e.g., redevelopment) could result in the generation of and exposure to impacted dust (soil sampling results showed CVOCs above UUSCOs and CUSCOs).

2.0 IDENTIFICATION OF STANDARDS, CRITERIA, GUIDANCE AND REMEDIAL ACTION OBJECTIVES

2.1 Introduction

In order to identify and screen potential remedial technologies, an initial identification of remedial action objectives (RAOs) and preliminary remediation goals (PRGs) is required. RAOs provide a general description of the objectives of a cleanup action. Furthermore, RAOs provide the basis for developing numerical remediation goals (the PRGs), which are used to identify the appropriate extent of a cleanup action. Regulatory criteria and risk-based levels are considered in identifying PRGs. This section also describes the potential standards, criteria, and guidance (SCGs) or applicable or relevant and appropriate requirements (ARARs) that a remedial action must achieve.

Once RAOs and PRGs are developed, general response actions (GRAs) are identified which satisfy the objectives. An initial evaluation is made of the areas and volumes of media to which the GRAs will be applied.

The GRAs are then used to develop a list of potential remedial technologies for each environmental matrix to be remediated. An initial screening of the technologies is conducted based on the technical implementability of the various technologies and the applicability of each to the Site. Site-specific characteristics or waste characteristics limit the applicability of certain technologies and are considered in determining which technologies are not appropriate for further consideration.

For the technologies that pass the initial screening, the associated technology process options are evaluated in greater detail to allow the selection of one process option to represent each technology type. The representative process option provides a basis for developing performance specifications that are used in evaluating that technology type; however, the specific process actually used to implement the remedial action may not be selected until the remedial design phase. To select a representative process, each process option is evaluated on the basis of effectiveness, implementability, and cost, with the greatest focus on effectiveness factors.

2.2 Remedial Action Objectives

RAOs are developed in order to set objectives for protecting public health and the environment early in the remedial alternatives development process. The objectives should be as specific as possible but should not unduly limit the range of alternatives that can be developed. The COCs discussed in Section 1.6 represent the specific contaminants of interest and allowable exposures are defined based on the SCGs (discussed in more detail in Section 2.3). RAOs should specify (1) the contaminants of concern; (2) the exposure route(s) and receptor(s); and (3) an acceptable contaminant level (or range of levels) for each exposure route.

The RI has identified cis-1,2-DCE, trans-1,2-DCE, PCE, TCE, and VC at concentrations greater than applicable regulatory criteria in Site soil and groundwater. The CVOC-impacted groundwater plume, at the time of the October 2021 monitoring well sampling event, extended from the area of the buried debris pile north to approximately monitoring well MW-14 and is estimated to be approximately 50,000 square feet. CVOC impacted soil is limited to on-Site soils near the suspected CVOC contaminant source. A detailed discussion of the CVOC-impacted soil can be found in Section 2.4 below.

The RAOs for the Site were developed in consideration of current known Site conditions and include the following:

- Eliminate or mitigate significant threats to public health and the environment.
- Restore the Site to pre-disposal/pre-release conditions, to the extent practicable. The listed pre-disposal conditions are with respect to Site COCs (i.e., CVOCs) only. Pre-disposal conditions are defined as:
    - Groundwater: Class GA Standards and Guidance Values (Class GA Values)
    - Soil: 6 NYCRR Part 375 UUSCOs
- Prevent direct contact (dermal absorption, inhalation, and incidental ingestion) with contaminated soil and groundwater.
- Prevent vapor intrusion in the event of use of the existing vacant building or new building construction on-Site.

2.3 Potentially Applicable Standards, Criteria, Guidance (SCGs), and Preliminary Remediation Goals

SCGs are defined as follows:

> "Standards and criteria are cleanup standards, standards of control, and other substantive environmental requirements, criteria, or limitations promulgated under federal or state law that specifically address a hazardous substance, pollutant, contaminant, remedial action, location or other circumstance."
>
> "Guidance are non-promulgated criteria, advisories and/or guidance that are not legal requirements and do not have the same status as standards and criteria; however, remedial alternatives should consider guidance documents that, based on professional judgment, may be applicable to the project."

Chemical-specific SCGs are usually health- or risk-based restrictions on the amount or concentration of a chemical that may be found in or discharged to the environment. These SCGs control remedial activities involving the design or use of certain activities or regulate discrete actions.

2.3.1 Chemical-Specific SCGs

2.3.1.1 Groundwater PRGs

The New York State groundwater classification for the Site is GA, which indicates waters that could be used as a source of potable water supply. Federal and state drinking water standards were considered as potential groundwater chemical-specific SCGs, based on the groundwater classification. State groundwater quality standards and guidance values were also considered. Potential federal and state chemical-specific SCGs include Maximum Contaminant Levels (MCLs) published under the Safe Drinking Water Act (40 CFR 141 and 141.61-64), New York MCLs (10 NYCRR 5-1.52), and New York Groundwater Quality Standards (6 NYCRR 703). Potential groundwater SCGs additionally include federal secondary MCLs and groundwater quality standards and guidance values established in the Division of Water Technical and Operational Guidance Series (TOGS) 1.1.1 based on the GA groundwater classification.

cis-1,2-DCE, trans-1,2-DCE, PCE, TCE and VC are the COCs in groundwater. The Class GA Values for CVOCs in groundwater are shown in **Table 1**.

2.3.1.2 Soil PRGs

The New York State chemical-specific SCGs for soil are published in 6 NYCRR Part 375, Tables 375-6.8(a) and (b): UUSCOs and CUSCOs. CUSCOs are being considered as part of the restricted use alternative for this property based on the current understanding of the use of the property as well as the likely future use in the event of site redevelopment. Ecological SCOs do not apply to the Site based on the results of the FWIA study. Protection of Groundwater (PoG) SCOs are the same as the UUSCOs for the COCs, which were applied in the evaluation of the alternatives presented below.

Cis-1,2-DCE, trans-1,2-DCE, PCE, TCE and VC are the COCs in soil. The 6 NYCRR Part 375-6.8 UUSCOs and CUSCOs for Site-related CVOCs in soil are shown in **Table 1**.

2.3.1.3 Sub-Slab Vapor PRGs

The decision matrices evaluating the recommended actions for potential future on-Site buildings based on sub-slab vapor and indoor air concentrations of CVOCs can be found in the NYSDOH Guidance for Evaluating Soil Vapor Intrusion in the State of New York. The COCs in soil and groundwater are also potential COCs for vapor intrusion; however, vapor intrusion sampling in off-Site structures indicated no required action and vapor intrusion sampling was not conducted on-Site as part of RI activities since currently there are no occupied structures on-Site. Accordingly, remedial alternatives specifically for vapor intrusion have not been included in this FFS (although the alternatives for remediation of CVOCs in soil and groundwater would be expected to mitigate the potential for vapor intrusion). Provisions related to vapor intrusion mitigation for future on-Site structures, in the event of Site development, would be addressed as part of a Site Management Plan (SMP) to be included if a restricted use alternative is selected for the Site.

2.4 General Response Actions

GRAs are remedial actions that will satisfy the RAOs identified in Section 2.2.

Impacts to soil and groundwater were considered in determining appropriate GRAs. For soil and groundwater, GRAs were identified and an initial evaluation of the areas or volumes to which the GRAs should be applied was conducted, as described below. In determining the volumes/areas of media, consideration was given to Site conditions, the nature and extent of contamination, acceptable exposure levels, and potential exposure routes.

2.4.1 Groundwater

As indicated in **Table 2**, GRAs identified to address groundwater impacts, are as follows:

- No Action
- Site Management
- Containment
- Extraction/Treatment/Discharge
- In-Situ Treatment

As described in the RI Report, CVOCs have been detected at concentrations greater than Class GA Values in on and off-Site groundwater. The CVOC-impacted groundwater plume, at the time of the October 2021 monitoring well sampling event, extended from the area of the buried debris pile approximately to monitoring well MW-14 and is estimated to be approximately 50,000 square feet. CVOC impacts were also detected further downgradient at MW-17R; however, due to the isolated nature of that well and lack of groundwater data in the vicinity of MW-17R it is unclear if that contamination is attributable to the Rosendale Cleaners property. CVOC impacts are anticipated to be limited to shallow groundwater since Class GA exceedances were not detected in deep well MW-12 during the RI activities, with the exception of a slight exceedance of the criteria for cis-1,2-DCE (9.5 ug/L) during the January 2013 sampling. Elevated concentrations of PCE were limited to wells MW-15 and MW-18, which are located within the presumptive contamination source area. Off-Site, groundwater impacts are primarily limited to PCE breakdown products (primarily cis-1,2-DCE), indicating the plume source is likely limited to the on-Site source and attenuating down gradient. CVOCs detected in groundwater samples collected from monitoring wells in October 2021 are shown on **Figure 5A** and the inferred limits of the CVOC groundwater impacts, estimated from monitoring and temporary well sampling data, are shown on **Figure 5B**.

2.4.2 Soil

As indicated in **Table 3**, GRAs identified to address soil impacts, are as follows:

- No Action
- Site Management
- Containment
- Removal
- In-Situ Treatment

As described in the RI Report, CVOCs have been detected at concentrations greater than UUSCOs and CUSCOs in samples collected from soil borings in and around the buried debris mound, which is approximately 30 feet in diameter and 3 feet above surrounding grade. Soil samples collected from borings ROS-SB-205 and ROS-SB-208, approximately 5 feet below grade, were found to contain PCE at concentrations above the CUSCO. Accordingly, additional investigation was completed in November of 2020, which identified PCE at concentrations above the CUSCO in multiple soil samples. As of the November 2020 sampling event, on-Site impacts to soil in the area of the debris mound have been roughly delineated horizontally to CUSCOs with the exception of south of ROS-BS-304/305/306 and north of ROS-SB-302. Additionally, impacts to soil have been delineated vertically to CUSCOs with the exception of at ROS-SB-311, where PCE was detected at a concentration above the CUSCO at the maximum sampling depth of 15 feet. The Site grade begins to drop sharply south of ROS-SB-304/305/306 towards the unnamed creek, creating access challenges for soil contamination delineation. The location of the debris pile and estimated horizontal limits of impacted soil above CUSCOs are shown on **Figure 6.** The impacts to soil are not currently well delineated vertically or horizontally to UUSCOs. For the purposes of the FFS, based on currently available data, the estimated limits of impacts to soil above CUSCOs and the debris mound correspond to approximately 800 cubic yards (encompassing approximately 1,700 square feet with an average depth of approximately 12 feet) and the estimated limits of impacts to soil above UUSCOs correspond to approximately 2,800 cubic yards (encompassing approximately 3,000 square feet with an average depth of approximately 25 feet).

3.0 IDENTIFICATION AND SCREENING OF TECHNOLOGIES AND PROCESS OPTIONS

The GRAs are developed further through the identification and screening of remedial technologies which would potentially meet the RAOs and PRGs. Following a screening of the remedial technologies on the basis of technical implementability, the process options associated with each technology were screened based on effectiveness, implementability, and cost. Representative process options were chosen for inclusion in the comprehensive remedial alternatives developed for the Site.

3.1 Technology Screening

Technology screening was performed to evaluate technologies for the remediation of soil and groundwater, as presented in **Tables 2** and **3,** respectively. The tables include a brief description of individual technologies or process options and present comments on applicability of each to the Site. Several GRAs were screened out for groundwater remediation. The implementation of containment technologies (e.g., sheet piles, slurry walls, etc.) for groundwater were determined to be impractical due to the extent of groundwater impacts. The effectiveness of extraction and treatment of groundwater is limited by the characteristics of the aquifer, which would likely result in low yield during extraction and would likely not be viable for remediation of contamination that has already migrated offsite. No GRAs were fully screened out for soil remediation, however several technologies and process options were determined to be impractical. The technology screening process results indicate with respect to soil and groundwater that the focus should be on Site Management, source removal, and *in-situ* treatment technologies. The technology options that do not pass the screening process on the basis of technical implementability are indicated in **Tables 2** and **3** and will not be retained for further consideration.

3.2 Process Option Screening

After identification of technologies that are technically implementable, the process options were further evaluated to select representative process options. The process options were evaluated on the basis of effectiveness, implementability, and cost. The groundwater and soil process option evaluations are presented in **Tables 4** and **5,** respectively. No Action, Site Management (environmental easement and groundwater sampling), and In-Situ Treatment (enhanced reductive bioremediation, natural attenuation, and chemical reduction) were selected as the process options for groundwater. No Action, Site Management (environmental easement and subsurface soil sampling), Containment (in-situ stabilization and solidification [ISS]), Removal (excavation and off-site disposal/treatment), and In-Situ Treatment (enhanced reductive bioremediation) were selected as the process options for soil. These options have been included among the alternatives described in Section 4.0.

4.0 IDENTIFICATION OF ALTERNATIVES

4.1 Introduction

This section describes the development of several remedial options to achieve the RAOs identified above. CVOCs in soil and groundwater have been identified as potential risks to protection of public health at the Site. As such, the focus of this section and the following sections of the FFS Report is evaluation of alternatives for CVOCs in soil and groundwater.

In consultation with NYSDEC, focused review of remedial technologies and options for applicability and feasibility was completed, as documented in **Tables 4** and **5**. The technologies and process options identified in Section 3.0 were combined to form a limited number of remedial alternatives, including a no action alternative.

The remedial alternatives developed in this FFS would attain remedial goals to varying degrees and within different time periods. Site Management elements are evaluated as individual components of remedial alternatives that would result in residual contamination at the Site following implementation.

Seven alternatives have been developed for evaluation. These alternatives were selected in consideration of the RAOs and based on an evaluation of the results of environmental investigations and site-specific conditions, an analysis of technological implementability, effectiveness, cost, and professional judgment.

For the alternatives developed for the Site, general descriptions of the alternatives and associated technologies are provided in Sections 4.2. Detailed analysis of each remedial alternative is presented in Section 5.0.

4.2 Development of Alternatives

The RAOs, as presented in Section 2.2, were used as a guide in the development of remedial alternatives. Descriptions of the alternatives follow.

Alternative 1: No action.

- No Action as an alternative is only an option at sites that could benefit from natural processes which would degrade the contamination to levels below the cleanup goals. This alternative is considered as a baseline for comparison as required by DER-10. This alternative would not involve periodic monitoring to evaluate natural attenuation,but would include periodic evaluation of Site conditions.

Alternative 2: Excavation, ISS, Implementation of Institutional Controls and Site Management

Alternative 2 is intended to address the debris pile and contaminated soil by removing the debris pile and stabilizing and solidifying impacted soil above CUSCOs. Alternative 2 would include:

- A pre-design investigation to complete delineation of soil with CVOCs at concentrations above CUSCOs.
- Excavation and off-site disposal of the debris pile (approximately 210 tons). The buried debris pile rises to approximately 3 feet above surrounding ground surface, is approximately 30 feet in diameter, and extends approximately 6 feet below the surrounding ground surface. Buried debris includes metal, lumber, concrete, brick, and textiles, all of which are likely associated with the former dry cleaner.
- Beyond the limits of the debris pile, excavation of soil within the area targeted for ISS (as shown on **Figure 7**) to approximately 4 feet below grade will be required to account for expansion of in-place soil from ISS. It is anticipated excavated soil will be used to raise the grade within the footprint of the debris pile excavation to match the new ground surface elevation in the area of the 4-foot deep cut. Excess soil from the cut will be disposed of offsite (approximately 210 tons).
- In-situ stabilization and solidification (ISS) will be performed to the limits of CUSCO exceedances to reduce the potential for the soil to act as an on-going source of groundwater contamination. ISS would be implemented by mixing a binding/stabilizing agent into the targeted contaminated soil volume using an auger (or similar method).
- Excavations will be backfilled to grade with clean, imported soil and the ground surface will be seeded.
- Establishment of an environmental easement (or similar) to document residual soil and groundwater contamination at the Site, prohibit the use of the Site for purposes other than commercial use, prohibit local groundwater extraction and use, prohibit the excavation of stabilized soil and require compliance with a Site Management Plan (SMP).
- Development and implementation of an SMP, including semi-annual inspections and groundwater monitoring quarterly for the first two years, annually years 3 through 5, and biannually beyond year 5 using a part of the existing monitoring well network.
- Periodic review of Site conditions and data and submission of Periodic Review Reports (PRRs) on an annual basis.

<u>*Alternative 3:*</u> Excavation, ISCR/Bioremediation, Implementation of Institutional Controls and Site Management

Alternative 3 includes the same pre-design investigation, debris pile removal, environmental easement, SMP and PRR components as Alternative 2. Alternative 3 additionally includes removal of contaminated soil above the water table with concentrations of CVOCs above CUSCOs, application of in-situ chemical reduction (ISCR)/Bioremediation amendment to the bottom of the completed excavation, and backfilling. Alternative 3 would include:

- All Alternative 2 items (with the exception of tasks associated with ISS).
- Contaminated soil removal. The volume of contaminated soil to be removed would be expanded from the originally proposed IRM based on data gathered during the supplemental RI activities completed to date and the results of the pre-design investigation. It is estimated approximately 1,300 tons of soil/debris would be excavated, removed, and disposed of off-Site as part of this alternative. The estimated limits of excavation based on the sampling and investigation work completed during the RI are shown on **Figure 6.**
- An ISCR/Bioremediation reagent would be applied to the bottom of the excavation and blended with the top 2 to 3 feet of existing soil. For the purposes of this FFS it is estimated that the soil blending during ISCR application would address CUSCO exceedances below the groundwater table identified during the pre-design investigation.
- The excavation will be backfilled to grade with clean, imported soil and the ground surface will be seeded.

Alternative 4A: Excavation, Groundwater Treatment via Injection, Implementation of Institutional Controls and Site Management

Alternative 4A includes all Alternative 3 tasks. Alternative 4A additionally includes groundwater treatment beyond the footprint of the excavation. Alternative 4A would include:

- All Alternative 3 tasks.
- Implementation of a groundwater treatment program using ISCR, bioremediation, or a combination of the two technologies on-Site both within the contaminant source area and adjacent to the southwestern boundary of the Site. The conceptual extents of the injection area are shown on **Figure 8,** which includes the suspected source area of CVOC contamination as well as the localized areas on-Site with the highest total CVOCs detected in groundwater. Additionally, the Alternative 3 pre-design investigation would be expanded to obtain data for groundwater treatment design. The expanded pre-design investigation would include additional delineation of the extent of groundwater contamination and an injection pilot test.
- The groundwater treatment would be accomplished through injections to treat areas of elevated groundwater contamination and prevent continued off-Site migration of CVOC impacted groundwater.

Alternative 4B: Excavation, Groundwater Treatment via Permeable Reactive Barrier, Implementation of Institutional Controls and Site Management

Alternative 4B includes all Alternative 3 tasks. Alternative 4B additionally includes groundwater treatment beyond the footprint of the excavation. Alternative 4B would include:

- All Alternative 3 tasks.
- Implementation of a downgradient groundwater treatment program using ISCR, Bioremediation, or a combination of the two technologies along the western property boundary.
- The groundwater treatment would be accomplished through the installation of a shallow permeable reactive barrier (PRB) to prevent continued off-Site migration of CVOC impacted groundwater. The PRB would include granular activated carbon (GAC) and/or zero valent iron to capture and/or degrade the CVOCs as the contaminants migrate across the barrier.
- The amendment would be installed using a series of tightly spaced injection points. The GAC and treatment materials (e.g., zero valent iron) are not soluble and would be injected as solids. Injection pressures will exceed the overburden confining pressure, fracturing the soil and installing the GAC and iron in the subsurface.
- It is anticipated the PRB will be installed in an approximately 15-foot thick zone, extending from the water table, which is approximately 10 feet below grade, to the lower permeability silt material encountered at a depth of approximately 25 feet during the installation of MW-9. Actual PRB depth will be determined following completion of the pre-design investigation.
- The PRB will be approximately 240 feet long, extending along the western property boundary. The PRB will run from south of soil boring location ROS-SB/GW-110 to the north next to MW-7, where it will turn east and run to the building foundation. PRB configuration will be determined following completion of the pre-design investigation.
- The Alternative 3 pre-design investigation would be expanded to obtain data necessary for the PRB design. The expanded pre-design investigation would include additional delineation of the extent of groundwater contamination, further characterization of subsurface geology and a PRB pilot test. The conceptual extents of the PRB are shown on **Figure 9**.

Alternatives 5A/5B: Excavation and Groundwater Treatment via Injection/Excavation and Groundwater Treatment via Permeable Reactive Barrier

Alternatives 5A or 5B include all items listed in Alternatives 4A and 4B, respectively, with the exception of application of an amendment in the completed excavation, implementation of an environmental easement, establishment of an SMP, and PRR requirements since the intent would be to restore the Site to pre-disposal conditions. Alternative 5A/5B would include:

- All Alternative 4A or 4B tasks with the exception of application of an amendment in completed excavation, implementation of an environmental easement, establishment of an SMP, and PRR requirements.
- Expansion of the excavation and off-site disposal of contaminated soil to remove all soil with CVOC concentrations above UUSCOs. It is anticipated dewatering and dewatering effluent treatment would be required during excavation. The contaminated soil volume to be removed and anticipated dewatering flow rates would be finalized following the implementation of pre-design investigation to be completed in support of the selected alternative; however, it is preliminarily estimated that approximately 5,300 tons of soil removal would be required for the purposes of this FFS.
- Treatment of groundwater (via Alternative 4A or 4B technologies and dewatering treatment) to below Class GA Values for CVOCs. The groundwater treatment area would encompass approximately 50,000 square feet based on the estimated plume size.
- Quarterly groundwater monitoring using a part of the existing monitoring well network. Monitoring would continue until two consecutive events documented groundwater analytical results below Class GA Values for CVOCs.

5.0 DETAILED ANALYSIS OF ALTERNATIVES

5.1 Introduction

This section provides a detailed analysis of the remedial alternatives described in Section 4.0 of this FFS Report. Each alternative is evaluated with respect to technical applicability and ability to protect against risks to public health and the environment. Additionally, each alternative is described in detail and compared on the basis of environmental benefits and costs using criteria established in 6 NYCRR Part 375, DER-10, and DER-31. A total of five remedial alternatives (including a "No Action" alternative) are described in this section and evaluated with respect to the RAOs for soil and groundwater for the Site. A soil vapor RAO is included in Section 2 above; however, provisions related to vapor intrusion mitigation for either occupancy of the existing vacant building or future on-Site structures would be addressed in a Site Management Plan (SMP) to be included as part of the restricted use alternatives.

5.1.1 Detailed Evaluation of Criteria

This section discusses the evaluation criteria against which each remedial alternative will be compared in accordance with 6 NYCRR Part 375 and Title 40 of the Code of Federal Regulations §300.430 (40 CFR §300.430, as required by DER-10). The evaluation criteria include the following:

- Overall protectiveness of public health and the environment
- Compliance with SCGs
- Short-term effectiveness and potential impacts during remediation
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility and volume of hazardous waste
- Implementation and technical reliability
- Cost
- Community acceptance
- Land use

When evaluating alternatives in terms of overall protectiveness of public health and the environment, consideration is given to the manner in which Site-related risks are eliminated, reduced, or controlled. Compliance with SCGs, long-term effectiveness and permanence, and short-term effectiveness are given major consideration in determining the overall protectiveness offered by each alternative.

The alternatives are assessed to determine whether each would attain SCGs under applicable federal environmental laws and state environmental laws. The identification of SCGs is a site-specific process which is dependent on the specific hazardous substances, pollutants, and contaminants at a site, the physical characteristics and location of a site and the remedial actions under consideration. Therefore, it is an iterative process that requires re-examination throughout the RI/FS process, until the Record of Decision (ROD) is issued. Chemical-specific SCGs were previously discussed in Section 2.3. In the following alternative analyses, the individual remedial alternatives are evaluated in detail to determine compliance with SCGs that are applicable to the specific media being addressed by the alternative, and the potential impacts of SCGs on implementation of each alternative.

Selected remedial actions must meet the threshold criteria, and thereby be protective of public health and the environment. Effectiveness of an alternative is determined by evaluation with respect to the criteria listed above, including cost[1]. The result is a selected alternative that satisfies the threshold criteria and provides the best balance of the criteria, with an emphasis on long-term effectiveness and reduction of toxicity, mobility, and volume.

Community acceptance is not evaluated in the following sections since the related criteria will be evaluated as part of future activities (e.g., future public participation events). Land use is not evaluated in detail in the following sections as land use would be consistent for all alternatives.

5.1.2 DER-31 Implementation

The approach to remediating sites in the context of the larger environment is a concept referred to as "Green Remediation." The approach is intended to minimize overall environmental impacts by promoting the use of more sustainable practices and technologies. Green Remediation practices and technologies are less disruptive to the environment, generate less waste, increase reuse and recycling, use less energy and emit fewer pollutants, including greenhouse gases, to the atmosphere.

As part of the FFS process, TRC considered NYSDEC DER-31 implementation objectives. Remedial alternatives and technologies were evaluated with respect to DER-31 throughout the FFS process as part of the overall protectiveness of public health and the environment evaluation criteria.

TRC utilized the Spreadsheets for Environmental Footprint Analysis (SEFA) developed by the U.S. Environmental Protection Agency (USEPA) to quantify the environmental footprint of each alternative. Remedial alternatives and technologies were evaluated using SEFA Version 3.0, November 2019. The Environmental Footprint Summary for each remedial alternative is included as **Table 14**. The detailed summary tables and graphs of the footprint assessment are included as **Appendix A**.

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[1] For the purposes of this FFS, a discount rate of 7% was used in the present worth analyses.

5.2 Remedial Alternatives

5.2.1 Alternative 1: No Action

5.2.1.1 Description

Alternative 1, the No Action Alternative, involves no remedial activities. NYSDEC 6 NYCRR Part 375 requires consideration of the No Action Alternative; at a minimum it provides a baseline for comparison with other alternatives. Natural attenuation would be the sole method of remediation. Because contaminants would remain at the Site above levels that would allow for unlimited use and unrestricted exposure, periodic reviews of the No Action decision would be required under 40 CFR 300.430(f)(4)(ii).

Detailed Evaluation with Respect to Criteria

5.2.1.2 Overall Protectiveness of Public Health and the Environment

This alternative is not protective of public health and the environment since it does not adequately limit the potential for exposure to impacted soil and groundwater. Natural attenuation (e.g., volatilization, dispersion, etc.) of CVOCs is likely occurring at a limited rate. This alternative is not effective in the short-term, but may achieve RAOs in the long-term.

With respect to sustainability, Alternative 1 utilizes very few natural resources and does not include the disturbance of the existing landscape. The only consumption of resources would be limited field and administrative work associated with periodic regulatory review.

5.2.1.3 Compliance with SCGs

Alternative 1 may meet chemical-specific SCGs if long-term natural attenuation processes eventually result in lower CVOC concentrations in groundwater. However, it is unlikely Alternative 1 would achieve soil SCGs within an acceptable timeframe. Alternative 1 includes no groundwater or soil sampling to monitor progress towards achieving chemical-specific SCGs.

5.2.1.4 Short-Term Impacts and Effectiveness

Alternative 1 would not result in any increased short-term risks, due to the lack of activities associated with its implementation. However, Alternative 1 does not include any Site use restrictions to prevent exposures to contamination. Therefore, no action does pose a short-term risk under the current Site conditions. RAOs would not be achieved over the short-term.

5.2.1.5 Long-Term Effectiveness and Permanence

Alternative 1 is potentially effective in the long-term. Since no additional contamination is being generated by the current Site use, natural attenuation processes may achieve RAOs in the long-term; however, since there is still a significant source of PCE remaining in Site soil that will potentially continue to "feed" the groundwater plume, it is likely the timeframe to achieve RAOs would be significant. Also, Alternative 1 does not include any long-term monitoring or Site use restrictions to prevent exposures to contamination. Due to the residual risk that would be associated with Alternative 1, periodic reviews of the no action decision would be required.

5.2.1.6 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 1 does not include any treatment methods other than naturally occurring attenuation processes. Therefore, the alternative offers no significant reductions in the toxicity, mobility, or volume of contamination through treatment.

5.2.1.7 Implementability

Alternative 1 would require no implementation other than the performance of periodic reviews. Its implementation would not limit the future implementation of additional remedial actions, if needed.

5.2.1.8 Cost

Costs associated with implementation of Alternative 1 would involve the minimal costs associated with the performance of periodic reviews. A period of 30 years is used in the cost estimate as the period over which periodic reviews would be conducted for Alternative 1. The estimated present value of this alternative, including contingency ($16,000), is approximately $79,000. A detailed cost estimate is presented in **Table 6**.

5.2.2 Alternative 2: Excavation, ISS, Implementation of Institutional Controls and Site Management

5.2.2.1 Description

Alternative 2 includes the following components:

- A pre-design investigation to complete delineation of impacts to soil above CUSCOs.
- Excavation and off-site disposal of the debris pile and excess soils from the cut required for ISS. It is anticipated soil removal will be limited to above the water table. The estimated volume of soil/debris to be removed is approximately 420 tons;
- In-situ stabilization and solidification (ISS). An estimated 600 CY of soil (to the limits of CUSCO exceedances) would be stabilized and solidified (refer to **Figure 7** for the conceptual ISS area);

- Fill material that does not exceed CUSCOs will be used to backfill to grade above the ISS treated soil. Additional backfill will be imported as needed to restore the Site to existing grade and seeded;
- Establishment of an Environmental Easement (or similar);
- Preparation and implementation of an SMP; and
- Groundwater Monitoring and Periodic Review for a period of 15 years.

Alternative 2 includes excavation and off-site disposal of the debris pile and contaminated soil, and subsequent stabilization of underlying soil. Site soils above CUSCOs would be mixed with a combination of powdered carbon and cement in order to reduce both the toxicity and mobility of the soils and associated contaminants. Additionally, Alternative 2 includes the establishment of institutional controls (e.g., environmental easement) limiting the use and future development of the Site to commercial uses, prohibiting the use of Site groundwater and requiring compliance with the SMP. The SMP developed for Alternative 2 would include requirements for notifications, soil management (if disturbed), periodic inspection and maintenance (as required), long-term groundwater monitoring for CVOCs, engineering controls for vapor intrusion in the event of use of the existing vacant building or new building construction, and record keeping and reporting.

Groundwater monitoring is included in the Site Management component of Alternative 2 to evaluate the effectiveness of source removal and natural attenuation. The scope of the groundwater monitoring program used for development of the cost estimate includes sampling of a network consisting of 16 existing wells (MW-01, MW-04, MW-05, MW-07 through MW-10, MW-11R, MW-12 through MW-16, MW-17R, MW-18, and RW-03). The actual number and location of the wells included in the monitoring program would be determined as part of final remedy selection, subject to future revisions if the areal extent of groundwater impacts changes.

Groundwater monitoring under Alternative 2 would be performed quarterly for the first two years and annually years 3 through 5. After 5 years the requirement for further groundwater monitoring would be evaluated and likely reduced to biannual sampling. Monitoring is expected to continue for approximately 15 years. Estimated costs are based on analysis of groundwater samples for CVOCs, MNA parameters, and geochemical parameters. However, an alternative-specific groundwater monitoring program would be developed after remedy implementation.

Semi-annual inspection of the Site would be performed to confirm the condition of the groundwater monitoring wells. Notifications would be required for proposed changes to Site conditions (e.g., building demolition and/or redevelopment) as well as related revisions to the SMP. Results of Site inspections and analytical data generated as part of Site Management activities would be reported to NYSDEC in semi-annual reports. Periodic Review Reports (PRRs) of Site conditions and data would be submitted to NYSDEC on an annual basis.

Detailed Evaluation with Respect to Criteria

5.2.2.2 Overall Protectiveness of Public Health and the Environment

Alternative 2 provides limited protectiveness to public health by limiting potential for exposure to contamination via excavation and removal of the debris pile and solidification and stabilization of contaminated soil CUSCOs, as well as institutional controls associated with restrictions on groundwater and Site use and requiring vapor intrusion mitigation as part of redevelopment. It is expected that the mobility and toxicity of groundwater contaminants would be reduced through natural attenuation and stabilization of soils within the source area and removal of the debris pile. Alternative 2 is not completely effective in the short-term as achievement of SCGs for groundwater is estimated to be within 15 years, though risks associated with contaminated soils/debris above CUSCOs would be eliminated. With respect to sustainability, Alternative 2 would contribute to vehicular traffic/emissions during excavation, handling, and loading of material and consume energy during solidification/stabilization, backfilling, and groundwater sampling. Further sustainability considerations for this alternative are discussed in Section 6.2 below.

5.2.2.3 Compliance with SCGs

Alternative 2 uses long-term groundwater monitoring to monitor changes in exceedances of chemical-specific SCGs in Site groundwater. Natural attenuation processes and debris removal/soil stabilization are not expected to result in achievement of chemical-specific SCGs for Site groundwater in the short-term. Stabilization/solidification of soil with concentrations of CVOCs exceeding CUSCOs and subsequent backfilling with clean imported material would comply with applicable commercial use soil SCGs.

5.2.2.4 Short-Term Impacts and Effectiveness

There would be minimal short-term risks during implementation of excavation, ISS, and backfilling work. Risk to workers (or the adjacent community) would be mitigated by the use of appropriate PPE, establishment of an exclusion zone, and performance of a community air monitoring program (CAMP). Direct contact risk with soil above CUSCOs would be removed in the short-term, following the removal of debris and solidification of the remaining contaminated soil with concentrations of CVOCs above CUSCOs. The implementation of institutional controls (environmental easement restricting groundwater use and compliance with the SMP) would be effective at minimizing potential exposure to groundwater contamination; however, the groundwater monitoring program would not be effective in the short-term at minimizing CVOC concentrations in groundwater, other than providing evidence of groundwater plume stability. Implementation of groundwater monitoring poses minimal potential short-term risks to field sampling crews due to the potential for exposure to contaminated groundwater. These risks would be mitigated by using appropriate personal protective equipment (PPE) and protocols.

5.2.2.5 Long-Term Effectiveness and Permanence

Alternative 2 offers long-term effectiveness for restricted Site use (commercial). Removal of the debris pile and implementation of ISS provide long-term effectiveness by reducing the potential for contaminated soil to act as an on-going source of groundwater contamination and eliminating the direct contact risk with soil above CUSCOs. However, Alternative 2 would not significantly reduce current levels of groundwater contamination, particularly in downgradient areas. The implementation of a groundwater monitoring program is not effective in minimizing the concentrations of CVOC in groundwater but would provide evidence of groundwater plume stability and/or reduction via natural attenuation. Implementation of institutional controls would prevent exposure in the long-term by restricting the use of the Site and requiring vapor mitigation for potential future development on-Site.

5.2.2.6 Reduction of Toxicity, Mobility, and Volume through Treatment

Removal of the debris pile will reduce the volume of contamination on-Site. Additionally, the ISS will limit the mobility of contaminants. Limited reduction to the toxicity, mobility, and volume of groundwater contamination would be expected due to partial removal and stabilization and solidification of the contaminant source.

5.2.2.7 Implementability

Alternative 2 requires the implementation of a pre-design investigation, excavation, ISS, backfill, a groundwater monitoring program, institutional controls, site inspections and reporting. All of the primary elements of Alternative 2 would utilize well-proven technologies, and vendors with the qualifications to implement the alternative are readily available. Mobilization and staging of ISS equipment may represent coordination issues (e.g., with the existing property owner), but there is adequate space on-Site to implement this remedy. Additionally, the Site contains a steep slope to the unnamed creek near the southern boundary of the current limits of delineated soil contamination, and the limits of CVOC contamination above CUSCOs will be unknown until the pre-design investigation is completed. There may be challenges implementing the soil cut and soil mixing for the ISS if the impacts above CUSCOs extend far down the slope toward the creek since specialized excavation support and equipment may be required.

5.2.2.8 Cost

The primary costs of Alternative 2 are associated with pre-design investigation, excavation, ISS, backfilling, and long-term groundwater monitoring. The estimated direct capital cost (i.e., pre-design investigation, excavation, transport and disposal, ISS and backfill) for Alternative 2 is $620,000. Based on the use of existing monitoring wells, groundwater monitoring does not contribute to direct capital costs for Alternative 2. The estimated indirect capital cost (i.e., preparation of the Environmental Easement and SMP, and groundwater monitoring) for Alternative 2 is $217,000. The estimated present value for future actions is $345,000.

Therefore, the estimated present value of Alternative 2, including contingency ($296,000), is $1,478,000. A detailed cost estimate is presented in **Table 7**.

5.2.3 Alternative 3: Excavation, ISCR/Bioremediation, Implementation of Institutional Controls and Site Management

The primary difference between Alternative 3 and Alternative 2 is the expansion of contaminated soil removal and application of an ISCR/Bioremediation reagent to reduce the concentrations of CVOCs. Additionally, no ISS would be performed under Alternative 3 since soil removal will be completed to the limits of CUSCOs.

5.2.3.1 Description

As part of Alternative 3, the excavation and off-site disposal of the debris pile, groundwater monitoring program and institutional controls included in Alternative 2 would be implemented. Alternative 3 would expand the volume of contaminated soil to be removed to soil exceeding CUSCOs. The estimated limits of CUSCO contamination are described in Section 2.4 and shown on **Figure 6**. The limits will be further defined as part of pre-design investigation activities. Additionally, an ISCR/Bioremediation reagent would be applied to the bottom of the excavation and blended with the in-place soil to reduce concentrations of CVOCs in Site soil and groundwater. Saturated soils with concentrations of CVOCs above CUSCOs identified during the pre-design investigation will be treated via the ISCR/Bioremediation agent rather than via excavation below the water table. Amendments would be selected and employed to accelerate the degradation of CVOC contamination. Excavations will be backfilled with clean imported soil, from an off-Site source.

For the purposes of this assessment, and utilizing data generated during RI, it is estimated approximately 1,300 tons of material will be excavated and 9 tons of ISCR reagent will be applied and blended into the top 2 to 3 feet of soil in the bottom of the excavation. However, the excavation and reagent quantity estimates would be updated based on information from the pre-design investigation.

Detailed Evaluation with Respect to Criteria

5.2.3.2 Overall Protectiveness of Public Health and the Environment

Alternative 3 provides protectiveness to public health and the environment through the removal of the debris pile and contaminated soil and application of ISCR/Bioremediation amendments to reduce concentrations of CVOCs in soil and groundwater, therefore limiting potential for exposure to contamination. Additionally, potential for exposure to contamination would be minimized via institutional controls. It is anticipated Alternative 3 would achieve SCGs for soil following excavation and soil blending, and groundwater SCGs in approximately 15 years. With respect to sustainability, Alternative 3 represents a greater contribution to vehicular traffic and emissions than Alternative 2 due to increased soil removal; however, the energy required for ISCR application and soil blending would likely be less than for ISS proposed in Alternative 2. Further sustainability considerations for this alternative are discussed in Section 6.2 below.

5.2.3.3 Compliance with SCGs

Alternative 3 would excavate contaminated soils and apply ISCR/Bioremediation amendments to the excavation footprint to remove soil above restricted use SCGs, backfill with clean imported soil, and accelerate the attenuation of contamination in groundwater to below chemical-specific SCGs.

5.2.3.4 Short-Term Impacts and Effectiveness

The excavation of debris/soil, application of ISCR/Bioremediation amendments, and backfilling is expected to provide protection in the short term from direct contact with soil/debris. Performance of excavation, amendment application, and groundwater sampling could present minor increased short-term risks to workers and field sampling crews. These risks would be minimized through the use of proper PPE, protocols, and CAMP implementation. Alternative 3 would be effective at achieving soil RAOs in the short-term, though likely would not result in significant short-term groundwater quality improvements. The implementation of institutional controls (environmental easement restricting groundwater use and compliance with the SMP) would be effective at minimizing potential exposure to groundwater contamination. Similar to Alternative 2, short-term impacts to the community from, for example, truck traffic and site work, would be expected to be minimal.

5.2.3.5 Long-Term Effectiveness and Permanence

Alternative 3 would be effective in reducing the long-term risks associated with the presence of CVOCs in soil and groundwater through excavation and the in-situ treatment of impacted groundwater. Implementation of institutional controls would minimize the potential for exposure in the long-term by restricting the use of the site and requiring vapor mitigation for potential future development of buildings on-Site. Periodic reviews of the action would be required until RAOs are achieved.

5.2.3.6 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 3 would provide reductions in the toxicity of groundwater contaminants through bioremediation of CVOCs to less toxic compounds. Reductions in contaminant volumes would be accomplished by excavation and off-site disposal of the debris mound and contaminated soil.

5.2.3.7 Implementability

Alternative 3 requires implementation of a pre-design investigation, the removal of the debris pile and contaminated soil; application of ISCR/Bioremediation amendment; backfilling; implementation of a groundwater monitoring program; institutional controls; and site inspections and reporting. All of the primary elements of Alternative 3 would utilize well-proven technologies, and vendors with the qualifications to implement the alternative are readily available. Additionally, the Site contains a steep slope to the unnamed creek near the southern boundary of the current limits of delineated soil contamination, and the final limits of CVOC contamination above CUSCOs will not be known until the pre-design investigation is completed. There may be challenges completing the excavation if the impacts above CUSCOs extend far down this slope toward the creek since specialized excavation equipment and support may be required.

5.2.3.8 Cost

The principal costs of Alternative 3 are associated with preparing a implementation of a pre-design investigation, excavation, transport and disposal of soil, ISCR application/soil blending, backfilling, and groundwater monitoring. The direct capital cost of Alternative 3 is estimated at $1,136,000 and the estimated indirect capital cost is estimated at $399,000. The estimated present value for future actions is estimated at $345,000. Therefore, the estimated present value of this alternative, including contingency ($470,000), is $2,350,000. A detailed cost estimate is presented in **Table 8**.

5.2.4 Alternative 4A: Excavation, Groundwater Treatment via Injection, Implementation of Institutional Controls and Site Management

The primary difference between Alternative 4A and Alternative 3 is the treatment of groundwater beyond the excavation footprint to reduce the concentrations of CVOCs.

5.2.4.1 Description

As part of Alternative 4A, the excavation and off-site disposal of the debris pile and contaminated soil, application of amendment to the bottom of the excavation, backfilling, groundwater monitoring and institutional controls included in Alternative 3 would be implemented. Alternative 4A would include implementation of a downgradient groundwater treatment program using ISCR, Bioremediation, or a combination of the two technologies both within the source area and adjacent to the southwestern boundary of the Site. The Alternative 3 pre-design investigation would be expanded to obtain design data for groundwater treatment. The expanded pre-design investigation would include additional delineation of the extent of groundwater contamination and an injection pilot test. The groundwater treatment would be accomplished through injections to reduce contaminant concentrations in the existing plume and limit off-Site migration of CVOC impacted groundwater.

Estimated costs for Alternative 4A are based on an initial injection followed by a second injection event at year 3; however, remedial design parameters for injections will be established following the completion of the pre-design investigation and injection pilot testing. A conceptual layout of the injection area is included on **Figure 8.** For the purposes of this evaluation, it is estimated 42 injection wells will be installed to complete the injection program.

Detailed Evaluation with Respect to Criteria

5.2.4.2 Overall Protectiveness of Public Health and the Environment

Alternative 4A provides protectiveness to public health and the environment through the debris and soil removal and treatment described under Alternative 3 as well as application of ISCR/Bioremediation amendments via injection to further reduce concentrations of CVOCs in groundwater. It is estimated that implementation of Alternative 4A would result in achievement of SCGs for groundwater in 10 years or less. Alternative 4A would consume more energy than Alternative 3 due to the addition of groundwater treatment through injections. Further sustainability considerations for this alternative are discussed in Section 6.2 below.

5.2.4.3 Compliance with SCGs

Alternative 4A would remove contaminated soils above restricted use SCGs. Injection of ISCR/Bioremediation amendments would remediate groundwater contaminants above chemical-specific SCGs within the treatment area.

5.2.4.4 Short-Term Impacts and Effectiveness

The injection program would be expected to provide greater effectiveness in reducing impacts to groundwater in the short term than the amendment application proposed in Alternative 3. Performance of excavation, backfilling, injections, and groundwater sampling could present minor increased short-term risks to workers and field sampling crews. These risks would be minimized through the use of proper PPE protocols, and CAMP. Similar to Alternatives 2 and 3, short-term impacts to the surrounding community are expected to be minimal. Alternative 4A would likely be effective at achieving soil RAOs in the short-term and groundwater RAOs within 10 years.

5.2.4.5 Long-Term Effectiveness and Permanence

Alternative 4A would be effective in reducing the long-term risks associated with the presence of CVOCs in soil and groundwater through excavation of contaminated soil and the in-situ treatment of impacted groundwater. Implementation of institutional controls would minimize the potential for exposure in the long-term by restricting the use of the site and requiring vapor mitigation for potential future development on-Site. Periodic reviews of the action would be required until RAOs are achieved.

5.2.4.6 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternative 4A would provide reductions in the volume and toxicity of soil contamination through excavation and off-Site disposal of contaminated soil and reductions in the volume and toxicity of groundwater contamination by bioremediation of CVOCs in groundwater to less toxic compounds.

5.2.4.7 Implementability

Alternative 4A requires implementation of a pre-design investigation; the excavation of the debris pile and contaminated soil; groundwater treatment using ISCR and/or Bioremediation injections; implementation of a groundwater monitoring program; institutional controls; and site inspections and reporting. All of the primary elements of Alternative 4A would utilize well-proven technologies, and vendors with the qualifications to implement the alternative are readily available.

However, the area wide injections proposed on-Site for Alternative 4A would be difficult to implement due to the complex geology. The subsurface soils at the Site include shallow and deep low permeability layers, composed of clay or silty clay, and a relatively thin lens of more permeable sand and silty sand. This permeable layer varies in thickness from less than 5 feet to over 10 feet, and occasionally includes thin layers of gravel. The proposed injection program would be appropriate for the permeable layers; however, low injection rates and radii of influence would be expected in the low permeability zones, potentially limiting the effectiveness of Alternative 4A. A pilot test would be necessary to further assess the implementability of injections as part of the remedy under this Alternative. Additionally, the Site contains a steep slope to the unnamed creek near the southern boundary of the current limits of delineated soil contamination, and the final limits of CVOC contamination above CUSCOs will not be known until the pre-design investigation is completed. There may be challenges completing the excavation if the impacts above CUSCOs extend far down this slope toward the creek since specialized excavation equipment and support may be required.

5.2.4.8 Cost

The principal costs of Alternative 4A are associated with the pre-design investigation (including injection pilot testing), excavation, transport and disposal of soils/debris, amendment injection, and groundwater monitoring. The direct capital cost of Alternative 4A is estimated at $1,578,000 and the estimated indirect capital cost is estimated at $553,000. The estimated present value for future actions is estimated at $462,000. Therefore, the estimated present value of this alternative, including contingency ($649,000), is $3,242,000. A detailed cost estimate is presented in **Table 9**.

5.2.5 Alternative 4B: Excavation, Groundwater Treatment via Permeable Reactive Barrier, Implementation of Institutional Controls and Site Management

The primary difference between Alternative 4B and Alternative 4A is the treatment of groundwater through the installation of a permeable reactive barrier (PRB) along the western property boundary to control off-Site migration of the CVOC plume (**Figure 9**), rather than installing injection wells across the treatment area (**Figure 8**) to remediate the groundwater contamination on-Site. Alternative 4B will prevent groundwater contamination from leaving the Site, but it will rely on source mass removal and attenuation to treat the on-Site impacted groundwater.

5.2.5.1 Description

As part of Alternative 4B, the excavation and off-site disposal of the debris pile, groundwater monitoring program, and institutional controls included in Alternative 3 would be implemented. Alternative 4B would include groundwater treatment accomplished through the installation of a shallow PRB to prevent continued off-Site migration of CVOC impact groundwater. Similar to Alternative 4A, the Alternative 4B pre-design investigation would be expanded to obtain design data for groundwater treatment. The expanded pre-design investigation would include additional delineation of the extent of groundwater contamination and a PRB pilot test.

The detailed evaluation of Alternative 4B is similar to the evaluation of Alternative 4A. The only difference between the alternatives is the remedial strategy employed for groundwater treatment; therefore, with respect to the evaluation criteria, the most significant difference is in long-term effectiveness and cost associated with groundwater treatment. Therefore, the detailed evaluation presented below is limited to these two criteria. A conceptual layout of the PRB is shown on **Figure 9.** The sustainability considerations for this alternative are discussed in Section 6.2 below.

5.2.5.2 Long-Term Effectiveness

The long-term effectiveness of Alternative 4B is expected to be slightly lower than Alternative 4A, because this alternative will rely on the excavation and natural attenuation to address on-Site groundwater impacts. Alternative 4A is expected to treat the impacted on-Site groundwater through the addition of a bioremediation amendment, while Alternative 4B would be effective at preventing off-Site migration of the plume, it would not be actively remediate on-Site groundwater contamination (beyond removal of source area contamination). The proposed excavation included in Alternatives 4A and 4B are expected to significantly improve groundwater quality by removing source material that is continuing to maintain the groundwater plume. The presence of breakdown compounds in the plume demonstrates that bioremediation is already occurring and should be able to attenuate the plume after the source material is removed.

The PRB will have a finite lifespan, based on the groundwater flow rates, contaminant concentrations and the mass of activated carbon and zero valent iron installed. For the purpose of this FFS a 20-year duration for effective treatment by the PRB has been used, which is within a reasonable timeframe for the on-Site groundwater to attenuate after source removal. Alternative 4B is expected to be effective in long-term treatment; however, MNA rates and contaminant half-lives would have to be considered during the design to result in PRB longevity equal to or greater than the on-Site MNA time frame.

5.2.5.3 Cost

The principal costs of Alternative 4B are associated with performance of a pre-design investigation, excavation, transport and disposal of soils/debris, installation of a PRB, and groundwater monitoring. The direct capital cost of Alternative 4B is estimated at $1,675,000 and the estimated indirect capital cost is estimated at

$587,000. The estimated present value for future tasks is estimated at $308,000. Therefore, the estimated present value of this alternative, including contingency ($643,000), is $3,213,000. A detailed cost estimate is presented in **Table 10**.

5.2.6 Alternatives 5A/5B: Excavation and Groundwater Treatment via Injection/Excavation and Groundwater Treatment via Permeable Reactive Barrier

The primary difference between Alternatives 5A/5B and Alternatives 4A and 4B is the objective of Alternatives 5A/5B would be to restore the Site to pre-disposal conditions. Therefore, Alternatives 5A/5B do not include institutional controls and long-term monitoring and reporting requirements; however, the scope of pre-design investigation (to delineate to UUSCOs), soil removal and groundwater treatment (for the injection alternative) would be increased.

5.2.6.1 Description

As a part of Alternatives 5A/5B, the excavation and off-site disposal of contaminated soil would be expanded to remove all soil above CVOC UUSCOs. It is anticipated that during excavation work, dewatering and dewatering effluent treatment would be required. As described above, the limits of contaminated soil are not well delineated to UUSCOs and would be defined by a pre-design investigation. Anticipated dewatering flowrates would be finalized following the implementation of pre-design investigation activities, which would include a pumping test. Backfilling with imported material that meets UUSCOs would be completed following excavation work. Alternatives 5A/5B would also include treatment of groundwater to below Class GA values for CVOCs using the treatment technology from Alternative 4A or 4B and dewatering treatment. Quarterly groundwater monitoring using part of the existing monitoring well network would be performed until two consecutive events document analytical results below Class GA values.

For the limited purposes of this assessment, and utilizing data generated during RI, in addition to the scope of Alternatives 4A/4B it is estimated the excavation would be expanded to approximately 5,300 tons of material, and injection frequency would increase to every two (2) years (for Alternative 5A). The excavation would likely extend into groundwater and dewatering (and treatment of dewatering fluid) would be required during the excavation work. It is expected that an initial injection event would encompass on-Site as well as significant off-Site area, the second injection event would require approximately half of the injection locations of the initial event, and the third injection would be on-Site only. However, the recommended injection parameters would be updated based on the results of the pre-design investigation.

<u>Detailed Evaluation with Respect to Criteria</u>

5.2.6.2 Overall Protectiveness of Public Health and the Environment

Alternatives 5A/5B provide the highest level of protectiveness to public health and the environment by restoring the Site to pre-disposal conditions. This eliminates the potential for exposure to remaining contamination. It is anticipated Alternatives 5A/5B would achieve SCGs for soil and groundwater within 5 years. The sustainability considerations for these alternatives are discussed in Section 6.2 below.

5.2.6.3 Compliance with SCGs

Alternatives 5A/5B would include removal of all soil with CVOCs at concentrations above UUSCOs and treat groundwater to remediate contaminants above chemical-specific SCGs.

5.2.6.4 Short-Term Impacts and Effectiveness

Removal of soil with concentrations of CVOCs above UUSCOs and treatment of groundwater via dewatering and injection (or PRB) are expected to be effective in the short term. Expanded excavation, treatment, and groundwater sampling could present minor increased short-term risks to workers and field sampling crews. These risks would be minimized through the use of proper PPE, protocols, and CAMP. Additionally, the larger excavation footprint (and the larger area-wide injection program for Alternative 5A) would result in greater short term impacts than the other alternatives, such as increased truck traffic, potential temporary road closures, and increased noise in the vicinity of the Site and on neighboring properties. Alternatives 5A/5B would be effective at achieving RAOs in the short-term.

5.2.6.5 Long-Term Effectiveness and Permanence

Alternatives 5A/5B would be effective in reducing the long-term risks associated with the presence of CVOCs in soil and groundwater through contaminated soil removal, dewatering, and the in-situ treatment of impacted groundwater. Periodic reviews of the action would be required until RAOs are achieved.

5.2.6.6 Reduction of Toxicity, Mobility, and Volume through Treatment

Alternatives 5A/5B would provide reductions in the volume and toxicity of soil contaminants through excavation and off-Site disposal of contaminated soil. Bioremediation of CVOCs in groundwater would additionally result in reduction of toxicity and volume of impacted groundwater.

5.2.6.7 Implementability

Alternatives 5A/5B require the removal of the debris pile and contaminated soils above UUSCOs; excavation dewatering; ISCR injections or installation of a PRB; and implementation of a groundwater monitoring program. All of the primary elements of Alternatives 5A/5B would utilize well-proven technologies, and vendors with the qualifications to implement the alternative are readily available. However, due to the geography of the Site, which contains a steep slope to the unnamed creek near the southern boundary of the current limits of delineated soil contamination, excavation of soil to UUSCOs in this area may be difficult to accomplish. Clearing large sections of the wooded area and specialized excavation support may be required. Additionally, access agreements would be required for off-Site work and would be required for work within rights-of-way, potentially requiring local permits. Therefore, implementation of the soil removal component of this Alternative is expected to be challenging.

The area wide injections proposed both on and off-Site for Alternative 5A would be difficult to implement due to the complex Site geology. The subsurface soils at the Site include shallow and deep low permeability layers, composed of clay or silty clay, and a relatively thin lens of more permeable sand and silty sand. This permeable layer varies in thickness from less than 5 feet to over 10 feet, and occasionally includes thin layers of gravel. The proposed injection program would be appropriate for the permeable layers but low injection rates and radii of influence would be expected in the low permeability zones, potentially limiting the effectiveness of Alternative 5A. A pilot test would be necessary to further assess the implementability of injections as part of Alternative 5A.

5.2.6.8 Cost

The principal costs of Alternatives 5A/5B are associated with pre-design investigation, excavation, transport and disposal of contaminated soil, groundwater treatment via injection or PRB, and groundwater monitoring. The direct capital cost of Alternative 5A is estimated at $5,634,000 and the estimated indirect capital cost is estimated at $1,973,000. The estimated present value for future actions is estimated at $815,000. Therefore, the estimated present value of Alternative 5A, including contingency ($2,106,000), is $10,528,000. The direct capital cost of Alternative 5B is estimated at $5,116,000 and the estimated indirect capital cost is estimated at $1,792,000. The estimated present value for future actions is estimated at $275,000. Therefore, the estimated present value of Alternative 5B, including contingency ($1,796,000), is $8,979,000. Detailed cost estimates for Alternatives 5A and 5B are presented in **Tables 11** and **12**.

6.0 COMPARATIVE ANALYSIS OF REMEDIAL ALTERNATIVES

6.1 Introduction

The comparative analysis presented in this section evaluates the relative performance of each alternative using the same criteria by which the detailed analysis of each alternative was conducted. The purpose of the comparative analysis is to identify the advantages and disadvantages of each alternative relative to one another to aid in selecting an overall remedy for the Site.

The comparative analysis includes a narrative discussion of the strengths and weaknesses of the alternatives relative to one another with respect to each criterion. A qualitative approach to comparison is used, with the exceptions of comparing estimated alternative costs and the required time to implement each alternative.

6.2 Comparison of Alternatives

Overall Protectiveness of Public Health and the Environment – Alternative 1 is the least protective of public health and the environment and does not include any active remedial components, evaluation, or monitoring of existing exposure pathways. Alternative 2 includes removal of the debris pile and stabilization/solidification of contaminated soil above CUSCOs; however, it does not include active groundwater remediation, therefore groundwater attenuation would only occur naturally and potential for exposure would not be completely eliminated for many years. Alternative 3 includes a greater degree of soil removal (to the extent of concentrations above CUSCOs) than Alternative 2 and active remediation from the application of amendment to the bottom of the excavation; however, the application of amendment would not have a significant short-term impact on the off-Site contaminated groundwater and would only limit future migration from the source area. Alternatives 4A and 4B, in addition to all Alternative 3 tasks, would include active groundwater remediation on-Site beyond the source area, and are approximately equally protective of public health and the environment. Alternatives 4A and 4B would provide shorter term results and quicker attenuation of CVOCs in off-Site groundwater than Alternatives 1, 2 and 3 and, therefore, provide greater overall protectiveness than Alternatives 1, 2 and 3. Alternatives 5A/5B provide the highest level of protectiveness since SCGs would be achieved with greatest certainty and in the shortest timeframe. Additionally, refer to the green remediation analysis below with regard to an evaluation of the sustainability of the alternatives.

Compliance with SCGs – Alternative 1 likely would not result in achievement of soil SCGs within a reasonable timeframe. Alternatives 2 and 3 would likely result in compliance with soil SCGs in the short-term for restricted Site use, and groundwater SCGs after an extended timeframe via natural attenuation. Similar to Alternative 3, Alternatives 4A and 4B are likely to result in compliance with soil SCGs for restricted use in the short-term and groundwater SCGs within a 10-year timeframe. Alternatives 5A and 5B would result in compliance with unrestricted soil SCGs in the short-term and groundwater SCGs with greatest certainty and within the shortest time frame.

Short-term Impacts and Effectiveness – Alternative 1 is not effective in the short-term and would have no impacts. The effectiveness of reducing/stabilizing CVOC concentrations in soil in the short-term would be similar under Alternatives 2, 3, 4A and 4B. Of Alternatives 2, 3, 4A and 4B, short-term effectiveness at reducing CVOC concentrations in groundwater would likely be greatest for Alternative 4A, slightly more effective than Alternative 4B, followed by Alternatives 2 and 3, which would be less effective in the short-term than Alternatives 4A/4B. Alternatives 5A/5B would be most effective with respect to remediating soil and groundwater impacts in the short-term. Alternative 1 would result in the least short-term impacts, Alternative 2 and 3 would result in minor short-term impacts, primarily confined to the Site, Alternatives 4A and 4B would create greater short-term impacts on-Site, and Alternatives 5A/5B would result in the greatest short-term impacts both on-Site and off-Site, including higher worker exposure during the larger excavation program of Alternatives 5A/5B and greater impact to the community, due to the injection program extending beyond the Site boundaries.

Long-term Effectiveness and Permanence – Each alternative is expected to be effective and permanent in the long-term. However, Alternative 1 does not include any controls or monitoring to confirm the effectiveness of natural attenuation processes and would require the longest timeframe to achieve RAOs.

Reduction of Toxicity, Mobility, and Volume by Treatment – Alternative 1 provides no reduction of toxicity, mobility, or volume of contaminants other than through naturally occurring attenuation processes. Alternative 2 would reduce the toxicity, mobility, and volume of CVOCs in soil via excavation and ISS but would not actively reduce current levels of CVOCs in groundwater. Alternative 3 would offer greater reduction of CVOCs in soils and also provide limited groundwater treatment via amendment application to the completed excavation. Alternatives 4A and 4B would reduce the toxicity, mobility, and volume of CVOCs in soil and groundwater through excavation and application of amendment and groundwater treatment via injections or installation of a PRB, respectively. Alternatives 5A/5B would restore the Site to pre-disposal conditions and would reduce the toxicity, mobility, and volume of CVOCs in soil and groundwater to the greatest extent through excavation and groundwater treatment.

Implementability – Alternative 1 is the most easily implemented since it requires no action. Alternatives 2 and 3 are approximately equally implementable. The technologies for Alternatives 4A and 4B are approximately equally implementable initially; however, it would be easier to implement additional injection events on-Site via Alternative 4A than complete reinstallation of the PRB via Alternative 4B. Excavation or ISS to the limits of CUSCO exceedances would present similar access challenges down the slope near the southern boundary of the Site as part of Alternatives 2, 3, and 4A/B. Alternatives 5A/5B would be the most difficult to implement due to complications associated with the likely requirement for soil excavation in part of the Site with difficult access adjacent to the unnamed creek, required dewatering and treatment of groundwater during excavation work, and off-Site access requirements. The area wide injections proposed on-Site for Alternative 4A and both on and off-Site for Alternative 5A would also be difficult to implement due to the complex geology. The subsurface soils at the Site include shallow and deep low permeability layers, composed of clay or silty clay, and a relatively thin lens of more permeable sand and silty sand. This permeable layer varies in thickness from less than 5 feet to over 10 feet, and occasionally includes thin layers of gravel. The proposed injection program would be appropriate for the permeable layers but low injection rates and radii of influence in the low permeability zones are likely, potentially limiting the implementability of Alternatives 4A and 5A.

Cost-Effectiveness – Alternatives 1 is the most cost-effective. The estimated costs for Alternatives 4A/4B are greater than the estimated cost for Alternative 3, and the estimated cost for Alternative 2 is lower than the estimated cost for Alternative 3. The estimated costs for Alternatives 5A/5B are the highest. A summary comparison of the estimated remedial alternative costs is presented in **Table 13**.

Land Use – The Site is currently zoned for business. Alternatives 2, 3, 4A and 4B are equal with respect to land use and all include the establishment of an environmental easement to prohibit the use of the Site for purposes other than commercial use. Alternatives 5A/5B are intended to restore the Site to pre-disposal conditions and would not require an environmental easement.

Green Remediation (DER-31 and SEFA) –

In compliance with DER-31, TRC considered the green remediation metrics of the alternatives described in this FFS. A footprint assessment of each alternative was conducted, with the exception of Alternative 1 because there are no on-Site activities which are part of Alternative 1. The footprint assessment was completed using the US Environmental Protection Agency Spreadsheets for Environmental Footprint Assessment (SEFA) tool. The SEFA tool estimated the remedy footprint by calculating metrics for four of the five core footprint elements. The five core footprint elements are:

1. Materials & Waste
2. Water Use
3. Energy Use
4. Air Emissions
5. Land & Ecosystems

The SEFA tool does not assess the impact to land and ecosystems; however, the alternatives presented in this FFS do not differ greatly in their land and ecosystem impacts and the overall footprint assessment is representative of each technology. The materials and waste element has been considered in the SEFA assessment and is included with the energy use and air emissions analysis, since energy use and air emissions are primarily related to the material use and waste transport and off-Site disposal. Water use is fairly minimal for this project, with the largest injection option (Alternative 5A) using less than 1 million gallons of water. None of the alternatives include long term water use or disposal (beyond minimal volumes during long-term groundwater sampling), and water use has not been considered as a differentiating factor for the assessment.

No efforts were made as part of this assessment to optimize the Alternatives with respect to the environmental footprint of each. Footprint reduction and optimization strategies, as well as the application of best management practices (BMPs), will be considered in the remedial design for the selected alternative.

Alternatives 5A/5B rate lowest with respect to green remediation due to the large amount of energy required for excavation and disposal of contaminated soil. The excavation and off-Site transportation and disposal of the soil accounts for the majority of the energy use and greenhouse gas emissions for Alternatives 5A and 5B. The energy use amounts for Alternatives 5A and 5B are approximately 65,900 and 64,800 million British Thermal Units (MMBTUs), respectively. Total greenhouse gas emissions for Alternatives 5A and 5B are estimated at approximately 12,700 and 12,600 equivalent tons of CO_2.

The environmental footprints for Alternatives 3, 4A and 4B are similar, especially with regard to waste disposal and greenhouse gas emissions. The amount of soil excavated, transported and treated off-Site is approximately equivalent in these options and the related work constitutes the source of the majority of the greenhouse gas emissions. The relatively small quantities of remediation amendments incorporated in the soil blending, groundwater injections and the PRB are similar in scope and do not significantly impact the overall footprints. The energy use for Alternatives 3, 4A and 4B are approximately 13,400 MMBTUs, 15,000 MMBTUs and 14,000 MMBTUs, respectively. Total greenhouse gas emissions for Alternatives 3 and 4B are approximately 2,600 equivalent tons of CO_2 and the total greenhouse gas emissions for Alternative 4A is approximately 2,700 equivalent tons of CO_2.

The environmental footprint for Alternative 2 is the lowest, due to the small excavation volume and limited groundwater treatment. As with all alternatives, the soil excavation, transportation and off-Site disposal constitutes the majority of the total energy use and greenhouse gas emissions. The refined material use for Alternative 2 is approximately 1,000 tons, and is mainly comprised of Portland cement. The energy use for Alternative 2 is approximately 3,700 MMBTUs, and the total greenhouse gas emissions for Alternative 2 is approximately 600 equivalent tons of CO_2.

The assessment shows that the environmental footprint is tied most closely to the size of the excavation and the volume of soil and debris shipped off-Site for disposal. The groundwater remedial actions do not have a large impact on the footprint, based on the SEFA assessment. A summary of the footprint assessment is provided in **Table 14**. The detailed graphs and tables for the assessment are presented in **Appendix A**.

7.0 RECOMMENDED REMEDIAL ALTERNATIVE

Results of the RI, presented in the March 2022 RI Report, indicate that concentrations of CVOCs are present in soil and groundwater above SCOs and Class GA Values, respectively. Alternative 1 is not recommended as it does not alleviate short-term direct contact risk with contaminated material at the Site and SCGs would not be achieved in a reasonable timeframe. Alternatives 2, 3, 4A and 4B all offer similar levels of short-term protection for direct contact with contaminated soils and achievement of soil SCGs for restricted use. Alternative 2 would rely on natural attenuation to reduce contaminant concentrations in groundwater concentrations, and would take longer to achieve SCGs when compared to Alternatives 3, 4A and 4B. Alternative 4A is anticipated to be more difficult to implement than Alternative 4B, although both represent challenges with regards to performing injections into complex Site geology. Although Alternatives 5A/5B offers the greatest level of protection and would not restrict Site use, both will likely be impractical to implement and the estimated costs of each are significantly higher than estimated costs for the other alternatives.

Although it would not achieve SCGs as quickly as Alternatives 4A/B, Alternative 3 would be the easier alternative to implement, and would perform similar with respect to the other screening criteria. Alternative 3 is also less costly and would result in lower energy use and lower greenhouse gas emissions when compared to Alternatives 4A and 4B. Alternative 3 is proposed as the recommended alternative because it strikes the best balance between short and long term effectiveness for soil and groundwater treatment, costs, and environmental footprint.

8.0 REFERENCES

1. 6 NYCRR 375, Remedial Program Requirements.
2. 6 NYCRR 703, Surface Water and Groundwater Quality Standards and Groundwater Effluent Limitations.
3. EA Engineering, P.C., Site Characterization Investigation Report, Rosendale Cleaners, 1090-1094 Route 32, Rosendale, New York, January 14, 2009.
4. Bedrock Geologic Map of New York, Lower Hudson Sheet, New York State Museum, 1970, reprinted 1995.
5. New York State Department of Environmental Conservation (NYSDEC) Division of Environmental Remediation (DER)-10, Technical Guidance for Site Investigation and Remediation, May 2010.
6. NYSDEC Division of Environmental Remediation (DER) Bureau of Program Management Work Assignment (WA) Notice to Proceed, June 29, 2020.
7. New York State Department of Health (NYSDOH), Guidance for Evaluating Soil Vapor Intrusion in the State of New York, October 2006, as amended.
8. Surficial Geologic Map of New York, Lower Hudson Sheet, New York State Museum, 1970.
9. TRC Engineers, Inc. Standby Engineering Contract Work Assignment (WA) No. D009812-09, NYSDEC-approved Scope of Work dated November 2, 2020.
10. TRC Engineers, Inc., “Data Usability Summary Reports (DUSRs) for Rosendale Cleaners, NYSDEC Site No. 356050”, September 2012, November 2012, January 2013, March 2013, April 2013, December 2017, June 2018, September 2021, and October 2021.
11. TRC Engineers, Inc., “Remedial Action Work Plan Interim Remedial Measure, NYSDEC Site No. 356050”, August 2019.
12. TRC Engineers, Inc., “Remedial Investigation Report for Rosendale Cleaners, NYSDEC Site No. 356050”, March 2022.
13. United States Department of Agriculture (USDA), Web Soil Survey, 2018.

Tables

Table 1
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Contaminants of Concern and Chemical-Specific SCGs

Contaminants of Concern for Soil and Groundwater	Class GA Value[1] (ug/L)	UUSCO[2] (mg/kg)	CUSCO[3] (mg/kg)
Volatile Organic Compounds			
cis-1,2-Dichloroethene	5	0.25	500
trans-1,2-Dichloroethene	5	0.19	500
Tetrachloroethylene	5	1.3	150
Trichloroethylene	5	0.47	200
Vinyl chloride	2	0.02	13

Notes

ug/L - Micrograms per liter

mg/kg - Milligrams per kilogram

[1] - NYSDEC Ambient Water Quality Standards and Guidance Values for Class GA Water

[2] - 6 NYCRR Part 375 Unrestricted Use Soil Cleanup Objective

[3] - 6 NYCRR Part 375 Commercial Use Soil Cleanup Objective

Table 2
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Summary of Groundwater Remedial Technology Screening

🟩 Retained
🟨 Limited Applicability
🟧 Screened Out on Basis of Technical Implementability

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	COMMENTS
No Action	None	🟩 Not Applicable	No action.	Fulfills requirement for consideration of no action alternative.
Site Management	Institutional Controls	🟨 Environmental Easement	Documents environmental conditions.	Not applicable alone due to magnitude of groundwater impacts. Will likely be required in conjuction with the selected remedy.
	Groundwater Monitoring	🟨 Groundwater Sampling	Documents environmental conditions.	Not applicable alone due to magnitude of groundwater impacts. Will likely be required in conjuction with the selected remedy.
Containment	Capping	🟧 Impermeable Cap	An impermeable cap can minimize infiltration of precipitation and associated transport of contaminants.	Screened out due to current plume extents. Passive technology. Would not meet applicable standards or address the contamination that has already migrated off-site.
	Vertical Barriers	🟧 Slurry Wall	Barrier formed by backfilling a trench with a low-permeability material.	Screened out due to current plume extents. Passive technology. Would not meet applicable standards or address the contamination that has already migrated off-site.
		🟧 Sheet Piling	Sheet piling is driven into the ground to form a barrier to groundwater migration.	Screened out due to current plume extents. Passive technology. Would not meet applicable standards or address the contamination that has already migrated off-site.
Extraction/ Treatment/Discharge	Extraction and On-Site Treatment	🟧 Pump and Treat System	Groundwater is extracted and treated using air stripping, granular activated carbon, and/or other unit operations. Treated groundwater is discharged to the sewer or surface water.	Technical practicability low due to low extraction yield in low-permeability soils. Unlikely to adequately address contamination that has already migrated off-site.
In-Situ Treatment	Biological Treatment	🟩 Enhanced Reductive Bioremediation	Addition of nutrients, carbon source, microbes or other substances to the subsurface to enhance existing bioremediation processes.	Technology is effective for site contaminants. Presence of daughter products indicates that biological reduction of contaminants is occuring naturally.
		🟧 Phytoremediation	Involves the use of plants to remove, detoxify or immobilize environmental contaminants through natural biological, chemical or physical activities and processes.	Not a feasible alternative due to depth of contamination.
		🟨 Natural Attenuation	Involves relying on natural processes (physical, chemical, and/or biological) to reduce contaminant concentrations over the long term.	Biological and abiotic attenuation processes (e.g., volatilization, dispersion, etc.) are occurring at the site, but would take considerable amount of time to reach applicable standards. Will likely be required in conjuction with the selected remedy.
		🟧 Biosparging	Injection of gas (e.g., air or compressed oxygen) in order to stimulate the aerobic bioremediation of VOCs; nutrients may be added to augment biodegradation.	Aerobic bioremediation is not considered effective for all site contaminants.

Table 2
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Summary of Groundwater Remedial Technology Screening

🟩 Retained
🟨 Limited Applicability
🟧 Screened Out on Basis of Technical Implementability

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GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	COMMENTS
In-Situ Treatment (cont.)	Physical/Chemical Treatment	🟧 Dual-Phase Extraction	Use of a high vacuum system in the subsurface to simultaneously remove various combinations of contaminated groundwater, separate-phase product, and vapor from the subsurface.	Impractical due to low-permeability soils. Additionally, limited applicability due to lack of separate-phase product, and low soil vapor concentrations.
		🟧 Air Sparging with Soil Vapor Extraction	Removes volatile groundwater contaminants through injection of gas (e.g., air) into groundwater and simultaneous extraction of vapors.	Effective in treating contaminants with high Henry's Law Constant values. Low-permeability soil will limit vapor extraction rates and ROI.
		🟧 Chemical Oxidation	Introduction of an oxidizing agent into the subsurface to chemically oxidize contaminants, breaking contaminants down into non-toxic substances.	Chemical oxidizing agents would be effective at concentrations detected. However, reducing conditions are present therefore reduction is more appropriate. Presence of metals in debris piles would result in high oxidant demand.
		🟧 Thermal	VOC removal enhanced by the addition of heat. Can include direct heating of the subsurface or the injection of steam.	Not practical considering small footprint of source area and mobilization and installation of significant infrastructure required for implementation.
		🟩 Chemical Reduction	Introduction of a reducing agent into the subsurface to chemically reduce contaminants, breaking contaminants down into non-toxic substances.	A chemical reducing agent such as zero-valent iron would react directly to degrade CVOCs.
		🟧 In-Well Air Stripping	Air is injected into a double-screened well, lifting the water in the well and forcing it out an upper screen. Simultaneously, additional water is drawn in the lower screen. VOCs in the contaminated groundwater are transferred from the dissolved phase to the vapor phase. Contaminated vapors are drawn off and treated by a vapor extraction system.	Effective in treating contaminants with high Henry's Law Constant values. Low-permeability soil will limit vapor extraction rates and ROI.

Table 3
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Summary of Soil Remedial Technology Screening

🟩 Retained
🟨 Limited Applicability
🟧 Screened Out on Basis of Technical Implementability

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	DESCRIPTION	COMMENTS
No Action	None	🟩 Not Applicable	No action.	Fulfills requirement for consideration of no action alternative.
Site Management	Institutional Controls	🟨 Environmental Easement	Documents environmental conditions.	Not applicable on its own due to magnitude of soil impacts. Will likely be required in conjuction with the selected remedy if UUSCOs are not met.
	Sampling	🟨 Subsurface Soil Sampling	Documents environmental conditions.	Not applicable on its own. Will likely be required in conjuction with the selected remedy.
Containment	Capping	🟧 Impermeable Cap	An impermeable cap can minimize infiltration of precipitation and associated transport of contaminants.	Screened out due to associated required restrictions on future site development.
	Solidification	🟩 In-Situ Stabilization & Solidification	Amendment is added to the soil to encapsulate waste and reduce leachability of waste via chemical reactions.	Would reduce contaminant mobility and toxicity.
Removal	Excavation	🟩 Excavation and Off-Site Disposal/Treatment	Contaminated soil is removed and transported to an off-site disposal facility, clean fill would be imported for backfill.	Would remove source material and reduce contamination leaching into groundwater.
		🟧 Excavation and On-Site Treatment	Contaminated soil is excavated, treated on site with thermal desorption, incineration, or bioremediation, and the treated soils are backfilled.	Requires a large area for treatment. Not practical considering small volume of impacted soil and installation of significant infrastructure required for implementation.
In-Situ Treatment	Biological Treatment	🟩 Enhanced Reductive Bioremediation	Addition of nutrients, carbon source, microbes or other substances to the subsurface to enhance existing bioremediation processes.	Technology is effective for site contaminants. Presence of breakdown products indicates that some biological reduction of contaminants is occuring naturally.
		🟧 Phytoremediation	Involves the use of plants to remove, detoxify or immobilize environmental contaminants through natural biological, chemical or physical activities and processes.	Not a feasible alternative due to depth and extent of contamination.
		🟨 Natural Attenuation	Involves relying on natural processes (physical, chemical and/or biological) to reduce contaminant concentrations over the long term.	Biological and abiotic attenuation processes (e.g., volatilizatioin, dispersion, etc.) are occuring at the site, but would take considerable amount of time to reach applicable standards. Will likely be required in conjuction with the selected remedy if UUSCOs are not met.
		🟧 Biosparging	Injection of gas (e.g., air or compressed oxygen) in order to stimulate the aerobic bioremediation of VOCs; nutrients may be added to augment biodegradation.	Screened out because aerobic bioremediation is not considered effective for all site contaminants of concern.
	Physical Treatment	🟧 Thermal	VOC removal enhanced by the addition of heat. Can include direct heating of the subsurface or the injection of steam.	Not practical considering small footprint of source area and mobilization and installation of significant infrastructure required for implementation.

Table 4
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Groundwater Process Option Screening

🟩 Selected process option
🟧 Screened out process option

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST
No Action	None	Not Applicable	Not effective in controlling contaminant migration.	No implementation required.	No cost other than regulatory administration.
Site Management	Institutional Controls	Environmental Easment	Documents environmental conditions and magnitude of contamination. Not effective in controlling contaminant migration.	Easily implemented.	Minimal or no capital; low OM&M.
	Groundwater Monitoring	Groundwater Sampling	Documents environmental conditions and magnitude of contamination. Not effective in controlling contaminant migration.	Routinely implemented. Would require continued groundwater monitoring.	Minimal or no capital; moderate OM&M.
In-Situ Treatment	Biological Treatment	Enhanced Reductive Bioremediation	Highly effective for CVOCs. Reductive bioremediation is occuring naturally at the site, as evidenced by PCE breakdown products in site groundwater. Bioaugmentation would increase the rate of biodegradation.	Moderately implemented. Would require treatability and pilot testing.	Low capital; low OM&M.
		Natural Attenuation	Presence of breakdown products indicates natural attenuation is occuring in groundwater at the site. Significant amount of time would be required to reach applicable standards. Not effective in controlling contaminant migration.	Easily implemented. Would require continued groundwater monitoring.	Minimal or no capital; low OM&M
	Physical/ Chemical Treatment	Chemical Reduction	Effective in treating VOCs in groundwater. Can enhance subsurface conditions to promote anaerobic bioremediation by reductive dechlorination.	Routinely implemented. Would require treatability and pilot testing.	Moderate capital; moderate OM&M.

Table 5
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Soil Process Option Screening

🟩 Selected process option
🟧 Screened out process option

GENERAL RESPONSE ACTION	TECHNOLOGY	PROCESS OPTION	EFFECTIVENESS	IMPLEMENTABILITY	COST
No Action	None	🟩 Not Applicable	Not effective in controlling contaminant migration.	No implementation required.	No cost other than regulatory administration.
Site Management	Institutional Controls	🟩 Environmental Easement	Effective in documenting contamination and encouraging the reuse and redevelopement of the site. Not effective in controlling contaminant migration.	Easily implemented.	Minimal or no capital; low OM&M.
	Sampling	🟩 Subsurface Soil Sampling	Effective in documenting contamination magnitude. Not effective in limiting contaminant mobility.	Easily implemented.	Minimal capital; no OM&M.
Containment	Solidification	🟩 In-situ Stabilization & Solidification	Effective in controlling contaminant migration and decreasing contaminant toxicity.	Routinely implemented.	Moderate capital; low OM&M.
Removal	Excavation	🟩 Excavation and Off-Site Disposal/Treatment	Effective in removing contamination source.	Routinely implemented.	High capital; low OM&M.
In-Situ Treatment	Biological Treatment	🟧 Enhanced Reductive Bioremediation	Reductive dechlorination is less effective in unsaturated soils. Screened out.	Difficultly implemented. Significant amendment volumes would be necessary to overcome oxidizing conditions.	Moderate capital; moderate OM&M.
		🟧 Natural Attenuation	Less effective in unsaturated soil, and would require significant amount of time to meet standards. Screened out.	Easily implemented.	Minimal or no capital; no OM&M.

Table 6
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Alternative 1 Cost Estimate
No Action

Item	Estimated Quantity	Estimated Units	Estimated Unit Cost	Estimated Extended Cost	# Yrs - Future Costs	Estimated Present Value
FUTURE ACTIONS						
Periodic Review	1	l.s.	$5,000	$5,000	30	$63,000
TOTAL PRESENT VALUE OF FUTURE ACTIONS						$63,000
CONTINGENCY (25%)	25%					$16,000
TOTAL PRESENT VALUE COST FOR ALTERNATIVE 1						$79,000

Notes

1. Discount rate of 7% used to calculate present value cost.
2. Cost estimate intended only for the purpose of determining relative cost in comparison to other alternatives.
3. Legal and administrative costs are not included in cost estimate.
4. All Estimated Present Values have been rounded to the nearest thousand dollars.

Table 7
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Alternative 2 Cost Estimate
Excavation, ISS, Implementation of Institutional Controls and Site Management

Item	Estimated Quantity	Estimated Units	Estimated Unit Cost	Estimated Extended Cost	# Yrs - Future Costs	Estimated Present Value
CAPITAL COST - DIRECT						
Pre-Design Investigation						
Soil Boring Investigation	1	l.s.	$40,000	$40,000	NA	$40,000
ISS Bench Scale Test	1	l.s.	$25,000	$25,000	NA	$25,000
Excavation						
Insurance, Mob./Demob., Submittals, Site Prep., etc.	1	l.s.	$130,000	$130,000	NA	$130,000
Excavation of Debris Pile and ISS Pre-Cut	260	cubic yard	$25	$6,500	NA	$7,000
Transport and Disposal	420	ton	$650	$273,000	NA	$273,000
Furnish and Install Clean Fill	260	cubic yard	$60	$15,600	NA	$16,000
Furnish and Install Topsoil and Seed	4,000	square foot	$10	$40,000	NA	$40,000
Land Surveys	1	l.s.	$15,000	$15,000	NA	$15,000
In-Situ Stabilization and Solidification (ISS)						
ISS	670	cubic yard	$110	$73,700	NA	$74,000
TOTAL DIRECT CAPITAL COSTS						$620,000
CAPITAL COST - INDIRECT						
Engineering and Design	20%			$124,000	NA	$124,000
Construction Phase Engineering Services	10%			$62,000	NA	$62,000
Project Management	5%			$31,000	NA	$31,000
TOTAL INDIRECT CAPITAL COSTS						$217,000
TOTAL CAPITAL COSTS						$837,000

Table 7
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Alternative 2 Cost Estimate
Excavation, ISS, Implementation of Institutional Controls and Site Management

Item	Estimated Quantity	Estimated Units	Estimated Unit Cost	Estimated Extended Cost	# Yrs - Future Costs	Estimated Present Value
FUTURE ACTIONS						
Preparation of Environmental Easement Documents	1	l.s. (per year)	$10,000	$10,000	1	$10,000
Preparation of Site Management Plan	1	l.s. (per year)	$20,000	$30,000	1	$29,000
Quarterly Groundwater Sampling/Reporting (Years 1 & 2)	1	l.s. (per year)	$57,000	$57,000	2	$104,000
Annual Groundwater Sampling/Reporting (Years 3-5)	1	l.s. (per year)	$14,300	$14,300	3	$33,000
Biennial Groundwater Sampling/Reporting (Years 6-15)	1	l.s. (per year)	$14,300	$14,300	5	$31,000
Semi-Annual Reviews	1	l.s. (per year)	$10,000	$10,000	15	$92,000
Periodic Review	1	l.s. (per year)	$5,000	$5,000	15	$46,000
TOTAL PRESENT VALUE OF FUTURE ACTIONS						$345,000
CONTINGENCY (25%)	25%					$296,000
TOTAL PRESENT VALUE COST FOR ALTERNATIVE 2						$1,478,000

Notes

1. Discount rate of 7% used to calculate present value cost.
2. Cost estimate intended only for the purpose of determining relative cost in comparison to other alternatives.
3. Legal and administrative costs are not included in cost estimate.
4. All Estimated Present Values have been rounded to the nearest thousand dollars.

Table 8
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Alternative 3 Cost Estimate
Excavation, ISCR/Bioremediation, Implementation of Institutional Controls and Site Management

Item	Estimated Quantity	Estimated Units	Estimated Unit Cost	Estimated Extended Cost	# Yrs - Future Costs	Estimated Present Value
CAPITAL COST - DIRECT						
Pre-Design Investigation						
Soil Boring Investigation	1	l.s.	$40,000	$40,000	NA	$40,000
ISCR Soil Blending Bench Scale Test	1	l.s.	$16,000	$16,000	NA	$16,000
Excavation and In-Situ Chemical Reduction (ISCR)						
Insurance, Mob./Demob., Submittals, Site Prep., etc.	1	l.s.	$72,000	$72,000	NA	$72,000
Excavation of Debris Pile and Additional Cont. Soil	790	cubic yard	$25	$19,750	NA	$20,000
Furnish and Apply ISCR	1	l.s.	$39,730	$39,730	NA	$40,000
Transport and Disposal	1,300	ton	$650	$845,000	NA	$845,000
Furnish and Install Clean Fill	790	cubic yard	$60	$47,400	NA	$48,000
Furnish and Install Topsoil and Seed	4,000	square foot	$10	$40,000	NA	$40,000
Land Surveys	1	l.s.	$15,000	$15,000	NA	$15,000
TOTAL DIRECT CAPITAL COSTS						$1,136,000
CAPITAL COST - INDIRECT						
Engineering and Design	20%			$227,200	NA	$228,000
Construction Phase Engineering Services	10%			$113,600	NA	$114,000
Project Management	5%			$56,800	NA	$57,000
TOTAL INDIRECT CAPITAL COSTS						$399,000
TOTAL CAPITAL COSTS						$1,535,000

Table 8
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Alternative 3 Cost Estimate
Excavation, ISCR/Bioremediation, Implementation of Institutional Controls and Site Management

Item	Estimated Quantity	Estimated Units	Estimated Unit Cost	Estimated Extended Cost	# Yrs - Future Costs	Estimated Present Value
FUTURE ACTIONS						
Preparation of Environmental Easement Documents	1	l.s. (per year)	$10,000	$10,000	1	$10,000
Preparation of Site Management Plan	1	l.s. (per year)	$30,000	$30,000	1	$29,000
Quarterly Groundwater Sampling/Reporting (Years 1 & 2)	1	l.s. (per year)	$57,000	$57,000	2	$104,000
Annual Groundwater Sampling/Reporting (Years 3-5)	1	l.s. (per year)	$14,300	$14,300	3	$33,000
Biennial Groundwater Sampling/Reporting (Years 6-15)	1	l.s. (per year)	$14,300	$14,300	5	$31,000
Semi-Annual Reviews	1	l.s. (per year)	$10,000	$10,000	15	$92,000
Periodic Review	1	l.s. (per year)	$5,000	$5,000	15	$46,000
TOTAL PRESENT VALUE OF FUTURE ACTIONS						$345,000
CONTINGENCY (25%)	25%					$470,000
TOTAL PRESENT VALUE COST FOR ALTERNATIVE 3						$2,350,000

Notes

1. Discount rate of 7% used to calculate present value cost.
2. Cost estimate intended only for the purpose of determining relative cost in comparison to other alternatives.
3. Legal and administrative costs are not included in cost estimate.
4. All Estimated Present Values have been rounded to the nearest thousand dollars.

Table 9
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Alternative 4A Cost Estimate
Excavation, Groundwater Treatment via Injection, Implementation of Institutional Controls and Site Management

Item	Estimated Quantity	Estimated Units	Estimated Unit Cost	Estimated Extended Cost	# Yrs - Future Costs	Estimated Present Value
CAPITAL COST - DIRECT						
Pre-Design Investigation						
Soil Boring Investigation	1	l.s.	$40,000	$40,000	NA	$40,000
Groundwater Delineation Investigation	1	l.s.	$40,000	$40,000	NA	$40,000
Injection Pilot Test & Assessment	1	l.s.	$100,000	$100,000	NA	$100,000
ISCR Soil Blending Bench Scale Test	1	l.s.	$16,000	$16,000	NA	$16,000
Excavation and In-Situ Chemical Reduction (ISCR)						
Insurance, Mob./Demob., Submittals, Site Prep., etc.	1	l.s.	$72,000	$72,000	NA	$72,000
Excavation of Debris Pile and Additional Cont. Soil	790	cubic yard	$25	$19,750	NA	$20,000
Furnish and Apply ISCR	1	l.s.	$39,730	$39,730	NA	$40,000
Transport and Disposal	1,300	ton	$650	$845,000	NA	$845,000
Furnish and Install Clean Fill	790	cubic yard	$60	$47,400	NA	$48,000
Furnish and Install Topsoil and Seed	4,000	square foot	$10	$40,000	NA	$40,000
Land Surveys	1	l.s.	$15,000	$15,000	NA	$15,000
ISCR and/or Bioremediation Injections						
Installation of Injection Wells	1	l.s.	$112,320	$112,320	NA	$113,000
ISCR and/or Bioremediation Injections	1	l.s.	$188,030	$188,030	NA	$189,000
TOTAL DIRECT CAPITAL COSTS						$1,578,000

Table 9
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Alternative 4A Cost Estimate
Excavation, Groundwater Treatment via Injection, Implementation of Institutional Controls and Site Management

Item	Estimated Quantity	Estimated Units	Estimated Unit Cost	Estimated Extended Cost	# Yrs - Future Costs	Estimated Present Value
CAPITAL COST - INDIRECT						
Engineering and Design	20%			$315,600	NA	$316,000
Construction Phase Engineering Services	10%			$157,800	NA	$158,000
Project Management	5%			$78,900	NA	$79,000
TOTAL INDIRECT CAPITAL COSTS						$553,000
TOTAL CAPITAL COSTS						$2,131,000
FUTURE ACTIONS						
Preparation of Environmental Easement Documents	1	l.s. (per year)	$10,000	$10,000	1	$10,000
Preparation of Site Management Plan	1	l.s. (per year)	$20,000	$30,000	1	$29,000
EISB Injection Event (Year 3)	1	l.s. (per year)	$188,100	$188,100	1	$154,000
Quarterly Groundwater Sampling/Reporting (Years 1 & 2)	1	l.s. (per year)	$57,000	$57,000	2	$104,000
Annual Groundwater Sampling/Reporting (Years 3-5)	1	l.s. (per year)	$14,300	$14,300	3	$33,000
Biennial Grounwater Sampling/Reporting (Years 6-10)	1	l.s. (per year)	$14,300	$14,300	2	$15,000
Semi-Annual Reviews	1	l.s. (per year)	$10,000	$10,000	10	$71,000
Periodic Review	1	l.s. (per year)	$5,000	$5,000	15	$46,000
TOTAL PRESENT VALUE OF FUTURE ACTIONS						$462,000
CONTINGENCY (25%)	25%					$649,000
TOTAL PRESENT VALUE COST FOR ALTERNATIVE 4A						$3,242,000

Notes

1. Discount rate of 7% used to calculate present value cost.
2. Cost estimate intended only for the purpose of determining relative cost in comparison to other alternatives.
3. Legal and administrative costs are not included in cost estimate.
4. All Estimated Present Values have been rounded to the nearest thousand dollars.

Table 10
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Alternative 4B Cost Estimate
Excavation, Groundwater Treatment via PRB, Implementation of Institutional Controls and Site Management

Item	Estimated Quantity	Estimated Units	Estimated Unit Cost	Estimated Extended Cost	# Yrs - Future Costs	Estimated Present Value
CAPITAL COST - DIRECT						
Pre-Design Investigation						
Soil Boring Investigation	1	l.s.	$40,000	$40,000	NA	$40,000
Groundwater Delineation Investigation	1	l.s.	$40,000	$40,000	NA	$40,000
PRB Pilot Test	1	l.s.	$100,000	$100,000	NA	$100,000
ISCR Soil Blending Bench Scale Test	1	l.s.	$16,000	$16,000	NA	$16,000
Excavation and In-Situ Chemical Reduction (ISCR)						
Insurance, Mob./Demob., Submittals, Site Prep., etc.	1	l.s.	$72,000	$72,000	NA	$72,000
Excavation of Debris Pile and Additional Cont. Soil	790	cubic yard	$25	$19,750	NA	$20,000
Furnish and Apply ISCR	1	l.s.	$39,730	$39,730	NA	$40,000
Transport and Disposal	1,300	ton	$650	$845,000	NA	$845,000
Furnish and Install Clean Fill	790	cubic yard	$60	$47,400	NA	$48,000
Furnish and Install Topsoil and Seed	4,000	square foot	$10	$40,000	NA	$40,000
Land Surveys	1	l.s.	$15,000	$15,000	NA	$15,000
Shallow Permeable Reactive Barrier						
Installation of PRB	1	l.s.	$398,570	$398,570	NA	$399,000
TOTAL DIRECT CAPITAL COSTS						$1,675,000

Table 10
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Alternative 4B Cost Estimate
Excavation, Groundwater Treatment via PRB, Implementation of Institutional Controls and Site Management

Item	Estimated Quantity	Estimated Units	Estimated Unit Cost	Estimated Extended Cost	# Yrs - Future Costs	Estimated Present Value
CAPITAL COST - INDIRECT						
Engineering and Design	20%			$335,000	NA	$335,000
Construction Phase Engineering Services	10%			$167,500	NA	$168,000
Project Management	5%			$83,750	NA	$84,000
TOTAL INDIRECT CAPITAL COSTS						$587,000
TOTAL CAPITAL COSTS						$2,262,000
FUTURE ACTIONS						
Preparation of Environmental Easement Documents	1	l.s. (per year)	$10,000	$10,000	1	$10,000
Preparation of Site Management Plan	1	l.s. (per year)	$20,000	$30,000	1	$29,000
Quarterly Groundwater Sampling/Reporting (Years 1 & 2)	1	l.s. (per year)	$56,990	$56,990	2	$104,000
Annual Groundwater Sampling/Reporting (Years 3-5)	1	l.s. (per year)	$14,250	$14,250	3	$33,000
Biennial Grounwater Sampling/Reporting (Years 6-10)	1	l.s. (per year)	$14,250	$14,250	2	$15,000
Semi-Annual Reviews	1	l.s. (per year)	$10,000	$10,000	10	$71,000
Periodic Review	1	l.s. (per year)	$5,000	$5,000	15	$46,000
TOTAL PRESENT VALUE OF FUTURE ACTIONS						$308,000
CONTINGENCY (25%)	25%					$643,000
TOTAL PRESENT VALUE COST FOR ALTERNATIVE 4B						$3,213,000

Notes

1. Discount rate of 7% used to calculate present value cost.
2. Cost estimate intended only for the purpose of determining relative cost in comparison to other alternatives.
3. Legal and administrative costs are not included in cost estimate.
4. All Estimated Present Values have been rounded to the nearest thousand dollars.

Table 11
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Alternative 5A Cost Estimate
Excavation and Groundwater Treatment via Injection

Item	Estimated Quantity	Estimated Units	Estimated Unit Cost	Estimated Extended Cost	# Yrs - Future Costs	Estimated Present Value
CAPITAL COST - DIRECT						
Pre-Design Investigation						
Soil Boring Investigation	1	l.s.	$40,000	$40,000	NA	$40,000
Groundwater Delineation Investigation	1	l.s.	$40,000	$40,000	NA	$40,000
Injection Pilot Test	1	l.s.	$100,000	$100,000	NA	$100,000
Dewatering Pump Test	1	l.s.	$75,000	$75,000	NA	$75,000
Excavation						
Insurance, Mob./Demob., Submittals, Site Prep., etc.	1	l.s.	$72,000	$72,000	NA	$72,000
Excavation of Debris Pile and All Soil Above CVOC UUSCOs	2,800	cubic yard	$40	$112,000	NA	$112,000
Dewatering	30	day	$20,000	$600,000	NA	$600,000
Transport and Disposal	5,300	ton	$650	$3,445,000	NA	$3,445,000
Furnish and Install Clean Fill	2,800	cubic yard	$60	$168,000	NA	$168,000
Furnish and Install Topsoil and Seed	5,000	square foot	$10	$50,000	NA	$50,000
Land Surveys	1	l.s.	$15,000	$15,000	NA	$15,000
ISCR and/or Bioremediation Injections						
Installation of Permanent Injection Wells	1	l.s.	$112,320	$112,320	NA	$113,000
On-site ISCR and/or Bioremediation Injections	1	l.s.	$188,030	$188,030	NA	$189,000
Off-site ISCR and/or Bioremediation Injections	1	l.s.	$614,920	$614,920	NA	$615,000
TOTAL DIRECT CAPITAL COSTS						$5,634,000

Table 11
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Alternative 5A Cost Estimate
Excavation and Groundwater Treatment via Injection

Item	Estimated Quantity	Estimated Units	Estimated Unit Cost	Estimated Extended Cost	# Yrs - Future Costs	Estimated Present Value
CAPITAL COST - INDIRECT						
Engineering and Design	20%			$1,126,800	NA	$1,127,000
Construction Phase Engineering Services	10%			$563,400	NA	$564,000
Project Management	5%			$281,700	NA	$282,000
TOTAL INDIRECT CAPITAL COSTS						$1,973,000
TOTAL CAPITAL COSTS						$7,607,000
FUTURE ACTIONS						
EISB Injection Event (Year 3)	1	l.s. (per year)	$495,490	$495,490	1	$405,000
EISB Injection Event (Year 5)	1	l.s. (per year)	$188,030	$188,030	1	$135,000
Quarterly Groundwater Sampling/Reporting (Years 1-5)	1	l.s. (per year)	$56,990	$56,990	5	$234,000
Semi-Annual Reviews	1	l.s. (per year)	$10,000	$10,000	5	$41,000
TOTAL PRESENT VALUE OF FUTURE ACTIONS						$815,000
CONTINGENCY (25%)	25%					$2,106,000
TOTAL PRESENT VALUE COST FOR ALTERNATIVE 5A						$10,528,000

Notes

1. Discount rate of 7% used to calculate present value cost.
2. Cost estimate intended only for the purpose of determining relative cost in comparison to other alternatives.
3. Legal and administrative costs are not included in cost estimate.
4. All Estimated Present Values have been rounded to the nearest thousand dollars.

Table 12
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Alternative 5B Cost Estimate
Excavation and Groundwater Treatment via PRB

Item	Estimated Quantity	Estimated Units	Estimated Unit Cost	Estimated Extended Cost	# Yrs - Future Costs	Estimated Present Value
CAPITAL COST - DIRECT						
Pre-Design Investigation						
Soil Boring Investigation	1	l.s.	$40,000	$40,000	NA	$40,000
Groundwater Delineation Investigation	1	l.s.	$40,000	$40,000	NA	$40,000
PRB Pilot Test	1	l.s.	$100,000	$100,000	NA	$100,000
Dewatering Pump Test	1	l.s.	$75,000	$75,000	NA	$75,000
Excavation						
Insurance, Mob./Demob., Submittals, Site Prep., etc.	1	l.s.	$72,000	$72,000	NA	$72,000
Excavation of Debris Pile and All Soil Above CVOC UUSCOs	2,800	cubic yard	$40	$112,000	NA	$112,000
Dewatering	30	day	$20,000	$600,000	NA	$600,000
Transport and Disposal	5,300	ton	$650	$3,445,000	NA	$3,445,000
Furnish and Install Clean Fill	2,800	cubic yard	$60	$168,000	NA	$168,000
Furnish and Install Topsoil and Seed	5,000	square foot	$10	$50,000	NA	$50,000
Land Surveys	1	l.s.	$15,000	$15,000	NA	$15,000
Shallow Permeable Reactive Barrier						
Installation of PRB	1	l.s.	$398,570	$398,570	NA	$399,000
TOTAL DIRECT CAPITAL COSTS						$5,116,000
CAPITAL COST - INDIRECT						
Engineering and Design	20%			$1,023,200	NA	$1,024,000
Construction Phase Engineering Services	10%			$511,600	NA	$512,000
Project Management	5%			$255,800	NA	$256,000
TOTAL INDIRECT CAPITAL COSTS						$1,792,000
TOTAL CAPITAL COSTS						$6,908,000

Table 12
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Alternative 5B Cost Estimate
Excavation and Groundwater Treatment via PRB

Item	Estimated Quantity	Estimated Units	Estimated Unit Cost	Estimated Extended Cost	# Yrs - Future Costs	Estimated Present Value
FUTURE ACTIONS						
Quarterly Groundwater Sampling/Reporting (Years 1-5)	1	l.s. (per year)	$56,990	$56,990	5	$234,000
Semi-Annual Reviews	1	l.s. (per year)	$10,000	$10,000	5	$41,000
TOTAL PRESENT VALUE OF FUTURE ACTIONS						$275,000
CONTINGENCY (25%)	25%					$1,796,000
TOTAL PRESENT VALUE COST FOR ALTERNATIVE 5B						$8,979,000

Notes

1. Discount rate of 7% used to calculate present value cost.
2. Cost estimate intended only for the purpose of determining relative cost in comparison to other alternatives.
3. Legal and administrative costs are not included in cost estimate.
4. All Estimated Present Values have been rounded to the nearest thousand dollars.

Table 13
New York State Department of Environmental Conservation
Rosendale Cleaners Site – 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Comparison of Remedial Alternative Costs

Alternative	Estimated Total Capital Cost	Estimated Present Worth of Future Actions Cost	Estimated Total Present Worth[1]
Alternative 1 - No Action	$0	$63,000	$79,000
Alternative 2 – Excavation, ISS, Implementation of Institutional Controls and Site Management	$837,000	$345,000	$1,478,000
Alternative 3 – Excavation, ISCR/Bioremediation, Implementation of Institutional Controls and Site Management	$1,535,000	$345,000	$2,350,000
Alternative 4A – Excavation, Groundwater Treatment via Injection, Implementation of Institutional Controls and Site Management	$2,131,000	$462,000	$3,242,000
Alternative 4B – Excavation, Groundwater Treatment via Permeable Reactive Barrier, Implementation of Institutional Controls and Site Management [1]	$2,262,000	$308,000	$3,213,000
Alternative 5A – Excavation and Groundwater Treatment via Injection	$7,607,000	$815,000	$10,528,000
Alternative 5B – Excavation and Groundwater Treatment via Permeable Reactive Barrier [1]	$6,908,000	$275,000	$8,979,000

Notes:

Estimated costs are rounded.

[1] Includes contingency.

ISCR – *In-Situ* Chemical Reduction

ISS – *In-Situ* Stabilization and Solidification

Discount rate of 7% used to calculate present value cost

Table 14

New York State Department of Environmental Conservation

Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York

Focused Feasibility Study Report

Spreadsheet for Environmental Footprint Analysis Summary

Environmental Footprint Summary

Core Element	Metric		Unit of Measure	Alt 2: Excavation, ISS, Implementation of ICs and SM	Alt 3: Excavation, ISCR/Bioremediation, Implementation of ICs and SM	Alt 4A: Excavation, Groundwater Treatment via Injection, Implementation of ICs and SM	Alt 4B: Excavation, Groundwater Treatment via Permeable Reactive Barrier, Implementation of ICs and SM	Alt 5A: Excavation, Groundwater Treatment via Injection	Alt 5B: Excavation, Groundwater Treatment via Permeable Reactive Barrier
Materials & Waste	M&W-1	Refined materials used on-site	Tons	1,081.1	1,009.7	15.2	14.7	25.3	5.0
	M&W-3	Unrefined materials used on-site	Tons	0.0	1,035.0	1,032.0	1,032.0	2,583.0	2,583.0
	M&W-5	On-site hazardous waste disposed of off-site	Tons	226.0	1,037.0	1,037.0	1,037.0	5,087.0	5,087.0
Energy	E-1	Total energy used (on-site and off-site)	MMBtu	3,684.4	13,413.1	15,048.0	14,038.6	65,935.3	64,794.3
Air	A-3	Total NOx, SOx, and PM emissions	Pounds	5,442.4	8,415.1	10,397.6	10,620.2	40,249.7	40,349.3
	A-4	Total HAP emissions	Pounds	58.9	204.4	214.5	211.3	920.5	918.2
	A-5	Total greenhouse gas emissions	Tons CO_2e*	616.7	2,584.2	2,730.1	2,631.0	12,737.3	12,583.8

** Total greenhouse gases emissions (in CO_2e) include consideration of CO_2, CH_4, and N_2O (Nitrous oxide) emissions.*

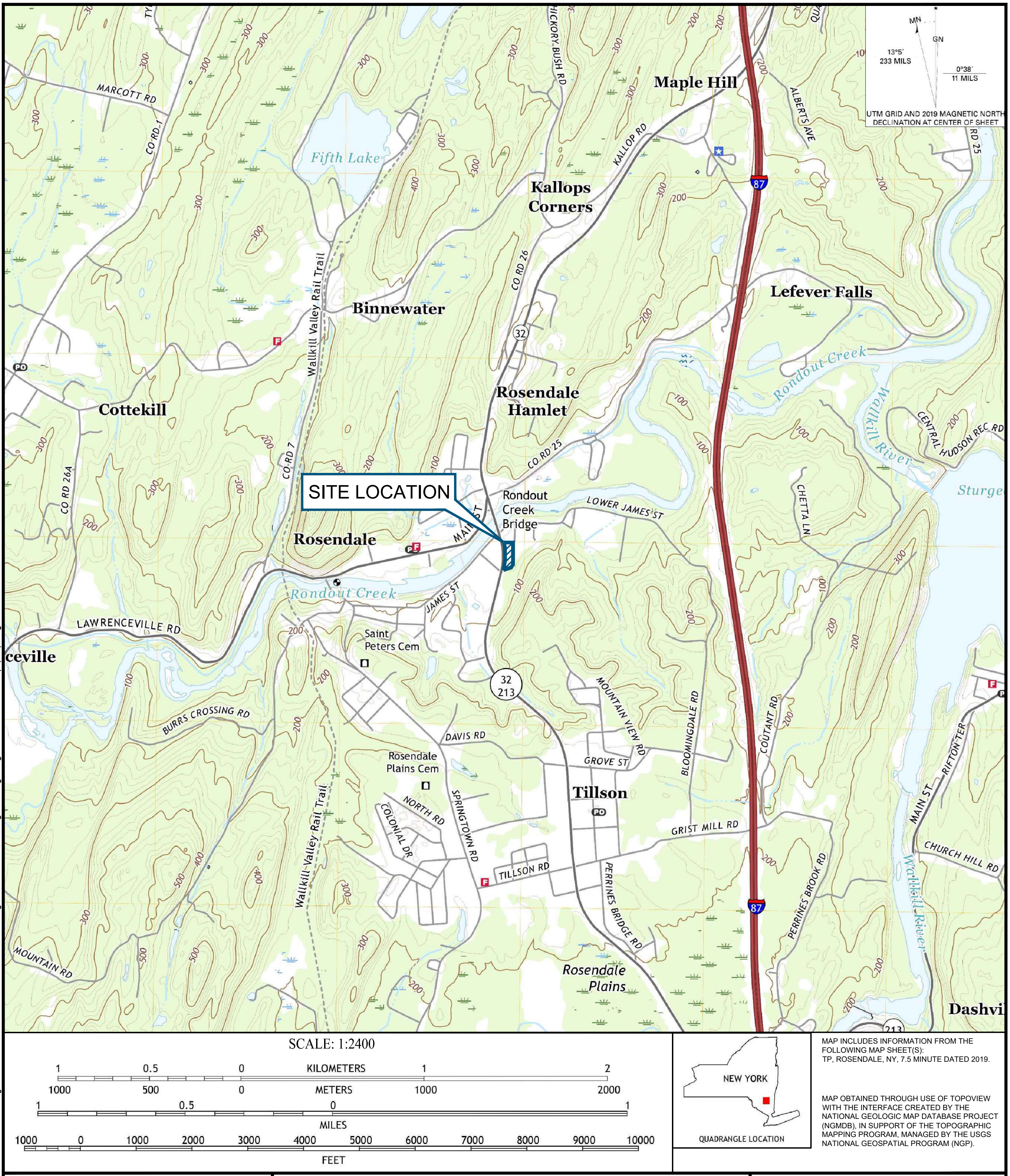
"MMBtu" = millions of Btus

"CO_2e" = carbon dioxide equivalents of global warming potential

"MWh" = megawatt hours (i.e., thousands of kilowatt-hours or millions of Watt-hours)

"Tons" = short tons (2,000 pounds)

Figures



MAP INCLUDES INFORMATION FROM THE FOLLOWING MAP SHEET(S):
TP, ROSENDALE, NY, 7.5 MINUTE DATED 2019.

MAP OBTAINED THROUGH USE OF TOPOVIEW WITH THE INTERFACE CREATED BY THE NATIONAL GEOLOGIC MAP DATABASE PROJECT (NGMDB), IN SUPPORT OF THE TOPOGRAPHIC MAPPING PROGRAM, MANAGED BY THE USGS NATIONAL GEOSPATIAL PROGRAM (NGP).

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Phone: 518.348.1190
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PROJECT:
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ROSENDALE CLEANERS SITE - SITE NO. 356050
TOWN OF ROSENDALE, NEW YORK

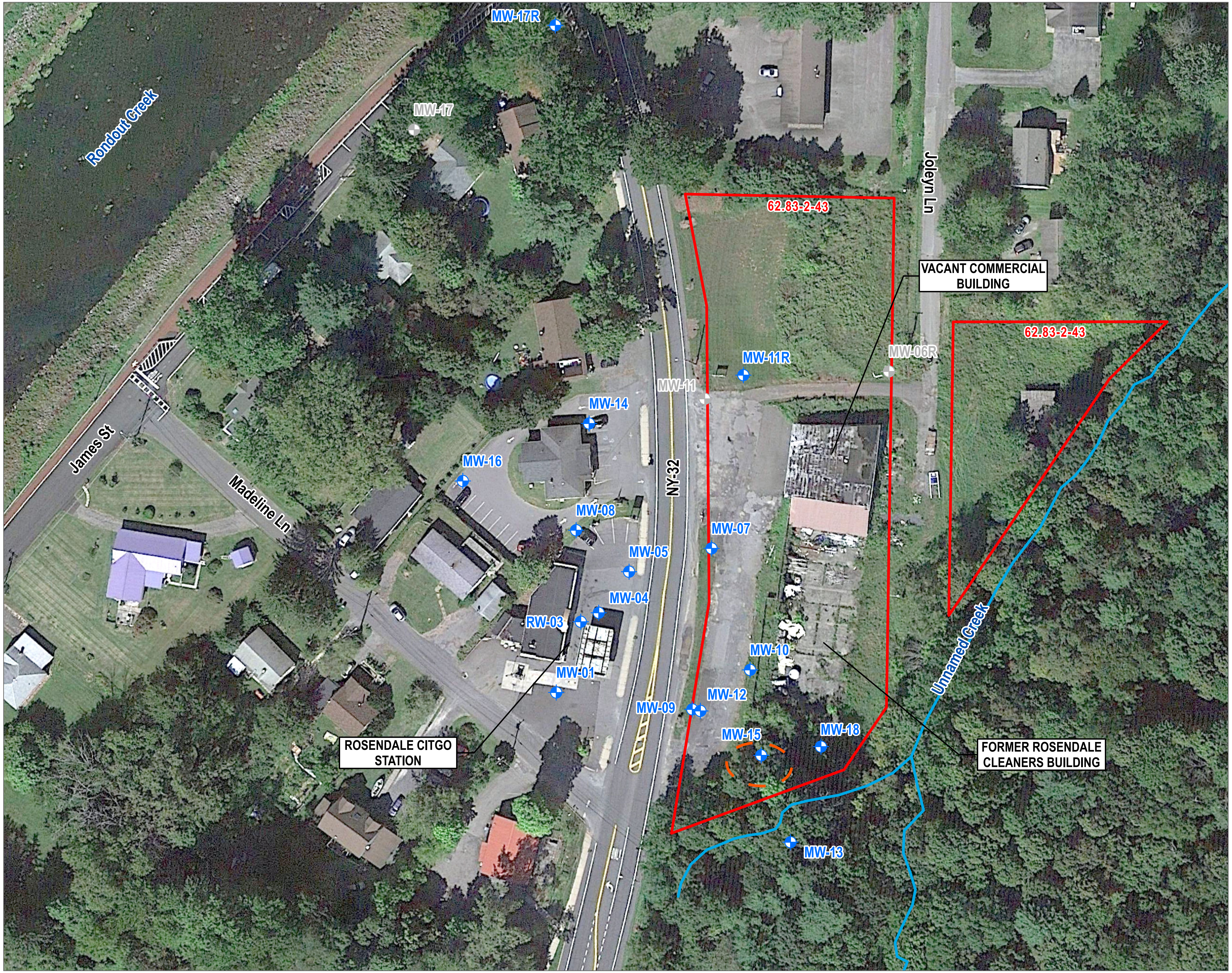
TITLE:

SITE LOCATION MAP

DRAWN BY:	H. DELGADO
CHECKED BY:	T. SHANLEY
APPROVED BY:	H. NICHOLS
DATE:	JUNE 2022
PROJ. NO.:	403739.0000.0000
FILE:	Fig 1 - Site Location Map (RC).dwg

FIGURE 1

8.5x11 --- ATTACHED XREFS: --- ATTACHED IMAGES: NY_Rosendale_20190923_TM;
DRAWING NAME: B:\Projects\NYSDEC\D009812\Work Assignments\D009812-09 Rosendale Cleaners\Figures\FS\TRC Working Drawings\ Fig 1 - Site Location Map (RC).dwg --- PLOT DATE: June 01, 2022 - 3:04PM --- LAYOUT: 8.5x11L



LEGEND (SYMBOLS NOT TO SCALE)

- MONITORING WELL
- DESTROYED/ABANDONED MONITORING WELL
- 🟥 TAX PARCEL BOUNDARY
- LIMITS OF BURIED DEBRIS MOUND (2014)

NOTES:

1. SITE FEATURES, LOCATIONS AND PROPERTY BOUNDARIES ARE APROXIMATE.

N

1:900

1" = 75'

0 75 150 FEET

BASE MAP: GOOGLE EARTH IMAGERY, 2019
DATA SOURCES: TRC
SHEET SIZE: 11X17L

PROJECT:
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ROSENDALE CLEANERS - SITE NO. 356050
TOWN OF ROSENDALE, NEW YORK

TITLE:
SITE LAYOUT MAP

DRAWN BY:	L. LILL	PROJ. NO.:	403739.0000.0000
CHECKED BY:	J. KING	FIGURE 2	
APPROVED BY:	J. MAGDA		
DATE:	JUNE 2022		

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Phone: 518-348-1190
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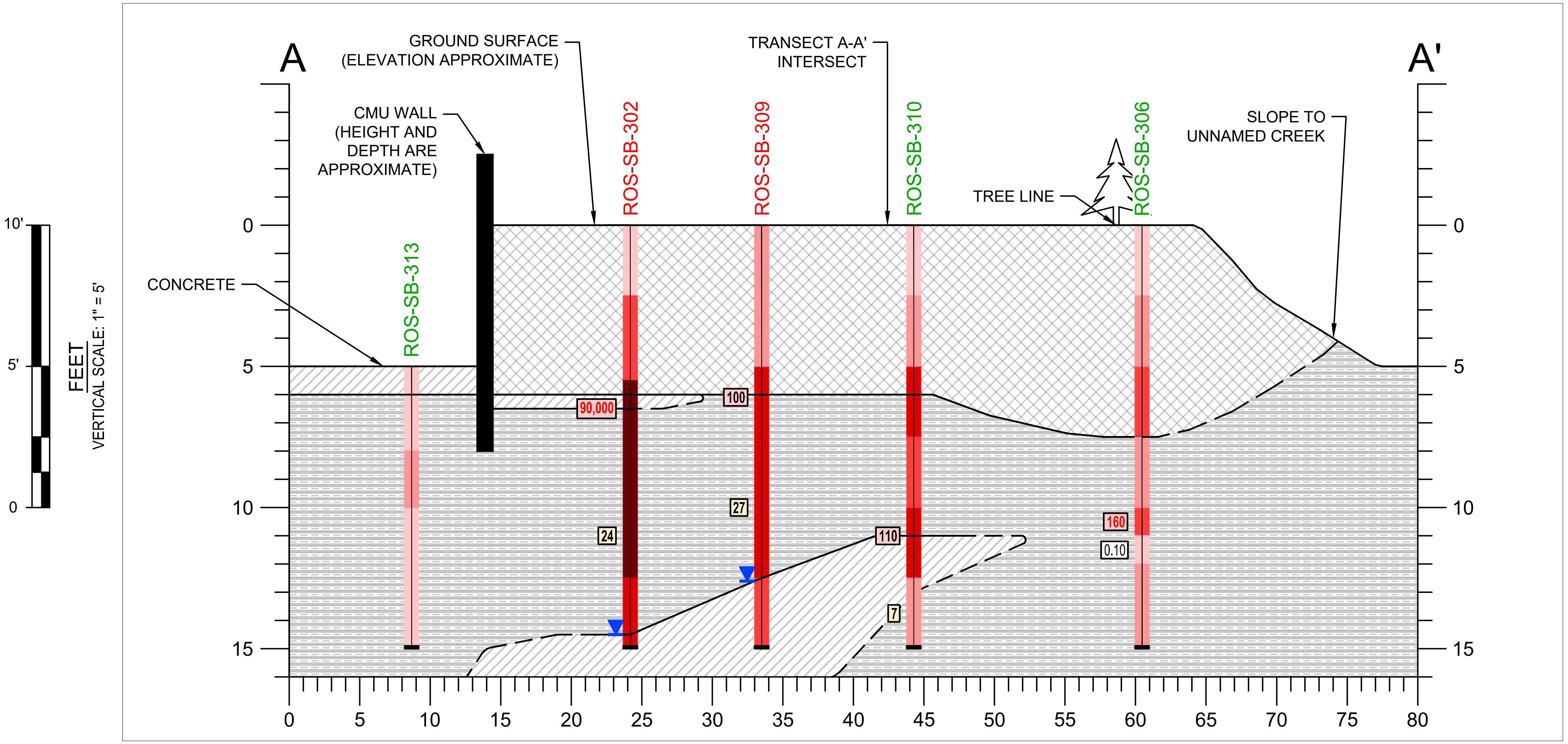
FILE: sitelayout.aprx

Coordinate System: NAD 1983 StatePlane New York East FIPS 3101 Feet; Map Rotation: 0
-- Saved By: LLILL on 6/8/2022, 11:59:51 AM; File Path: T:\1-PROJECTS\NYSDEC\403739_RosendaleCleaners\2-APRX\sitelayout\sitelayout.aprx; Layout Name: Figure 2 - Rosendale Cleaners Site Layout Map_20220608



LEGEND (SYMBOLS NOT TO SCALE):

- ☐100 - TETRACHLOROETHENE (PCE) (mg/kg) DETECTED IN SOIL.
- 🟥 - PID RESPONSE OF 5 PPM OR LOWER
- 🟥 - PID RESPONSE FROM 5.1 PPM TO 25 PPM
- 🟥 - PID RESPONSE FROM 25.1 PPM TO 100 PPM
- 🟥 - PID RESPONSE FROM 100.1 PPM TO 500 PPM
- 🟥 - PID RESPONSE 500.1 PPM OR GREATER

LITHOLOGY KEY

- ▨ FILL - SAND WITH DEBRIS (METAL, GLASS, CONCRETE, TEXTILES, BRICK, ETC.)
- ▤ ML / CL - CLAYEY SILTS / SILTY CLAYS / CLAYS / SILTS
- ▨ SP / SW - POORLY / WELL SORTED SANDS
- ▼ ELEVATION OF SATURATED SOIL

BOLD	EXCEEDS UUSCO
BOLD	EXCEEDS CUSCO
BOLD	EXCEEDS UTS
BOLD	EXCEEDS LDR

GEOLOGICAL CROSS-SECTION A-A'

HORIZONTAL SCALE: 1" = 10'

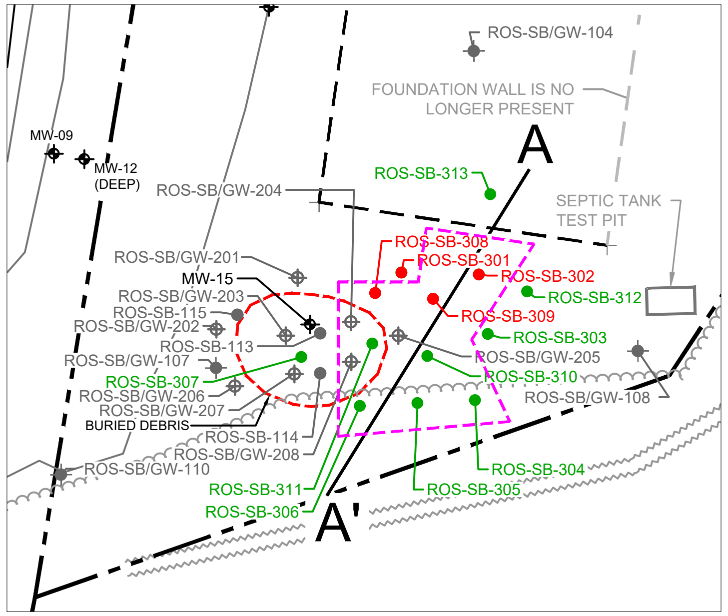
0 10' 20'

NOTES:

1. TO AID WITH VISUALIZATION AND SINCE CERTAIN BORINGS AND WELLS ARE OFFSET AND HAVE BEEN PROJECTED ONTO CROSS-SECTIONS, SPACING BETWEEN DATA POINTS DOES NOT MATCH ACTUAL FIELD CONDITIONS EXACTLY.
2. SOIL BORINGS LOCATED WITHIN 5 FEET OF THE TRANSECT LINE HAVE BEEN INCORPORATED INTO THE CROSS SECTION.
3. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND SOIL BORINGS ARE APPROXIMATE.
4. INFERRED BOUNDARIES BETWEEN SOIL TYPES ARE DASHED.
5. mg/kg - MILLIGRAMS PER KILOGRAM.
6. PID - PHOTOIONIZATION DETECTOR.
7. PPM - PARTS PER MILLION
8. UUSCO - NYSDEC PART 375 UNRESTRICTED USE SOIL CLEANUP OBJECTIVE.
9. CUSCO - NYSDEC PART 375 COMMERCIAL USE SOIL CLEANUP OBJECTIVE.
10. UTS - USEPA 40 CFR § 268.48 UNIVERSAL TREATMENT STANDARD: NONWASTEWATER STANDARD.
11. LDR - USEPA 40 CFR § 268.49 ALTERNATIVE LAND DISPOSAL RESTRICTION TREATMENT STANDARD FOR CONTAMINATED SOIL.

LEGEND (SYMBOLS NOT TO SCALE):

- – – – CMU BLOCK WALL FOUNDATION
- —·—·— PROPERTY LOT BOUNDARY
- ⊕ MW-## GROUNDWATER MONITORING WELL (2012)
- ● ROS-SB/GW-1## DIRECT PUSH SOIL BORING AND "GRAB" GROUNDWATER SAMPLE (2012)
- ● ROS-SB-1## SOIL BORING (2013)
- ⊕ ROS-SB/GW-2## SOIL BORING AND "GRAB" GROUNDWATER SAMPLE (2017)
- ● ROS-SB-3## DELINEATION / SOIL RE-USE SOIL BORING (2020)
- ● ROS-SB-3## WASTE CHARACTERIZATION SOIL BORING (2020)
- ◯ APPROXIMATE LIMITS OF BURIED DEBRIS MOUND (2014)
- ⌒⌒⌒ TREE LINE / WOODED AREA
- ☐ ANTICIPATED REMEDIAL EXCAVATION AREA FOR RESTRICTED USE (CUSCO) ALTERNATIVES
- A — A' CROSS SECTION TRANSECT



CROSS-SECTION TRANSECT A-A' MAP

SCALE: 1" = 40'

0 40' 80'

SHEET SIZE: 11" BY 17"

PROJECT:

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ROSENDALE CLEANERS SITE - SITE NO. 356050
TOWN OF ROSENDALE, NEW YORK

TITLE:

CROSS-SECTION TRANSECT A-A'

DRAWN BY:	H. DELGADO	PROJ NO.:	403739.0000.0000
CHECKED BY:	T. SHANLEY	**FIGURE 3A**	
APPROVED BY:	H. NICHOLS		
DATE:	JUNE 2022		

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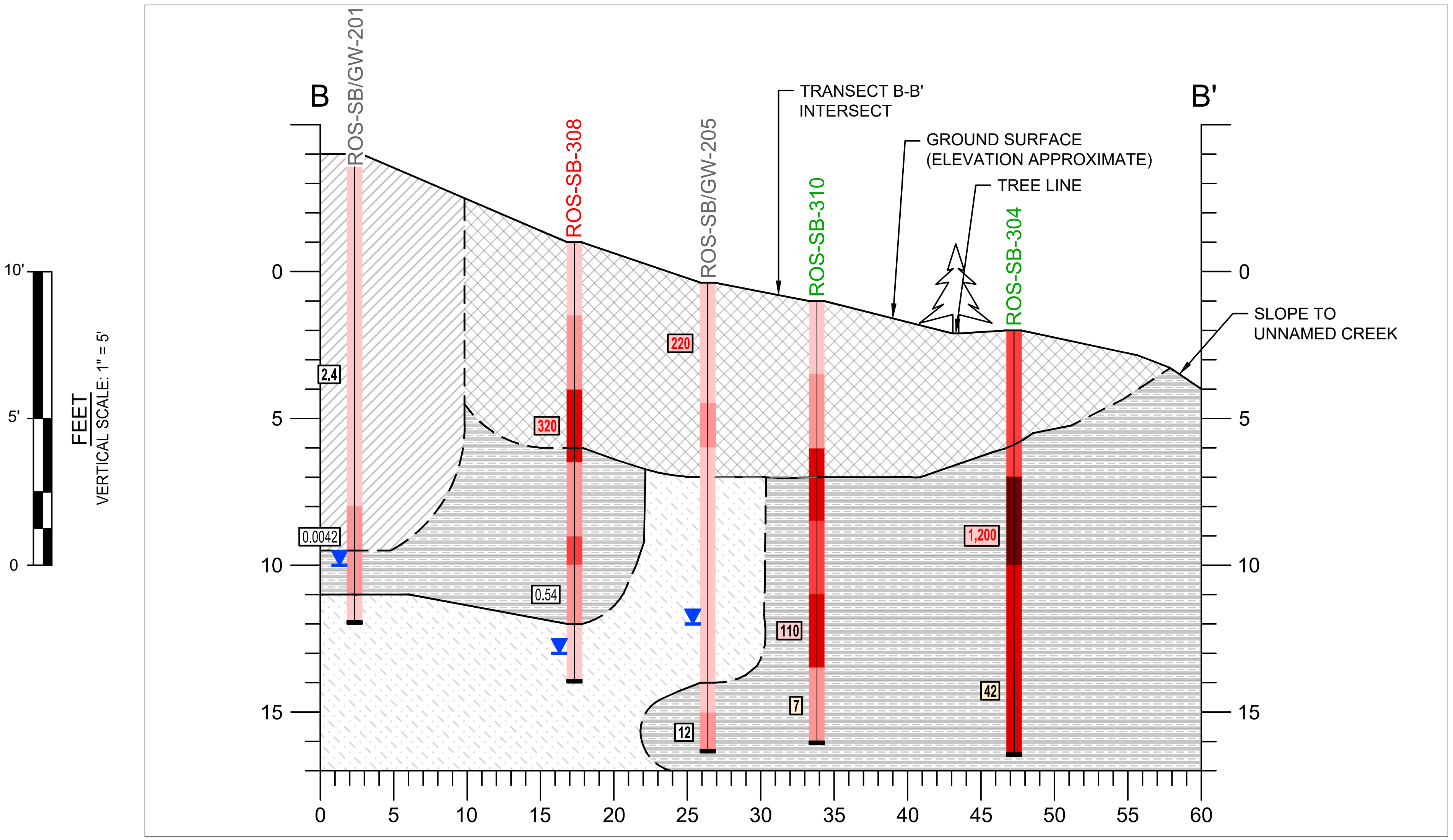
FILE NO.: Fig 3A-3B - X-Sct-Transects A-A' & B-B' (RC).dwg

11x17 --- ATTACHED XREFS: --- ATTACHED IMAGES: Transect A-A'; Transect B-B';
DRAWING NAME: B:\Projects\NYSDEC\D009812\Work Assignments\D009812-09 Rosendale Cleaners\Figures\FS\TRC Working Drawings\ Fig 3A-3B - X-Sct-Transects A-A' & B-B' (RC).dwg --- PLOT DATE: June 09, 2022 - 10:05AM --- LAYOUT: 11x17L (A-A')



GEOLOGICAL CROSS-SECTION B-B'

HORIZONTAL SCALE: 1" = 10'

0 10' 20'

LEGEND (SYMBOLS NOT TO SCALE):

- 100 - TETRACHLOROETHENE (PCE) (mg/kg) DETECTED IN SOIL.
- 🟥 - PID RESPONSE OF 5 PPM OR LOWER
- 🟥 - PID RESPONSE FROM 5.1 PPM TO 25 PPM
- 🟥 - PID RESPONSE FROM 25.1 PPM TO 100 PPM
- 🟥 - PID RESPONSE FROM 100.1 PPM TO 500 PPM
- 🟥 - PID RESPONSE 500.1 PPM OR GREATER

LITHOLOGY KEY

- ▨ FILL - SAND WITH DEBRIS (METAL, GLASS, CONCRETE, TEXTILES, BRICK, ETC.)
- ▤ ML / CL - CLAYEY SILTS / SILTY CLAYS / CLAYS / SILTS
- ░ SM - SILTY SANDS
- ▨ SP / SW - POORLY / WELL SORTED SANDS
- ▼ ELEVATION OF SATURATED SOIL

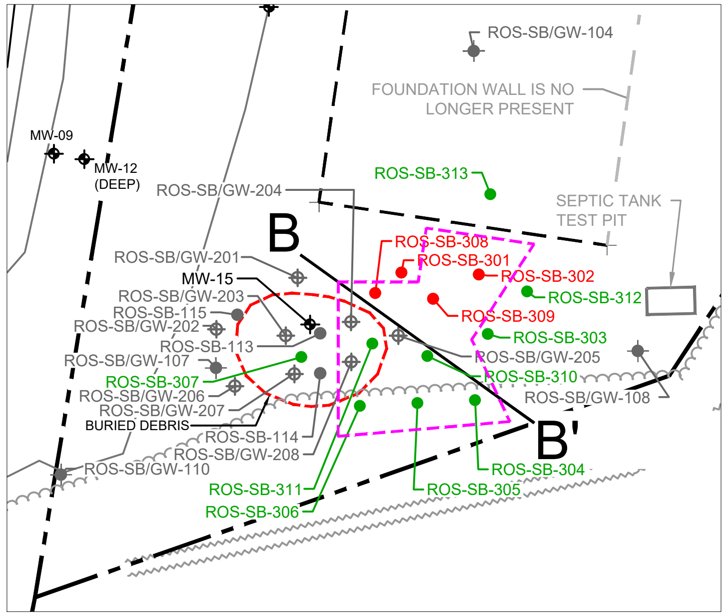
BOLD	EXCEEDS UUSCO
BOLD	EXCEEDS CUSCO
BOLD	EXCEEDS UTS
BOLD	EXCEEDS LDR

NOTES:

1. TO AID WITH VISUALIZATION AND SINCE CERTAIN BORINGS AND WELLS ARE OFFSET AND HAVE BEEN PROJECTED ONTO CROSS-SECTIONS, SPACING BETWEEN DATA POINTS DOES NOT MATCH ACTUAL FIELD CONDITIONS EXACTLY.
2. SOIL BORINGS LOCATED WITHIN 5 FEET OF THE TRANSECT LINE HAVE BEEN INCORPORATED INTO THE CROSS SECTION.
3. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND SOIL BORINGS ARE APPROXIMATE.
4. INFERRED BOUNDARIES BETWEEN SOIL TYPES ARE DASHED.
5. mg/kg - MILLIGRAMS PER KILOGRAM.
6. PID - PHOTOIONIZATION DETECTOR.
7. PPM - PARTS PER MILLION
8. UUSCO - NYSDEC PART 375 UNRESTRICTED USE SOIL CLEANUP OBJECTIVE.
9. CUSCO - NYSDEC PART 375 COMMERCIAL USE SOIL CLEANUP OBJECTIVE.
10. UTS - USEPA 40 CFR § 268.48 UNIVERSAL TREATMENT STANDARD: NONWASTEWATER STANDARD.
11. LDR - USEPA 40 CFR § 268.49 ALTERNATIVE LAND DISPOSAL RESTRICTION TREATMENT STANDARD FOR CONTAMINATED SOIL.

LEGEND (SYMBOLS NOT TO SCALE):

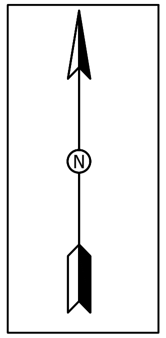
- – – – CMU BLOCK WALL FOUNDATION
- – · – PROPERTY LOT BOUNDARY
- ⊕ MW-## GROUNDWATER MONITORING WELL (2012)
- ⊕ ROS-SB/GW-1## DIRECT PUSH SOIL BORING AND "GRAB" GROUNDWATER SAMPLE (2012)
- ● ROS-SB-1## SOIL BORING (2013)
- ⊕ ROS-SB/GW-2## SOIL BORING AND "GRAB" GROUNDWATER SAMPLE (2017)
- ● ROS-SB-3## DELINEATION / SOIL RE-USE SOIL BORING (2020)
- ● ROS-SB-3## WASTE CHARACTERIZATION SOIL BORING (2020)
- ○ APPROXIMATE LIMITS OF BURIED DEBRIS MOUND (2014)
- ⌒⌒⌒ TREE LINE / WOODED AREA
- ☐ ANTICIPATED REMEDIAL EXCAVATION AREA FOR RESTRICTED USE (CUSCO) ALTERNATIVES
- B — B' CROSS SECTION TRANSECT



CROSS-SECTION TRANSECT B-B' MAP

SCALE: 1" = 40'

0 40' 80'



SHEET SIZE: 11" BY 17"

PROJECT:

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ROSENDALE CLEANERS SITE - SITE NO. 356050
TOWN OF ROSENDALE, NEW YORK

TITLE:

CROSS-SECTION TRANSECT B-B'

DRAWN BY:	H. DELGADO	PROJ NO.:	403739.0000.0000
CHECKED BY:	T. SHANLEY	**FIGURE 3B**	
APPROVED BY:	H. NICHOLS		
DATE:	JUNE 2022		

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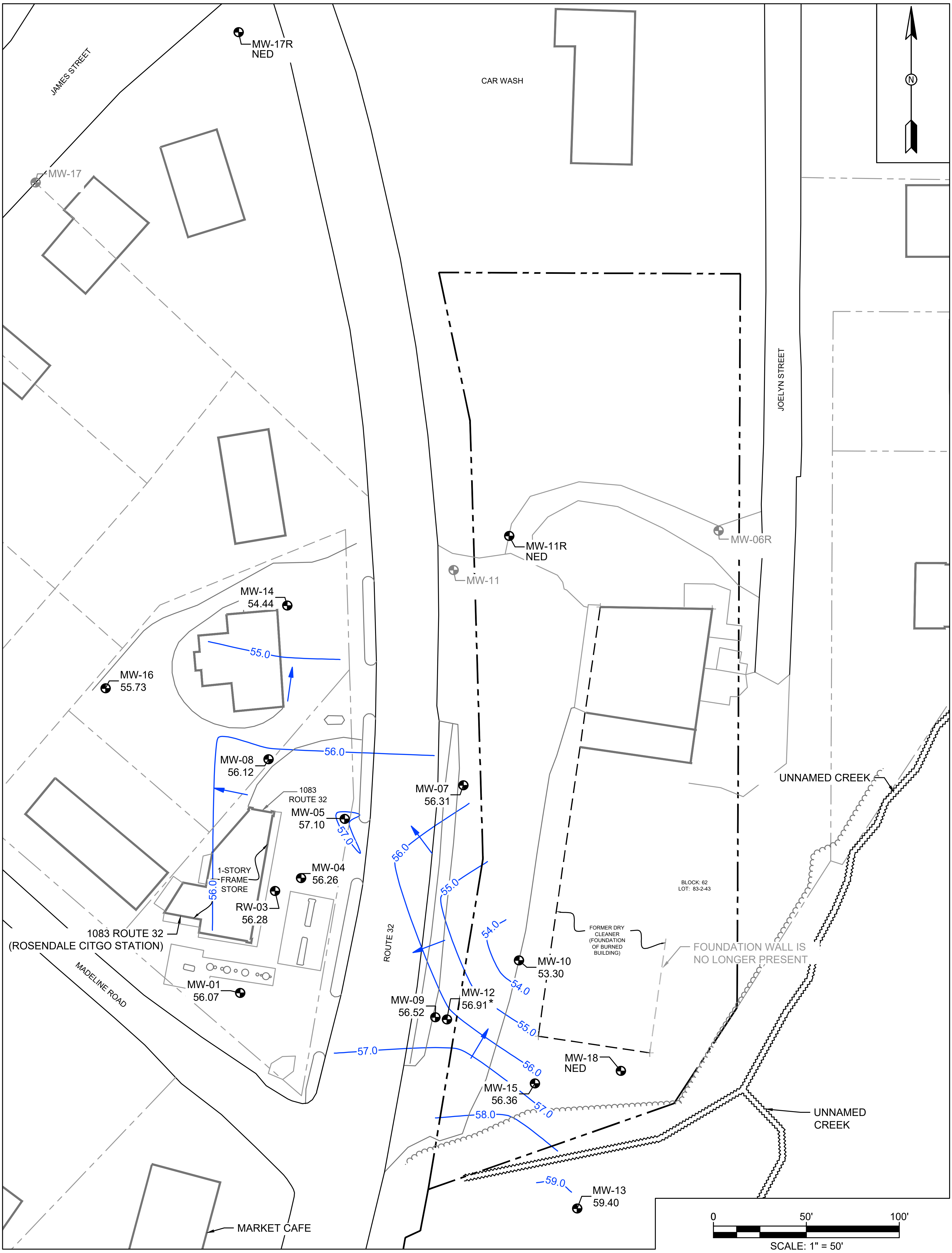
FILE NO.: Fig 3A-3B - X-Sct-Transects A-A' & B-B' (RC).dwg

11x17 --- ATTACHED XREFS: --- ATTACHED IMAGES: Transect A-A'; Transect B-B';
DRAWING NAME: B:\Projects\NYSDEC\D009812\Work Assignments\D009812-09 Rosendale Cleaners\Figures\FS\TRC Working Drawings\ Fig 3A-3B - X-Sct-Transects A-A' & B-B' (RC).dwg --- PLOT DATE: June 09, 2022 - 10:06AM --- LAYOUT: 11x17L (B-B')



SCALE: 1" = 50'
SHEET SIZE: 11" BY 17"

LEGEND (SYMBOLS NOT TO SCALE):

— — —	CMU BLOCK WALL FOUNDATION
—·—·—	PROPERTY LOT BOUNDARY
● MW-##	GROUNDWATER MONITORING WELL
● MW-##	DAMAGED / DESTROYED / ABANDONED GROUNDWATER MONITORING WELL
54.0	INFERRED GROUNDWATER SURFACE ELEVATION CONTOUR (1.0 FOOT INTERVALS)
56.23	GROUNDWATER SURFACE ELEVATION
⟶	APPARENT GROUNDWATER FLOW DIRECTION

NOTES:

1. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND PROPERTY BOUNDARIES ARE APPROXIMATE.
2. GROUNDWATER SURFACE ELEVATIONS BASED ON WATER ELEVATION MEASUREMENTS ON OCTOBER 6 2021 AND WELL SURVEY DATA FROM YEC, INC. DATED FEBRUARY 2013.
3. * = MEASUREMENT FOR MW-12 WAS NOT USED IN GENERATING GROUNDWATER SURFACE ELEVATION CONTOURS.
4. HORIZONTAL DATUM IN NORTH AMERICAN DATUM 1983 NEW YORK STATE PLANE COORDINATE SYSTEM EAST ZONE, US SURVEY FOOT (NY83-EF).
5. VERTICAL DATUM IN NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88).
6. NED = NO ELEVATION DATA.

PROJECT:
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ROSENDALE CLEANERS SITE - SITE NO. 356050
TOWN OF ROSENDALE, NEW YORK

TITLE:
GROUNDWATER SURFACE ELEVATION
CONTOUR MAP (OCTOBER 2021)

DRAWN BY:	H. DELGADO	PROJ NO.:	403739.0000.0000
CHECKED BY:	T. SHANLEY	FIGURE 4	
APPROVED BY:	H. NICHOLS		
DATE:	JUNE 2022		

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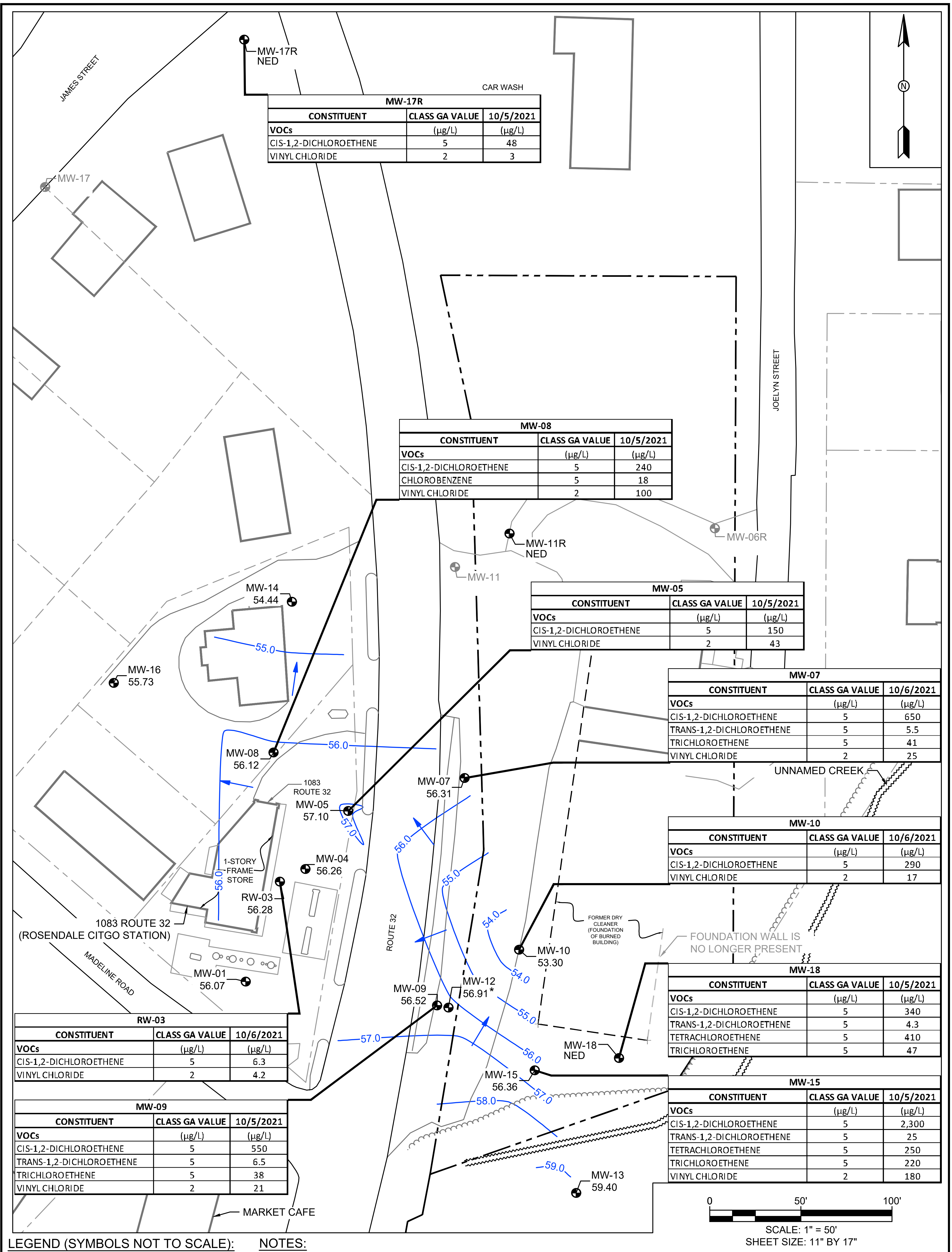
FILE NO.: Fig 4 - GW SEC Map (10.2021) (RC).dwg

Version: 2017-10-21

11x17 --- USER: HDelgado --- ATTACHED XREFS: rosendale(NY83-EF) --- ATTACHED IMAGES: Figure 1 - Proposed SB Locations (002); Google Earth Image; Rosendale CITGO map_image;
DRAWING NAME: B:\Projects\NYSDEC\D009812\Work Assignments\D009812-09 Rosendale Cleaners\Figures\FS\TRC Working Drawings\ Fig 4 - GW SEC Map (10.2021) (RC).dwg --- PLOT DATE: June 16, 2022 - 12:41PM --- LAYOUT: 11x17P



SCALE: 1" = 50'
SHEET SIZE: 11" BY 17"

MW-17R

CONSTITUENT	CLASS GA VALUE	10/5/2021
VOCs	(µg/L)	(µg/L)
CIS-1,2-DICHLOROETHENE	5	48
VINYL CHLORIDE	2	3

MW-08

CONSTITUENT	CLASS GA VALUE	10/5/2021
VOCs	(µg/L)	(µg/L)
CIS-1,2-DICHLOROETHENE	5	240
CHLOROBENZENE	5	18
VINYL CHLORIDE	2	100

MW-05

CONSTITUENT	CLASS GA VALUE	10/5/2021
VOCs	(µg/L)	(µg/L)
CIS-1,2-DICHLOROETHENE	5	150
VINYL CHLORIDE	2	43

MW-07

CONSTITUENT	CLASS GA VALUE	10/6/2021
VOCs	(µg/L)	(µg/L)
CIS-1,2-DICHLOROETHENE	5	650
TRANS-1,2-DICHLOROETHENE	5	5.5
TRICHLOROETHENE	5	41
VINYL CHLORIDE	2	25

MW-10

CONSTITUENT	CLASS GA VALUE	10/6/2021
VOCs	(µg/L)	(µg/L)
CIS-1,2-DICHLOROETHENE	5	290
VINYL CHLORIDE	2	17

MW-18

CONSTITUENT	CLASS GA VALUE	10/5/2021
VOCs	(µg/L)	(µg/L)
CIS-1,2-DICHLOROETHENE	5	340
TRANS-1,2-DICHLOROETHENE	5	4.3
TETRACHLOROETHENE	5	410
TRICHLOROETHENE	5	47

MW-15

CONSTITUENT	CLASS GA VALUE	10/5/2021
VOCs	(µg/L)	(µg/L)
CIS-1,2-DICHLOROETHENE	5	2,300
TRANS-1,2-DICHLOROETHENE	5	25
TETRACHLOROETHENE	5	250
TRICHLOROETHENE	5	220
VINYL CHLORIDE	2	180

RW-03

CONSTITUENT	CLASS GA VALUE	10/6/2021
VOCs	(µg/L)	(µg/L)
CIS-1,2-DICHLOROETHENE	5	6.3
VINYL CHLORIDE	2	4.2

MW-09

CONSTITUENT	CLASS GA VALUE	10/5/2021
VOCs	(µg/L)	(µg/L)
CIS-1,2-DICHLOROETHENE	5	550
TRANS-1,2-DICHLOROETHENE	5	6.5
TRICHLOROETHENE	5	38
VINYL CHLORIDE	2	21

LEGEND (SYMBOLS NOT TO SCALE):

— — —	CMU BLOCK WALL FOUNDATION
—·—	PROPERTY LOT BOUNDARY
● MW-##	GROUNDWATER MONITORING WELL
● MW-##	DAMAGED / DESTROYED / ABANDONED GROUNDWATER MONITORING WELL
54.0	INFERRED GROUNDWATER SURFACE ELEVATION CONTOUR (1.0 FOOT INTERVALS)
56.23	GROUNDWATER SURFACE ELEVATION
→	APPARENT GROUNDWATER FLOW DIRECTION

NOTES:

1. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND PROPERTY BOUNDARIES ARE APPROXIMATE.
2. GROUNDWATER SURFACE ELEVATIONS BASED ON WATER ELEVATION MEASUREMENTS ON OCTOBER 6 2021 AND WELL SURVEY DATA FROM YEC, INC. DATED FEBRUARY 2013.
3. * = MEASUREMENT FOR MW-12 WAS NOT USED IN GENERATING GROUNDWATER SURFACE ELEVATION CONTOURS.
4. HORIZONTAL DATUM IN NORTH AMERICAN DATUM 1983 NEW YORK STATE PLANE COORDINATE SYSTEM EAST ZONE, US SURVEY FOOT (NY83-EF).
5. VERTICAL DATUM IN NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88).
6. CLASS GA VALUE = NYSDEC AMBIENT WATER QUALITY STANDARDS AND GUIDANCE VALUES FOR CLASS GA WATER.
7. ONLY CVOC RESULTS ABOVE CLASS GA VALUES SHOWN.
8. µg/L = MICROGRAMS PER LITER.
9. NED = NO ELEVATION DATA.

PROJECT:
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ROSENDALE CLEANERS SITE - SITE NO. 356050
TOWN OF ROSENDALE, NEW YORK

TITLE:
SUMMARY OF RESULTS OF GROUNDWATER SAMPLING (OCTOBER 2021)

DRAWN BY:	H. DELGADO	PROJ NO.:	403739.0000.0000
CHECKED BY:	T. SHANLEY	**FIGURE 5A**	
APPROVED BY:	H. NICHOLS		
DATE:	JUNE 2022		

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Phone: 518.348.1190
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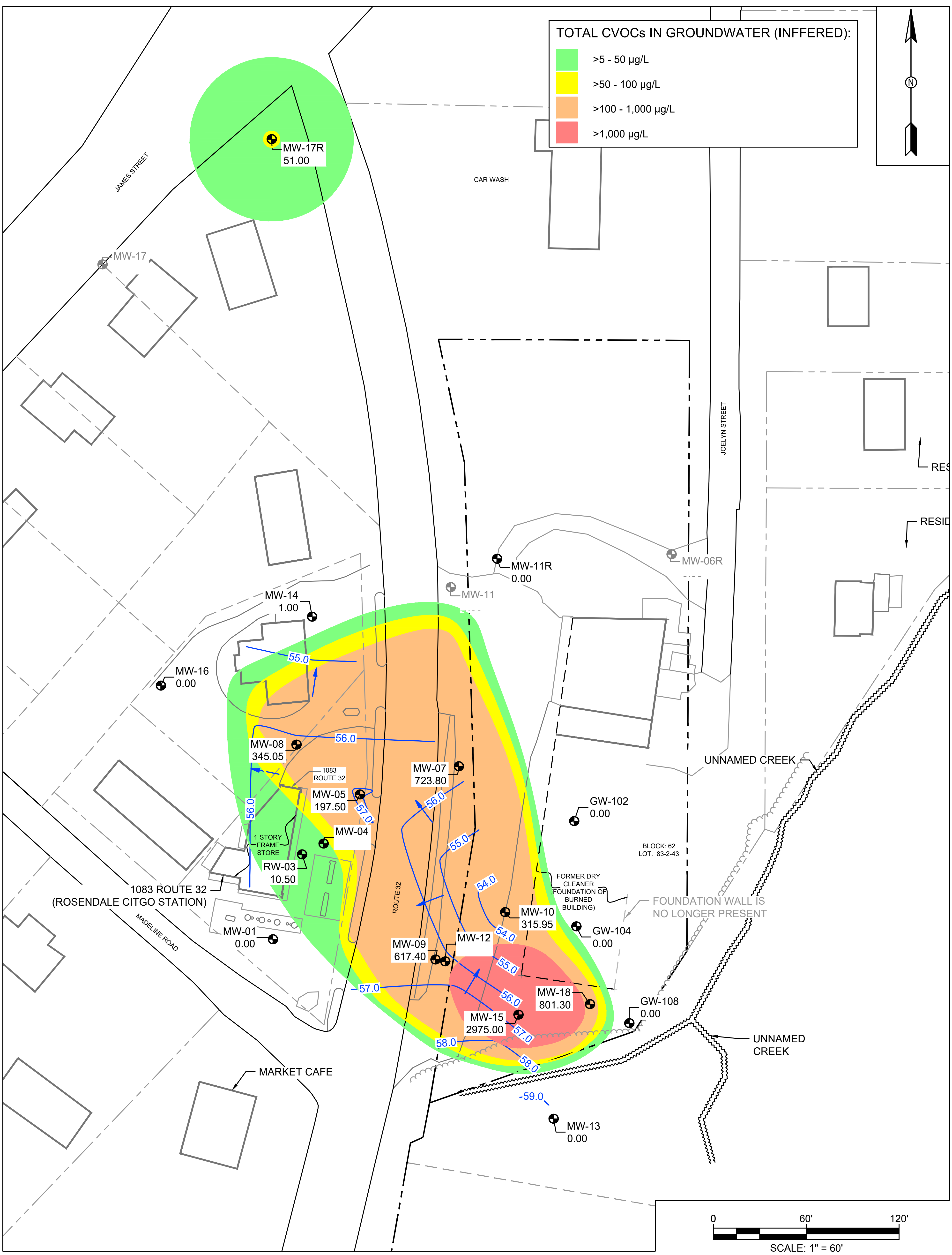
FILE NO.: Fig 5A - Sum. of Res. GW Samp. (10.2021) (RC).dwg

11x17 --- USER: HDelgado --- ATTACHED XREFS: rosendale(NY83-EF) --- ATTACHED IMAGES: Figure 1 - Proposed SB Locations (002); Google Earth Image; Rosendale CITGO map_image;
DRAWING NAME: B:\Projects\NYSDEC\D009812\Work Assignments\D009812-09 Rosendale Cleaners\Figures\FS\TRC Working Drawings\ Fig 5A - Sum. of Res. GW Samp. (10.2021) (RC).dwg --- PLOT DATE: June 16, 2022 - 12:54PM --- LAYOUT: 11x17P
Version: 2017-10-21



SCALE: 1" = 60'
SHEET SIZE: 11" BY 17"

LEGEND (SYMBOLS NOT TO SCALE):

— — —	CMU BLOCK WALL FOUNDATION
— · —	PROPERTY LOT BOUNDARY
MW-## ###	GROUNDWATER MONITORING WELL AND TOTAL CVOC CONCENTRATION (MICROGRAMS/LITER)
MW-##	DAMAGED / DESTROYED / ABANDONED GROUNDWATER MONITORING WELL
54.0	INFERRED GROUNDWATER SURFACE ELEVATION CONTOUR (1.0 FOOT INTERVALS)
→	APPARENT GROUNDWATER FLOW DIRECTION

NOTES:

1. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND PROPERTY BOUNDARIES ARE APPROXIMATE.
2. GROUNDWATER SURFACE ELEVATIONS BASED ON WATER ELEVATION MEASUREMENTS ON OCTOBER 2021 AND WELL SURVEY DATA FROM YEC, INC. DATED FEBRUARY 2013.
3. MEASUREMENT FOR MW-12 WAS NOT USED IN GENERATING GROUNDWATER SURFACE ELEVATION CONTOURS.
4. VERTICAL DATUM IN NORTH AMERICAN VERTICAL DATUM 1988 (NAVD88).
5. MW-12 (DEEP WELL) AND MW-04 WERE NOT USED TO GENERATE THE TOTAL CVOC CONTOURS.
6. DATA FROM PRIOR SAMPLING OF TEMPORARY WELLS GW-102, GW-104, AND GW-108 (2013) WAS USED TO INFER EXTENTS OF IMPACTS.

PROJECT:
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ROSENDALE CLEANERS SITE - SITE NO. 356050
TOWN OF ROSENDALE, NEW YORK

TITLE:
TOTAL CVOC CONCENTRATIONS IN GROUNDWATER (OCTOBER 2021)

DRAWN BY:	H. DELGADO	PROJ NO.:	403739.0000.0000
CHECKED BY:	P. CASTELLANO	**FIGURE 5B**	
APPROVED BY:	H. NICHOLS		
DATE:	JUNE 2022		

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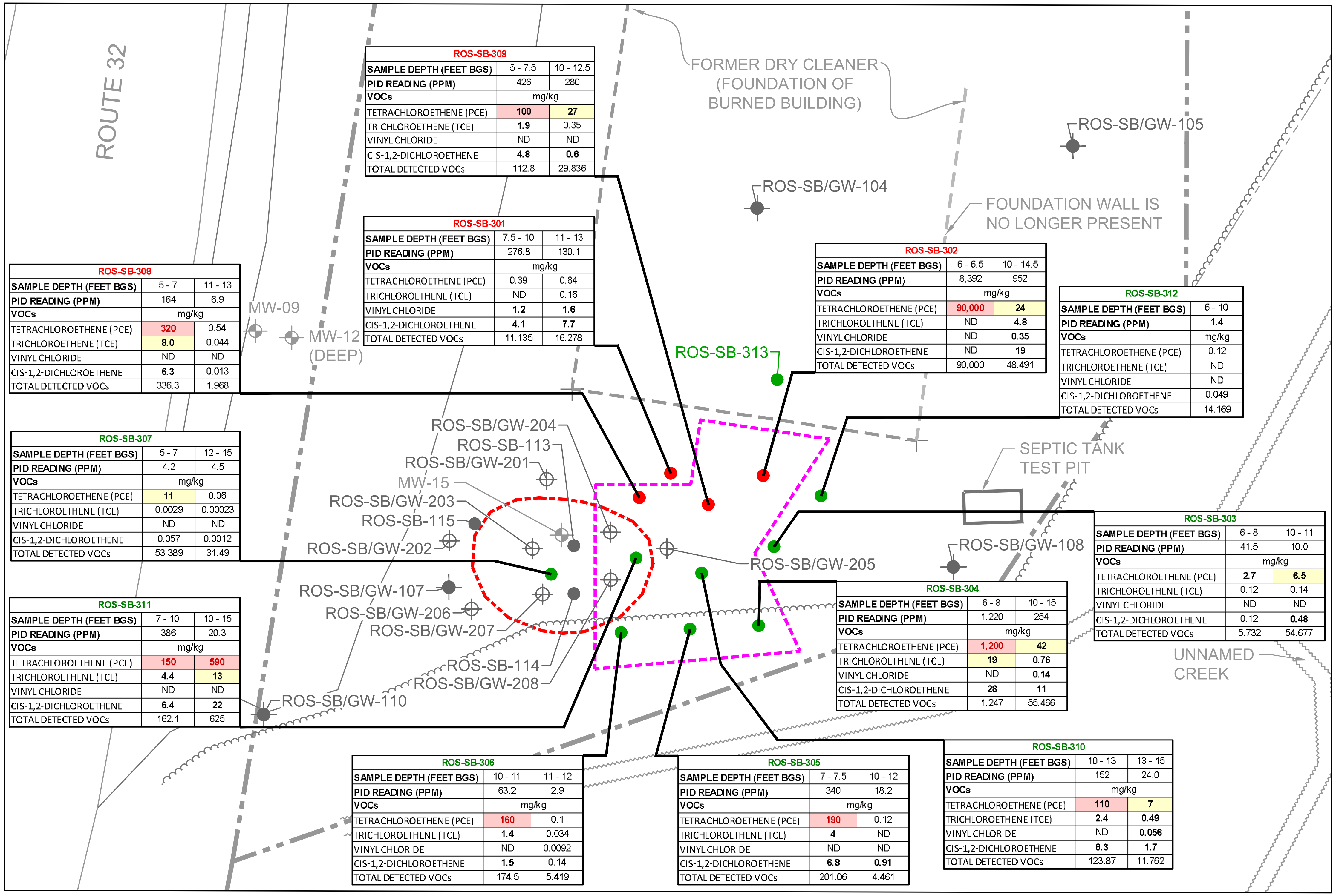
FILE NO.: Fig 5B - Total CVOC Conc. in GW (10.2021)(RC).dwg

DRAWING NAME: B:\Projects\NYSDEC\D009812\Work Assignments\D009812.09 Rosendale Cleaners\Figures\FS\TRC Working Drawings\ Fig 5B - Total CVOC Conc. in GW (10.2021)(RC).dwg --- PLOT DATE: June 16, 2022 - 12:58PM --- LAYOUT: 11x17P



ROS-SB-309

SAMPLE DEPTH (FEET BGS)	5 - 7.5	10 - 12.5
PID READING (PPM)	426	280
VOCs	mg/kg	
TETRACHLOROETHENE (PCE)	**100**	**27**
TRICHLOROETHENE (TCE)	**1.9**	0.35
VINYL CHLORIDE	ND	ND
CIS-1,2-DICHLOROETHENE	**4.8**	**0.6**
TOTAL DETECTED VOCs	112.8	29.836

ROS-SB-301

SAMPLE DEPTH (FEET BGS)	7.5 - 10	11 - 13
PID READING (PPM)	276.8	130.1
VOCs	mg/kg	
TETRACHLOROETHENE (PCE)	0.39	0.84
TRICHLOROETHENE (TCE)	ND	0.16
VINYL CHLORIDE	**1.2**	**1.6**
CIS-1,2-DICHLOROETHENE	**4.1**	**7.7**
TOTAL DETECTED VOCs	11.135	16.278

ROS-SB-308

SAMPLE DEPTH (FEET BGS)	5 - 7	11 - 13
PID READING (PPM)	164	6.9
VOCs	mg/kg	
TETRACHLOROETHENE (PCE)	**320**	0.54
TRICHLOROETHENE (TCE)	**8.0**	0.044
VINYL CHLORIDE	ND	ND
CIS-1,2-DICHLOROETHENE	**6.3**	0.013
TOTAL DETECTED VOCs	336.3	1.968

ROS-SB-302

SAMPLE DEPTH (FEET BGS)	6 - 6.5	10 - 14.5
PID READING (PPM)	8,392	952
VOCs	mg/kg	
TETRACHLOROETHENE (PCE)	**90,000**	**24**
TRICHLOROETHENE (TCE)	ND	**4.8**
VINYL CHLORIDE	ND	**0.35**
CIS-1,2-DICHLOROETHENE	ND	**19**
TOTAL DETECTED VOCs	90,000	48.491

ROS-SB-312

SAMPLE DEPTH (FEET BGS)	6 - 10
PID READING (PPM)	1.4
VOCs	mg/kg
TETRACHLOROETHENE (PCE)	0.12
TRICHLOROETHENE (TCE)	ND
VINYL CHLORIDE	ND
CIS-1,2-DICHLOROETHENE	0.049
TOTAL DETECTED VOCs	14.169

ROS-SB-307

SAMPLE DEPTH (FEET BGS)	5 - 7	12 - 15
PID READING (PPM)	4.2	4.5
VOCs	mg/kg	
TETRACHLOROETHENE (PCE)	**11**	0.06
TRICHLOROETHENE (TCE)	0.0029	0.00023
VINYL CHLORIDE	ND	ND
CIS-1,2-DICHLOROETHENE	0.057	0.0012
TOTAL DETECTED VOCs	53.389	31.49

ROS-SB-303

SAMPLE DEPTH (FEET BGS)	6 - 8	10 - 11
PID READING (PPM)	41.5	10.0
VOCs	mg/kg	
TETRACHLOROETHENE (PCE)	**2.7**	**6.5**
TRICHLOROETHENE (TCE)	0.12	0.14
VINYL CHLORIDE	ND	ND
CIS-1,2-DICHLOROETHENE	0.12	**0.48**
TOTAL DETECTED VOCs	5.732	54.677

ROS-SB-311

SAMPLE DEPTH (FEET BGS)	7 - 10	10 - 15
PID READING (PPM)	386	20.3
VOCs	mg/kg	
TETRACHLOROETHENE (PCE)	**150**	**590**
TRICHLOROETHENE (TCE)	**4.4**	**13**
VINYL CHLORIDE	ND	ND
CIS-1,2-DICHLOROETHENE	**6.4**	**22**
TOTAL DETECTED VOCs	162.1	625

ROS-SB-304

SAMPLE DEPTH (FEET BGS)	6 - 8	10 - 15
PID READING (PPM)	1,220	254
VOCs	mg/kg	
TETRACHLOROETHENE (PCE)	**1,200**	**42**
TRICHLOROETHENE (TCE)	**19**	**0.76**
VINYL CHLORIDE	ND	**0.14**
CIS-1,2-DICHLOROETHENE	**28**	**11**
TOTAL DETECTED VOCs	1,247	55.466

ROS-SB-306

SAMPLE DEPTH (FEET BGS)	10 - 11	11 - 12
PID READING (PPM)	63.2	2.9
VOCs	mg/kg	
TETRACHLOROETHENE (PCE)	**160**	0.1
TRICHLOROETHENE (TCE)	**1.4**	0.034
VINYL CHLORIDE	ND	0.0092
CIS-1,2-DICHLOROETHENE	**1.5**	0.14
TOTAL DETECTED VOCs	174.5	5.419

ROS-SB-305

SAMPLE DEPTH (FEET BGS)	7 - 7.5	10 - 12
PID READING (PPM)	340	18.2
VOCs	mg/kg	
TETRACHLOROETHENE (PCE)	**190**	0.12
TRICHLOROETHENE (TCE)	**4**	ND
VINYL CHLORIDE	ND	ND
CIS-1,2-DICHLOROETHENE	**6.8**	**0.91**
TOTAL DETECTED VOCs	201.06	4.461

ROS-SB-310

SAMPLE DEPTH (FEET BGS)	10 - 13	13 - 15
PID READING (PPM)	152	24.0
VOCs	mg/kg	
TETRACHLOROETHENE (PCE)	**110**	**7**
TRICHLOROETHENE (TCE)	**2.4**	**0.49**
VINYL CHLORIDE	ND	**0.056**
CIS-1,2-DICHLOROETHENE	**6.3**	**1.7**
TOTAL DETECTED VOCs	123.87	11.762

LEGEND (SYMBOLS NOT TO SCALE):

— — —	CMU BLOCK WALL FOUNDATION
—·—·—	PROPERTY LOT BOUNDARY
MW-##	GROUNDWATER MONITORING WELL (2012)
ROS-SB/GW-1##	DIRECT PUSH SOIL BORING AND "GRAB" GROUNDWATER SAMPLE (2012)
● ROS-SB-1##	SOIL BORING (2013)
ROS-SB/GW-2##	SOIL BORING AND "GRAB" GROUNDWATER SAMPLE (2017)
🟢 ROS-SB-3##	DELINEATION / SOIL RE-USE SOIL BORING (2020)
🔴 ROS-SB-3##	WASTE CHARACTERIZATION SOIL BORING (2020)
◌	APPROXIMATE LIMITS OF BURIED DEBRIS MOUND (2014)
⌒⌒⌒	TREE LINE / WOODED AREA
⬚	ANTICIPATED REMEDIAL EXCAVATION AREA FOR RESTRICTED USE (CUSCO) ALTERNATIVES

N

NOTES:

1. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND PROPERTY BOUNDARIES ARE APPROXIMATE.
2. SOIL SAMPLES WERE SUBMITTED FOR LABORATORY ANALYSIS OF TCL VOCs + 10 TICs.
3. ONLY SELECT CVOCs AND TOTAL DETECTED VOC CONCENTRATIONS (INCLUDING TICs) ARE SHOWN.
4. LABORATORY ANALYTICAL DATA QUALIFERS HAVE BEEN OMITTED. REFER TO THE DATA SUMMARY TABLES IN THE REMEDIAL INVESTIGATION REPORT FOR QUALIFIERS.
5. NO SOIL SAMPLES COLLECTED FROM ROS-SB-313 WERE SUBMITTED FOR LABORATORY ANALYSIS.
6. SOIL SAMPLE RESULTS FROM PRIOR SAMPLING EVENTS NOT SHOWN.

0 20' 40'

SCALE: 1" = 20'
SHEET SIZE: 11" BY 17"

ACRONYMS:

1. CVOCs - CHLORINATED VOLATILE ORGANIC COMPOUNDS.
2. FEET BGS - FEET BELOW GROUND SURFACE.
3. mg/kg - MILLIGRAMS PER KILOGRAM.
4. ND - NOT DETECTED ABOVE THE LABORATORY QUANTITATION LIMIT.
5. PID - PHOTO-IONIZATION DETECTOR.
6. PPM - PARTS PER MILLION.
7. TCL - TARGET COMPOUND LIST
8. TICs - TENTATIVELY IDENTIFIED COMPOUNDS.
9. VOCs - VOLATILE ORGANIC COMPOUNDS.
10. UUSCO - 6 NYCRR PART 375 UNRESTRICTED USE SOIL CLEANUP OBJECTIVE.
11. CUSCO - 6 NYCRR PART 375 COMMERCIAL USE SOIL CLEANUP OBJECTIVE.
12. UTS - USEPA 40 CFR § 268.48 UNIVERSAL TREATMENT STANDARD: NONWASTEWATER STANDARD.
13. LDR - USEPA 40 CFR § 268.49 ALTERNATIVE LAND DISPOSAL RESTRICTION TREATMENT STANDARD FOR CONTAMINATED SOIL.

LOCATION ID

SAMPLE DEPTH (FEET BGS)	# - #			
PID READING (PPM)	##			
ANALYTE	UUSCO	CUSCO	UTS	LDR
VOCs	mg/kg			
TETRACHLOROETHENE (PCE)	1.3	150	6.0	60
TRICHLOROETHENE (TCE)	0.47	200	6.0	60
VINYL CHLORIDE	0.02	13	6.0	60
CIS-1,2-DICHLOROETHENE	0.25	500	NA	NA

BOLD	EXCEEDS UUSCO
BOLD	EXCEEDS CUSCO
BOLD	EXCEEDS UTS
BOLD	EXCEEDS LDR

PROJECT:

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ROSENDALE CLEANERS SITE - SITE NO. 356050
TOWN OF ROSENDALE, NEW YORK

TITLE: **SELECT SOIL ANALYTICAL RESULTS MAP AND ANTICIPATED RESTRICTED USE EXCAVATION AREA (ALTERNATIVE 3)**

DRAWN BY:	H. DELGADO	PROJ NO.:	403739.0000.0000
CHECKED BY:	T. SHANLEY	**FIGURE 6**	
APPROVED BY:	H. NICHOLS		
DATE:	JUNE 2022		

TRC

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Clifton Park, NY 12065
Phone: 518.348.1190
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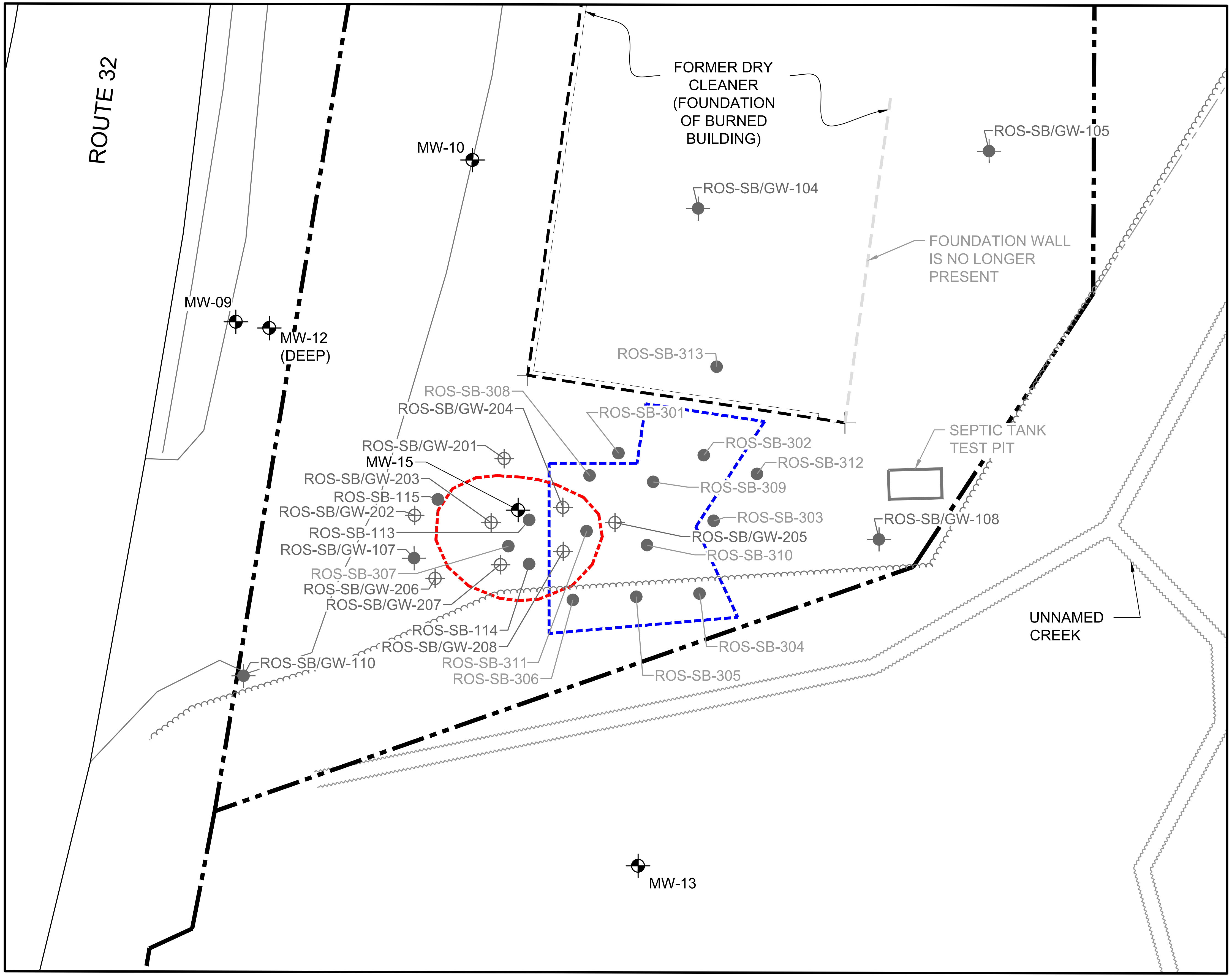
FILE NO.: Fig 6 - Select Soil Anal. Results Map (11.2020) (RC).dwg

DRAWING NAME: B:\Projects\NYSDEC\D009812\Work Assignments\D009812-09 Rosendale Cleaners\Figures\FS\TRC Working Drawings\ Fig 6 - Select Soil Anal. Results Map (11.2020) (RC).dwg --- PLOT DATE: June 14, 2022 - 2:23PM --- LAYOUT: 11x17L
11x17 --- ATTACHED XREFS: rosendale --- ATTACHED IMAGES: Figure 1 - Proposed SB Locations (002); Google Earth Image; Rosendale CITGO map_image;
Version: 2017-03-03



LEGEND (SYMBOLS NOT TO SCALE):

- — — — CMU BLOCK WALL FOUNDATION
- —·— PROPERTY LOT BOUNDARY
- ⊕ MW-XX GROUNDWATER MONITORING WELL LOCATION AND IDENTIFICATION NUMBER (2012)
- ● SB/GW-1XX DIRECT PUSH SOIL BORING AND "GRAB" GROUNDWATER SAMPLE LOCATION AND IDENTIFICATION NUMBER (2012)
- ● ROS-SB-XXX SOIL BORING LOCATION AND IDENTIFICATION NUMBER (2013 AND 2020)
- ⊕ ROS-SB/GW-2XX SOIL BORING AND "GRAB" GROUNDWATER SAMPLE LOCATION AND IDENTIFICATION NUMBER (2017)
- ○ APPROXIMATE LIMITS OF BURIED DEBRIS MOUND (2014)
- ⌒⌒⌒ TREE LINE / WOODED AREA
- ▭ CONCEPTUAL IN-SITU STABILIZATION AND SOLIDIFICATION (ISS) EXTENTS

N

NOTES:

1. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND PROPERTY BOUNDARIES ARE APPROXIMATE.

0 20' 40'

SCALE: 1" = 20'
SHEET SIZE: 11" BY 17"

PROJECT:
NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ROSENDALE CLEANERS SITE - SITE NO. 356050
TOWN OF ROSENDALE, NEW YORK

TITLE:
CONCEPTUAL ISS PLAN (ALTERNATIVE 2)

DRAWN BY:	H. DELGADO	PROJ NO.:	403739.0000.0000
CHECKED BY:	C. LUTHER		**FIGURE 7**
APPROVED BY:	H. NICHOLS		
DATE:	JUNE 2022		

TRC

10 Maxwell Drive, Suite 200
Clifton Park, NY 12065
Phone: 518.348.1190
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FILE NO.: Fig 7 - Conceptual ISS Plan (RC).dwg

DRAWING NAME: B:\Projects\NYSDEC\D009812\Work Assignments\D009812-09 Rosendale Cleaners\Figures\FS\TRC Working Drawings\Fig 7 - Conceptual ISS Plan (RC).dwg --- PLOT DATE: June 14, 2022 - 2:25PM --- LAYOUT: 11x17L
11x17 --- ATTACHED XREFS: rosendale --- ATTACHED IMAGES: Figure 1 - Proposed SB Locations (002) ; ; ;

Version: 2017-03-03

LEGEND (SYMBOLS NOT TO SCALE):

— — —	CMU BLOCK WALL FOUNDATION
—·—·—	PROPERTY LOT BOUNDARY
⊕ MW-XX	GROUNDWATER MONITORING WELL LOCATION AND IDENTIFICATION NUMBER (2012)
● SB/GW-1XX	DIRECT PUSH SOIL BORING AND "GRAB" GROUNDWATER SAMPLE LOCATION AND IDENTIFICATION NUMBER (2012)
● ROS-SB-XXX	SOIL BORING LOCATION AND IDENTIFICATION NUMBER (2013 AND 2020)
⊕ ROS-SB/GW-2XX	SOIL BORING AND "GRAB" GROUNDWATER SAMPLE LOCATION AND IDENTIFICATION NUMBER (2017)
○	APPROXIMATE LIMITS OF BURIED DEBRIS MOUND (2014)
⌒⌒⌒	TREE LINE / WOODED AREA)
▭	ANTICIPATED REMEDIAL EXCAVATION AREA FOR RESTRICTED USE (CUSCO) ALTERNATIVES
▭	CONCEPTUAL INJECTION AREA EXTENTS

NOTES:

1. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND PROPERTY BOUNDARIES ARE APPROXIMATE.

0 30' 60'

SCALE: 1" = 30'
SHEET SIZE: 11" BY 17"

PROJECT:

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ROSENDALE CLEANERS SITE - SITE NO. 356050
TOWN OF ROSENDALE, NEW YORK

TITLE:

CONCEPTUAL INJECTION PLAN (ALTERNATIVE 4A)

DRAWN BY:	H. DELGADO	PROJ NO.:	403739.0000.0000
CHECKED BY:	C. LUTHER	**FIGURE 8**	
APPROVED BY:	H. NICHOLS		
DATE:	JUNE 2022		

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FILE NO.: Fig 8 - Conceptual Inj. Plan (RC).dwg

11x17 --- ATTACHED XREFS: rosendale --- ATTACHED IMAGES: Figure 1 - Proposed SB Locations (002); ; ;
DRAWING NAME: B:\Projects\NYSDEC\D009812\Work Assignments\D009812-09 Rosendale Cleaners\Figures\FS\TRC Working Drawings\ Fig 8 - Conceptual Inj. Plan (RC).dwg --- PLOT DATE: June 14, 2022 - 2:32PM --- LAYOUT: 11x17L

Version: 2017-03-03

LEGEND (SYMBOLS NOT TO SCALE):

— — —	CMU BLOCK WALL FOUNDATION
—·—·—	PROPERTY LOT BOUNDARY
⊕ MW-XX	GROUNDWATER MONITORING WELL LOCATION AND IDENTIFICATION NUMBER (2012)
● SB/GW-1XX	DIRECT PUSH SOIL BORING AND "GRAB" GROUNDWATER SAMPLE LOCATION AND IDENTIFICATION NUMBER (2012)
● ROS-SB-XXX	SOIL BORING LOCATION AND IDENTIFICATION NUMBER (2013 AND 2020)
⊕ ROS-SB/GW-2XX	SOIL BORING AND "GRAB" GROUNDWATER SAMPLE LOCATION AND IDENTIFICATION NUMBER (2017)
○	APPROXIMATE LIMITS OF BURIED DEBRIS MOUND (2014)
⌒⌒⌒	TREE LINE / WOODED AREA
▭	ANTICIPATED REMEDIAL EXCAVATION AREA FOR RESTRICTED USE (CUSCO) ALTERNATIVES
▭	CONCEPTUAL PERMEABLE REACTIVE BARRIER EXTENTS

NOTES:

1. LOCATIONS AND DIMENSIONS OF PHYSICAL FEATURES AND PROPERTY BOUNDARIES ARE APPROXIMATE.

0 30' 60'

SCALE: 1" = 30'
SHEET SIZE: 11" BY 17"

PROJECT:

NEW YORK STATE DEPARTMENT OF ENVIRONMENTAL CONSERVATION
ROSENDALE CLEANERS SITE - SITE NO. 356050
TOWN OF ROSENDALE, NEW YORK

TITLE:

CONCEPTUAL PRB PLAN (ALTERNATIVE 4B)

DRAWN BY:	H. DELGADO	PROJ NO.:	403739.0000.0000
CHECKED BY:	C. LUTHER	**FIGURE 9**	
APPROVED BY:	H. NICHOLS		
DATE:	JUNE 2022		

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FILE NO.: Fig 9 - Conceptual PRB Plan (RC).dwg

11x17 --- ATTACHED XREF'S: rosendale --- ATTACHED IMAGES: Figure 1 - Proposed SB Locations (002); ; ;
DRAWING NAME: B:\Projects\NYSDEC\D009812\Work Assignments\D009812-09 Rosendale Cleaners\Figures\FS\TRC Working Drawings\ Fig 9 - Conceptual PRB Plan (RC).dwg --- PLOT DATE: June 14, 2022 - 2:35PM --- LAYOUT: 11x17L

Version: 2017-03-03

Appendix A

Appendix A
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Spreadsheet for Environmental Footprint Analysis

Environmental Footprint Summary

Core Element	Metric		Unit of Measure	Alt 2: Excavation, ISS, Implementation of ICs and SM				Alt 3: Excavation, ISCR/Bioremediation, Implementation of ICs and SM			
				Debris and Soil Excavations	In-Situ Stabilization	Long-Term Groundwater Sampling	Total	Debris and Soil Excavations	Soil Blending	Long-Term Groundwater Sampling	Total
Materials & Waste	M&W-1	Refined materials used on-site	Tons	0.0	81.1	1,000.0	1,081.1	0.0	9.7	1,000.0	1,009.7
	M&W-2	% of refined materials from recycled or reused material	%		0.0%	100.0%			0.0%	100.0%	
	M&W-3	Unrefined materials used on-site	Tons	0.000	0.000	0.000	0.0	1,035.000	0.000	0.000	1,035.0
	M&W-4	% of unrefined materials from recycled or reused material	%					0.0%			
	M&W-5	On-site hazardous waste disposed of off-site	Tons	226.0	0.0	0.0	226.0	1,037.0	0.0	0.0	1,037.0
	M&W-6	On-site non-hazardous waste disposed of off-site	Tons	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	M&W-7	Recycled or reused waste	Tons	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	M&W-8	% of total potential waste recycled or reused	%	0.0%				0.0%			
Water (used on-site)	W-1	Public water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-2	Groundwater use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-3	Surface water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-4	Reclaimed water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-5	Storm water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-6	User-defined water resource #1	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-7	User-defined water resource #2	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-8	Wastewater generated	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy	E-1	Total energy used (on-site and off-site)	MMBtu	2,863.1	782.0	39.3	3,684.4	13,116.0	257.8	39.3	13,413.1
	E-2	Energy voluntarily derived from renewable resources									
	E-2A	On-site renewable energy generation or use + on-site biodiesel use + biodiesel and other renewable resource use for transportation	MMBtu	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E-2B	Voluntary purchase of renewable electricity	MWh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E-3	Voluntary purchase of RECs	MWh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E-4	On-site grid electricity use	MWh	0.000	0.000	0.000	0.0	0.000	0.000	0.000	0.0
Air	A-1	On-site NOx, SOx, and PM emissions	Pounds	80.5	200.4	0.0	280.9	295.0	71.3	0.0	366.4
	A-2	On-site HAP emissions	Pounds	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	A-3	Total NOx, SOx, and PM emissions	Pounds	1,706.8	3,627.4	108.2	5,442.4	7,795.6	511.3	108.2	8,415.1
	A-3A	Total NOx emissions	Pounds	845.7	1,513.2	39.7	2,398.6	3,836.7	239.3	39.7	4,115.8
	A-3B	Total SOx emissions	Pounds	763.0	2,091.3	59.2	2,913.5	3,505.8	252.0	59.2	3,817.0
	A-3C	Total PM emissions	Pounds	98.1	22.9	9.3	130.3	453.1	19.9	9.3	482.4
	A-4	Total HAP emissions	Pounds	40.2	12.2	6.6	58.9	184.3	13.5	6.6	204.4
	A-5	Total greenhouse gas emissions	Tons CO_2e*	558.2	55.8	2.7	616.7	2,557.9	23.6	2.7	2,584.2

The above metrics are consistent with EPA's Methodology for Understanding and Reducing a Project's Environmental Footprint (EPA 542-R-12-002), February 2012

** Total greenhouse gases emissions (in CO_2e) include consideration of CO_2, CH_4, and N_2O (Nitrous oxide) emissions.*

"MMBtu" = millions of Btus

"MG" = millions of gallons

"CO_2e" = carbon dioxide equivalents of global warming potential

"MWh" = megawatt hours (i.e., thousands of kilowatt-hours or millions of Watt-hours)

"Tons" = short tons (2,000 pounds)

Appendix A
New York State Department of Environmental Conservation
Rosendale Cleaners Site - 1090-1094 Route 32, Rosendale, New York
Focused Feasibility Study Report
Spreadsheet for Environmental Footprint Analysis

Environmental Footprint Summary

Core Element	Metric		Unit of Measure	Alt 4A: Excavation, Groundwater Treatment via Injection, Implementation of ICs and SM					Alt 4B: Excavation, Groundwater Treatment via Permeable Reactive Barrier, Implementation of ICs and SM				
				Debris and Soil Excavations	Soil Blending	Groundwater Injection	Long-Term Groundwater Sampling	Total	Debris and Soil Excavations	Soil Blending	Permeable Reactive Barrier	Long-Term Groundwater Sampling	Total
Materials & Waste	M&W-1	Refined materials used on-site	Tons	0.0	9.7	5.5	0.0	15.2	0.0	9.7	5.0	0.0	14.7
	M&W-2	% of refined materials from recycled or reused material	%		0.0%	0.0%				0.0%	0.0%		
	M&W-3	Unrefined materials used on-site	Tons	1,032.000	0.000	0.000	0.000	1,032.0	1,032.000	0.000	0.000	0.000	1,032.0
	M&W-4	% of unrefined materials from recycled or reused material	%	0.0%					0.0%				
	M&W-5	On-site hazardous waste disposed of off-site	Tons	1,037.0	0.0	0.0	0.0	1,037.0	1,037.0	0.0	0.0	0.0	1,037.0
	M&W-6	On-site non-hazardous waste disposed of off-site	Tons	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	M&W-7	Recycled or reused waste	Tons	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	M&W-8	% of total potential waste recycled or reused	%	0.0%					0.0%				
Water (used on-site)	W-1	Public water use	MG	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.0
	W-2	Groundwater use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-3	Surface water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-4	Reclaimed water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-5	Storm water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-6	User-defined water resource #1	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-7	User-defined water resource #2	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-8	Wastewater generated	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy	E-1	Total energy used (on-site and off-site)	MMBtu	13,170.4	257.8	1,586.0	33.8	15,048.0	13,170.4	257.8	576.6	33.8	14,038.6
	E-2	Energy voluntarily derived from renewable resources											
	E-2A	On-site renewable energy generation or use + on-site biodiesel use + biodiesel and other renewable resource use for transportation	MMBtu	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E-2B	Voluntary purchase of renewable electricity	MWh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E-3	Voluntary purchase of RECs	MWh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E-4	On-site grid electricity use	MWh	0.000	0.000	0.000	0.000	0.0	0.000	0.000	0.000	0.000	0.0
Air	A-1	On-site NOx, SOx, and PM emissions	Pounds	295.0	71.3	1,617.8	0.0	1,984.1	295.0	71.3	251.2	0.0	617.6
	A-2	On-site HAP emissions	Pounds	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0
	A-3	Total NOx, SOx, and PM emissions	Pounds	7,862.7	511.3	1,933.5	90.2	10,397.6	7,862.7	511.3	2,156.0	90.2	10,620.2
	A-3A	Total NOx emissions	Pounds	3,897.9	239.3	1,750.5	34.3	5,922.0	3,897.9	239.3	989.7	34.3	5,161.3
	A-3B	Total SOx emissions	Pounds	3,509.8	252.0	132.6	48.3	3,942.6	3,509.8	252.0	1,148.9	48.3	4,959.0
	A-3C	Total PM emissions	Pounds	455.0	19.9	50.4	7.6	533.0	455.0	19.9	17.4	7.6	499.9
	A-4	Total HAP emissions	Pounds	184.7	13.5	11.0	5.4	214.5	184.7	13.5	7.8	5.4	211.3
	A-5	Total greenhouse gas emissions	Tons CO_2e*	2,562.4	23.6	141.8	2.3	2,730.1	2,562.4	23.6	42.7	2.3	2,631.0

The above metrics are consistent with EPA's Methodology for Understanding and Reducing a Project's Environmental Footprint (EPA 542-R-12-002), February 2012

** Total greenhouse gases emissions (in CO_2e) include consideration of CO_2, CH_4, and N_2O (Nitrous oxide) emissions.*

"MMBtu" = millions of Btus

"MG" = millions of gallons

"CO_2e" = carbon dioxide equivalents of global warming potential

"MWh" = megawatt hours (i.e., thousands of kilowatt-hours or millions of Watt-hours)

"Tons" = short tons (2,000 pounds)

Appendix A
New York State Department of Environmental Conservation
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Environmental Footprint Summary

Core Element	Metric		Unit of Measure	Alt 5A: Excavation, Groundwater Treatment via Injection				Alt 5B: Excavation, Groundwater Treatment via Permeable Reactive Barrier			
				Debris and Soil Excavations	Groundwater Injection	Long-Term Groundwater Sampling	Total	Debris and Soil Excavations	Permeable Reactive Barrier	Long-Term Groundwater Sampling	Total
Materials & Waste	M&W-1	Refined materials used on-site	Tons	0.0	25.3	0.0	25.3	0.0	5.0	0.0	5.0
	M&W-2	% of refined materials from recycled or reused material	%		0.0%				0.0%		
	M&W-3	Unrefined materials used on-site	Tons	2,583.000	0.000	0.000	2,583.0	2,583.000	0.000	0.000	2,583.0
	M&W-4	% of unrefined materials from recycled or reused material	%	0.0%				0.0%			
	M&W-5	On-site hazardous waste disposed of off-site	Tons	5,087.0	0.0	0.0	5,087.0	5,087.0	0.0	0.0	5,087.0
	M&W-6	On-site non-hazardous waste disposed of off-site	Tons	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	M&W-7	Recycled or reused waste	Tons	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	M&W-8	% of total potential waste recycled or reused	%	0.0%				0.0%			
Water (used on-site)	W-1	Public water use	MG	0.0	0.4	0.0	0.4	0.0	0.0	0.0	0.0
	W-2	Groundwater use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-3	Surface water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-4	Reclaimed water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-5	Storm water use	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-6	User-defined water resource #1	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-7	User-defined water resource #2	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	W-8	Wastewater generated	MG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Energy	E-1	Total energy used (on-site and off-site)	MMBtu	64,171.1	1,717.5	46.7	65,935.3	64,171.0	576.6	46.7	64,794.3
	E-2	Energy voluntarily derived from renewable resources									
	E-2A	On-site renewable energy generation or use + on-site biodiesel use + biodiesel and other renewable resource use for transportation	MMBtu	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E-2B	Voluntary purchase of renewable electricity	MWh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E-3	Voluntary purchase of RECs	MWh	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	E-4	On-site grid electricity use	MWh	0.000	0.000	0.000	0.0	0.000	0.000	0.000	0.0
Air	A-1	On-site NOx, SOx, and PM emissions	Pounds	1,251.6	1,399.3	0.0	2,650.9	1,251.6	251.2	0.0	1,502.8
	A-2	On-site HAP emissions	Pounds	0.0	0.0	0.0	0.1	0.0	0.0	0.0	0.0
	A-3	Total NOx, SOx, and PM emissions	Pounds	38,061.2	2,056.2	132.3	40,249.7	38,061.0	2,156.0	132.3	40,349.3
	A-3A	Total NOx emissions	Pounds	18,683.2	1,808.8	46.9	20,539.0	18,683.2	989.7	46.9	19,719.8
	A-3B	Total SOx emissions	Pounds	17,169.4	196.2	73.8	17,439.5	17,169.4	1,148.9	73.8	18,392.2
	A-3C	Total PM emissions	Pounds	2,208.6	51.1	11.5	2,271.2	2,208.5	17.4	11.5	2,237.4
	A-4	Total HAP emissions	Pounds	902.2	10.1	8.2	920.5	902.2	7.8	8.2	918.2
	A-5	Total greenhouse gas emissions	Tons CO_2e*	12,538.0	196.2	3.1	12,737.3	12,538.0	42.7	3.1	12,583.8

The above metrics are consistent with EPA's Methodology for Understanding and Reducing a Project's Environmental Footprint (EPA 542-R-12-002), February 2012

** Total greenhouse gases emissions (in CO_2e) include consideration of CO_2, CH_4, and N_2O (Nitrous oxide) emissions.*

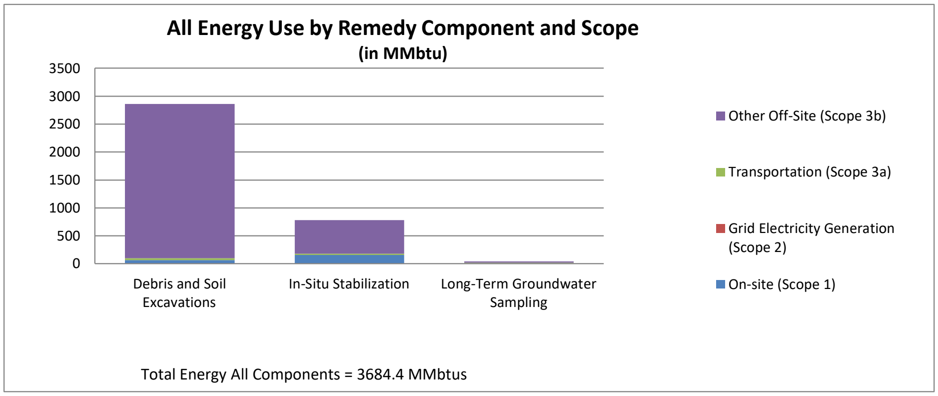
"MMBtu" = millions of Btus

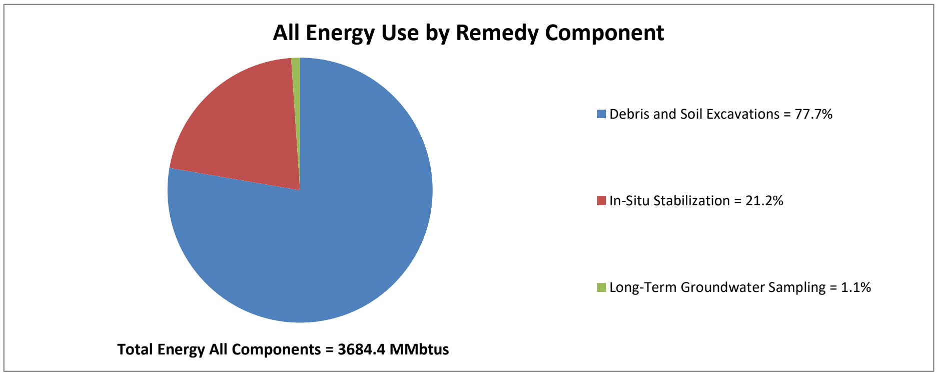
"MG" = millions of gallons

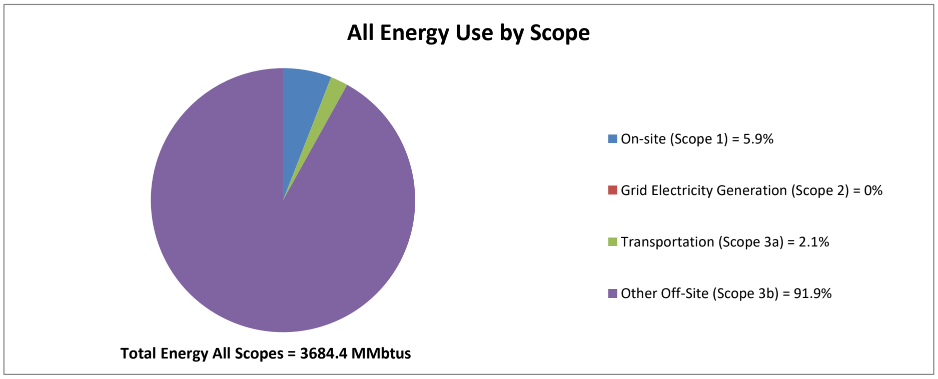
"CO_2e" = carbon dioxide equivalents of global warming potential

"MWh" = megawatt hours (i.e., thousands of kilowatt-hours or millions of Watt-hours)

"Tons" = short tons (2,000 pounds)







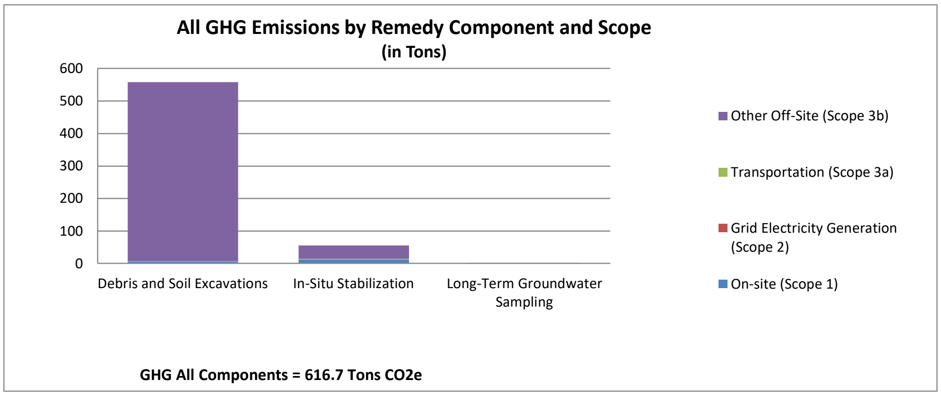
Total Energy
MMbtus

	Debris and Soil Excavations	In-Situ Stabilization	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	62.6	155.8	0.0	218.4
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	35.8	26.3	16.6	78.7
Other Off-Site (Scope 3b)	2,764.8	599.9	22.7	3,387.3
Total	2,863.1	782.0	39.3	3,684.4

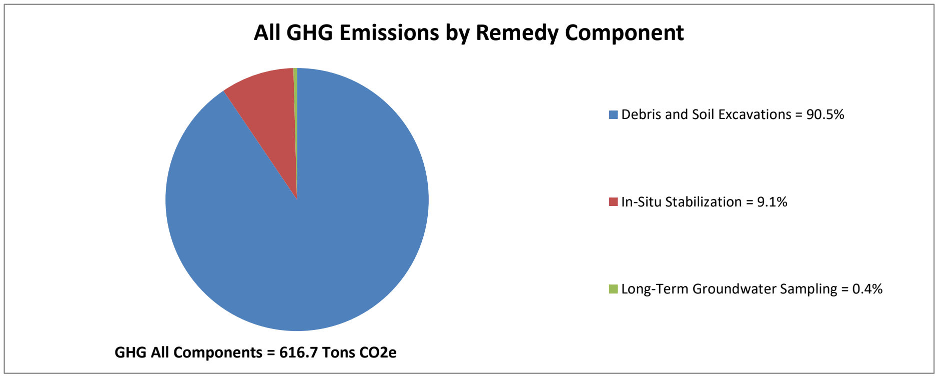
Debris and Soil Excavations = 77.7%
In-Situ Stabilization = 21.2%
Long-Term Groundwater Sampling = 1.1%

On-site (Scope 1) = 5.9%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 2.1%
Other Off-Site (Scope 3b) = 91.9%

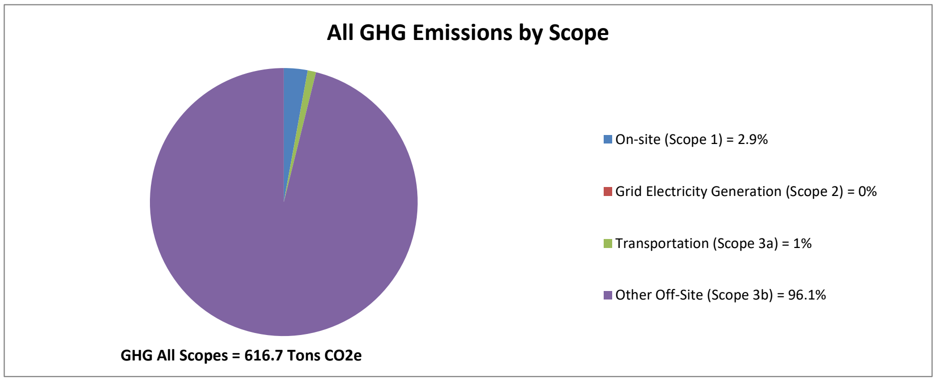
Total Energy All Components = 3684.4 MMbtus
Total Energy All Scopes = 3684.4 MMbtus


All GHG Emissions by Remedy Component and Scope
(in Tons)

GHG All Components = 616.7 Tons CO2e


All GHG Emissions by Remedy Component

GHG All Components = 616.7 Tons CO2e


All GHG Emissions by Scope

GHG All Scopes = 616.7 Tons CO2e

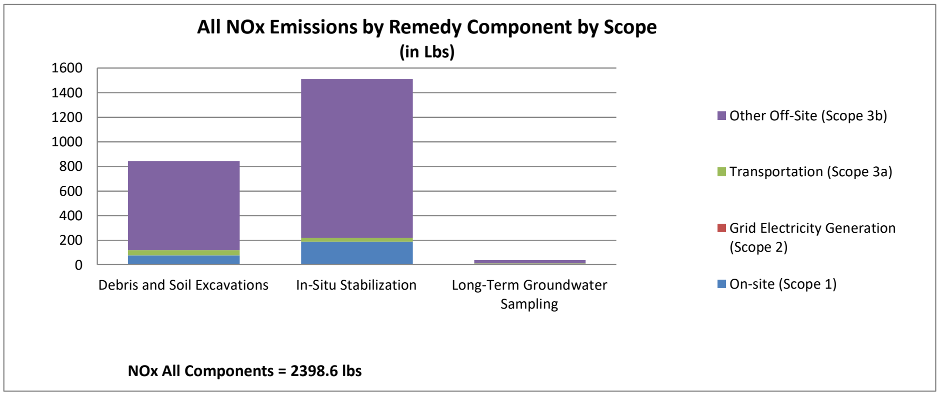
GHG
Tons CO2e

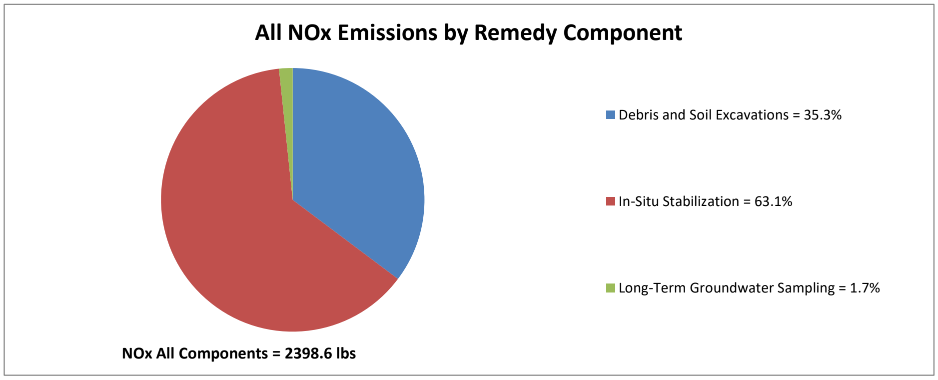
	Debris and Soil Excavations	In-Situ Stabilization	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	5.1	12.6	0.0	17.7
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	2.9	2.1	1.3	6.4
Other Off-Site (Scope 3b)	550.2	41.1	1.3	592.7
Total	558.2	55.8	2.7	616.7

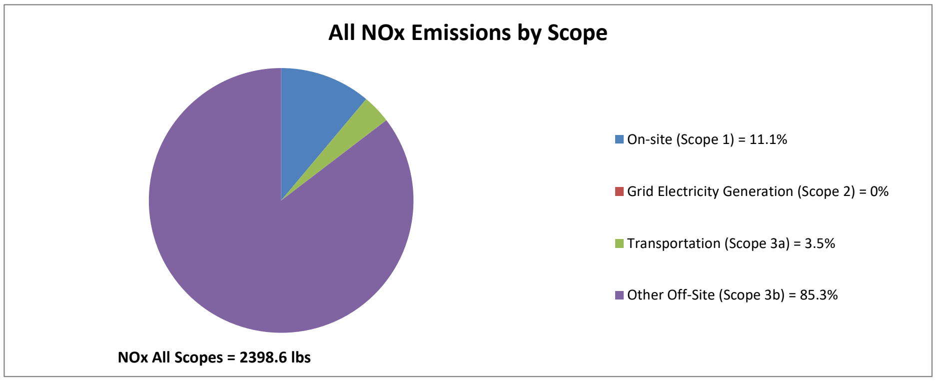
Debris and Soil Excavations = 90.5%
In-Situ Stabilization = 9.1%
Long-Term Groundwater Sampling = 0.4%

On-site (Scope 1) = 2.9%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 1%
Other Off-Site (Scope 3b) = 96.1%

GHG All Components = 616.7 Tons CO2e
GHG All Scopes = 616.7 Tons CO2e







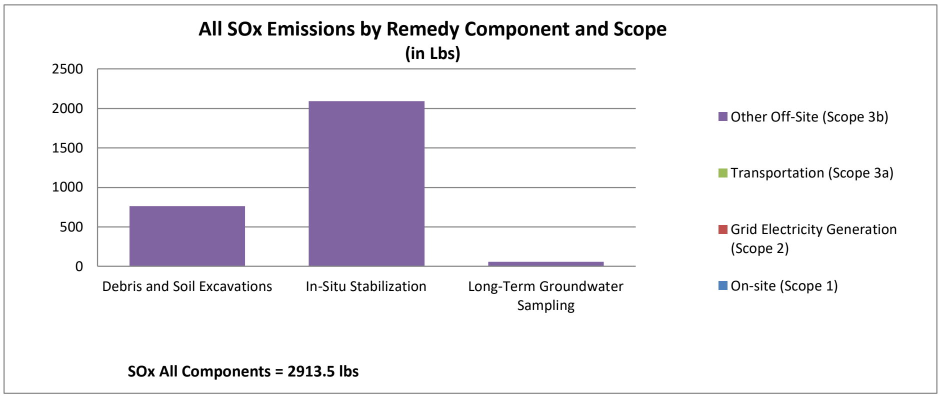
NOx
lbs

	Debris and Soil Excavations	In-Situ Stabilization	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	76.5	190.6	0.0	267.1
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	42.3	29.7	12.4	84.4
Other Off-Site (Scope 3b)	726.8	1,293.0	27.4	2,047.2
Total	845.7	1,513.2	39.7	2,398.6

Debris and Soil Excavations = 35.3%
In-Situ Stabilization = 63.1%
Long-Term Groundwater Sampling = 1.7%

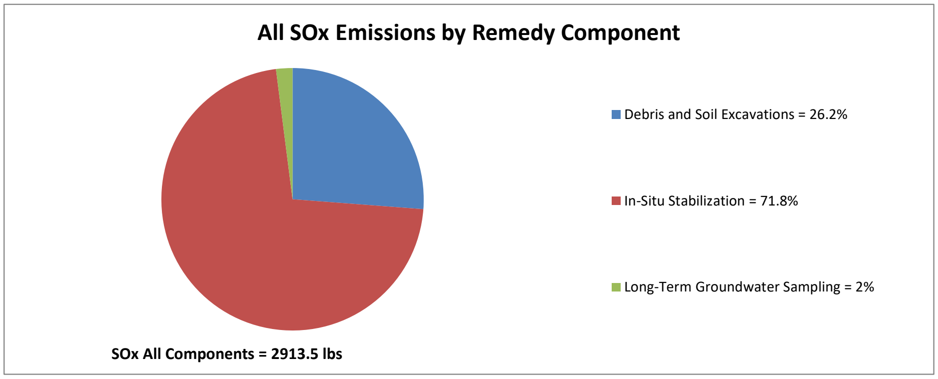
On-site (Scope 1) = 11.1%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 3.5%
Other Off-Site (Scope 3b) = 85.3%

NOx All Components = 2398.6 lbs
NOx All Scopes = 2398.6 lbs



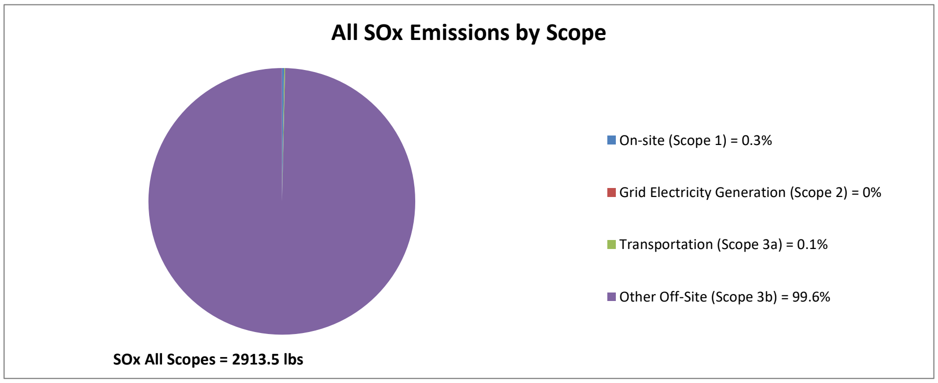
All SOx Emissions by Remedy Component and Scope (in Lbs)

SOx All Components = 2913.5 lbs



All SOx Emissions by Remedy Component

SOx All Components = 2913.5 lbs



All SOx Emissions by Scope

SOx All Scopes = 2913.5 lbs

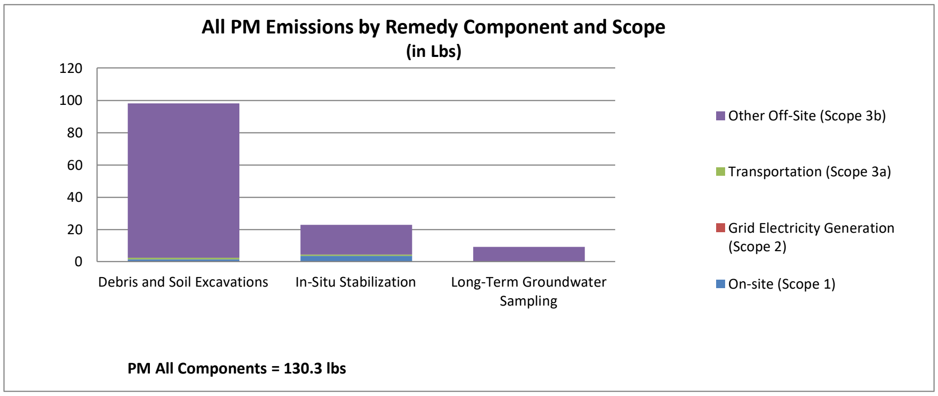
SOx
lbs

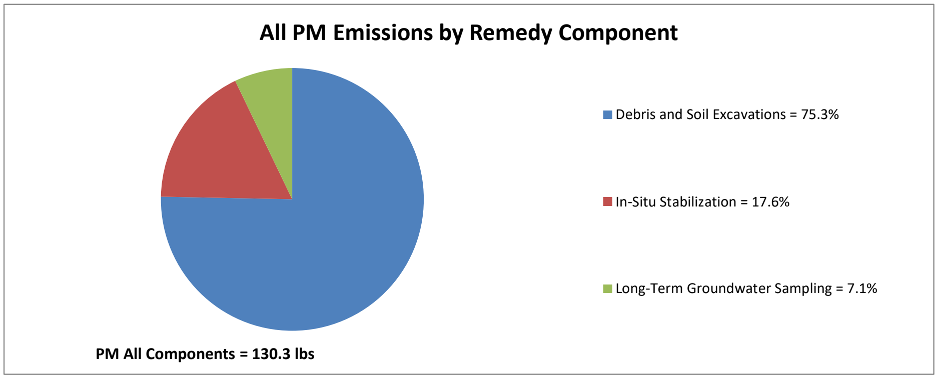
	Debris and Soil Excavations	In-Situ Stabilization	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	2.4	6.1	0.0	8.5
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	1.3	0.9	0.4	2.6
Other Off-Site (Scope 3b)	759.2	2,084.3	58.9	2,902.4
Total	763.0	2,091.3	59.2	2,913.5

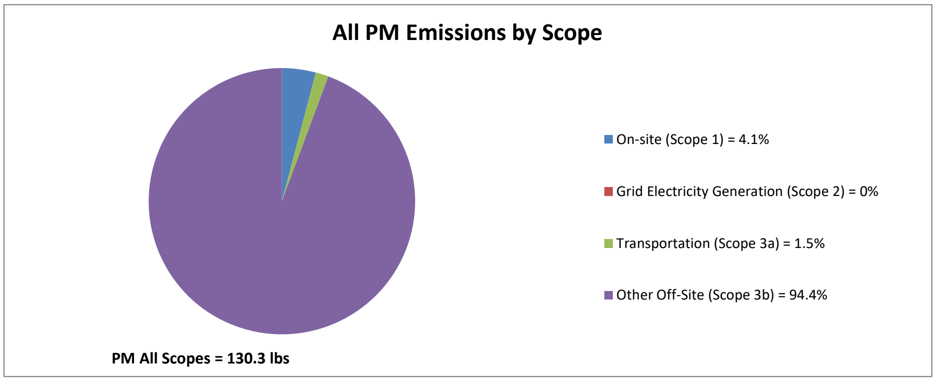
Debris and Soil Excavations = 26.2%
In-Situ Stabilization = 71.8%
Long-Term Groundwater Sampling = 2%

On-site (Scope 1) = 0.3%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 0.1%
Other Off-Site (Scope 3b) = 99.6%

SOx All Components = 2913.5 lbs
SOx All Scopes = 2913.5 lbs







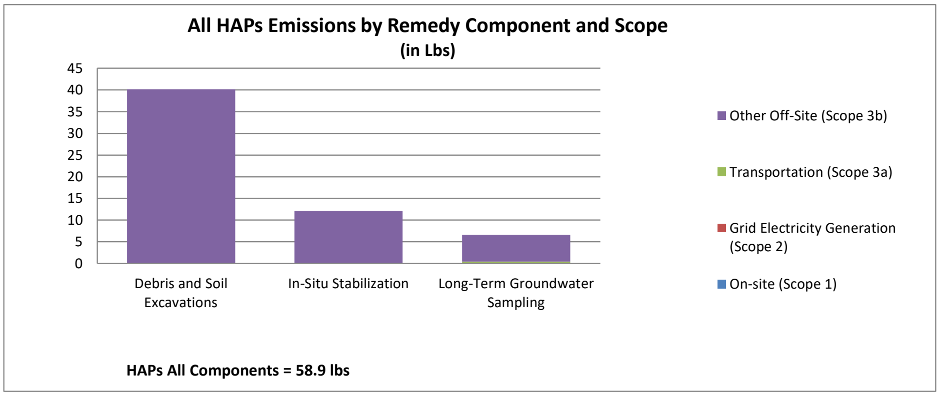
PM
lbs

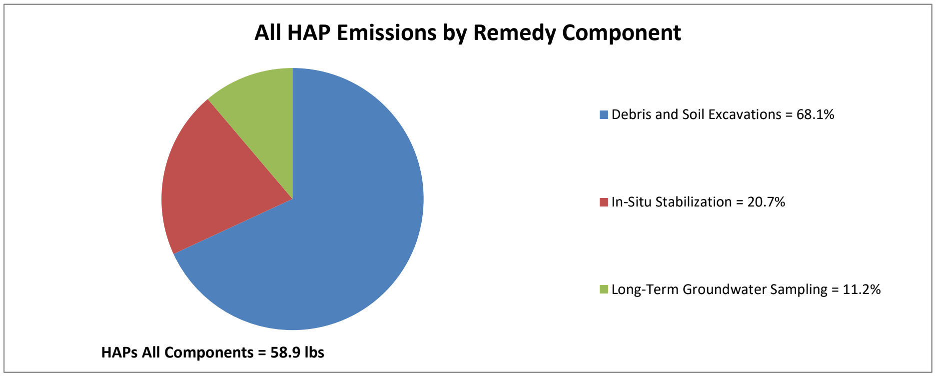
	Debris and Soil Excavations	In-Situ Stabilization	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	1.5	3.8	0.0	5.3
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	0.9	0.7	0.4	2.0
Other Off-Site (Scope 3b)	95.7	18.4	8.9	122.9
Total	98.1	22.9	9.3	130.3

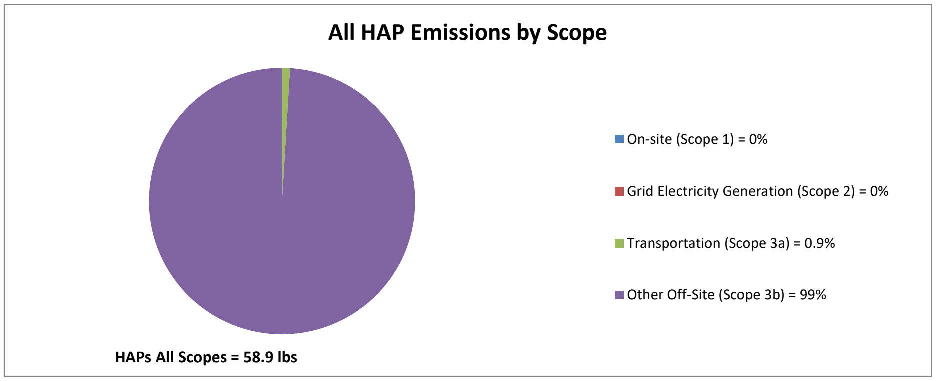
Debris and Soil Excavations = 75.3%
In-Situ Stabilization = 17.6%
Long-Term Groundwater Sampling = 7.1%

On-site (Scope 1) = 4.1%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 1.5%
Other Off-Site (Scope 3b) = 94.4%

PM All Components = 130.3 lbs
PM All Scopes = 130.3 lbs







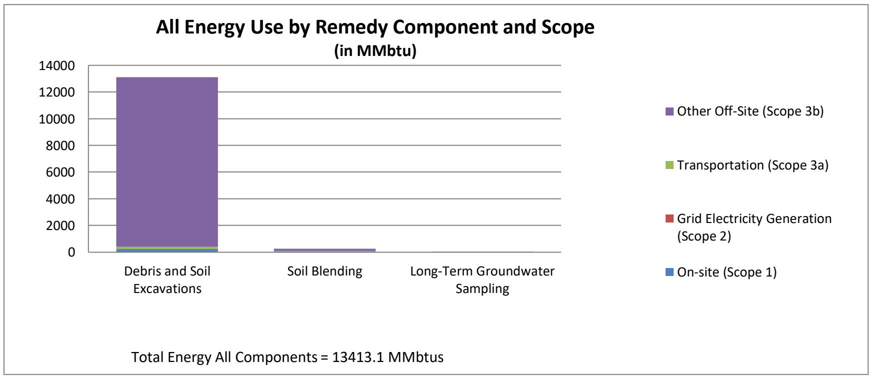
HAPs
lbs

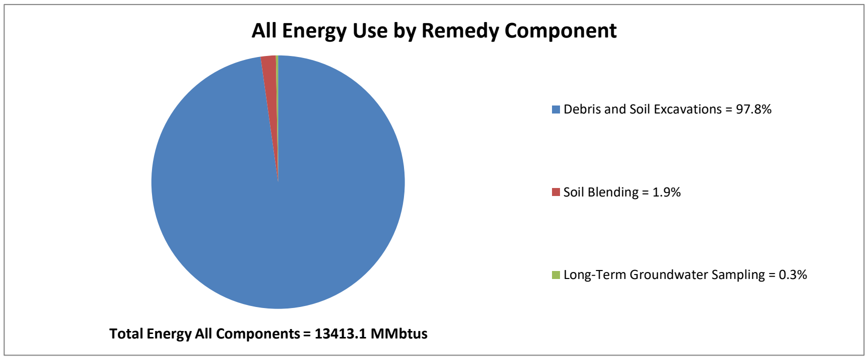
	Debris and Soil Excavations	In-Situ Stabilization	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	0.0	0.0	0.0	0.0
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	0.0	0.1	0.4	0.6
Other Off-Site (Scope 3b)	40.1	12.1	6.2	58.4
Total	40.2	12.2	6.6	58.9

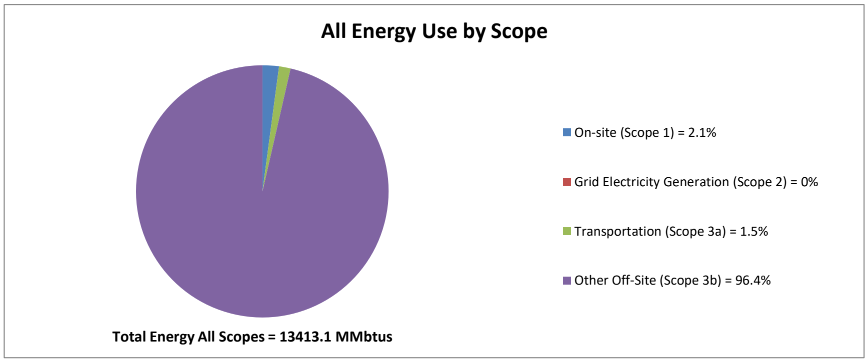
Debris and Soil Excavations = 68.1%
In-Situ Stabilization = 20.7%
Long-Term Groundwater Sampling = 11.2%

On-site (Scope 1) = 0%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 0.9%
Other Off-Site (Scope 3b) = 99%

HAPs All Components = 58.9 lbs
HAPs All Scopes = 58.9 lbs





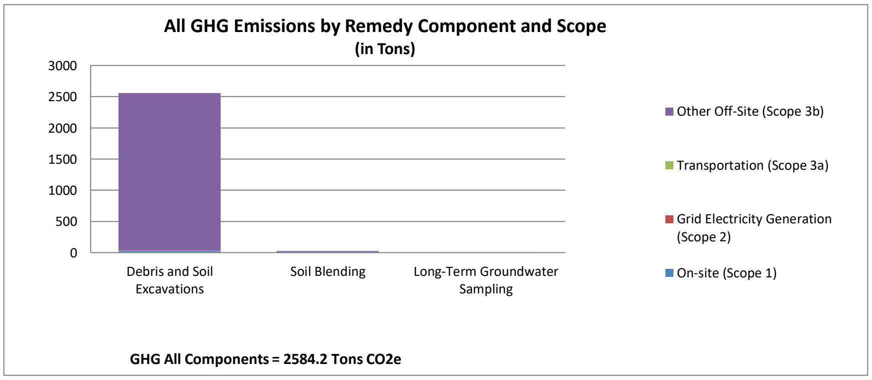


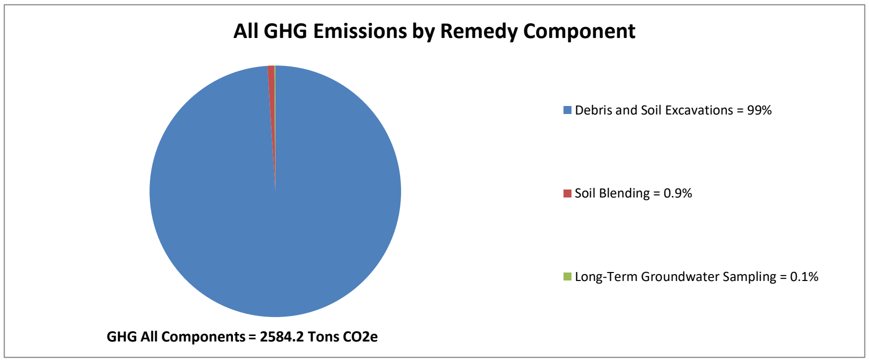
	Total Energy MMbtus			
	Debris and Soil Excavations	Soil Blending	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	229.4	55.5	0.0	284.8
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	156.9	25.8	16.6	199.4
Other Off-Site (Scope 3b)	12,729.7	176.5	22.7	12,928.9
Total	13,116.0	257.8	39.3	13,413.1

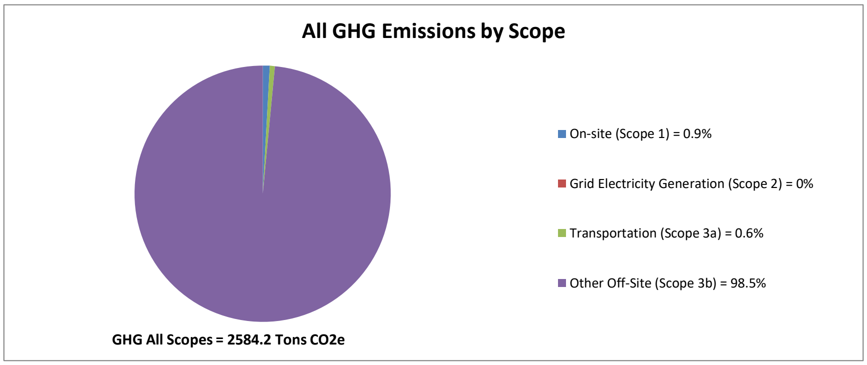
Debris and Soil Excavations = 97.8%
Soil Blending = 1.9%
Long-Term Groundwater Sampling = 0.3%

On-site (Scope 1) = 2.1%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 1.5%
Other Off-Site (Scope 3b) = 96.4%

Total Energy All Components = 13413.1 MMbtus
Total Energy All Scopes = 13413.1 MMbtus





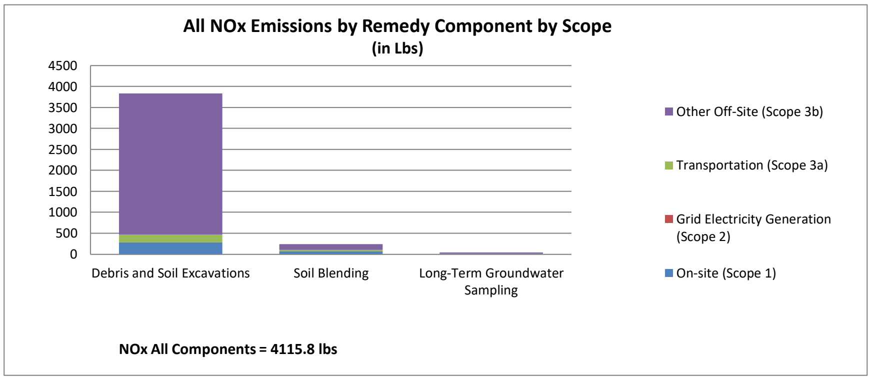


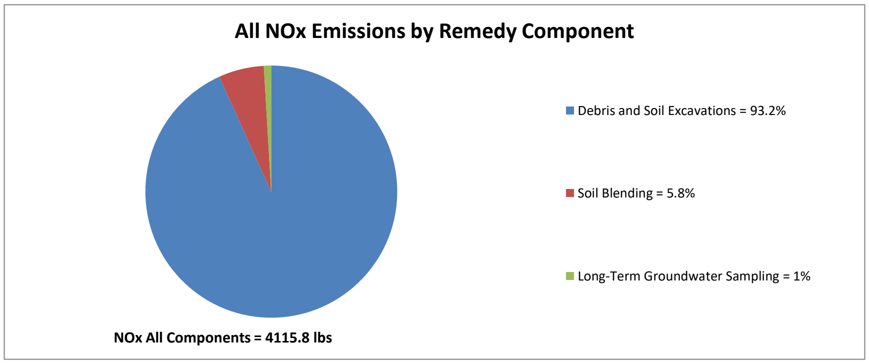
	GHG Tons CO2e			
	Debris and Soil Excavations	Soil Blending	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	18.6	4.5	0.0	23.1
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	12.7	2.1	1.3	16.1
Other Off-Site (Scope 3b)	2,526.6	17.1	1.3	2,545.0
Total	2,557.9	23.6	2.7	2,584.2

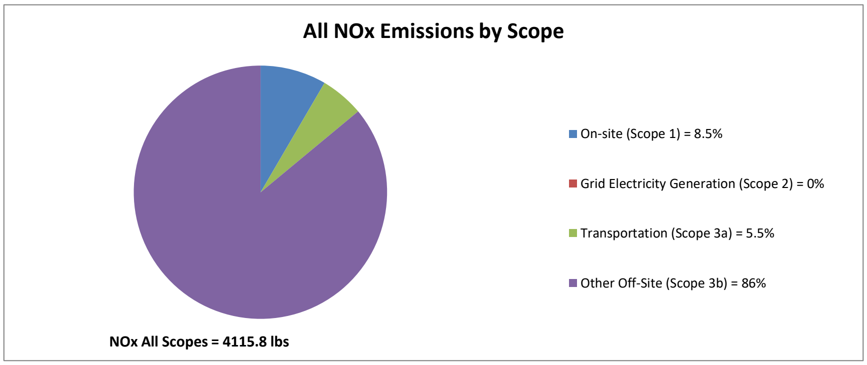
Debris and Soil Excavations = 99%
Soil Blending = 0.9%
Long-Term Groundwater Sampling = 0.1%

On-site (Scope 1) = 0.9%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 0.6%
Other Off-Site (Scope 3b) = 98.5%

GHG All Components = 2584.2 Tons CO2e
GHG All Scopes = 2584.2 Tons CO2e







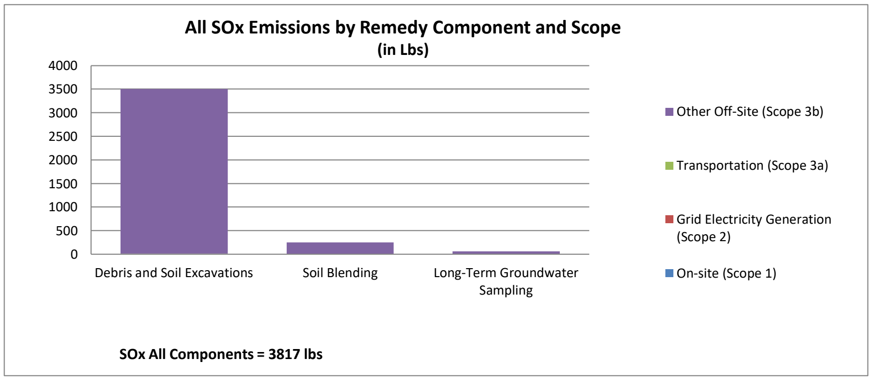
NOx
lbs

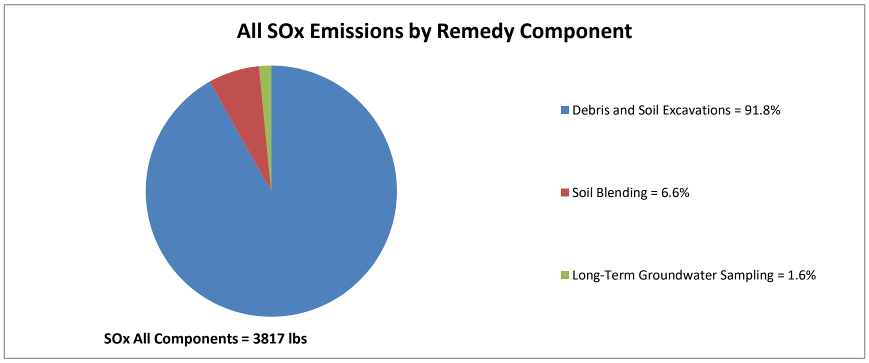
	Debris and Soil Excavations	Soil Blending	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	280.5	67.8	0.0	348.3
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	186.5	29.1	12.4	227.9
Other Off-Site (Scope 3b)	3,369.7	142.4	27.4	3,539.5
Total	3,836.7	239.3	39.7	4,115.8

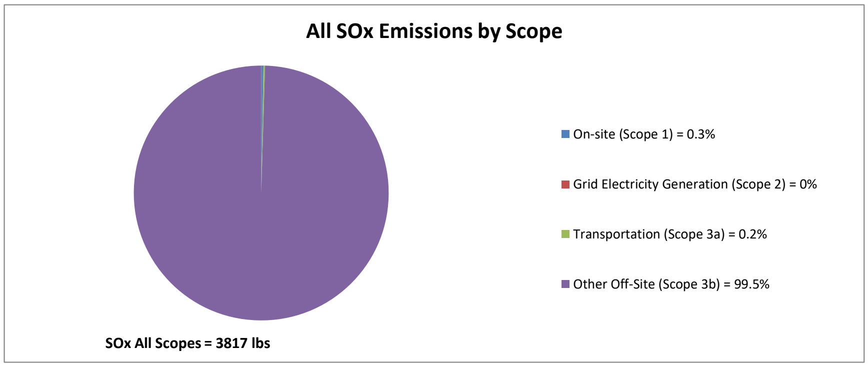
Debris and Soil Excavations = 93.2%
Soil Blending = 5.8%
Long-Term Groundwater Sampling = 1%

On-site (Scope 1) = 8.5%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 5.5%
Other Off-Site (Scope 3b) = 86%

NOx All Components = 4115.8 lbs
NOx All Scopes = 4115.8 lbs







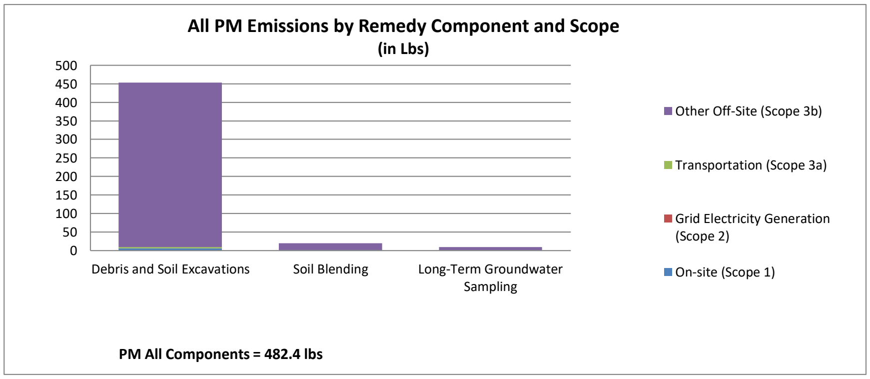
SOx
lbs

	Debris and Soil Excavations	Soil Blending	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	8.9	2.2	0.0	11.1
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	5.9	0.9	0.4	7.1
Other Off-Site (Scope 3b)	3,491.0	249.0	58.9	3,798.8
Total	3,505.8	252.0	59.2	3,817.0

Debris and Soil Excavations = 91.8%
Soil Blending = 6.6%
Long-Term Groundwater Sampling = 1.6%

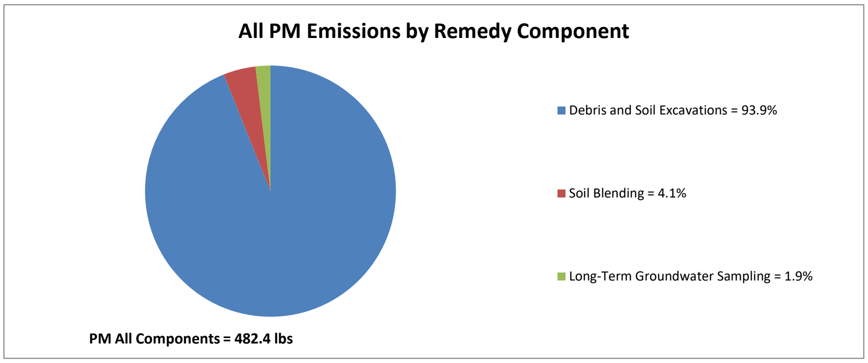
On-site (Scope 1) = 0.3%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 0.2%
Other Off-Site (Scope 3b) = 99.5%

SOx All Components = 3817 lbs
SOx All Scopes = 3817 lbs



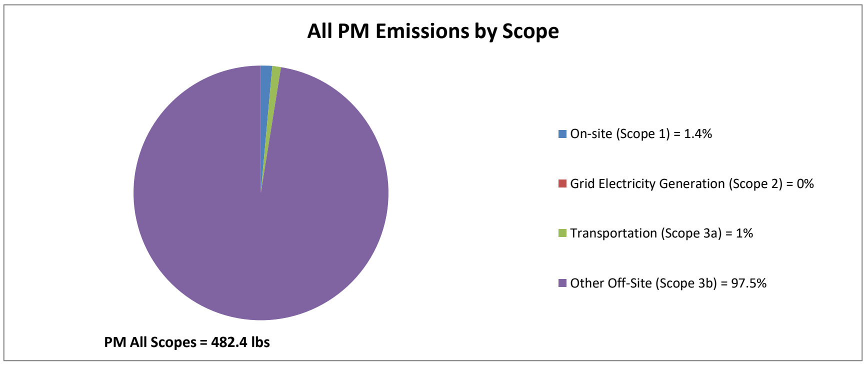
All PM Emissions by Remedy Component and Scope
(in Lbs)

PM All Components = 482.4 lbs



All PM Emissions by Remedy Component

PM All Components = 482.4 lbs



All PM Emissions by Scope

PM All Scopes = 482.4 lbs

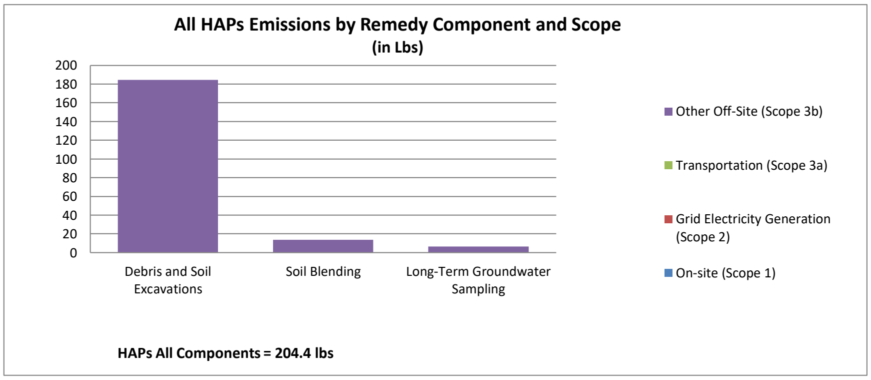
PM
lbs

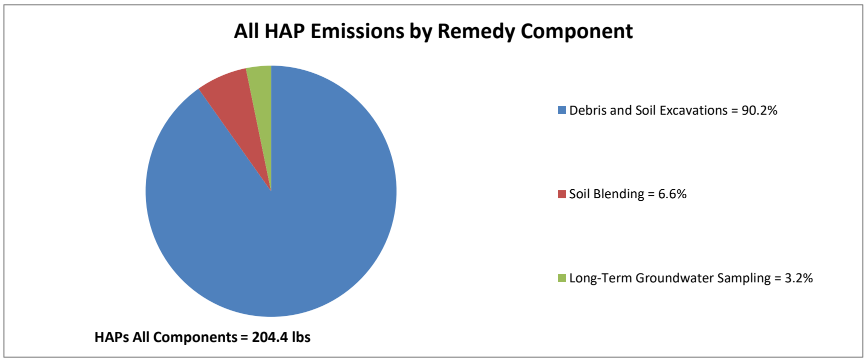
	Debris and Soil Excavations	Soil Blending	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	5.6	1.4	0.0	7.0
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	4.0	0.7	0.4	5.1
Other Off-Site (Scope 3b)	443.5	17.9	8.9	470.3
Total	453.1	19.9	9.3	482.4

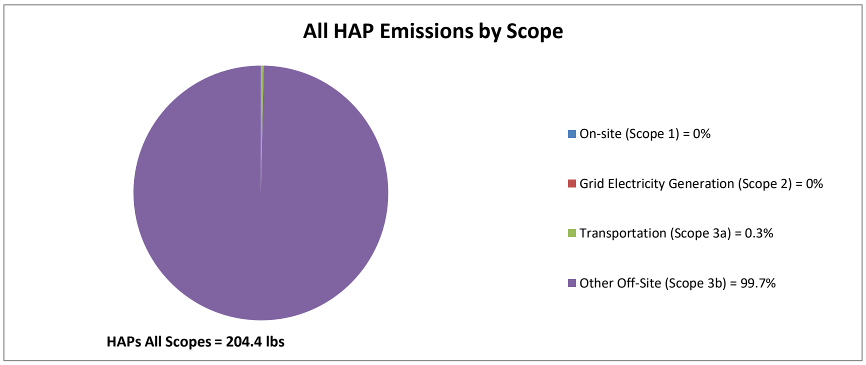
Debris and Soil Excavations = 93.9%
Soil Blending = 4.1%
Long-Term Groundwater Sampling = 1.9%

On-site (Scope 1) = 1.4%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 1%
Other Off-Site (Scope 3b) = 97.5%

PM All Components = 482.4 lbs
PM All Scopes = 482.4 lbs







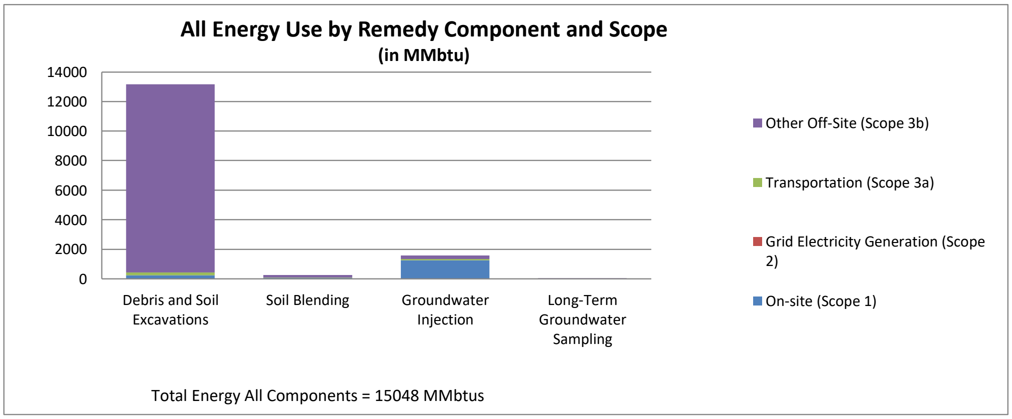
HAPs
lbs

	Debris and Soil Excavations	Soil Blending	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	0.0	0.0	0.0	0.0
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	0.2	0.1	0.4	0.7
Other Off-Site (Scope 3b)	184.1	13.4	6.2	203.7
Total	184.3	13.5	6.6	204.4

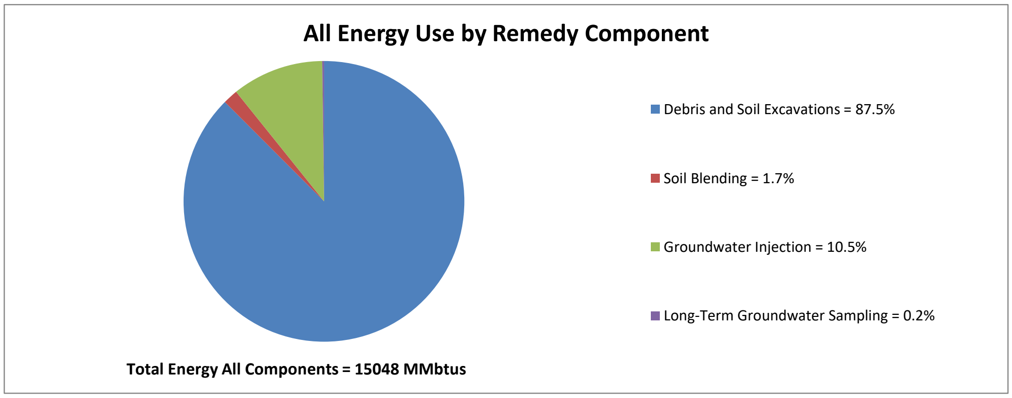
Debris and Soil Excavations = 90.2%
Soil Blending = 6.6%
Long-Term Groundwater Sampling = 3.2%

On-site (Scope 1) = 0%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 0.3%
Other Off-Site (Scope 3b) = 99.7%

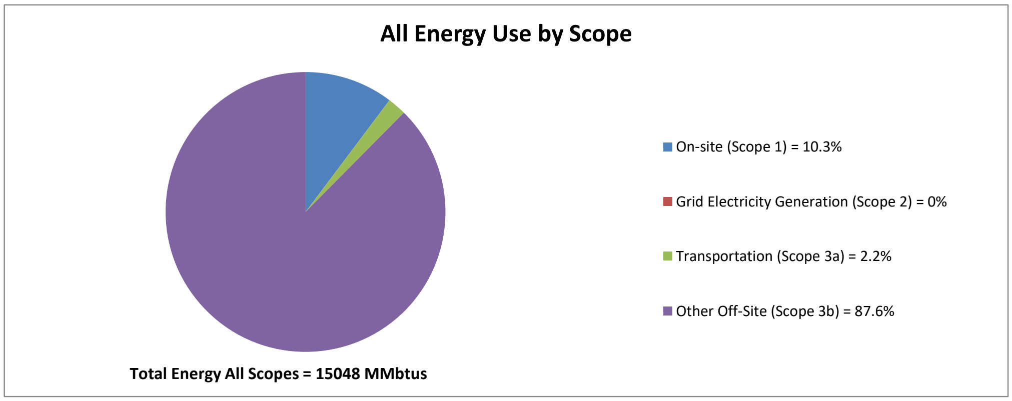
HAPs All Components = 204.4 lbs
HAPs All Scopes = 204.4 lbs



Total Energy All Components = 15048 MMbtus



Total Energy All Components = 15048 MMbtus



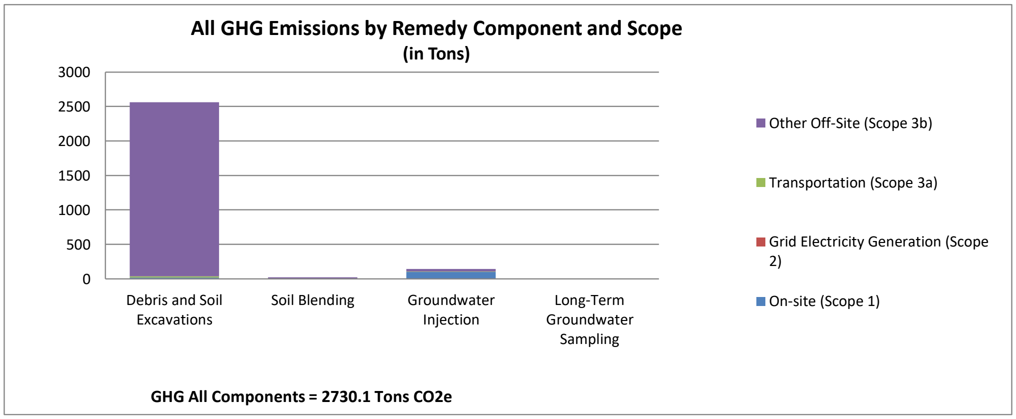
Total Energy All Scopes = 15048 MMbtus

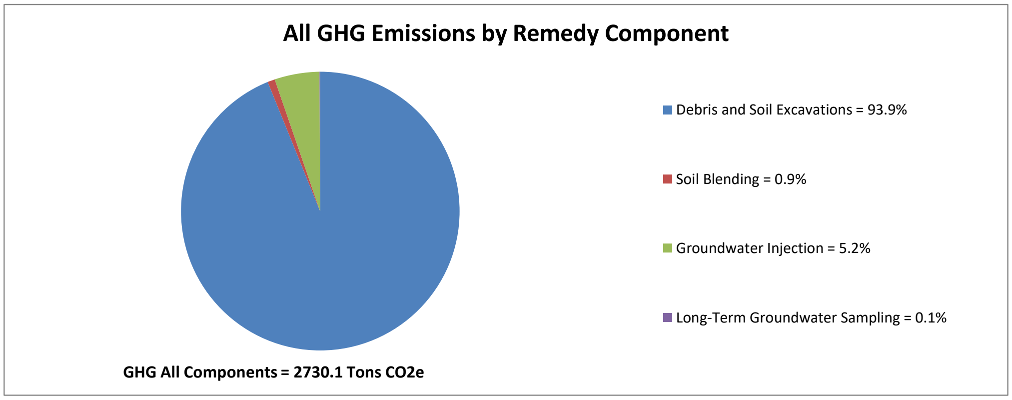
	Total Energy MMbtus				
	Debris and Soil Excavations	Soil Blending	Groundwater Injection	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	229.4	55.5	1,257.7	0.0	1,542.5
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	205.6	25.8	78.7	15.1	325.2
Other Off-Site (Scope 3b)	12,735.5	176.5	249.6	18.6	13,180.3
Total	13,170.4	257.8	1,586.0	33.8	15,048.0

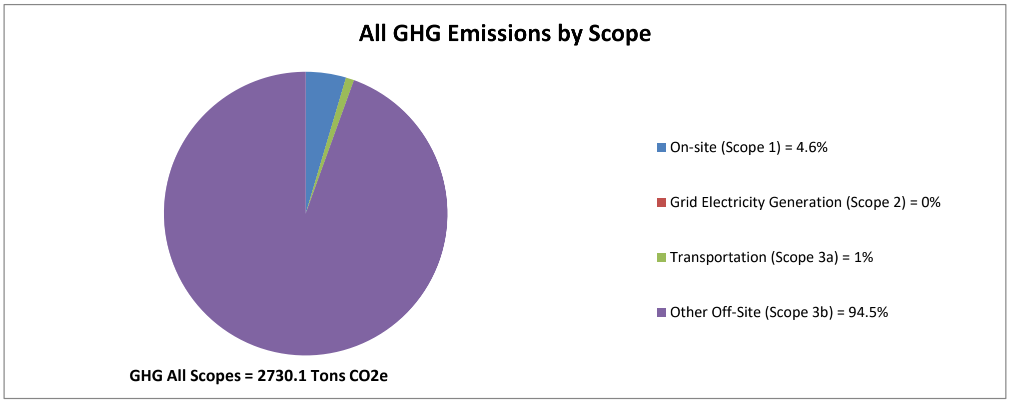
Debris and Soil Excavations = 87.5%
Soil Blending = 1.7%
Groundwater Injection = 10.5%
Long-Term Groundwater Sampling = 0.2%

Total Energy All Components = 15048 MMbtus
Total Energy All Scopes = 15048 MMbtus

On-site (Scope 1) = 10.3%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 2.2%
Other Off-Site (Scope 3b) = 87.6%





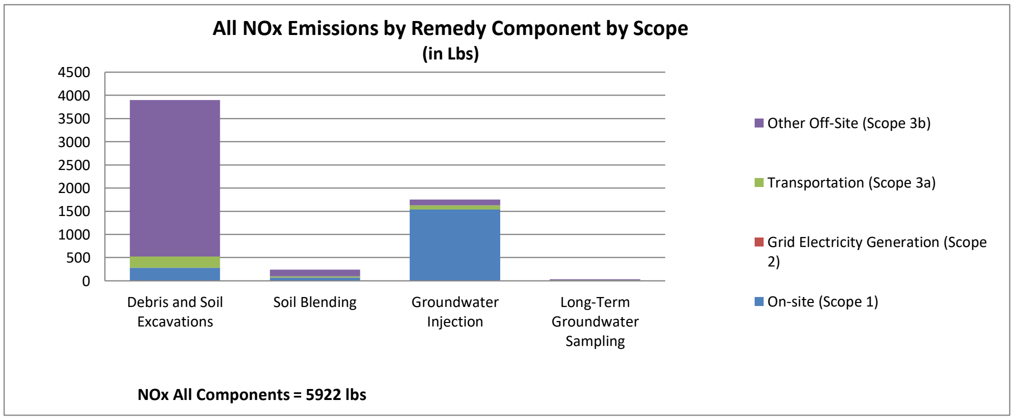


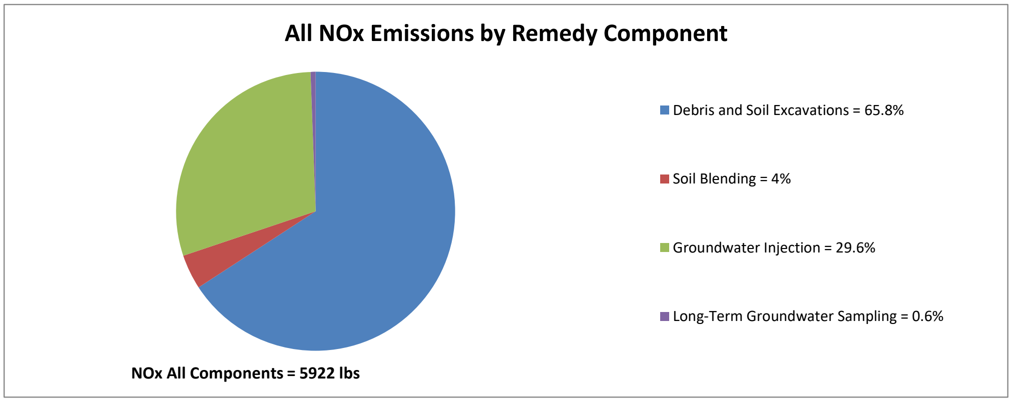
	GHG Tons CO2e				
	Debris and Soil Excavations	Soil Blending	Groundwater Injection	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	18.6	4.5	101.8	0.0	124.8
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	16.6	2.1	6.4	1.2	26.3
Other Off-Site (Scope 3b)	2,527.2	17.1	33.6	1.1	2,578.9
Total	2,562.4	23.6	141.8	2.3	2,730.1

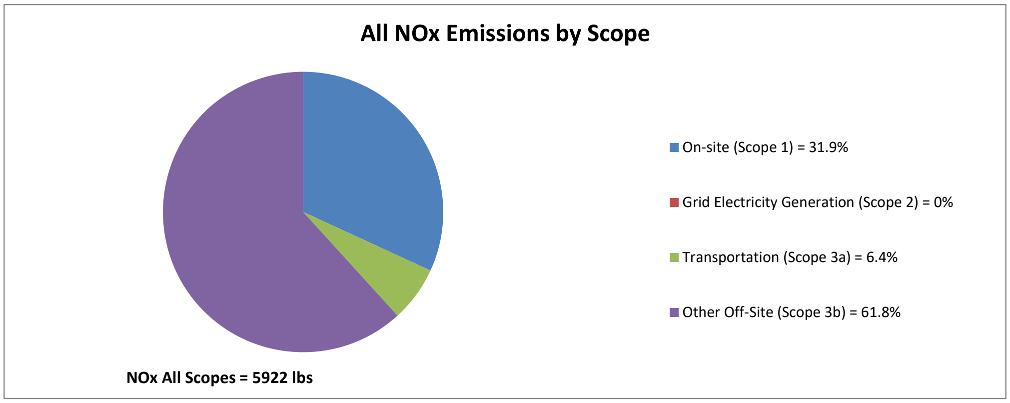
Debris and Soil Excavations = 93.9%
Soil Blending = 0.9%
Groundwater Injection = 5.2%
Long-Term Groundwater Sampling = 0.1%

GHG All Components = 2730.1 Tons CO2e
GHG All Scopes = 2730.1 Tons CO2e

On-site (Scope 1) = 4.6%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 1%
Other Off-Site (Scope 3b) = 94.5%







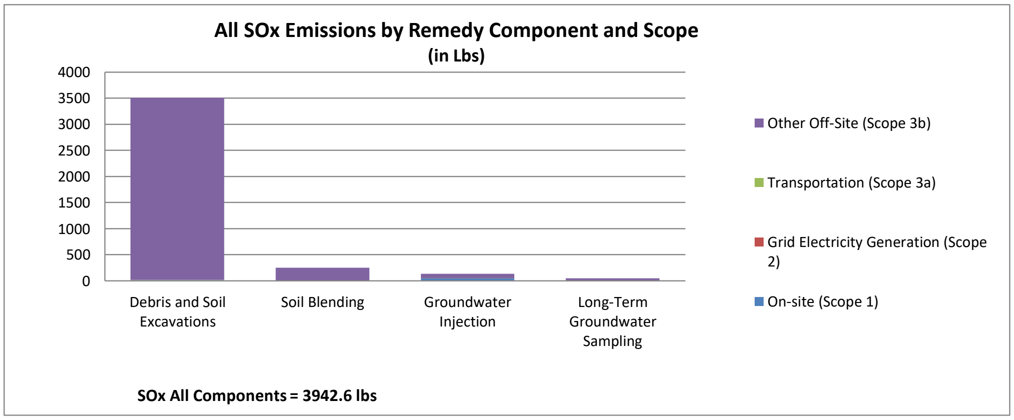
NOx
lbs

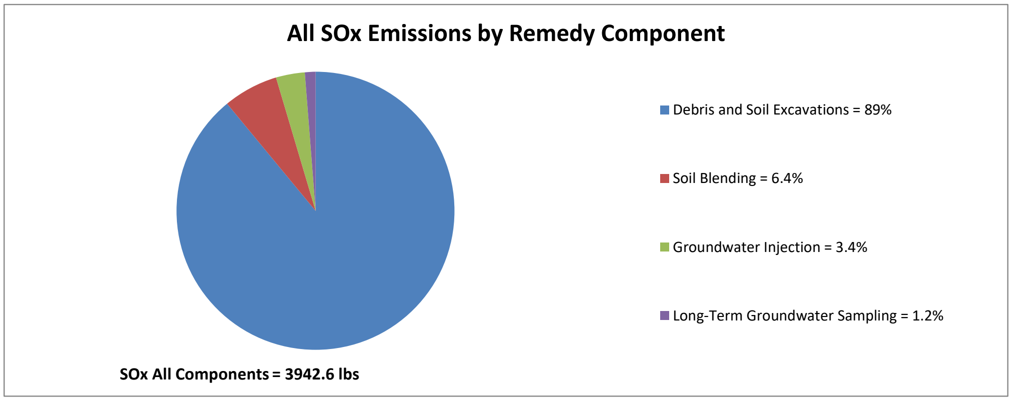
	Debris and Soil Excavations	Soil Blending	Groundwater Injection	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	280.5	67.8	1,538.2	0.0	1,886.5
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	246.0	29.1	90.0	12.0	377.1
Other Off-Site (Scope 3b)	3,371.4	142.4	122.3	22.3	3,658.4
Total	3,897.9	239.3	1,750.5	34.3	5,922.0

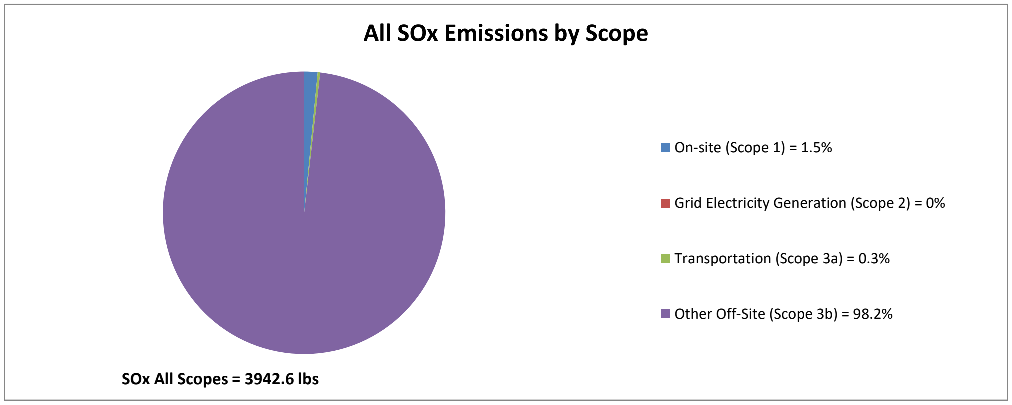
Debris and Soil Excavations = 65.8%
Soil Blending = 4%
Groundwater Injection = 29.6%
Long-Term Groundwater Sampling = 0.6%

On-site (Scope 1) = 31.9%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 6.4%
Other Off-Site (Scope 3b) = 61.8%

NOx All Components = 5922 lbs
NOx All Scopes = 5922 lbs







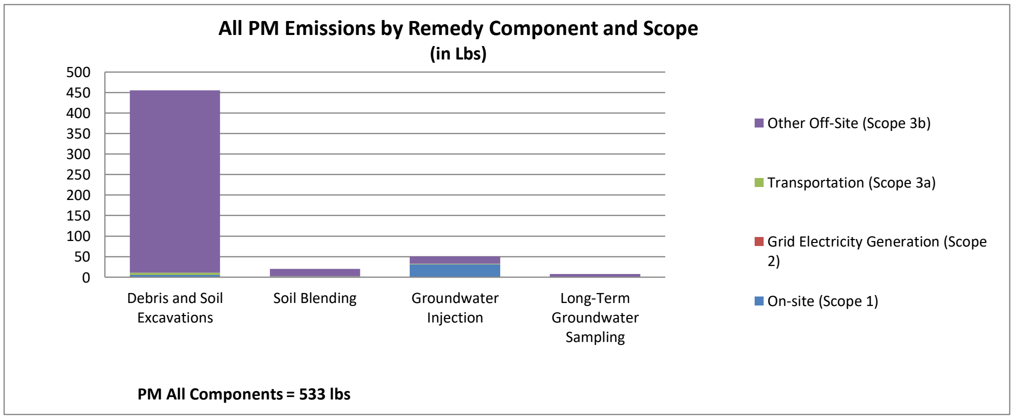
SOx
lbs

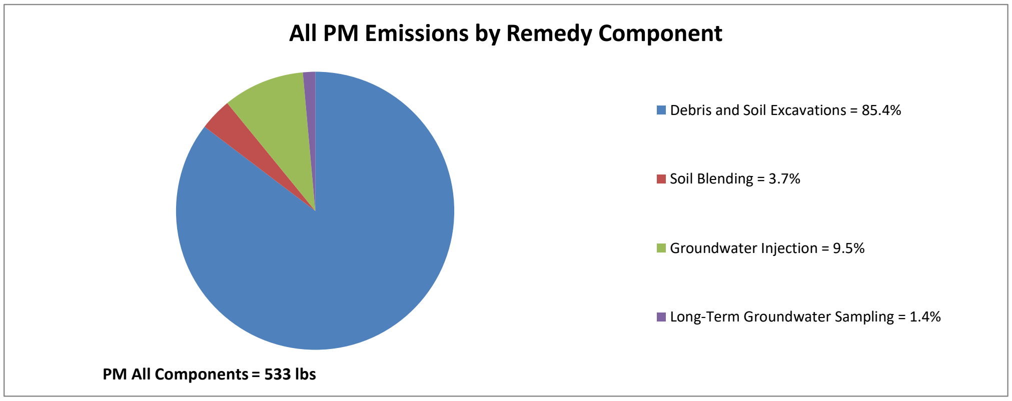
	Debris and Soil Excavations	Soil Blending	Groundwater Injection	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	8.9	2.2	48.9	0.0	59.9
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	7.7	0.9	2.8	0.4	11.8
Other Off-Site (Scope 3b)	3,493.1	249.0	80.9	47.9	3,870.9
Total	3,509.8	252.0	132.6	48.3	3,942.6

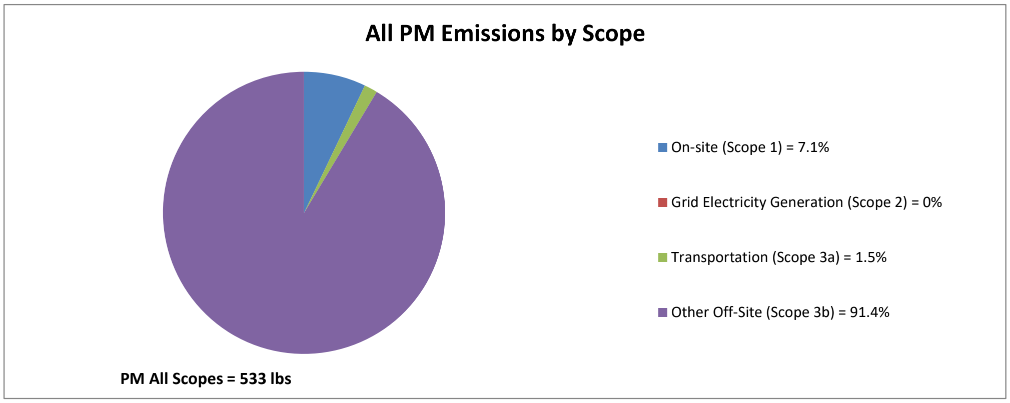
Debris and Soil Excavations = 89%
Soil Blending = 6.4%
Groundwater Injection = 3.4%
Long-Term Groundwater Sampling = 1.2%

SOx All Components = 3942.6 lbs
SOx All Scopes = 3942.6 lbs

On-site (Scope 1) = 1.5%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 0.3%
Other Off-Site (Scope 3b) = 98.2%







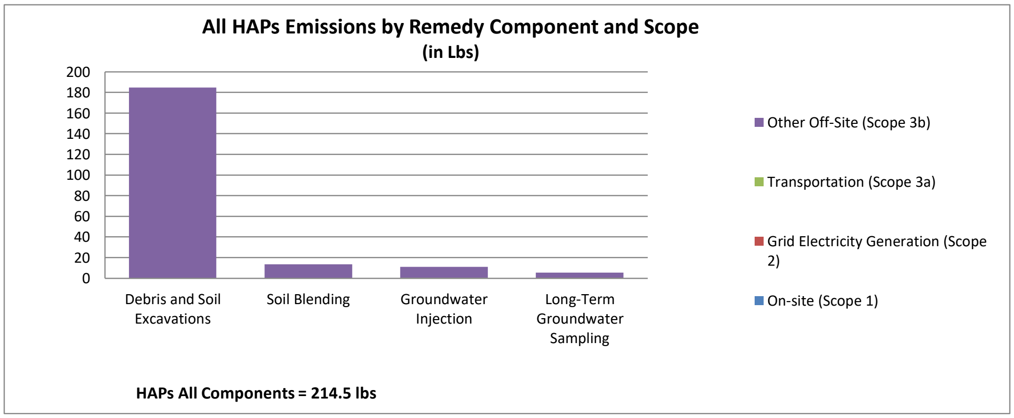
PM
lbs

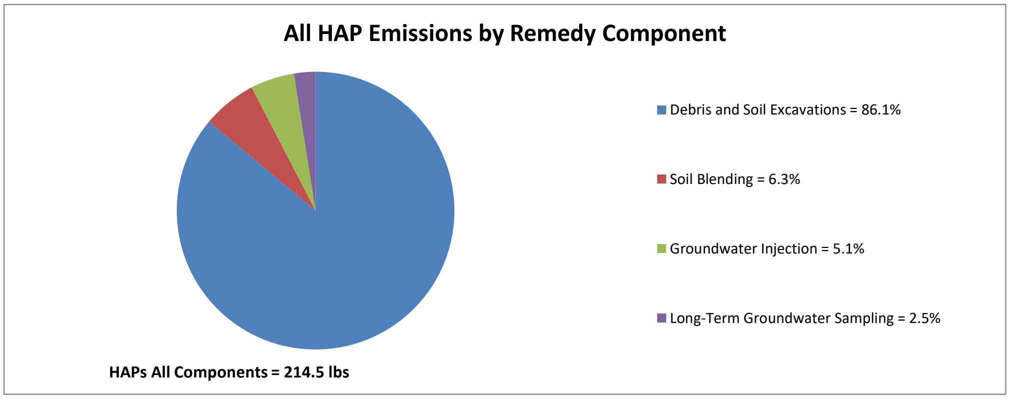
	Debris and Soil Excavations	Soil Blending	Groundwater Injection	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	5.6	1.4	30.8	0.0	37.7
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	5.2	0.7	1.9	0.4	8.1
Other Off-Site (Scope 3b)	444.2	17.9	17.8	7.2	487.1
Total	455.0	19.9	50.4	7.6	533.0

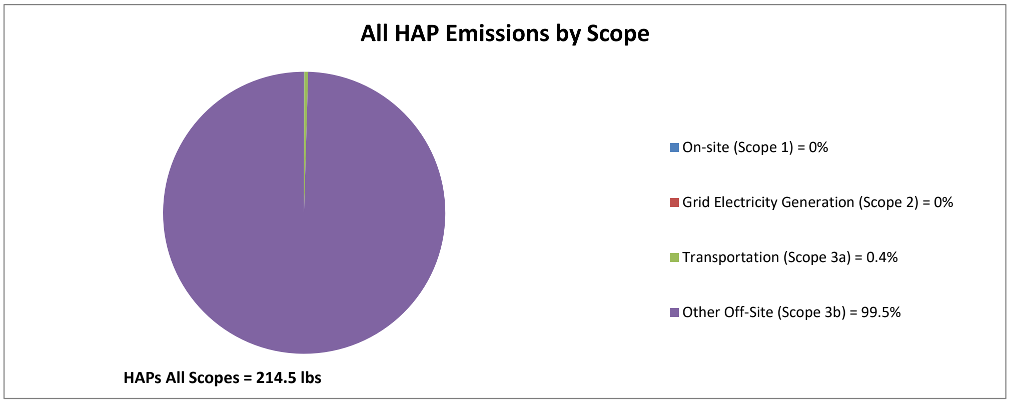
Debris and Soil Excavations = 85.4%
Soil Blending = 3.7%
Groundwater Injection = 9.5%
Long-Term Groundwater Sampling = 1.4%

On-site (Scope 1) = 7.1%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 1.5%
Other Off-Site (Scope 3b) = 91.4%

PM All Components = 533 lbs
PM All Scopes = 533 lbs





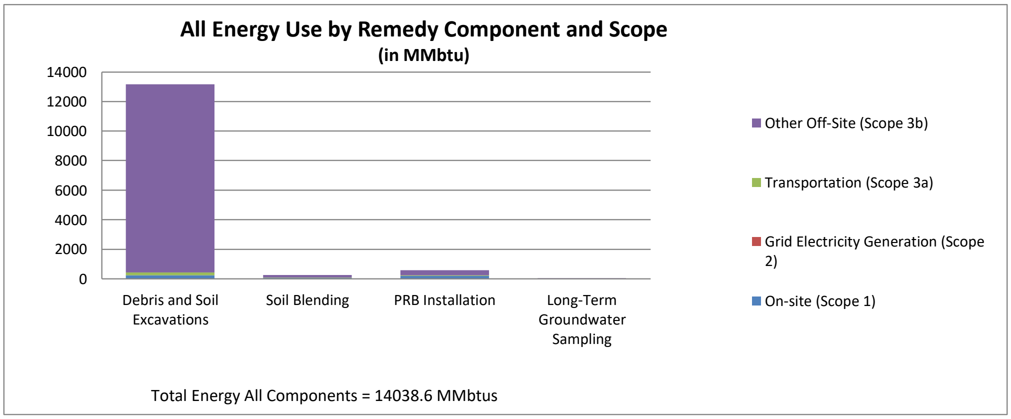


			HAPs lbs		
	Debris and Soil Excavations	Soil Blending	Groundwater Injection	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	0.0	0.0	0.0	0.0	0.1
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	0.2	0.1	0.3	0.3	0.9
Other Off-Site (Scope 3b)	184.5	13.4	10.6	5.0	213.5
Total	184.7	13.5	11.0	5.4	214.5

Debris and Soil Excavations = 86.1%
Soil Blending = 6.3%
Groundwater Injection = 5.1%
Long-Term Groundwater Sampling = 2.5%

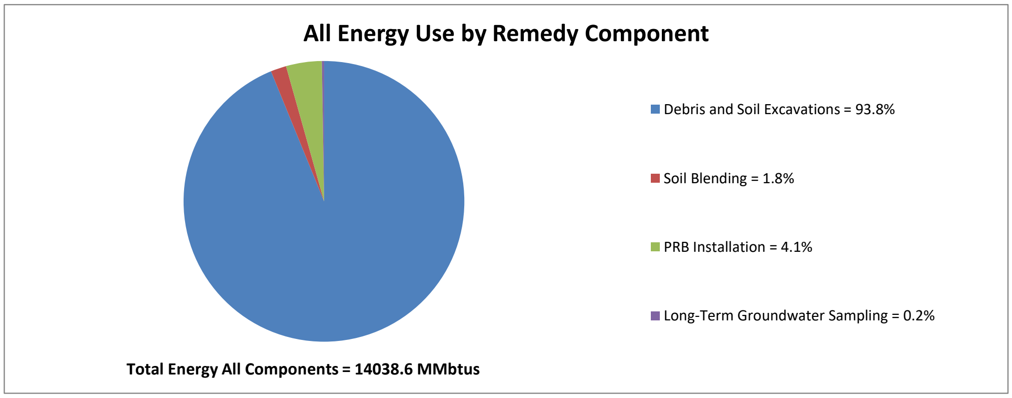
HAPs All Components = 214.5 lbs
HAPs All Scopes = 214.5 lbs

On-site (Scope 1) = 0%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 0.4%
Other Off-Site (Scope 3b) = 99.5%



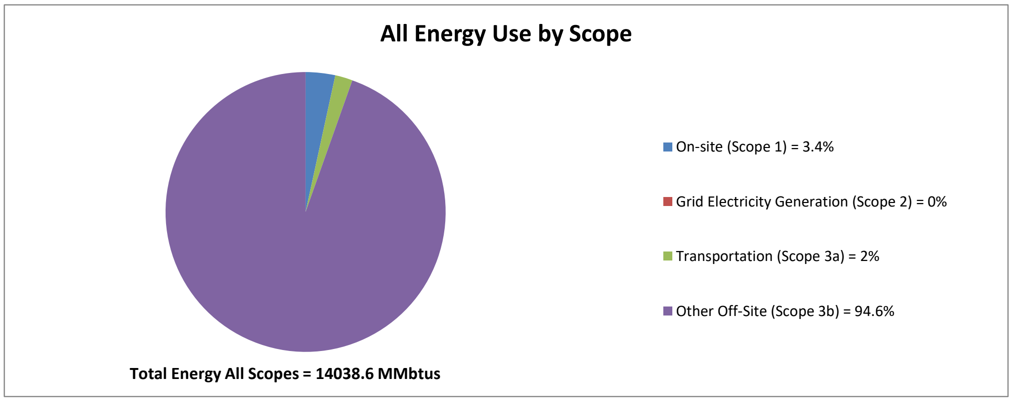
All Energy Use by Remedy Component and Scope
(in MMbtu)

Total Energy All Components = 14038.6 MMbtus



All Energy Use by Remedy Component

Total Energy All Components = 14038.6 MMbtus



All Energy Use by Scope

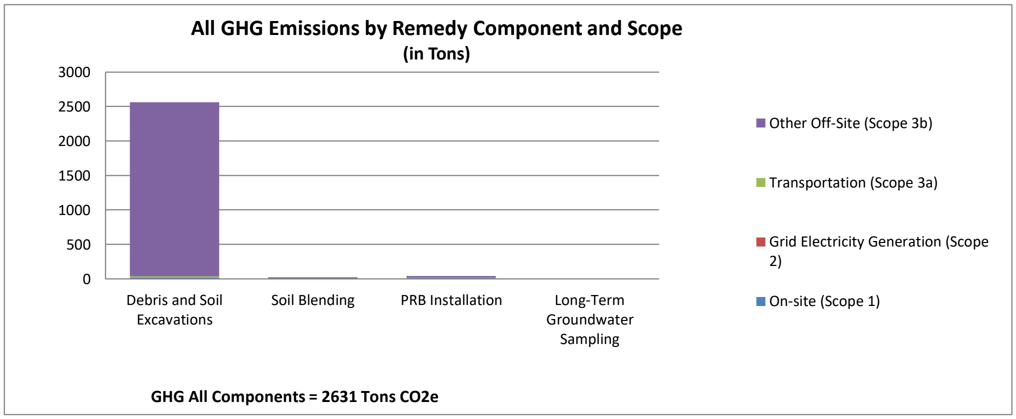
Total Energy All Scopes = 14038.6 MMbtus

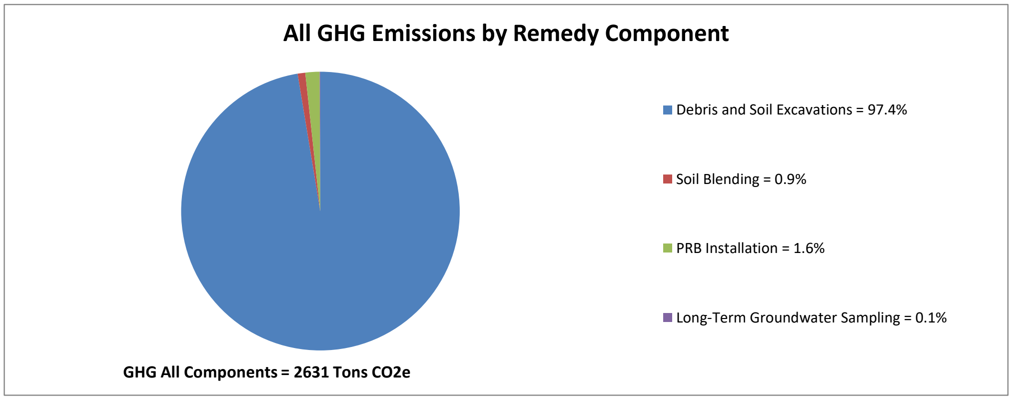
			Total Energy MMbtus		
	Debris and Soil Excavations	Soil Blending	PRB Installation	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	229.4	55.5	195.3	0.0	480.1
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	205.6	25.8	36.8	15.1	283.3
Other Off-Site (Scope 3b)	12,735.5	176.5	344.5	18.6	13,275.2
Total	13,170.4	257.8	576.6	33.8	14,038.6

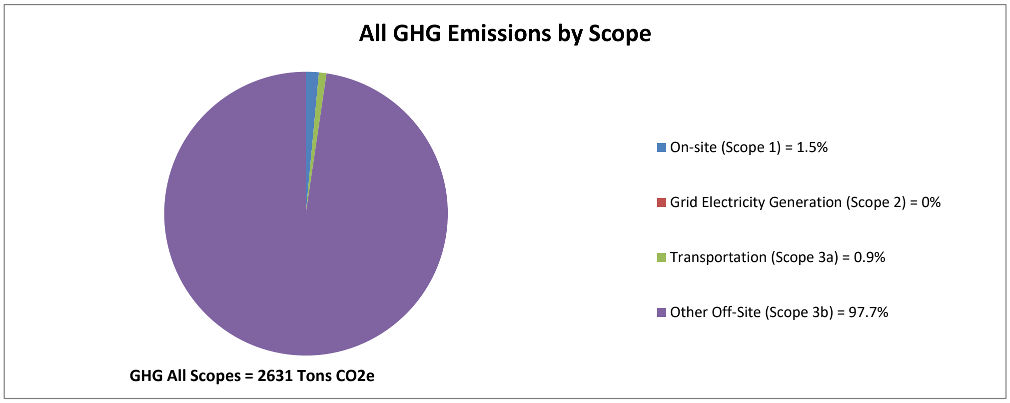
Debris and Soil Excavations = 93.8%
Soil Blending = 1.8%
PRB Installation = 4.1%
Long-Term Groundwater Sampling = 0.2%

On-site (Scope 1) = 3.4%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 2%
Other Off-Site (Scope 3b) = 94.6%

Total Energy All Components = 14038.6 MMbtus
Total Energy All Scopes = 14038.6 MMbtus





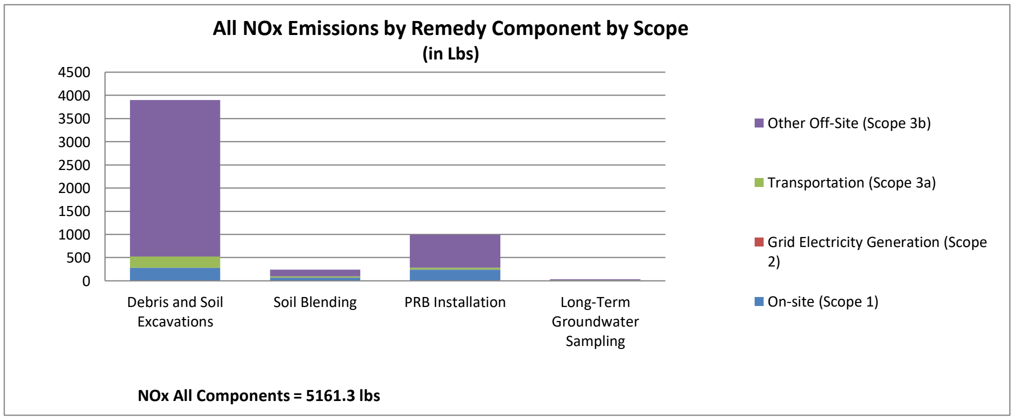


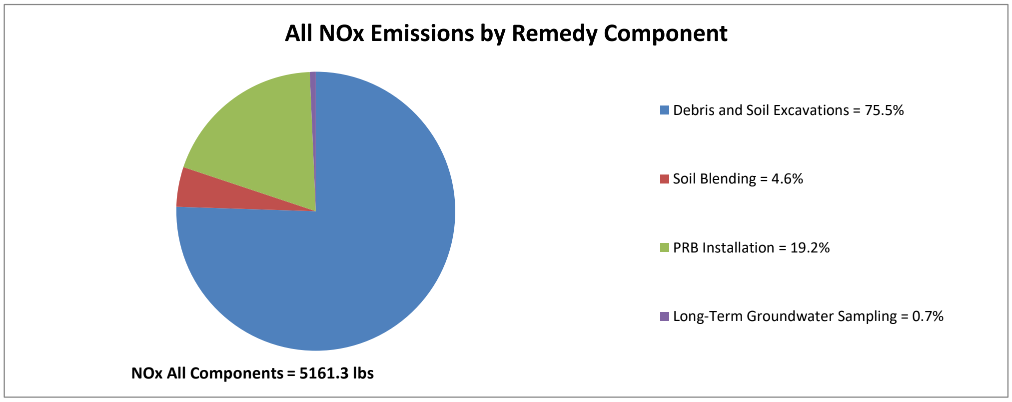
	GHG Tons CO2e				
	Debris and Soil Excavations	Soil Blending	PRB Installation	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	18.6	4.5	15.8	0.0	38.9
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	16.6	2.1	3.0	1.2	22.9
Other Off-Site (Scope 3b)	2,527.2	17.1	23.9	1.1	2,569.2
Total	2,562.4	23.6	42.7	2.3	2,631.0

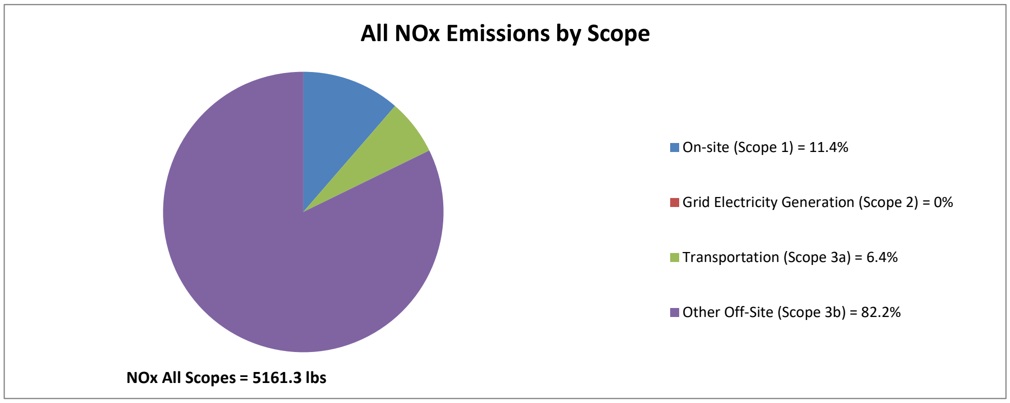
Debris and Soil Excavations = 97.4%
Soil Blending = 0.9%
PRB Installation = 1.6%
Long-Term Groundwater Sampling = 0.1%

GHG All Components = 2631 Tons CO2e
GHG All Scopes = 2631 Tons CO2e

On-site (Scope 1) = 1.5%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 0.9%
Other Off-Site (Scope 3b) = 97.7%







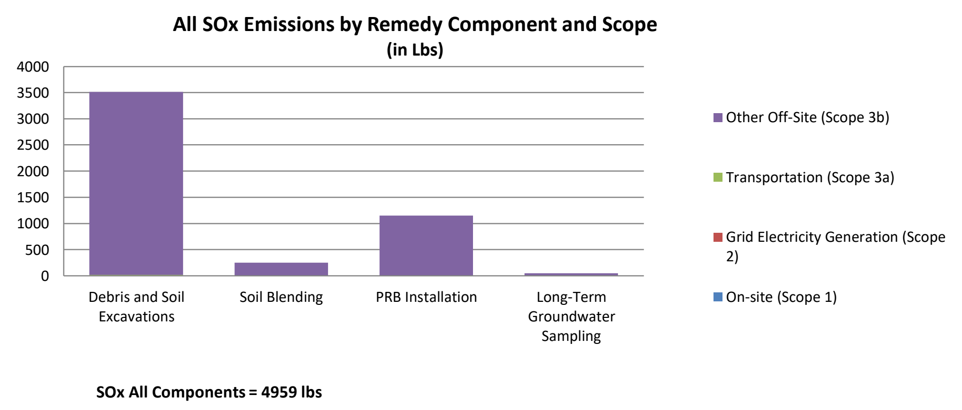
NOx
lbs

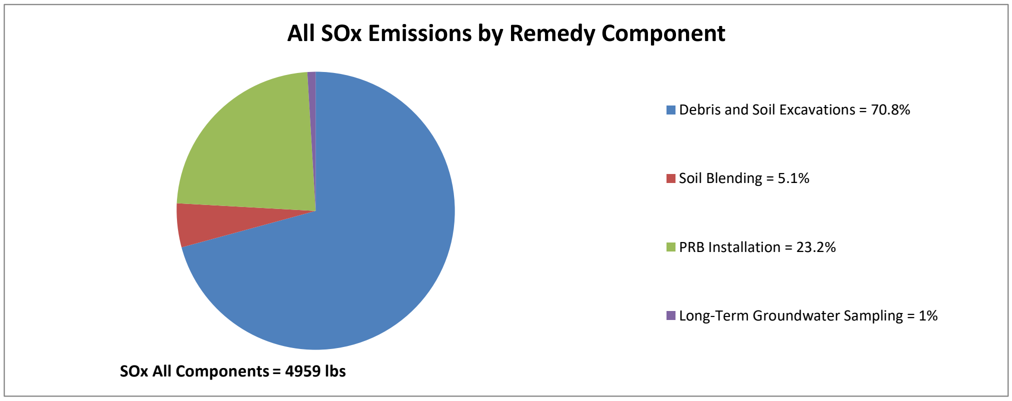
	Debris and Soil Excavations	Soil Blending	PRB Installation	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	280.5	67.8	238.9	0.0	587.2
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	246.0	29.1	42.5	12.0	329.6
Other Off-Site (Scope 3b)	3,371.4	142.4	708.3	22.3	4,244.5
Total	3,897.9	239.3	989.7	34.3	5,161.3

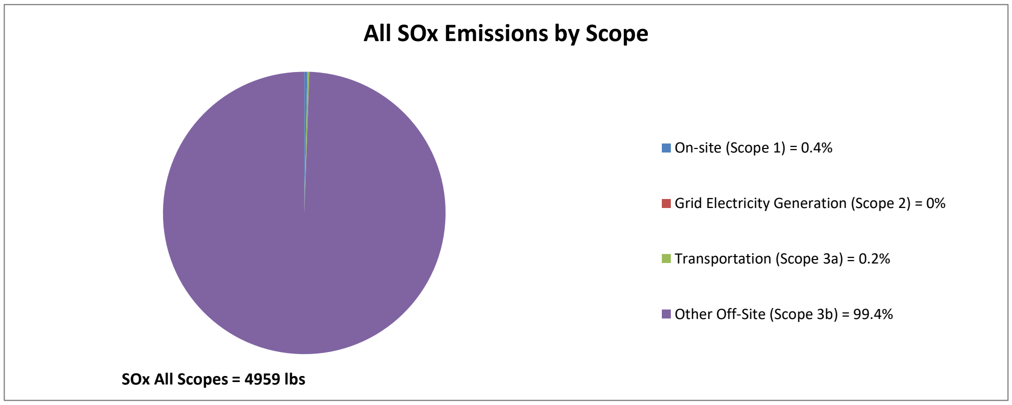
Debris and Soil Excavations = 75.5%
Soil Blending = 4.6%
PRB Installation = 19.2%
Long-Term Groundwater Sampling = 0.7%

On-site (Scope 1) = 11.4%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 6.4%
Other Off-Site (Scope 3b) = 82.2%

NOx All Components = 5161.3 lbs
NOx All Scopes = 5161.3 lbs







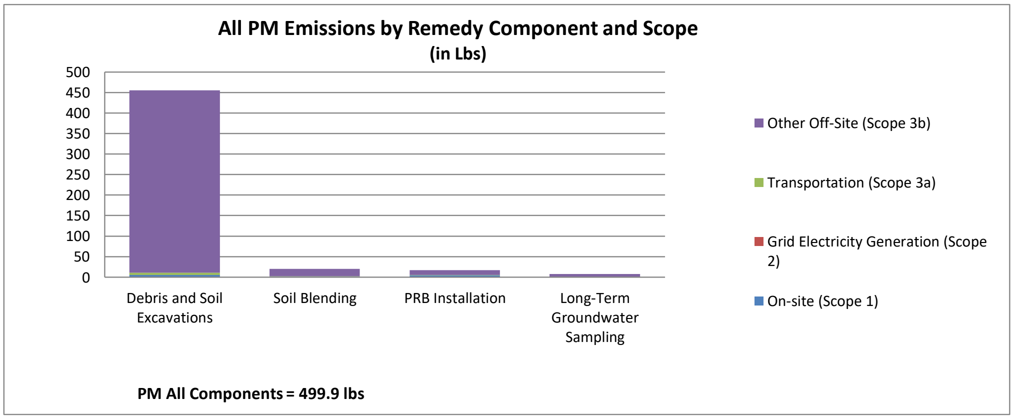
SOx
lbs

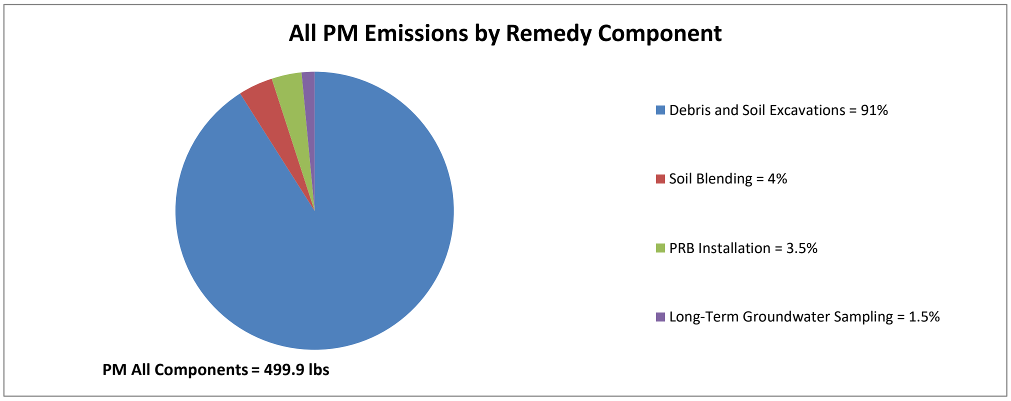
	Debris and Soil Excavations	Soil Blending	PRB Installation	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	8.9	2.2	7.6	0.0	18.7
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	7.7	0.9	1.3	0.4	10.3
Other Off-Site (Scope 3b)	3,493.1	249.0	1,140.0	47.9	4,930.0
Total	3,509.8	252.0	1,148.9	48.3	4,959.0

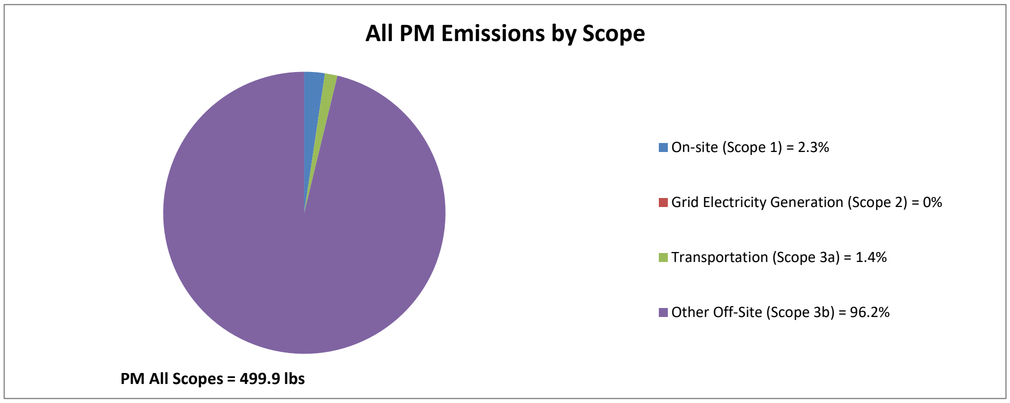
Debris and Soil Excavations = 70.8%
Soil Blending = 5.1%
PRB Installation = 23.2%
Long-Term Groundwater Sampling = 1%

On-site (Scope 1) = 0.4%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 0.2%
Other Off-Site (Scope 3b) = 99.4%

SOx All Components = 4959 lbs
SOx All Scopes = 4959 lbs







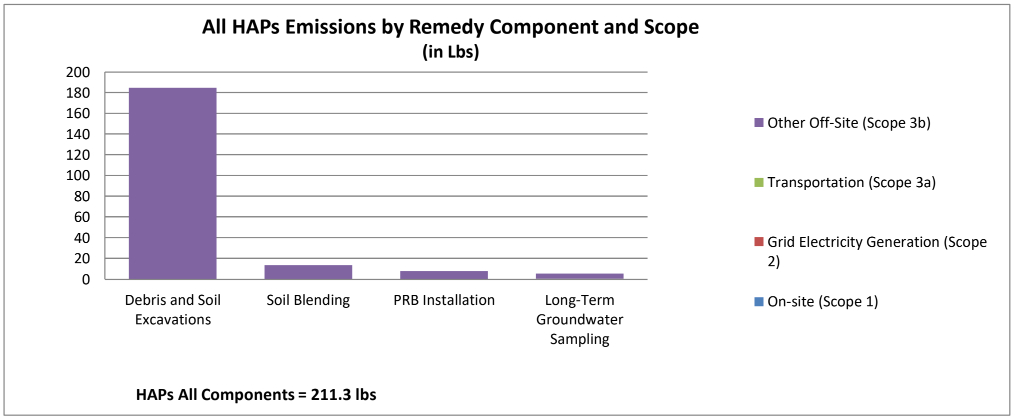
PM
lbs

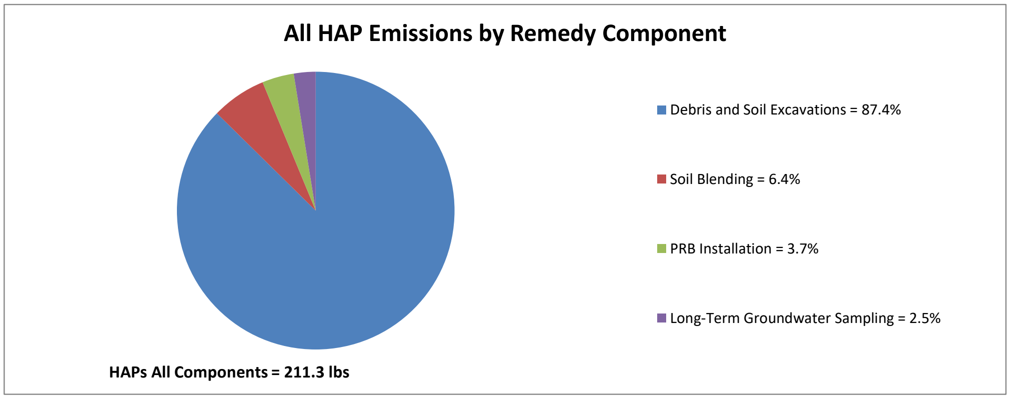
	Debris and Soil Excavations	Soil Blending	PRB Installation	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	5.6	1.4	4.8	0.0	11.7
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	5.2	0.7	0.9	0.4	7.1
Other Off-Site (Scope 3b)	444.2	17.9	11.7	7.2	481.1
Total	455.0	19.9	17.4	7.6	499.9

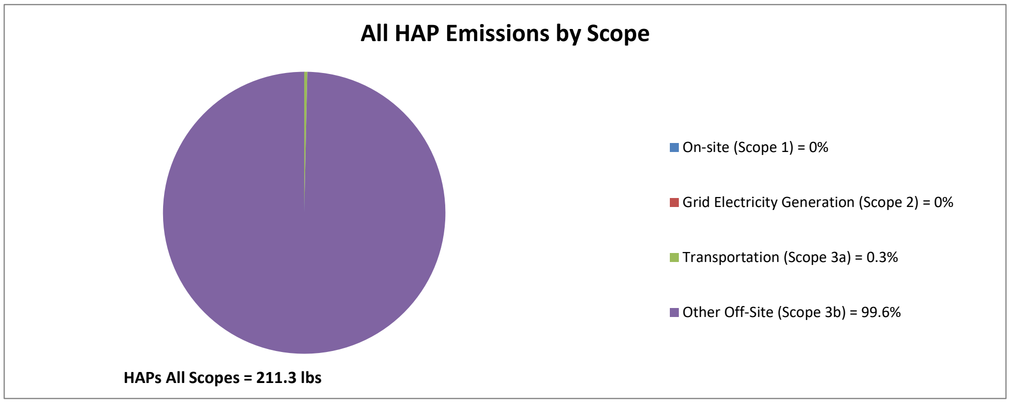
Debris and Soil Excavations = 91%
Soil Blending = 4%
PRB Installation = 3.5%
Long-Term Groundwater Sampling = 1.5%

PM All Components = 499.9 lbs
PM All Scopes = 499.9 lbs

On-site (Scope 1) = 2.3%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 1.4%
Other Off-Site (Scope 3b) = 96.2%







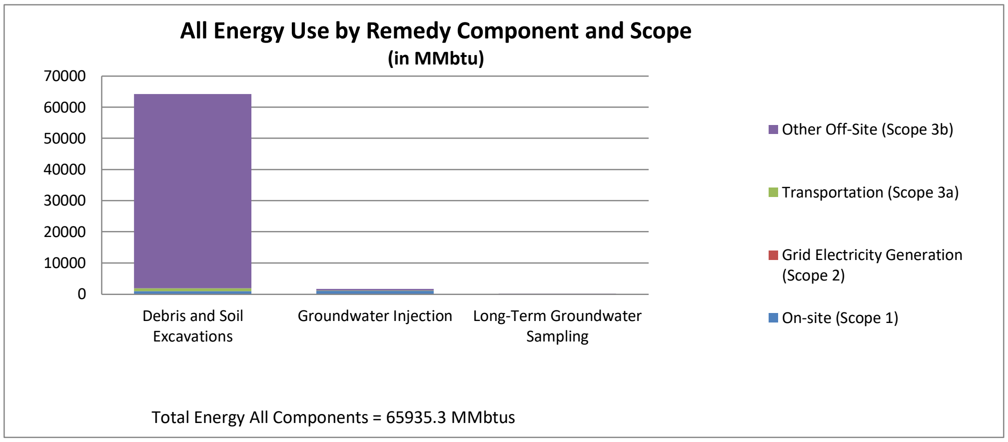
HAPs
lbs

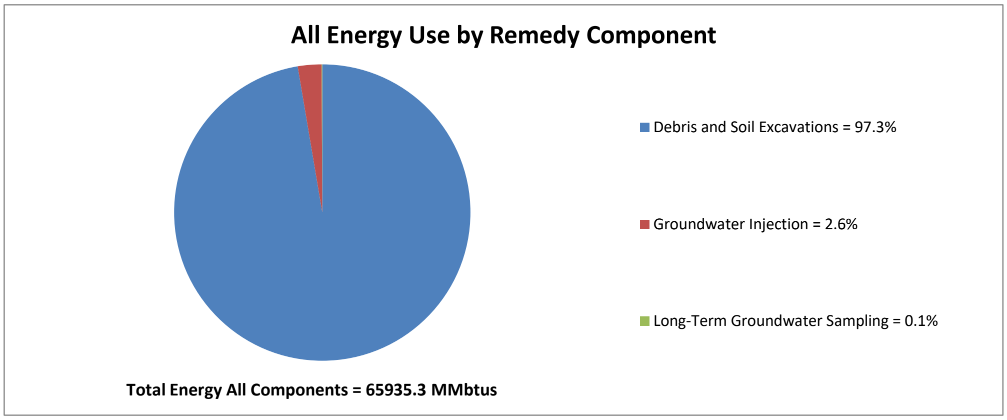
	Debris and Soil Excavations	Soil Blending	PRB Installation	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	0.0	0.0	0.0	0.0	0.0
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	0.2	0.1	0.1	0.3	0.7
Other Off-Site (Scope 3b)	184.5	13.4	7.7	5.0	210.6
Total	184.7	13.5	7.8	5.4	211.3

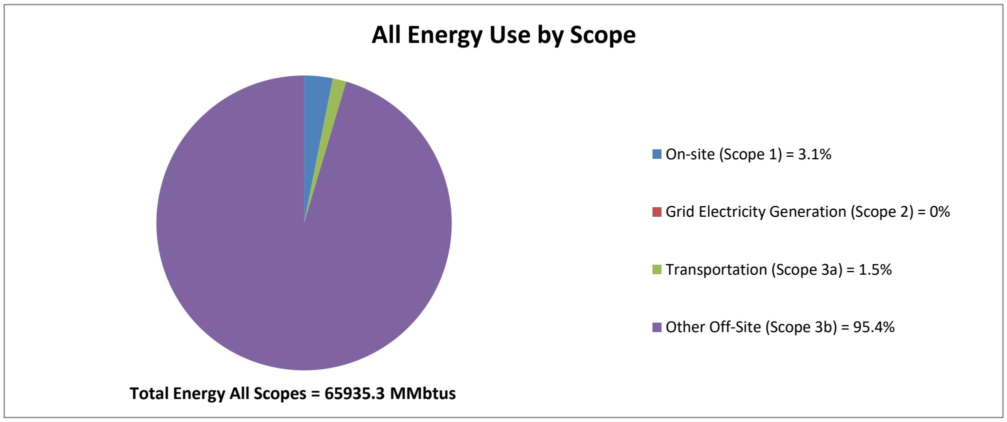
Debris and Soil Excavations = 87.4%
Soil Blending = 6.4%
PRB Installation = 3.7%
Long-Term Groundwater Sampling = 2.5%

On-site (Scope 1) = 0%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 0.3%
Other Off-Site (Scope 3b) = 99.6%

HAPs All Components = 211.3 lbs
HAPs All Scopes = 211.3 lbs





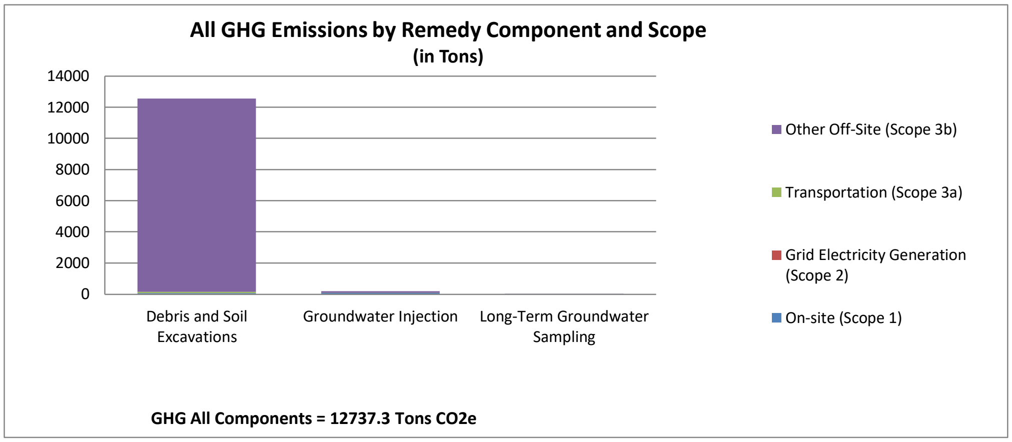


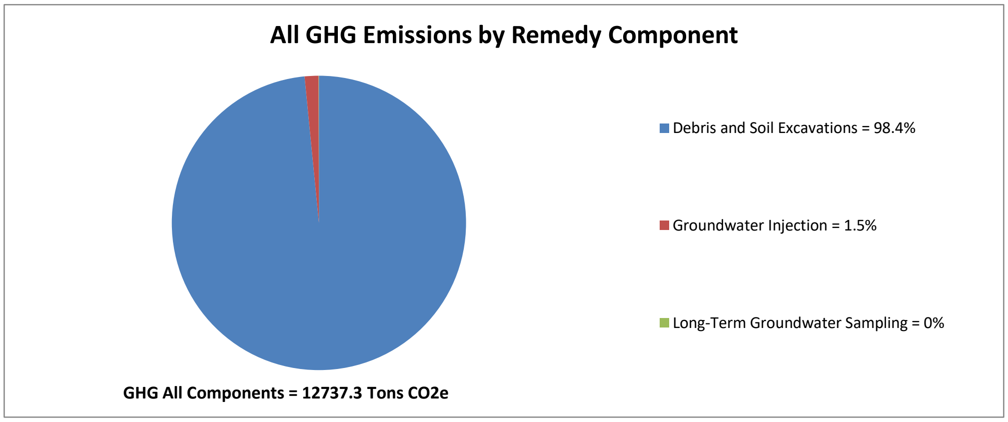
	Total Energy MMbtus			
	Debris and Soil Excavations	Groundwater Injection	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	973.0	1,087.8	0.0	2,060.8
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	881.9	90.5	18.6	991.0
Other Off-Site (Scope 3b)	62,316.1	539.2	28.1	62,883.4
Total	64,171.1	1,717.5	46.7	65,935.3

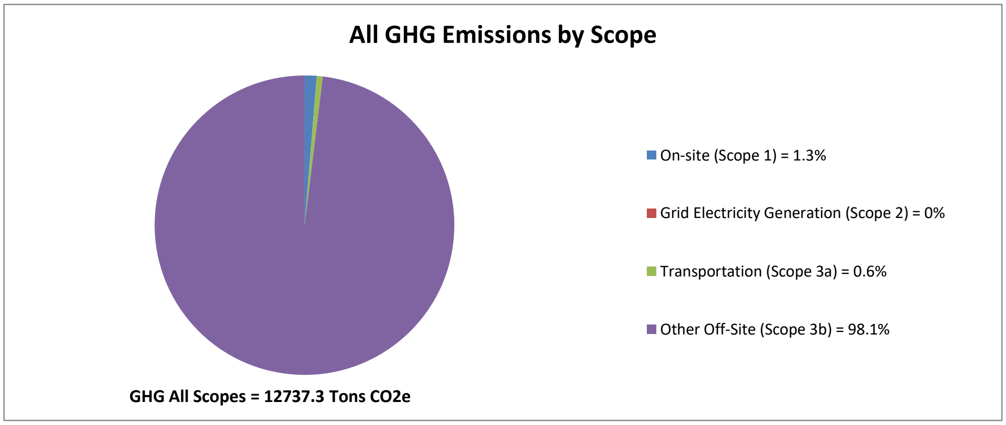
Debris and Soil Excavations = 97.3%
Groundwater Injection = 2.6%
Long-Term Groundwater Sampling = 0.1%

On-site (Scope 1) = 3.1%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 1.5%
Other Off-Site (Scope 3b) = 95.4%

Total Energy All Components = 65935.3 MMbtus
Total Energy All Scopes = 65935.3 MMbtus







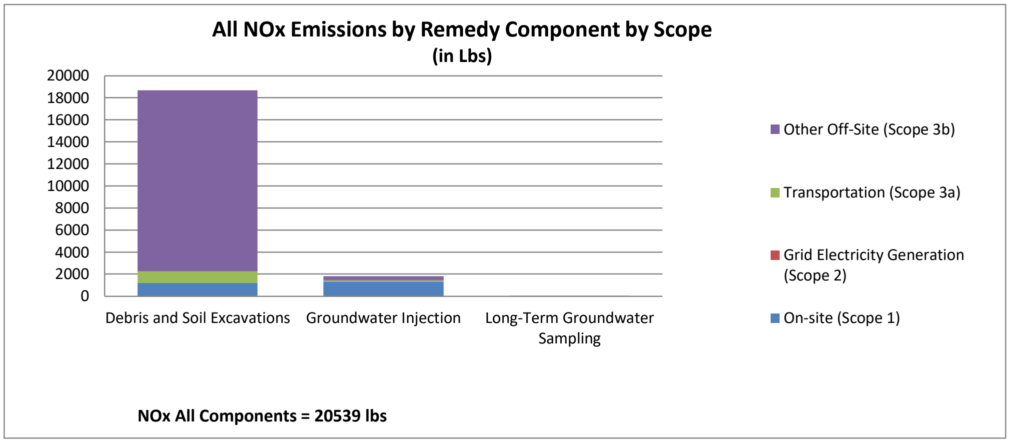
GHG
Tons CO2e

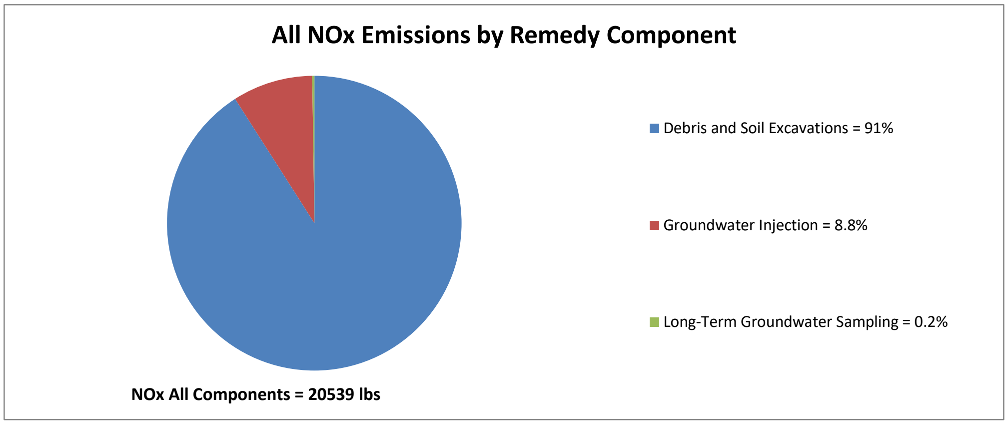
	Debris and Soil Excavations	Groundwater Injection	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	78.8	88.0	0.0	166.8
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	71.4	7.3	1.5	80.2
Other Off-Site (Scope 3b)	12,387.9	100.8	1.7	12,490.3
Total	12,538.0	196.2	3.1	12,737.3

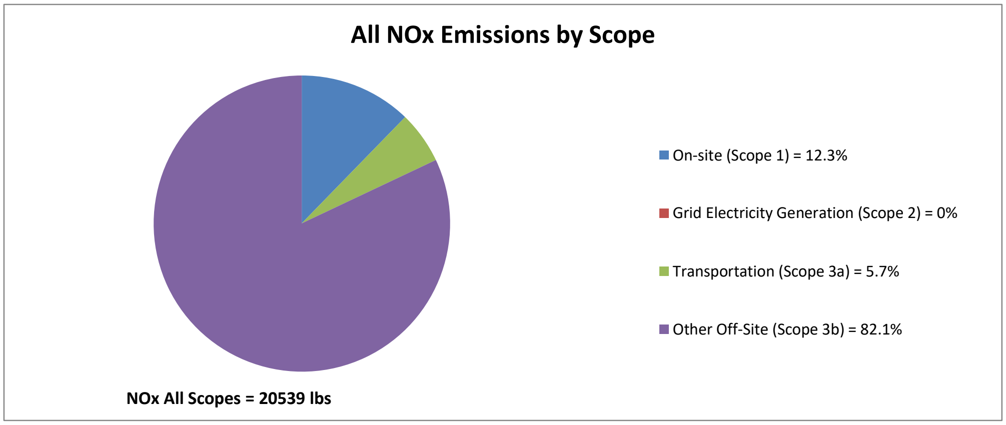
Debris and Soil Excavations = 98.4%
Groundwater Injection = 1.5%
Long-Term Groundwater Sampling = 0%

On-site (Scope 1) = 1.3%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 0.6%
Other Off-Site (Scope 3b) = 98.1%

GHG All Components = 12737.3 Tons CO2e
GHG All Scopes = 12737.3 Tons CO2e







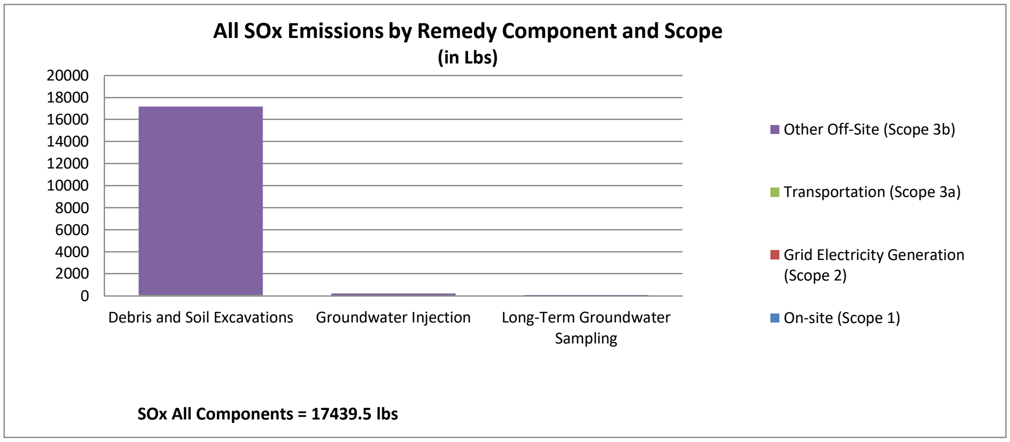
NOx
lbs

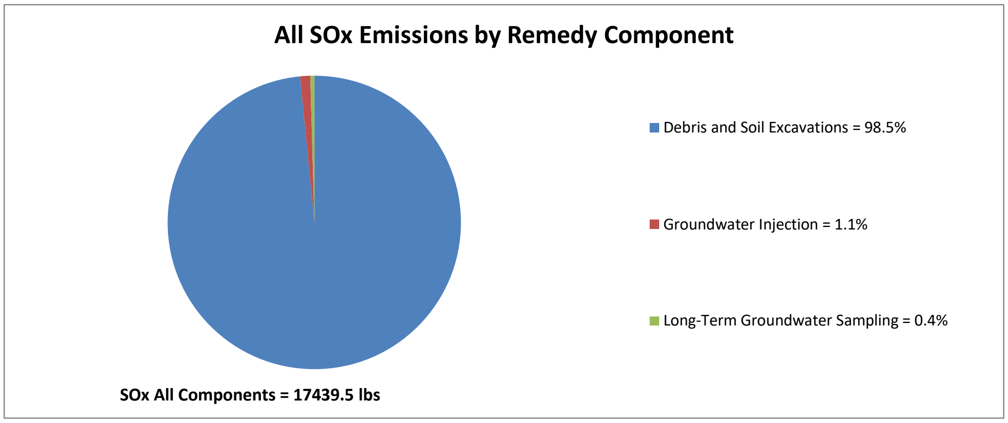
	Debris and Soil Excavations	Groundwater Injection	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	1,190.0	1,330.4	0.0	2,520.4
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	1,053.9	97.5	12.8	1,164.1
Other Off-Site (Scope 3b)	16,439.3	381.0	34.1	16,854.4
Total	18,683.2	1,808.8	46.9	20,539.0

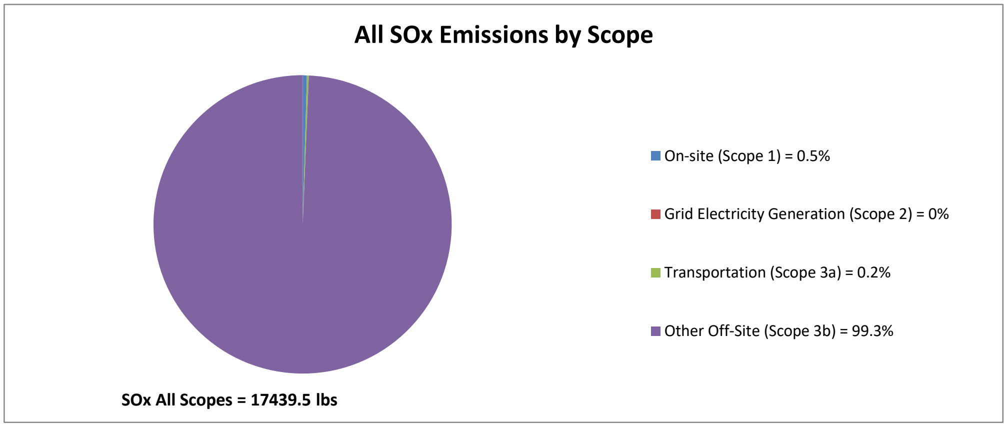
Debris and Soil Excavations = 91%
Groundwater Injection = 8.8%
Long-Term Groundwater Sampling = 0.2%

On-site (Scope 1) = 12.3%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 5.7%
Other Off-Site (Scope 3b) = 82.1%

NOx All Components = 20539 lbs
NOx All Scopes = 20539 lbs







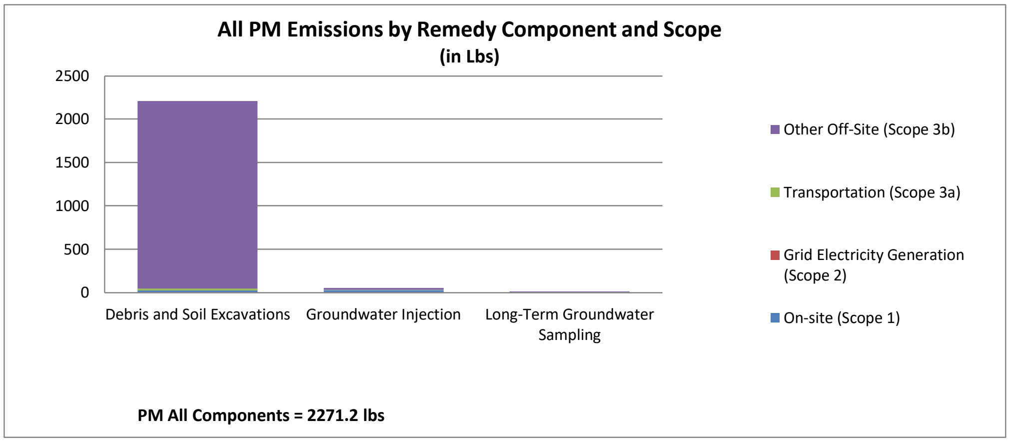
SOx
lbs

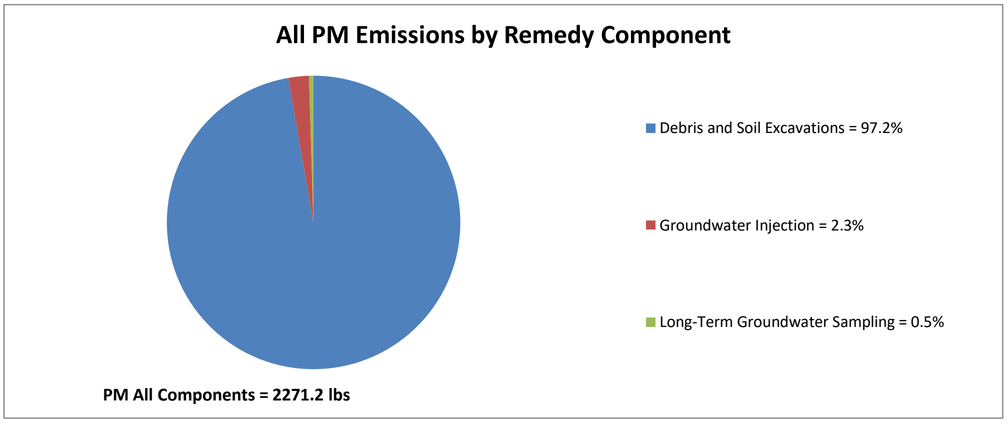
	Debris and Soil Excavations	Groundwater Injection	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	37.8	42.3	0.0	80.1
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	33.2	3.0	0.4	36.6
Other Off-Site (Scope 3b)	17,098.4	150.9	73.5	17,322.8
Total	17,169.4	196.2	73.8	17,439.5

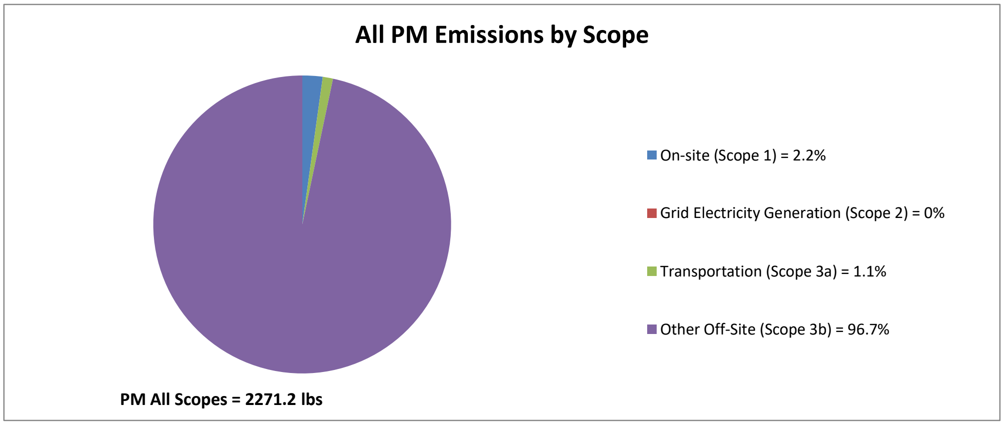
Debris and Soil Excavations = 98.5%
Groundwater Injection = 1.1%
Long-Term Groundwater Sampling = 0.4%

On-site (Scope 1) = 0.5%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 0.2%
Other Off-Site (Scope 3b) = 99.3%

SOx All Components = 17439.5 lbs
SOx All Scopes = 17439.5 lbs







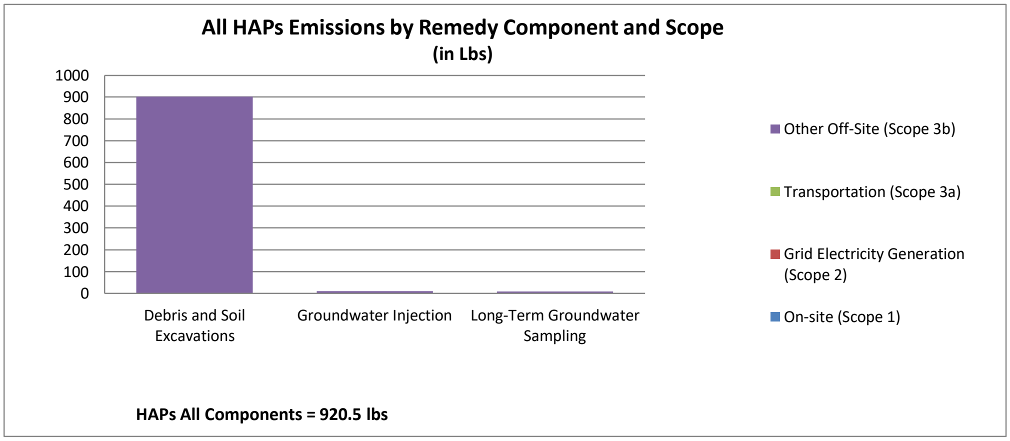
PM
lbs

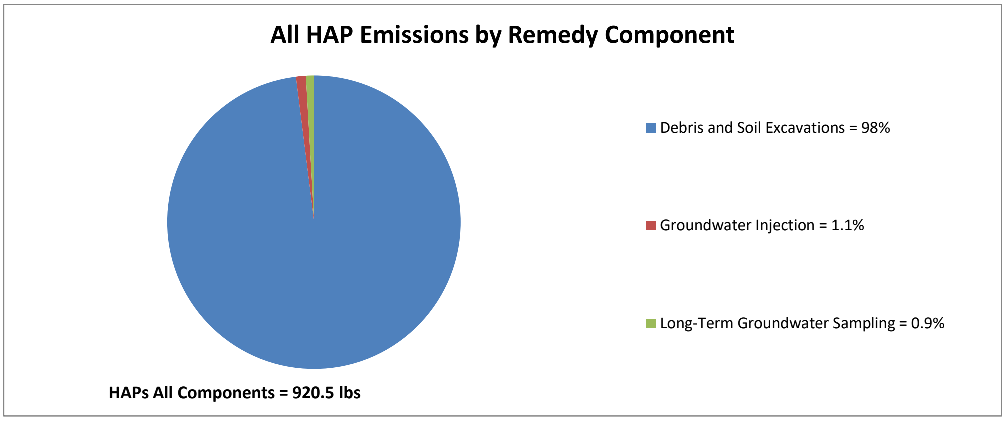
	Debris and Soil Excavations	Groundwater Injection	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	23.8	26.6	0.0	50.4
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	22.2	2.2	0.5	24.8
Other Off-Site (Scope 3b)	2,162.6	22.3	11.1	2,196.0
Total	2,208.6	51.1	11.5	2,271.2

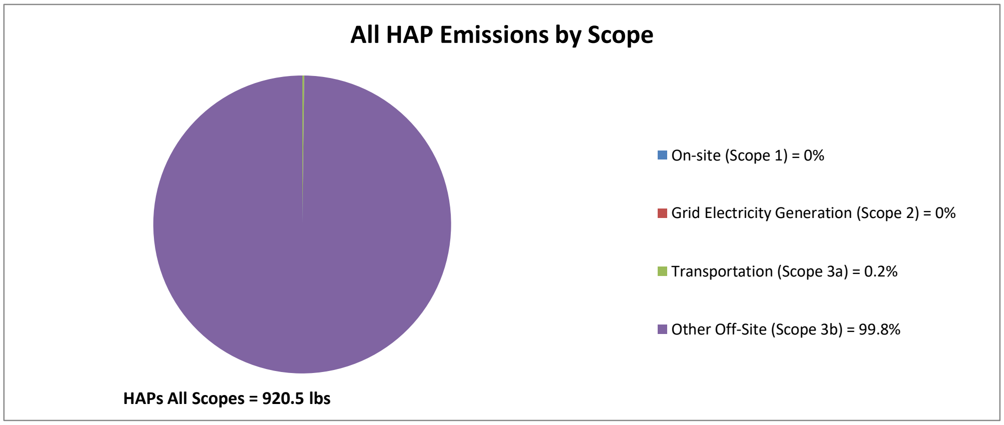
Debris and Soil Excavations = 97.2%
Groundwater Injection = 2.3%
Long-Term Groundwater Sampling = 0.5%

On-site (Scope 1) = 2.2%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 1.1%
Other Off-Site (Scope 3b) = 96.7%

PM All Components = 2271.2 lbs
PM All Scopes = 2271.2 lbs







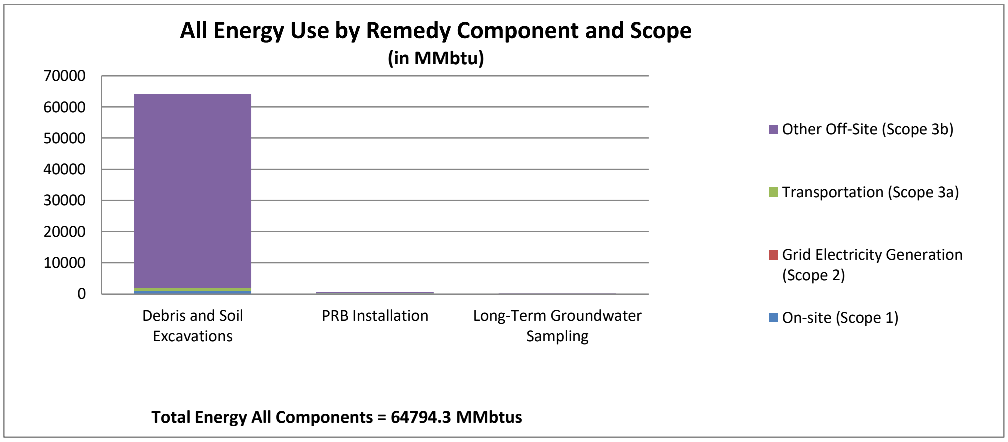
HAPs
lbs

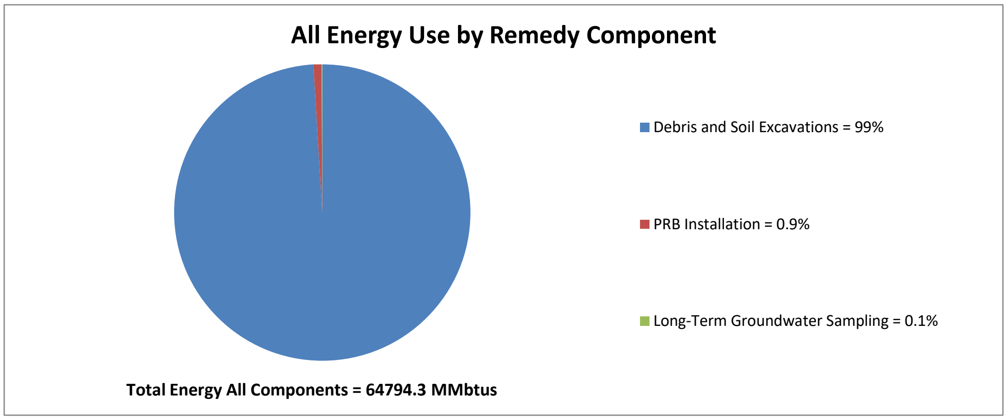
	Debris and Soil Excavations	Groundwater Injection	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	0.0	0.0	0.0	0.1
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	0.8	0.7	0.5	2.0
Other Off-Site (Scope 3b)	901.4	9.3	7.7	918.4
Total	902.2	10.1	8.2	920.5

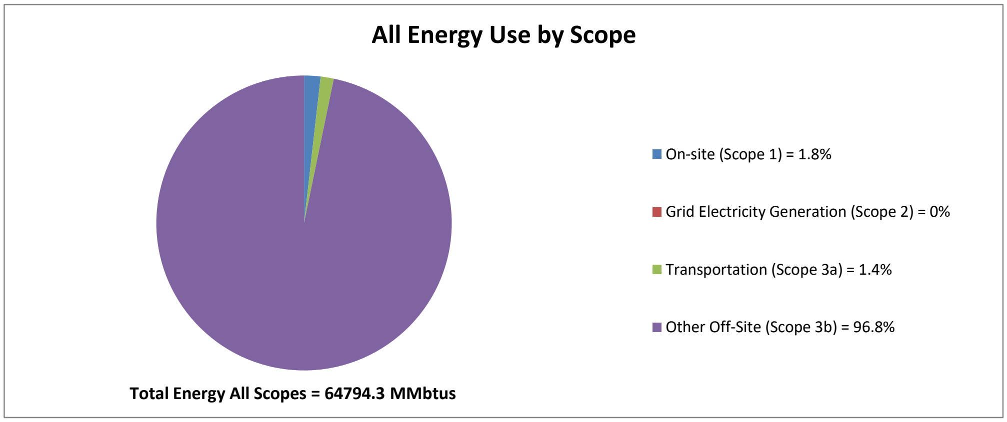
Debris and Soil Excavations = 98%
Groundwater Injection = 1.1%
Long-Term Groundwater Sampling = 0.9%

On-site (Scope 1) = 0%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 0.2%
Other Off-Site (Scope 3b) = 99.8%

HAPs All Components = 920.5 lbs
HAPs All Scopes = 920.5 lbs







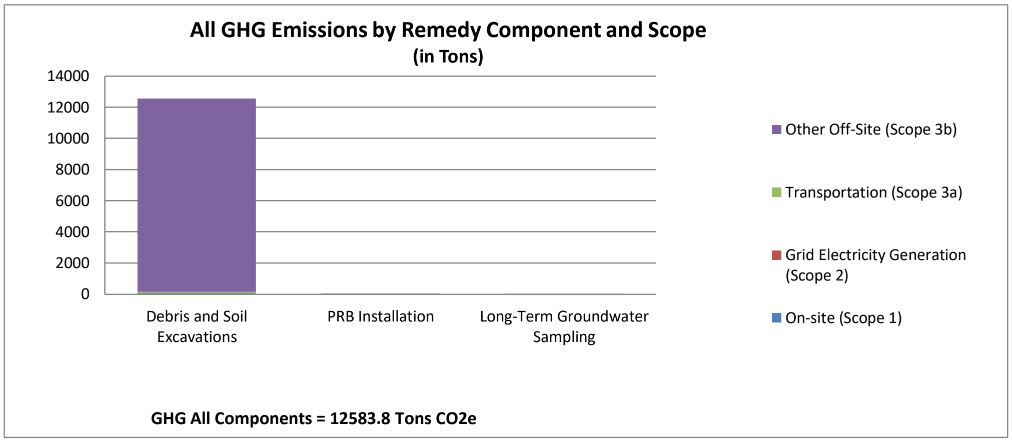
Total Energy
MMbtus

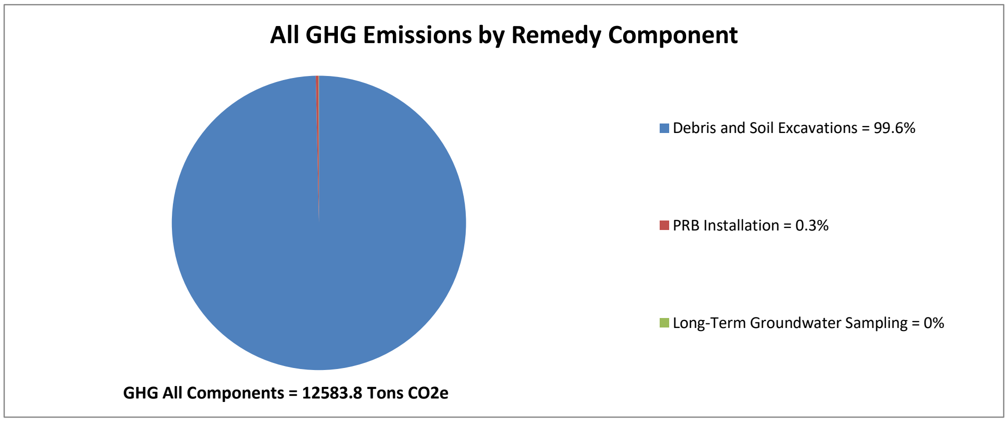
	Debris and Soil Excavations	PRB Installation	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	973.0	195.3	0.0	1,168.3
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	881.9	36.8	18.6	937.3
Other Off-Site (Scope 3b)	62,316.1	344.5	28.1	62,688.7
Total	64,171.0	576.6	46.7	64,794.3

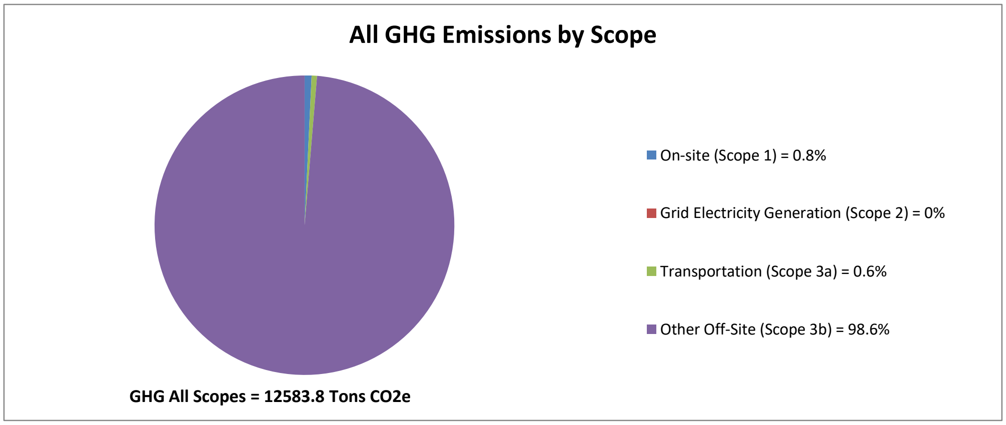
Debris and Soil Excavations = 99%
PRB Installation = 0.9%
Long-Term Groundwater Sampling = 0.1%

On-site (Scope 1) = 1.8%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 1.4%
Other Off-Site (Scope 3b) = 96.8%

Total Energy All Components = 64794.3 MMbtus
Total Energy All Scopes = 64794.3 MMbtus







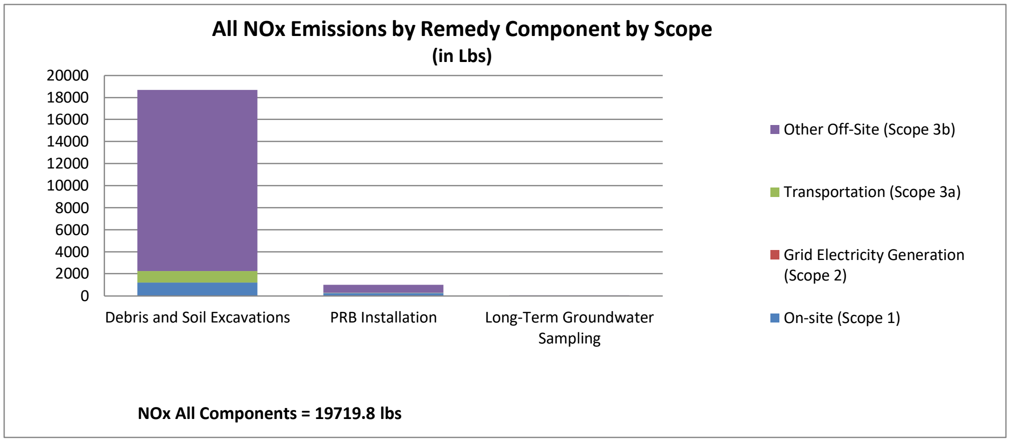
GHG
Tons CO2e

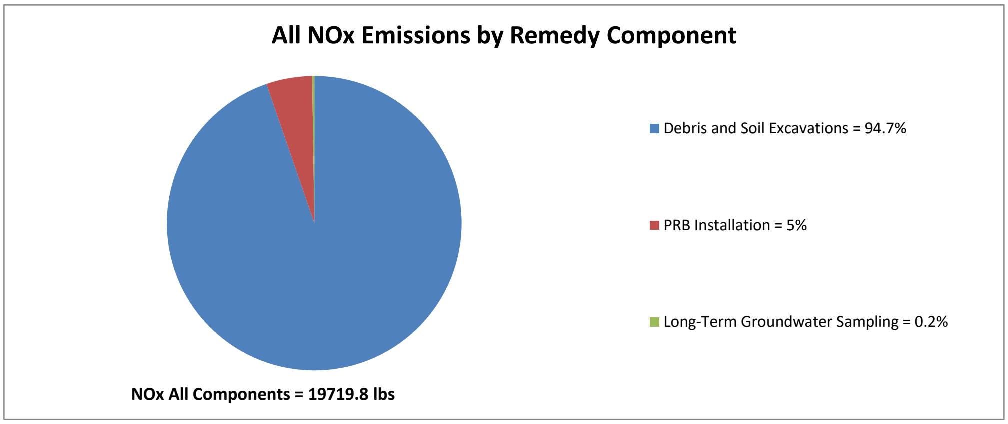
	Debris and Soil Excavations	PRB Installation	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	78.8	15.8	0.0	94.6
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	71.4	3.0	1.5	75.8
Other Off-Site (Scope 3b)	12,387.9	23.9	1.7	12,413.4
Total	12,538.0	42.7	3.1	12,583.8

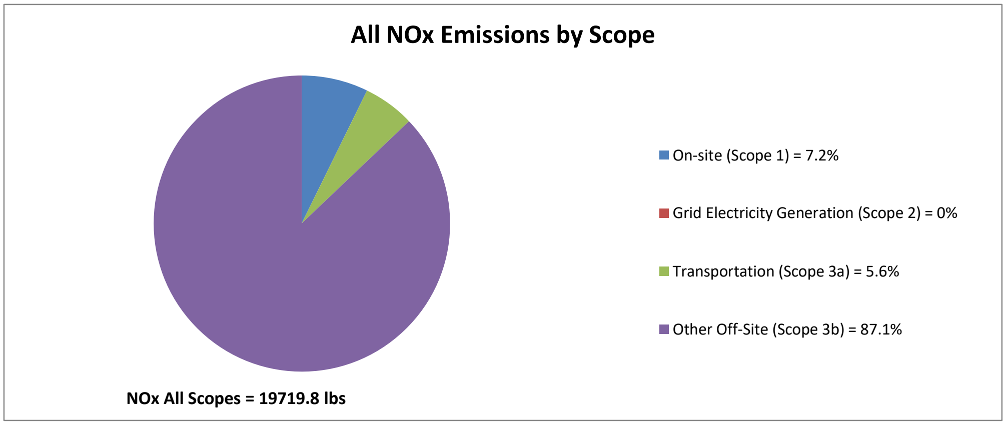
Debris and Soil Excavations = 99.6%
PRB Installation = 0.3%
Long-Term Groundwater Sampling = 0%

On-site (Scope 1) = 0.8%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 0.6%
Other Off-Site (Scope 3b) = 98.6%

GHG All Components = 12583.8 Tons CO2e
GHG All Scopes = 12583.8 Tons CO2e







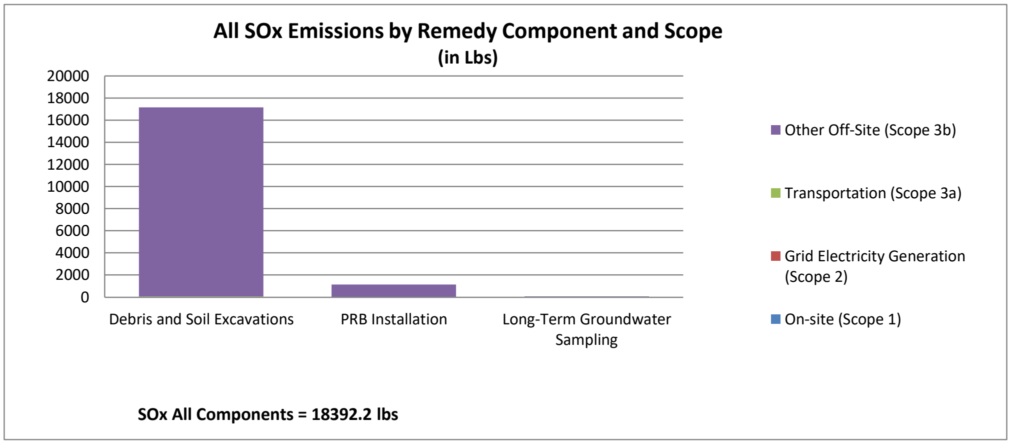
NOx
lbs

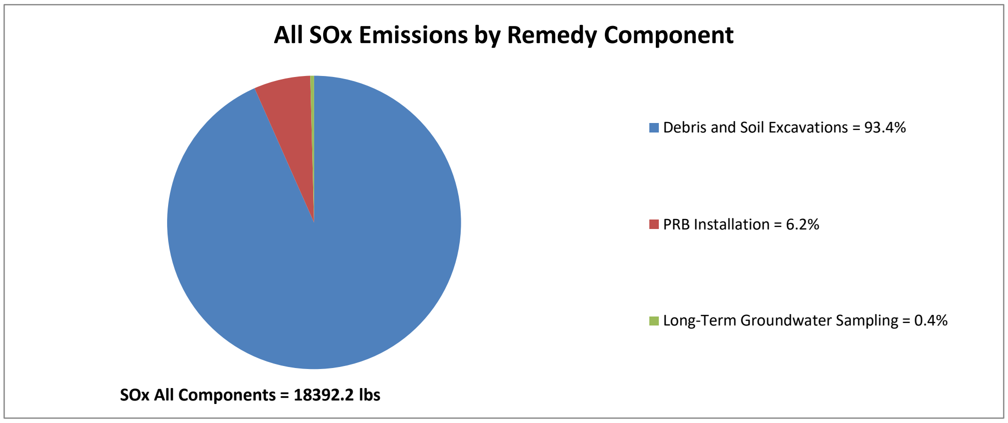
	Debris and Soil Excavations	PRB Installation	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	1,190.0	238.9	0.0	1,428.9
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	1,053.9	42.5	12.8	1,109.2
Other Off-Site (Scope 3b)	16,439.2	708.3	34.1	17,181.7
Total	18,683.2	989.7	46.9	19,719.8

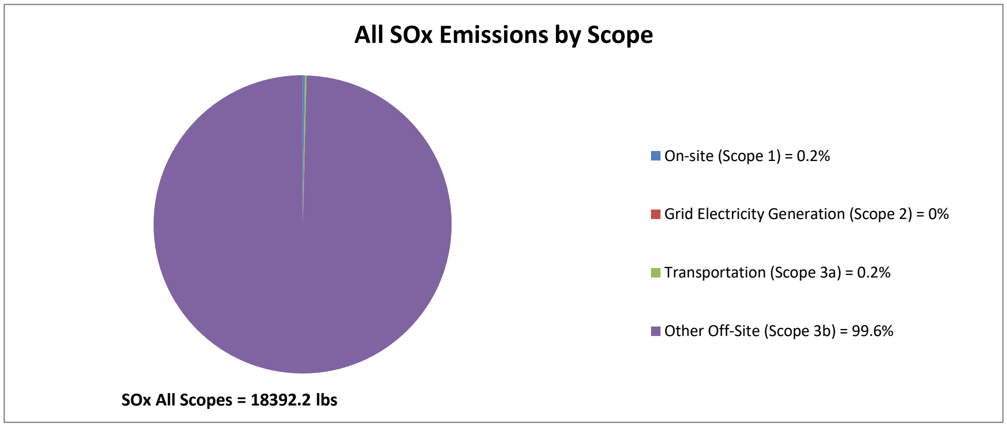
Debris and Soil Excavations = 94.7%
PRB Installation = 5%
Long-Term Groundwater Sampling = 0.2%

On-site (Scope 1) = 7.2%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 5.6%
Other Off-Site (Scope 3b) = 87.1%

NOx All Components = 19719.8 lbs
NOx All Scopes = 19719.8 lbs







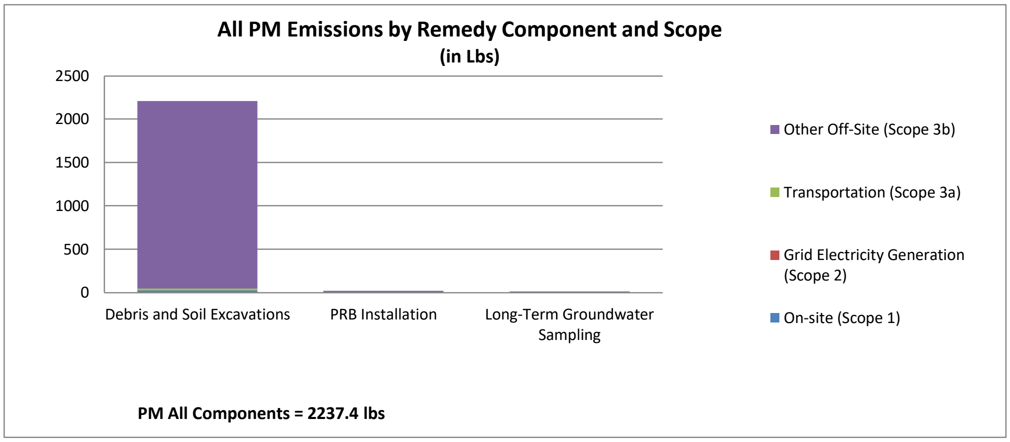
SOx
lbs

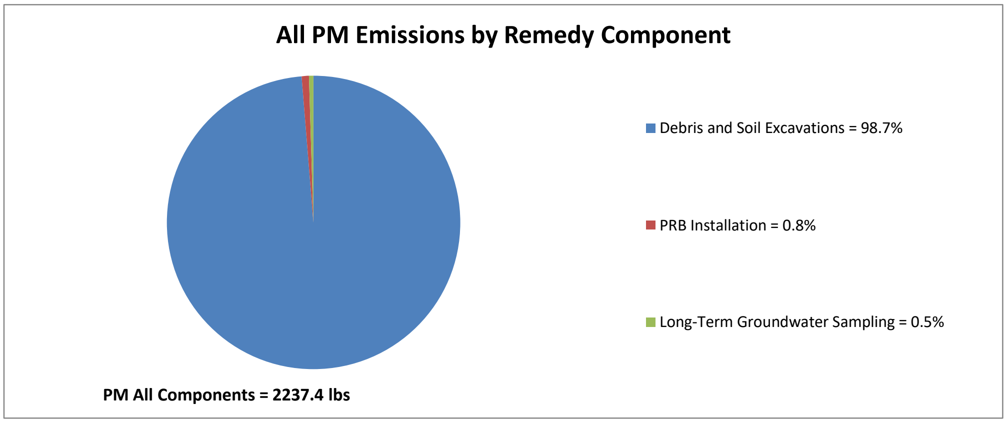
	Debris and Soil Excavations	PRB Installation	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	37.8	7.6	0.0	45.4
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	33.2	1.3	0.4	34.9
Other Off-Site (Scope 3b)	17,098.4	1,140.0	73.5	18,311.9
Total	17,169.4	1,148.9	73.8	18,392.2

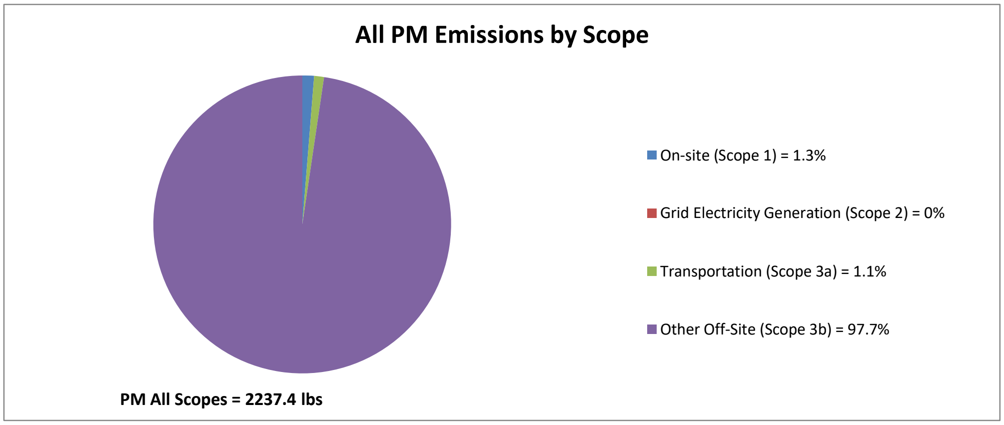
Debris and Soil Excavations = 93.4%
PRB Installation = 6.2%
Long-Term Groundwater Sampling = 0.4%

On-site (Scope 1) = 0.2%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 0.2%
Other Off-Site (Scope 3b) = 99.6%

SOx All Components = 18392.2 lbs
SOx All Scopes = 18392.2 lbs







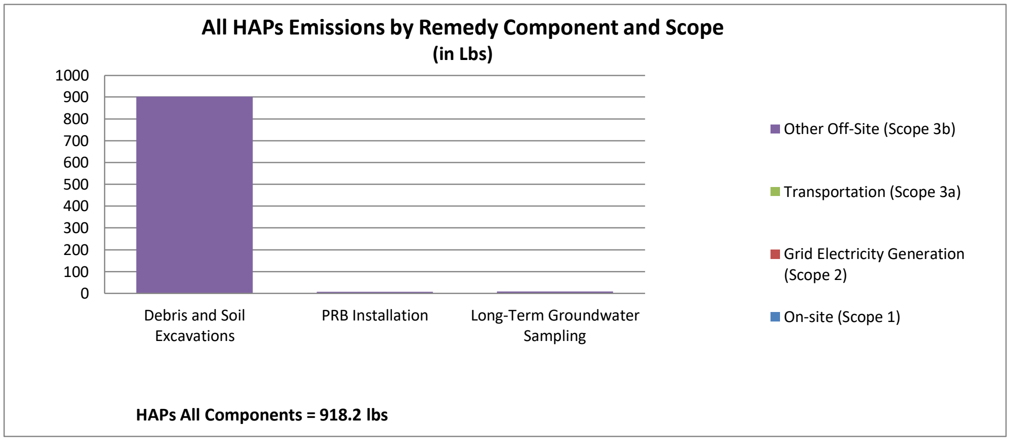
PM
lbs

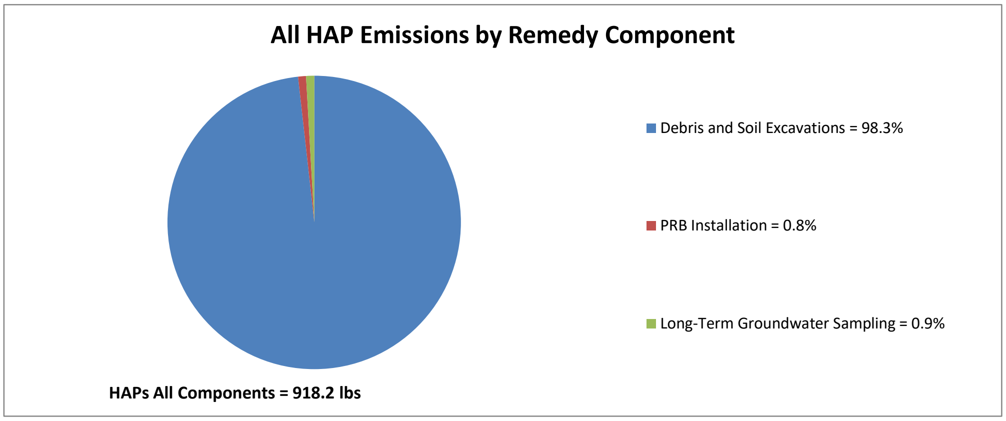
	Debris and Soil Excavations	PRB Installation	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	23.8	4.8	0.0	28.6
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	22.2	0.9	0.5	23.5
Other Off-Site (Scope 3b)	2,162.5	11.7	11.1	2,185.3
Total	2,208.5	17.4	11.5	2,237.4

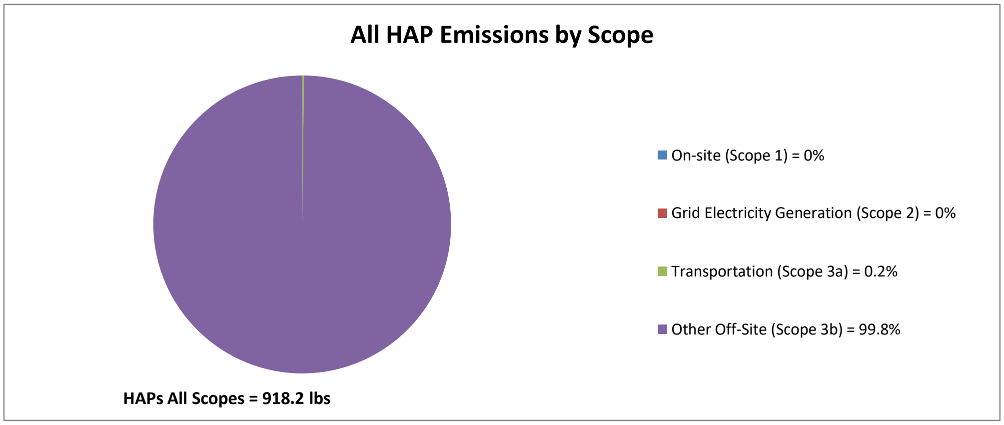
Debris and Soil Excavations = 98.7%
PRB Installation = 0.8%
Long-Term Groundwater Sampling = 0.5%

On-site (Scope 1) = 1.3%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 1.1%
Other Off-Site (Scope 3b) = 97.7%

PM All Components = 2237.4 lbs
PM All Scopes = 2237.4 lbs







HAPs
lbs

	Debris and Soil Excavations	PRB Installation	Long-Term Groundwater Sampling	Total
On-site (Scope 1)	0.0	0.0	0.0	0.0
Grid Electricity Generation (Scope 2)	0.0	0.0	0.0	0.0
Transportation (Scope 3a)	0.8	0.1	0.5	1.5
Other Off-Site (Scope 3b)	901.4	7.7	7.7	916.7
Total	902.2	7.8	8.2	918.2

Debris and Soil Excavations = 98.3%
PRB Installation = 0.8%
Long-Term Groundwater Sampling = 0.9%

On-site (Scope 1) = 0%
Grid Electricity Generation (Scope 2) = 0%
Transportation (Scope 3a) = 0.2%
Other Off-Site (Scope 3b) = 99.8%

HAPs All Components = 918.2 lbs
HAPs All Scopes = 918.2 lbs