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RCRA Corrective Action

Corrective Measures Study

Plants 2, 3, and 6 Industrial Land
Lansing, Michigan

Plants 2 and 3: EPA ID MID 980 700 827
Plant 6: EPA ID MID 005 356 928

June 2014

ARCADIS

RCRA Corrective Action

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Acronyms and Abbreviations

AOI	area of interest
ARCADIS	ARCADIS of Michigan, LLC
bgs	below ground surface
CMS	Corrective Measures Study
COC	constituent of concern
DC Criteria	Direct Contact Criteria
DW	Drinking Water
FESL	Flammability and Explosivity Screening Level
GSI	Groundwater Surface Water Interface
ISCO	in-situ chemical oxidation
K	hydraulic conductivity
LNAPL	light non-aqueous phase liquid
MDEQ	Michigan Department of Environmental Quality
MPE	multi-phase extraction
Part 201 Criteria	Part 201 Generic Cleanup Criteria
PCB	polychlorinated biphenyl
PFM	passive flux meter
PSIC	Particulate Soil Inhalation Criteria
RACER	Revitalizing Auto Communities Environmental Response

RCRA	Resource Conservation and Recovery Act
RCRA CMS Report	Resource Conservation Recovery Act Corrective Action Corrective Measures Study
RFI	RCRA Facility Investigation
RFI Phase 2 Report	*Resource Conservation and Recovery Act Facility Investigation (RFI) Phase 2 Activities Summary Report*
RFI Supplemental Phase 2 Report	*RFI Supplemental Phase 2 Activities Summary Report*
Site	RACER Trust Lansing Plants 2, 3, and 6 located in Lansing, Michigan
SVE	soil vapor extraction
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound

Executive Summary

This Resource Conservation Recovery Act Corrective Action Corrective Measures Study (RCRA CMS Report) has been prepared on behalf of the Revitalizing Auto Communities Environmental Response Trust for Lansing Plants 2, 3, and 6 located in Lansing, Michigan (Site). This RCRA CMS Report has been developed in accordance with U.S. Environmental Protection Agency (USEPA) guidance (USEPA 2005) and Part 201 of the Michigan Natural Resources and Environmental Protection Act (Act 451, 1994, as amended). The purpose of this RCRA CMS Report is to develop and evaluate corrective measure alternatives based on the findings of the RCRA Facility Investigation (RFI) and to propose the corrective measure(s) to be taken. Part 201 Generic Cleanup Criteria and Screening Levels (Part 201 Criteria) and Site characteristics were used to establish relevant pathways and applicable criteria. Based on this evaluation and the Environmental Response Trust Consent Decree and Settlement Agreement, cleanup goals for the Site will be non-residential criteria, such that residential criteria will not be exceeded off Site unless restrictions are established.

Tables 1 and 2 identify the areas of interest (AOIs) that have been determined to require corrective measures based on the RFI findings and Part 201 Criteria. Table 2 also identifies corrective measures that were evaluated for each of the targeted AOIs. These corrective measures were screened against RCRA's threshold criteria (protection of human health and the environment, attainment of media cleanup objectives, and controlling the sources or demonstrating plume stability [USEPA 2005]). After screening against the threshold criteria, various corrective measures were combined to form corrective measures alternatives. Corrective measures alternatives developed as a result of the screening process were then measured against the following RCRA evaluation criteria as presented in Table 3: long-term reliability and effectiveness; reduction of toxicity, mobility, and volume of waste; short-term effectiveness; implementation; community acceptance; state acceptance; and cost (USEPA 2005). In addition, sustainability and the Light Non-Aqueous Phase Liquid (LNAPL) Remedial Decision Tree (developed in collaboration with the Michigan Department of Environmental Quality [MDEQ] Technical Assistance Program Support team) were used to evaluate the alternatives.

After assessing the corrective measures alternatives per the above-described process, the proposed final corrective measures alternative for the Site consists of the elements described below. Figures ES-1 and ES-2 illustrate the locations of each element.

- Land Use Restrictions: Limit future use for the entire Site to commercial and/or industrial use, requiring Site-wide contaminated soil management, and incorporating Site-wide vapor exposure restrictions. The restrictions will also include subgrade utility restrictions in Areas 2, 5-1, 5-2, 5-5, 5-6, 5-8, and 17 and health and safety requirements for intrusive activities in Areas 2, 5-1, 5-2, 5-3, 5-5, 5-6, 5-8, 16, 17, 18, 19, 20, and 21.

- Groundwater Use Restrictions: Prohibit the use of groundwater for the entire Site for consumption, irrigation, or any other purpose, with the exception of evaluating groundwater, remediation of subsurface contamination, or short-term dewatering for construction purposes.

- Monitored Plume Stability: Implement a Site-wide monitoring program that provides the data to continue to verify plume stability. In addition, surface cover will be maintained/retained (e.g., building slabs, asphalt, concrete) near soil and groundwater impacts to minimize infiltration and maximize the potential for the perched groundwater plume to remain stable and on Site.

- Targeted Excavations: Removal of soils in Areas 5-7, 7, and 9 to address concentrations of constituents of concern (COCs) that represent a direct contact and/or vapor intrusion risk near the property boundary. In addition, removal of these soils will reduce the potential for off-Site migration of the COCs via groundwater. A targeted excavation within Area 5-2 is being completed as an interim corrective measure to remove a former concrete vault and surrounding LNAPL- and polychlorinated biphenyl-impacted soils. The Interim Corrective Measures Work Plan (Appendix D) has been submitted to the MDEQ and USEPA for a coordinated approval and is currently in review.

- Caps: Utilize caps to reduce the potential for exposure to soils exceeding Direct Contact Criteria, Particulate Soil Inhalation Criteria, and to mitigate potential direct contact risks associated with LNAPL exposure. Existing building slabs will be utilized as caps in Areas 5-1, 5-2, 5-3, 5-8, 19, and 21 (with some extensions in Areas 5-2 and 5-3). Existing cover (i.e., existing soil, gravel, concrete, or asphalt) or placement of clean soil will be used as a cap in Areas 2, 5-5, 5-6, 16, 18, and 20.

- Groundwater Recirculation: This remedy would address the lower 1,4-dioxane plume on Plants 2 and 3. The remedy consists of extraction of groundwater from the plume, above-grade treatment, and reinjection of treated water into the plume.

Recirculation of the groundwater enhances pore flushing, making the remedy aggressive and reduces the overall remediation timeframe when compared to other pumping alternatives.

The above approach and associated cost estimates are based on current available information and data. As pre-design information is obtained, the corrective measures and costs will be updated accordingly. Corrective measures will be implemented to meet the cleanup goals or until it is determined to be not technically practical and/or cost prohibitive.

As data is collected, it will be evaluated and actions will be recommended to MDEQ as appropriate. However, the proposed corrective measures specifically include that the selected corrective measures will be reviewed to optimize performance in 2018, after 5 years of monitoring have been completed.

Contingency remedies will be considered in the event of the following:

- Ongoing plume stability evaluation shows that one or more groundwater plume(s) attributable to the Site is not stable and migrating off Site above Part 201 Criteria.
- Pre-design testing shows a perched zone source area near the “coliseum” (Plant 3 Area 11) is contributing to the lower 1,4-dioxane plume above the corrective action objectives.
- Pre-design testing shows that groundwater recirculation is not a feasible remedy for the lower 1,4-dioxane plume.
- Performance monitoring of the groundwater recirculation system shows that the corrective action objectives cannot be met technically and/or cost effectively.

The contingency remedies would likely consist of corrective measures already evaluated in this RCRA CMS Report, as they are considered relevant and applicable methods to meet the corrective action objectives, but could include other measures based on the available information at that time. In the event that a contingency measure is required, additional evaluation and pre-design activities may be required to determine the appropriate corrective measure(s). The Corrective Measures Implementation Work Plan (or subsequent reports) will present these evaluation and pre-design activities, as well as updated cost estimates.

1. Introduction

This Resource Conservation Recovery Act Corrective Action Corrective Measures Study Report (RCRA CMS Report) has been prepared on behalf of the Revitalizing Auto Communities Environmental Response (RACER) Trust for Lansing Plants 2 and 3 (U.S. Environmental Protection Agency [USEPA] ID MID 980 700 827) and Plant 6 (USEPA ID MID 005 356 928) located in Lansing, Michigan (Site). RACER Trust was established and assumed the rights, title, and interest of Motors Liquidation Company in and to the Site pursuant to an Environmental Response Trust Consent Decree and Settlement Agreement ("Settlement Agreement") entered by the U.S. Bankruptcy Court for the Southern District of New York on March 29, 2011, in the case of *In re Motors Liquidation Company*, etc. et al, Debtors, Case No. 09-50026 (REG), among the Debtors; the United States of America; certain states, including the State of Michigan; the Saint Regis Mohawk Tribe; and EPLET, LLC, (not individually but solely in its representative capacity as Administrative Trustee of RACER Trust).

This RCRA CMS Report has been developed in accordance with USEPA guidance (USEPA 2005) and Part 201 of the Michigan Natural Resources and Environmental Protection Act (Act 451, 1994, as amended). The purpose of this RCRA CMS Report is to develop and evaluate corrective measures alternatives and recommend a corrective measures alternative for the Site that meets the corrective action objectives, RCRA evaluation criteria, and overall Site strategy. Figure 1 shows the location of the Site. Figure 2 shows the Site Layout.

1.1 Corrective Action Background

From 2011 through 2013, ARCADIS of Michigan, LLC (ARCADIS) completed Phases 1 and 2 of the RCRA Facility Investigation (RFI) at Plants 2, 3, and 6. Phase 1 of the RFI targeted areas of interest (AOIs) identified at the Site based on historical land use and previous investigation results. The AOIs investigated during Phase 1 were agreed upon by RACER Trust and the Michigan Department of Environmental Quality (MDEQ) as the most likely areas of the Site to be impacted by former Site activities. Based on the results of Phase 1, ARCADIS completed Phase 2 of the RFI to characterize and delineate soil and groundwater impacts identified during Phase 1. The results of the RFI were summarized in the *Resource Conservation and Recovery Act Facility Investigation (RFI) Phase 1 Activities Summary Report* (ARCADIS 2012), the *Resource Conservation and Recovery Act Facility Investigation (RFI) Phase 2 Activities Summary Report* (RFI Phase 2 Report; ARCADIS 2013), and the *RFI*

Supplemental Phase 2 Activities Summary Report (RFI Supplemental Phase 2 Report; ARCADIS 2014a).

ARCADIS has prepared this RCRA CMS Report on behalf of RACER Trust to present the identification and evaluation of corrective measures alternatives and describe the proposed corrective measures alternative for the Site for MDEQ consideration. This RCRA CMS Report references information that can be found in the RFI Phase 2 Report (ARCADIS 2013), RFI Supplemental Phase 2 Report (ARCADIS 2014a), *Preliminary Groundwater Geochemical and Plume Stability Assessment* (ARCADIS 2014b), *Revised Interim Groundwater Monitoring Work Plan* (ARCADIS 2014c), *Passive Flux Meter and Transducer Study Memorandum* (ARCADIS 2014d), and in other documents submitted to the MDEQ during the RCRA Corrective Action process as cited herein.

1.2 Corrective Action Objectives and Goals

The corrective action objective for the Site is to protect human health and the environment by achieving industrial/commercial closure (i.e., non-residential closure per MDEQ standards) in accordance with the Settlement Agreement.

Part 201 Generic Cleanup Criteria and Screening Levels (Part 201 Criteria) and Site characteristics were used to establish relevant pathways and applicable criteria. Based on this evaluation and the Settlement Agreement, cleanup goals for the Site will be non-residential criteria, such that residential criteria will not be exceeded off Site unless restrictions are established. Corrective measures alternatives will be implemented to meet the cleanup goals or until it is determined to be cost prohibitive.

2. Site Background

2.1 Site Location

The Site (Plants 2, 3, and 6) is located in western Lansing and occupies an area of approximately 250 acres. Figure 1 shows the locations of Plants 2, 3, and 6 relative to the greater Lansing area. The construction of the three plants was completed between the early 1900s (Plant 2), 1920s (Plant 6), and the 1930s (Plant 3), and operations were focused on various aspects of automobile assembly and manufacturing. Plants 2 and 3 are located in Lansing Township, and Plant 6 is located within the City of Lansing. The *Current Conditions Report* (ARCADIS 2008) provides a detailed description of the Site's history and operations.

2.2 Geology and Hydrogeology

The following provides a brief description of the Site hydrogeologic setting for reference. Additional details, including cross-sections and output from a three-dimensional model, are available as part of the RFI Phase 2 Report (ARCADIS 2013) and RFI Supplemental Phase 2 Report (ARCADIS 2014a).

2.2.1 Site Stratigraphy

The complex sedimentary environment present at the Site includes a thick sequence of "glaciofluvial" and glacial till sediments consisting predominantly of clays and silts, with discontinuous layers of sand, silty sand, and occasional gravel. Appendix A provides the RFI cross-sections for reference. For discussion purposes, the geology of the Site is divided into six general hydrostratigraphic units (from shallow to deep):

- Shallow fill – Typically 1 to 10 feet thick consisting of sand and gravel mixes brought to the Site as part of construction activities. The shallow fill occasionally contains shallow perched water when present above a clay layer.

- Interbedded zone – Typically interbedded soft clay, glacial tills, and isolated lenses of silt and sand. Sand and silt lenses are typically saturated, forming thin discontinuous zones of perched groundwater. This unit is primarily encountered on Plants 2, 6, and the southern portion of Plant 3. Saturated soils within the shallow fill and interbedded zone are generally referred to as the "perched water" or collectively as the "perched zone."

- Glacial till – A compact, dense, and mostly dry silt/sand/gravel/clay mix that creates a vertical barrier to groundwater flow and separates the perched water above from the deep overburden and weathered bedrock. Occasionally contains layers of saturated sand, especially in the central portion of Plant 6.

- Deep overburden – Consists of a mix of sand layers and sand-silt-clay till located above the bedrock. The deep overburden is dry beneath the glacial till but becomes saturated where encountered (deeper than 65 to 70 feet below ground surface [bgs]). Saturated deep overburden is only observed at Plant 3 where a southwest-northeast trending bedrock valley dips below the regional water table.

- Weathered bedrock – The transition from glacial overburden to consolidated rock is gradational, with a weathered bedrock layer typically ranging from 5 to 20 feet thick. The weathered bedrock zone, especially the weathered sandstone portion, is a preferential pathway for groundwater flow. Weathered bedrock is typically encountered between 60 to 75 feet bgs, except in the bedrock valley located across the northwestern portion of Plant 3, where bedrock can be encountered at depths greater than 100 feet bgs.

- Bedrock – Consists of the Grand River and Saginaw Formations. The Grand River Formation is a fine- to medium-grained sandstone that occupies erosional valleys within the Saginaw Formation (United States Geological Survey and National Parks Service 2000). Beneath the Site, the Saginaw Formation consists primarily of fine-grained sandstone with shale lenses of varying thickness. More significant layers of shale are encountered within the Saginaw Formation that can be up to 15 feet thick.

2.2.2 Site Hydrogeology

There are two water-bearing zones at the Site relevant to this RCRA CMS Report: 1) the perched water – occurring within the fill, interbedded zone, or occasionally within the glacial till and 2) the deep overburden and weathered bedrock where the lower 1,4-dioxane plume is present. The RFI Phase 2 Report (ARCADIS 2013) and RFI Supplemental Phase 2 Report (ARCADIS 2014a) provides additional detail regarding the water-bearing zones. The following provides a summary of the perched zone and deep overburden and weathered bedrock.

2.2.2.1 Perched Zone

Due to the predominance of clay-rich sediments, the interbedded zone has an overall low permeability and is characterized by isolated sand zones within layers of silt and clay. The lower hydraulic conductivity (K) clays and silts result in high horizontal gradients and reflect the discontinuous nature of the conductive sand zones.

Slug tests were completed at several locations within the perched zone. The results of the slug testing indicate that wells screened within permeable units of the perched zone have a K ranging from 0.07 to 40 feet per day. Based on the range of K, variable hydraulic gradients, and porosity associated with the sand-silt-clay soils, it is expected that groundwater flow velocities will range several orders of magnitude in the heterogeneous perched zone.

2.2.2.2 Deep Overburden and Weathered Bedrock

The lower 1,4-dioxane plume is present in the deep overburden and weathered bedrock. The lower 1,4-dioxane plume, extending from the Plant 3 coliseum area to the south-central portion of Plant 2, has been delineated with numerous vertical aquifer profiling borings and monitoring wells. Groundwater elevation measurements collected from the monitoring wells installed along the lower 1,4-dioxane plume reflect a complex heterogeneous aquifer structure. Due to large vertical gradients observed at certain areas of the Site, the observed groundwater elevation is variable depending on the specific depth of a well. Based on the evaluation presented in the RFI Phase 2 Supplemental Report (ARCADIS 2014a), as well as analysis completed in March and April 2014 utilizing passive flux meters (PFMs; EnviroFlux, Inc.), the groundwater flow along the lower 1,4-dioxane plume appears southerly, consistent with the plume morphology. The *Passive Flux Meter and Transducer Study Memorandum* (ARCADIS 2014d) presents a summary of the PFM study and results.

The measured hydraulic conductivity of the three aquifer hydrostratigraphic units ranges over several orders of magnitude. This result, coupled with the variability of the hydraulic gradient, resulted in a large range of possible groundwater velocities for the aquifer as reported in the RFI Phase 2 Supplemental Report (ARCADIS 2014a). Additional characterization of groundwater velocity was completed during the PFM study completed in March and April 2014. The actual measured groundwater velocity within the deep overburden and weathered bedrock ranges from 25 to 80 feet per year. Based on the length of the lower 1,4-dioxane plume (approximately 2,400 feet), the

plume has been in place, or otherwise migrating, for a minimum of 30 years (ARCADIS 2014d).

In addition to the PFM study, a transducer survey was completed at the Site to evaluate the hydraulic connection between the monitoring wells installed along the lower 1,4-dioxane plume and the municipal pumping wells. The results of the study show a hydraulic response at several bedrock wells located near the lower 1,4-dioxane source area. The highest amplitude of response was observed due to the pumping of Lansing Township Well #4 located approximately 1,000 feet west of the coliseum area. However, the bedrock at the Site is not impacted and operation of the municipal wells does not appear to effect the distribution of the lower 1,4-dioxane plume (ARCADIS 2014d).

2.3 Land Use

Currently, the Site is vacant, fenced, and a majority of the buildings have been demolished. The Site is currently zoned as heavy industrial, and is likely to be redeveloped for industrial and commercial uses in the future. It is surrounded by residential and commercial properties, parks, and school properties. During the RFI, the Site was evaluated based on a current and future non-residential use. Conditions at the Site were evaluated based on potentially exposed industrial and construction workers. Off-site properties were evaluated based on a residential exposure scenario.

2.4 Summary of the Resource Conservation and Recovery Act Facility Investigation

The *Resource Conservation and Recovery Act Facility Investigation (RFI) Phase 1 Activities Summary Report* (ARCADIS 2012), the RFI Phase 2 Report (ARCADIS 2013), and the RFI Supplemental Phase 2 Report (ARCADIS 2014a) summarized the results of the RFI. The RFI to date has adequately characterized the nature and extent of impacts, as well as relevant exposure pathways associated with the Site. The *Preliminary Geochemistry and Plume Stability Assessment* (ARCADIS 2014b) provided additional analysis of site groundwater conditions. Table 1 summarizes the basis for certain exceedances identified during the RFI not addressed as part of the CMS. Based on the work completed to date, the following will be addressed as part of this CMS:

- Impacts in the perched zone, including:

- Soil exceedances of Direct Contact Criteria (DC Criteria) and Particulate Soil Inhalation Criteria (PSIC) in Areas 2, 5-1, 5-2, 5-3, 5-8, 5-5, 5-6, 7, 9, 16, 18, 19, 20 and 21.

- Vapor intrusion exceedances in soil and groundwater across the Site, with more aggressive options considered in Areas 5-7, 7, and 9, where concentrations of volatile organic compounds (VOCs) in soil and groundwater represent a vapor intrusion risk near the property boundary.

- Light non-aqueous phase liquid (LNAPL) present in the central portion of Plant 2 (Area 5-2). LNAPL consists of cutting oil that contains elevated concentrations of VOCs and polychlorinated biphenyls (PCBs) in some areas.

- VOC impacts in perched water associated with LNAPL at Plant 2.

- 1,4-Dioxane impacts in perched water associated with LNAPL at Plant 2.

- LNAPL present within the shallow fill material in the north central portion of Plant 3 (Area 17) associated with a former underground storage tank farm. The LNAPL consists of gasoline with associated soil and groundwater impacts consisting primarily of benzene, toluene, ethylbenzene, and xylenes.

- VOCs in perched water associated with the LNAPL at Plant 3 (Area 17).

- VOC criteria exceedances in soil and perched water at locations throughout the Site.

- Metals exceedances in perched water where metals are known to be Site-related, in areas near Site boundaries, and in areas where the preliminary stability assessment showed increasing concentration trends (Areas 1, 5-5, 5-6, 5-7, 5-8, 6, 7, 9, 14, 17, and 19).

- Lower 1,4-dioxane plume at Plants 2 and 3. The source area for the lower 1,4-dioxane plume is located near the “coliseum” on the southwestern portion of Plant 3 (Area 11). Other VOCs, including benzene and acetone, exceed criteria at sporadic locations generally coincident with the lower 1,4-dioxane plume. Because the benzene and acetone impacts are co-located with 1,4-dioxane, the CMS strategy for mitigation of 1,4-dioxane will also address benzene and acetone.

3. Summary of Corrective Measures Alternatives

There are areas at the Site that exceed MDEQ Part 201 Criteria, including Residential Drinking Water (DW) Criteria, Residential DW Protection Criteria, Groundwater/Surface Water Interface (GSI) Criteria, GSI Protection Criteria, Non-Residential Draft Groundwater Concentrations for Vapor Intrusion, Non-Residential Soil Volatilization to Indoor Air Inhalation Criteria, Non-Residential PSIC, Flammability and Explosivity Screening Levels (FESLs), and/or Non-Residential DC Criteria. Tables 1 and 2 provide a summary of the applicable exceedances for each Plant, Area, and AOI based on the results of the RFI, and corrective measures alternatives were developed to address these applicable exceedances.

3.1 Identification of Corrective Measures Alternatives

Corrective measures for the applicable exceedances of Part 201 Criteria at the Site are detailed in the sections below and summarized in Table 2. The corrective measures have been screened against RCRA's threshold criteria (USEPA 2005), which are as follows:

- Protection of human health and the environment
- Attainment of media cleanup objectives
- Controlling the sources or demonstrating plume stability

After screening against the threshold criteria, the various corrective measures have been combined to form corrective measures alternatives for further evaluation; these alternatives are presented in Table 2.

3.2 Site-Wide Management Controls

3.2.1 Land Use Restriction

The exposure assessment discussed in Section 3 of the RFI Phase 2 Report (ARCADIS 2013) assumed that future land use at the Site would be industrial and/or commercial under a non-residential closure scenario. To reduce the likelihood of a change in land use and to address other potential exposures, a Restrictive Covenant would be recorded on the deeds and would cover the following:

- Site-wide Land Use Restriction: Land use at the entire Site would be limited to industrial and/or commercial uses (non-residential).

- Site-wide Contaminated Soil Management: All Site soils, media, and/or debris will be managed in accordance with the applicable requirements of RCRA and all other relevant state and federal laws.

- Site-wide Vapor Intrusion Exposure Restriction: Restricts the construction of new structures, unless such construction incorporates engineering controls designed to eliminate the potential for subsurface vapor-phase hazardous substances to migrate into the new structure at concentrations greater than applicable criteria; or, unless prior to construction of any structure, an evaluation of the potential for any hazardous substances to volatilize into indoor air assures the protection of persons who may be present in the buildings and is in compliance with all relevant federal, state, and local laws.

- Subgrade Utility Restrictions: Restricts the construction of subgrade utilities in Areas 2, 5-1, 5-2, 5-5, 5-6, 5-8, and 17, unless the construction incorporates engineering controls designed to eliminate the potential for perched water to enter and/or migrate along the utility corridor or for the utility to release fluids that could infiltrate through the subsurface and exacerbate impacts to groundwater.

- Health and Safety Requirement for Intrusive Activities in Areas 2, 5-1, 5-2, 5-3, 5-5, 5-6, 5-8, 7, 9, 16, 17, 18, 19, 20, and 21: Intrusive excavation activities will be conducted following a Site-specific Health and Safety Plan prepared by qualified professionals and intrusive activities are conducted by appropriately trained personnel.

3.2.2 Groundwater Use Restriction

The Restrictive Covenant would also include Site-wide groundwater use restrictions for perched, deep overburden, and bedrock groundwater. The restrictions will include prohibiting the construction and use of wells or other devices on the Site to extract groundwater for consumption, irrigation, or any other purpose, except as provided below:

- Wells and other devices constructed as part of a response activity for the purpose of evaluating groundwater quality or to remediate subsurface contamination associated with a release of hazardous substances into the environment are

permitted provided the construction of the wells or devices complies with all applicable local, state, and federal laws and regulations and does not cause or result in a new release, exacerbation of existing contamination, or any other violation of local, state, or federal laws or regulations.

- Short-term dewatering for construction purposes is permitted provided the dewatering, including management and disposal of the groundwater, is conducted in accordance with all applicable local, state, and federal laws and regulations and does not cause or result in a new release, exacerbation of existing contamination, or any other violation of local, state, and federal environmental laws and regulations.

3.3 Soil

3.3.1 Caps

Caps have been evaluated as potential corrective measures for soil exceedances of DC Criteria and PSIC. In Areas 5-1, 5-2, 5-3, 5-8, 19, and 21, existing building slabs currently in place cover (or partially cover) the DC Criteria and PSIC exceedances. Existing surface cover would be extended to cover the entire area of exceedances in Areas 5-2 and 5-3.

In other areas of the Site with soil exceedances of DC Criteria and PSIC where existing building slabs are not present (Areas 2, 5-5, 5-6, 7, 9, 16, 18, and 20), capping would include either placement of a clean surface cover (e.g., soil, gravel) or the utilization of an existing cover (e.g., sufficient existing soil/gravel, concrete, asphalt) to prevent exposure. If existing concrete and/or asphalt is present, it will be inspected and repaired/replaced as needed to prevent exposure. Figure 3 shows the proposed locations of the caps to be used as a potential corrective measure for DC Criteria and PSIC exceedances.

If capping were the (or part of the) selected corrective measures alternative, a Restrictive Covenant would be filed with the deeds to include prohibiting the removal, excavation, or other intrusive activity that could affect the integrity of the caps, except during short-term construction or repair projects, or for purposes of further treating or remediating the subject contamination. In any excavation area or area where other intrusive activities (i.e., removing, altering, or disturbing the caps) that could affect the integrity of the cap have occurred, the cap must be replaced with a cover that provides at least an equivalent degree of protection as the original cap. Repair and/or

replacement of the cap would be required unless additional sampling is conducted that demonstrates that a cap in the area is no longer necessary.

3.3.2 Targeted Excavation

Targeted excavation and off-site disposal at a licensed disposal facility was identified as a potentially feasible corrective measure in locations with soil exceedances of DC Criteria and PSIC, including Areas 2, 5-1, 5-2, 5-3, 5-5, 5-6, 5-8, 7, 9, 16, 18, 19, 20, and 21. This option may also include additional characterization to refine the proposed excavation area, if deemed necessary. Figure 3 shows the proposed locations of the excavations to be used as a potential corrective measure for DC Criteria and PSIC exceedances.

Targeted excavation was also considered for Areas 2, 5-7, 7, 9, and 11 where concentrations of constituents of concern (COCs) represent a direct contact and/or vapor intrusion risk near the property boundary. Removal of these soils would also reduce the potential for off-site migration of COCs via groundwater.

3.4 Groundwater

3.4.1 Monitored Plume Stability

Monitored plume stability has been identified as a potential Site-wide corrective measure to meet the corrective action objective. This corrective measure includes ongoing groundwater monitoring to collect the necessary data for evaluating trends and verifying the stability of groundwater impacts, as well as maintaining and retaining existing surface cover (e.g., building slabs, asphalt, concrete), to minimize infiltration and maximize the potential for the plume to remain stable and on Site.

3.4.1.1 Monitoring

If monitored plume stability was the (or part of the) selected corrective measure, ongoing groundwater monitoring would be completed to collect the necessary data for evaluating trends and verifying the stability of impacts. Specifically, data collected during groundwater monitoring would be used to:

- Verify the stability of the perched 1,4-dioxane and VOCs.

- Further evaluate metals in areas near Site boundaries, in areas where metals are known to be Site-related (chromium in Area 14), and in areas where the preliminary stability assessment showed increasing concentration trends.

- Determine the stability of 1,4-dioxane in the deep overburden and weathered bedrock.

- Detect vertical or horizontal migration of COCs via a network of sentinel wells.

- Monitor LNAPL thickness in monitoring wells at the Site to verify LNAPL is not migrating.

- Verify that changes to the Site storm sewer system and degradation of slabs across the Site do not result in VOCs, 1,4-dioxane, or metals leaving the Site via the storm sewer system at levels that may impact surface water.

Following each sampling event, ARCADIS would review the analytical results and determine if adjustments need to be made to the monitoring plan. In 2018, after 5 years of monitoring, a comprehensive plume stability analysis would be completed to verify plume stability and optimize the monitoring plan.

3.4.1.2 Infiltration Barrier

Removal of the existing surfaces at the Site has the potential to negatively impact plume stability, as it will result in an immediate increase in recharge to groundwater. Therefore, monitored plume stability includes retaining the existing surface cover (e.g., building slabs, concrete, asphalt) near groundwater impacts to limit infiltration in conjunction with ongoing groundwater monitoring. Two areas of existing building slabs located directly over source material would be maintained to their approximate current condition. Figure 4 identifies the areas for surface cover retention and maintenance.

All surface cover near groundwater impacts but not directly over source areas would be retained (i.e., not removed) but not maintained as part of corrective measures. Slow degradation of this surface cover would result in small changes in infiltration over time and be less likely to negatively impact plume stability. The ongoing groundwater monitoring program would be used to evaluate potential negative impacts on plume stability related to the degradation of the surface cover. Further, future redevelopment at the Site could replace or otherwise account for this surface cover.

3.4.1.3 Restrictions

If monitored plume stability is selected as a corrective measures alternative or element of the corrective measures alternative, a Restrictive Covenant would be filed with the deeds to prohibit any activity that would interfere with the function of, or obstruct access to, any monitoring wells and devices located on site or provide for acceptable replacement of any monitoring well. In addition, the Restrictive Covenant would prohibit any excavation or other intrusive activity that could affect the integrity of the surface cover over the source areas, except during short-term construction or repair projects or for purposes of further treating or remediating the subject contamination. Any excavation or other intrusive activity, including removing, altering, or disturbing the surface cover over source areas that could affect the integrity of the surface cover must include the use of engineering controls to prevent the infiltration of water into the contaminated soil underlying the barrier until the existing surface cover is repaired or replaced. The surface cover over source areas must be repaired or replaced with a cover that provides at least an equivalent degree of protection as the original. Repair and/or replacement of the surface cover over source areas would be required unless it is determined that surface cover in the area is no longer necessary to limit infiltration.

3.4.2 In-Situ Chemical Oxidization

In-situ chemical oxidation (ISCO) has been identified as part of a potential corrective measures alternative for Areas 9 and 11 for source treatment. ISCO was not considered for areas with LNAPL. Generally, oxidant reactions occur in the dissolved phase and do not directly treat LNAPL. Results of the RFI indicate that, where present, LNAPL is generally the source of dissolved-phase impacts. Therefore, if LNAPL cannot be effectively treated with ISCO, any temporary dissolved-phase treatment will likely rebound due to the ongoing presence of LNAPL.

For Area 9, ISCO would consist of injection of a chemical oxidant through permanent injection wells targeting the area where groundwater concentrations of xylenes exceed FESLs and Non-Residential Soil Volatilization to Indoor Air Inhalation Criteria. This option would include additional characterization to refine the proposed injection area, as well as field injection pilot testing to further evaluate the feasibility prior to full-scale application. Figure 4 shows the proposed location for ISCO to be used as a potential corrective measure for FESL exceedances in Area 9.

For Area 11, ISCO would consist of injection of a chemical oxidant through permanent injection wells targeting the 1,4-dioxane source area where high groundwater

concentrations are contributing to the lower 1,4-dioxane plume. This option would include additional characterization to refine the proposed injection area, as well as field injection pilot testing to further evaluate the feasibility prior to full-scale application. Figure 4 shows the proposed location for ISCO to be used as a potential corrective measure for source mass reduction in Area 11.

3.4.3 Hydraulic Control

Hydraulic control has been considered as part of a corrective measures alternative for perched impacts and the lower 1,4-dioxane groundwater plume. Based on the range of contaminants at the Site, all hydraulic control options (perched or lower) would require an above-grade treatment system that may include equalization, aeration, pH adjustment, filtration, air stripping, advanced oxidation, ion exchange, and granular-activated carbon. The treatment system effluent would be discharged in accordance with a National Pollutant Discharge Elimination System permit or publicly owned treatment works permit.

If hydraulic control is selected to address the 1,4-dioxane plume(s), it would be recommended that pre-design testing (e.g., treatability testing, pump testing) be implemented prior to full-scale application to verify design parameters, performance, and costs. Preliminary treatability testing has been completed for the lower 1,4-dioxane plume to determine the appropriate advanced oxidation treatment technology to meet discharge standards (Appendix B).

The perched water and lower 1,4-dioxane plume have been evaluated separately as discussed in the following sections.

3.4.3.1 Perched Zone Hydraulic Control

Hydraulic control has been considered as part of a corrective measures alternative for the perched zone. Preliminary plume stability assessment results indicate impacts present in perched groundwater are stable. However, perched hydraulic control could be implemented if ongoing groundwater sampling identifies certain plumes are not stable.

For the purposes of this RCRA CMS Report, the area for perched hydraulic control has been assumed to be all locations near property boundaries where perched impacts are present. However, any hydraulic control recovery and treatment would be designed to address the specific shallow plumes that are not stable and where restrictions are not

possible. Pumping wells would only be located near the property boundaries to prevent off-site migration, where applicable and where restrictions are not possible.

3.4.3.2 Lower 1,4- Dioxane Hydraulic Containment

Hydraulic containment has been considered as a corrective measure alternative for the lower 1,4-dioxane plume in groundwater. Hydraulic containment would be composed of pumping wells located at Plant 2 near the downgradient (i.e., southern) edge of the lower 1,4-dioxane plume to prevent off-site migration. Figure 5 shows a potential conceptual layout for hydraulic containment extraction wells to be used as a potential corrective measure for the lower 1,4-dioxane plume.

3.4.3.3 Lower 1,4-Dioxane Aggressive Pump and Treat

Aggressive pump and treat has been considered a corrective measures alternative for the lower 1,4-dioxane plume. Aggressive pump and treat would be composed of pumping wells located at Plant 2 near the downgradient edge of the lower 1,4-dioxane plume to prevent off-site migration. In addition, pumping wells would be located along the spine of the plume and in the source area located on Plant 3. Pumping along the entire the plume increases the aggressiveness of the corrective measure and reduces the overall operational timeframe when compared to the containment-only option. Figure 6 shows a potential conceptual layout for aggressive pump and treat extraction wells to be used as a potential corrective measure for the lower 1,4-dioxane plume.

3.4.3.4 Lower 1,4-Dioxane Groundwater Recirculation

Groundwater recirculation has been considered a corrective measures alternative for lower 1,4-dioxane plume. The remedy consists of extraction of groundwater from the plume via extraction wells, above-grade treatment of groundwater, and reinjection of treated groundwater back into the plume via injection wells. Recirculation of the groundwater enhances pore flushes and mass removal, making the remedy more aggressive and a shorter timeframe when compared to other pumping-only alternatives. Figure 7 shows a potential conceptual layout for groundwater recirculation injection and extraction wells to be used as a potential corrective measure for the lower 1,4-dioxane plume.

3.5 Light Non-Aqueous Phase Liquid

Corrective measures to address LNAPL at the Site have been evaluated as part of following the LNAPL Conceptual Site Model Decision Tree, which was developed in collaboration with the MDEQ Technical Assistance Program Support team. Appendix C provides evaluations utilizing the LNAPL Conceptual Site Model Decision Tree for Areas 5-2 and 17. The following sections detail the corrective measures evaluated for LNAPL.

3.5.1 Cap

Caps have been evaluated as potential corrective measures for the areas with LNAPL to limit infiltration and reduce the potential of exposure. For Area 5-2, capping would include preserving the current condition of the existing surface cover (e.g., building slabs, concrete, asphalt) with some extension to cover the LNAPL footprint. LNAPL in Area 17 is currently covered by concrete and asphalt. Figures 8 and 9 show the proposed cap areas for Area 5-2 and Area 17, respectively.

If capping were the (or part of the) selected corrective measures alternative, a Restrictive Covenant would be filed with the deeds to include prohibiting the removal, excavation, or other intrusive activity that could affect the integrity of the caps, except during short-term construction or repair projects or for purposes of further treating or remediating the subject contamination. In any excavation area or area where other intrusive activities (e.g., removing, altering, disturbing the caps) that could affect the integrity of the cap have occurred, the cap must be replaced with a cover that provides at least an equivalent degree of protection as the original cap. Repair and/or replacement of the caps would be required unless additional evaluation is conducted that demonstrates that a cap in the area is no longer necessary.

3.5.2 Excavation

Excavation and off-site disposal at a licensed disposal facility to remove LNAPL was evaluated as part of a potentially feasible corrective measures alternative for Areas 5-2 and 17. Two alternatives for the excavation option were considered: 1) removal of all LNAPL impacted soils and 2) targeted excavation of LNAPL-impacted soils. For the first alternative, the excavation would extend until all LNAPL was removed. For the targeted excavation option in Area 5-2, the excavation would be limited to specific locations within the LNAPL that have the highest fraction of VOCs to eliminate ongoing potential sources to groundwater. For the targeted excavation option in Area 17, the

excavation would be limited to the location where LNAPL is present in shallow soils (i.e., less than 5 feet below ground surface). A targeted excavation within Area 5-2 is being completed as an interim corrective measure to remove a former concrete vault and surrounding LNAPL- and PCB-impacted soils. The Interim Corrective Measures Work Plan is included in Appendix D. The work plan has been submitted to the MDEQ and USEPA for a coordinated approval and is currently in review.

If excavation were the (or part of the) selected corrective measures alternative, additional characterization to refine the proposed excavation area would be completed, if deemed necessary. Figure 8 shows the proposed excavation locations and the planned interim measure excavation in Plant 2, Area 5-2, and Figure 9 shows the proposed excavation locations in Plant 3, Area 17.

3.5.3 Light Non-Aqueous Phase Liquid Recovery (Skimming)

LNAPL skimming has been evaluated to remove LNAPL to the extent practicable. LNAPL skimming would involve installation of skimmers (i.e., belt skimmers or skimmer pumps) in permanent recovery wells to remove free-phase LNAPL that collects in wells. LNAPL would be transferred to an above-grade storage tank or drum and removed and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws. Figures 8 and 9 show the proposed LNAPL skimming areas for Area 5-2 and Area 17, respectively.

3.5.4 Soil Vapor Extraction

Soil vapor extraction (SVE) has been evaluated as an appropriate technology to volatilize and enhance aerobic degradation of LNAPL in Area 17 (gasoline) to mitigate compositional concerns of LNAPL. The LNAPL present in Area 5-2 consists of cutting oil with limited volatile components; therefore, SVE has not been evaluated for Area 5-2.

In Area 17, SVE would consist of installation of SVE wells across the perched water table to draw air across the surface of LNAPL to volatize and enhance aerobic degradation of the LNAPL. Pilot testing would be completed to determine the appropriate well spacing, extraction flow rates, wellhead vacuum, extraction equipment requirements, and air treatment requirements (if any). An air permit would be obtained, if required. Figure 9 shows the proposed SVE area for Area 17.

3.5.5 Multi-Phase Extraction

Multi-phase extraction (MPE) has been evaluated as a potential corrective measure to remove LNAPL from Areas 5-2 and 17 to the extent practicable, reduce volatile constituent concentrations, and mitigate compositional concerns of the LNAPL. Figures 8 and 9 show the proposed MPE areas for Area 5-2 and Area 17, respectively.

MPE would involve the installation of extraction wells to recover LNAPL and perched groundwater by pumping or high vacuum extraction. Soil vapor would also be removed to enhance recovery of the LNAPL and promote volatilization and aerobic biodegradation, when applicable. The groundwater and LNAPL would be separated above grade and the groundwater would be treated and discharged in accordance with a National Pollutant Discharge Elimination System permit or publicly owned treatment works permit.

Based on the range of contaminants at the Site, the above-grade treatment system may include equalization, aeration, pH adjustment, filtration, air stripping, advanced oxidation, ion exchange, and granular-activated carbon. Treatability testing would be required to determine the appropriate treatment technologies to meet the standards.

If groundwater treatment is required to address 1,4-dioxane in recovered groundwater, it is recommended that an extended field-scale pilot test of a unit treatment system be implemented prior to Site-wide application to verify long-term performance and costs, as operating requirements and costs can be significant for advanced oxidation process treatment units.

Recovered LNAPL would be removed and disposed in accordance with applicable requirements of RCRA and all other relevant federal, state and local laws. Pilot testing would be completed to determine the appropriate well spacing, extraction flow rates, wellhead vacuum, extraction equipment requirements, and air treatment requirements (if any). An air permit would be obtained, if deemed necessary.

4. Evaluation of Corrective Measures Alternatives

Table 3 presents evaluation of the corrective measures alternatives that meet the screening criteria for soil, groundwater, and LNAPL, and includes a description of the corrective measures alternative, the proposed treatment area for the corrective measures, evaluation of the corrective measures against the RCRA evaluation criteria (described below), and required pre-design testing.

The RCRA corrective measures alternative evaluation criteria are summarized below. Table 3 summarizes the results of the evaluation for each area.

- Long-Term Reliability and Effectiveness: This criterion considers both the level of threat posed by hazardous constituents remaining in place and the adequacy of the remedial alternative and the risk associated with any treatment residuals compared to untreated waste.

- Reduction of Toxicity, Mobility, or Volumes of Waste: This criterion considers the ability of the remedial alternatives to reduce the toxicity, mobility, or volume of waste significantly and permanently.

- Short-term Effectiveness: This criterion evaluates the effects of the remedial alternatives on human health and the environment during their implementation period. It considers factors such as impacts from remedy construction, transportation, and air quality.

- Implementation: This criterion considers the technical and administrative feasibility of implementing the selected remedial alternative.

- Community Acceptance: This criterion evaluates the issues and concerns the local community may have regarding the alternatives. The USEPA encourages community involvement in remedial alternatives, and community acceptance will be considered in the remedial alternative selection.

- State Acceptance: This criterion evaluates the technical and administrative issues and concerns the state may have regarding the alternatives. The USEPA encourages coordination with state agencies, and state acceptance will be considered in the remedial alternative selection.

- Cost: This criterion considers the cost effectiveness of each alternative. Cost effectiveness is evaluated by comparing the costs proportional to the effectiveness achieved by the remedial alternative. The basis for the cost estimates provided in Tables 3, are included in Appendix E.

- Sustainability: This criterion considers the sustainability of each alternative with regard to energy requirements; air emissions; water requirements, including impacts on water resources; land and ecosystem impacts; and material consumption and waste generation. The sustainability evaluation was used in conjunction with the core elements of the RCRA corrective measures alternatives evaluation to identify corrective measures alternatives that would balance effectiveness and sustainability.

In the perched zone where exceedances were limited to DW, DW Protection, GSI, and/or GSI Protection, the corrective measures alternatives considered were: 1) land and groundwater use restrictions with monitored plume stability and 2) hydraulic control. Based on the detailed information presented in Table 3, the variable nature of the perched zone, range of COCs, and geochemical conditions, hydraulic control would be very difficult to reliably implement and would be very costly. Current data indicates impacts in the perched zone are stable and on site. Therefore, land and groundwater use restrictions with monitored plume stability are appropriate corrective measures to mitigate risk, can be readily implemented, and are relatively cost effective.

In the perched zone, caps and excavations were considered for areas with exceedances of DC Criteria and PSIC. Caps are equally protective when compared to excavation, but are easier to implement and are relatively cost effective compared to excavation.

Land use restrictions and targeted excavation were the corrective measures evaluated for vapor intrusion risk present in the perched zone. For areas internal to the Site, land use restrictions will be effective in the short- and long-term to mitigate risk, are easy to implement, and are relatively cost effective. In areas near the property boundary where the potential for off-site impact is higher when compared to areas internal to the Site, excavation is more effective in mitigating short- and long-term risk.

For the lower 1,4-dioxane plume, source area ISCO, hydraulic containment, aggressive pump and treat, and groundwater recirculation were considered. All pumping options effectively mitigate risk associated with off-site migration in the short- and long-term and are implementable. Groundwater recirculation is the most aggressive option, will reduce concentrations in a shorter timeframe, and is relatively cost effective.

5. Proposed Corrective Measures Alternative

Table 4 presents the proposed final corrective measures alternative for Plants 2, 3, and 6 based on the evaluation of the potential corrective measures with respect to the RCRA evaluation criteria and is shown on Figure 10. The proposed final corrective measures alternative for the Site includes:

- Land Use Restrictions
- Groundwater Use Restrictions
- Monitored Plume Stability
- Caps
- Targeted Excavation
- Lower 1,4-Dioxane Groundwater Recirculation

5.1 Land Use Restrictions

To meet the corrective action objective, land use restrictions will be implemented as part of the corrective measures alternative. A Restrictive Covenant will be recorded with the deeds and will cover the following:

- Site-wide Land Use Restriction: Land use at the entire Site would be limited to industrial and/or commercial uses.
- Site-wide Contaminated Soil Management: All Site soils, media, and/or debris will be managed in accordance with the applicable requirements of RCRA and all other relevant state and federal laws.
- Site-wide Vapor Intrusion Exposure Restriction: Restricts the construction of new structures, unless such construction incorporates engineering controls designed to eliminate the potential for subsurface vapor-phase hazardous substances to migrate into the new structure at concentrations greater than applicable criteria, or unless prior to construction of any structure, an evaluation of the potential for any hazardous substances to volatilize into indoor air verifies the protection of persons

who may be present in the buildings and is in compliance with all relevant federal, state, and local laws.

- Subgrade Utility Restrictions: Restricts the construction of subgrade utilities in Areas 2, 5-1, 5-2, 5-5, 5-6, 5-8, and 17, unless the construction incorporates engineering controls designed to eliminate the potential for perched water to enter and/or migrate along the utility corridor or for the utility to release fluids that could infiltrate through the subsurface and exacerbate impacts to groundwater.

- Health and Safety Requirements for Intrusive Activities in Area 2s, 5-1, 5-2, 5-3, 5-5, 5-6, 5-8, 7, 16, 17, 18, 19, 20, and 21: Intrusive excavation activities will be conducted following a Site-specific Health and Safety Plan prepared by qualified professionals and intrusive activities are conducted by appropriately trained personnel.

5.2 Groundwater Use Restrictions

To meet the corrective action objective, groundwater use restrictions will be recorded on the deeds prohibiting the construction and use of wells or other devices on the Site to extract groundwater for consumption, irrigation, or any other purpose, except as provided below:

- Wells and other devices constructed as part of a response activity for the purpose of evaluating groundwater quality or to remediate subsurface contamination associated with a release of hazardous substances into the environment are permitted, provided the construction of the wells or devices complies with all applicable local, state, and federal laws and regulations and does not cause or result in a new release, exacerbation of existing contamination, or any other violation of local, state, or federal laws or regulations.

- Short-term dewatering for construction purposes is permitted provided the dewatering, including management and disposal of the groundwater, is conducted in accordance with all applicable local, state, and federal laws and regulations and does not cause or result in a new release, exacerbation of existing contamination, or any other violation of local, state, and federal environmental laws and regulations.

5.3 Monitored Plume Stability

Site-wide monitored plume stability is an integral part of the corrective measure, as it will provide important data to evaluate plume stability and the effectiveness of the selected corrective measures.

A majority of the investigation work completed at the Site has been completed in the past 2 to 3 years. The *Preliminary Geochemistry and Plume Stability Assessment* (ARCADIS 2014b) provides initial evaluation of existing groundwater sampling data (general four to six data points per well). This evaluation suggests the perched impacts, including 1,4-dioxane and VOCs, are stable, and that generally, metals exceedances are likely the result of slight shifts in the regional mildly reducing geochemical conditions. Monitoring will be completed in accordance with the *Revised Interim Groundwater Monitoring Work Plan* (ARCADIS 2014c), submitted on May 23, 2014, or as otherwise agreed to with MDEQ, beginning the second quarter of 2014. Data collected during the sampling activities will be used to:

- Verify the stability of the perched 1,4-dioxane and VOCs.
- Further evaluate metals in areas near Site boundaries, in areas where metals are known to be Site-related (chromium in Area 14), and in areas where the preliminary stability assessment showed increasing concentration trends.
- Determine stability of the lower 1,4-dioxane plume.
- Detect vertical or horizontal migration of COCs via a network of sentinel wells.
- Monitor LNAPL thickness in monitoring wells at the Site to verify LNAPL is not mobile.
- Verify changes to the Site storm sewer system and degradation of slabs across the Site do not result in VOCs, 1,4-dioxane, or metals leaving the Site via the storm sewer system at levels that may impact surface water.

Following each sampling event, ARCADIS will review the analytical results and determine if adjustments need to be made to the sampling plan or other action is appropriate. In 2018, after 5 years of monitoring a comprehensive plume stability analysis will be completed to optimize the monitoring plan and any other aspects of the corrective measure.

A Restrictive Covenant will be filed with the deeds to prohibit any activity that would interfere with the function of or obstruct access to any monitoring wells and devices located on the Site or allow for replacement. If one or more of the plumes are not stable, evaluation of contingency strategies will be initiated as discussed in Section 5.8.

The existing surface cover in the identified areas will be left in place to minimize recharge and to maximize the potential for the groundwater impacts to remain stable. Two areas of existing building slabs located directly over source material at Plant 2 (Areas 5-1, 5-2, 5-3, and 5-5) and Plant 3 (Areas 14, 17, and 18) will be maintained to their approximate current condition. All other surface cover near groundwater impacts will be retained (i.e., not removed) but will not be maintained as part of the corrective measures. Further, future redevelopment at the Site could replace or otherwise account for this surface cover.

A Restrictive Covenant will be filed with the deeds to prohibit any excavation or other intrusive activity that could affect the integrity of the surface cover over source areas, except during short-term construction or repair projects or for purposes of further treating or remediating the subject contamination. Any excavation or other intrusive activity, including removing, altering, or disturbing the surface cover over source areas, that could affect the existing integrity of the surface cover, must include the use of engineering controls to limit the infiltration of water until the surface cover over source areas is repaired or replaced. The surface cover over source areas must be repaired or replaced with a cover that provides at least an equivalent degree of protection as the original cap. Repair and/or replacement of the surface cover over source areas is required unless additional evaluation is conducted, which demonstrates that the surface cover in the area is no longer necessary to limit infiltration.

5.4 Caps

Caps have been selected as part of the proposed corrective measures alternative to meet various needs at the Site. As previously discussed, the existing surface cover will be left in place over all areas of the Site where perched impacts have been observed and will be maintained as part of the corrective measures in areas directly over perched source areas. This has been incorporated into the monitored plume stability corrective measure to limit infiltration and maximize the potential to maintain a stable perched groundwater plume.

In addition, capping will be incorporated to reduce the potential for exposure to soils exceeding DC Criteria and PSIC. In Areas 5-1, 5-2, 5-3, 5-8, 19, and 21, existing

building slabs currently in place cover (or partially cover) the DC Criteria and PSIC exceedances. Existing building slabs will be extended to cover the entire area of exceedances in Areas 5-2 and 5-3. In Areas 2, 5-5, 5-6, 7, 16, 18, Area 20, where existing building slabs are not present, capping will include either placement of clean surface cover (e.g., soil, gravel) or utilizing existing cover (i.e., sufficient existing soil/grave, concrete, or asphalt) to prevent exposure. If existing concrete and/or asphalt is present, it will be inspected and repaired/replaced as needed.

Based on the evaluation of LNAPL present in Areas 5-2 and 17, utilizing the LNAPL Conceptual Site Model Decision Tree provided in Appendix C, caps are appropriate to mitigate the risk associated with LNAPL for these areas. The existing building slab in Area 5-2 will be extended to cover the extent of LNAPL in this area, with the objective of minimizing infiltration of precipitation and providing an exposure barrier. Existing concrete and asphalt present in Area 17 will be inspected, repaired, and/or replaced as deemed necessary to minimize infiltration and provide an exposure barrier.

A Restrictive Covenant will be filed with the deeds to include prohibiting the removal, excavation, or other intrusive activity that could affect the integrity of the caps, except during short-term construction or repair projects or for purposes of further treating or remediating the subject contamination. Any excavation or other intrusive activity, including removing, altering, or disturbing the caps, that could affect the integrity of the barrier, must be replaced with a cover that provides at least an equivalent degree of protection as the original barrier. Repair and/or replacement of the caps would be required unless additional sampling is conducted that demonstrates a cap in the area is no longer necessary.

5.5 Targeted Excavation

Targeted excavations have been selected as part of the proposed corrective measures alternative for Areas 5-7, 7, and 9 where concentrations of COCs represent a vapor intrusion risk near the property boundary. In addition, removal of these soils will also reduce the potential for off-site migration of the COCs via groundwater. Excavated soils will be transported and disposed at a licensed disposal facility.

A targeted excavation within Area 5-2 is being completed as an interim corrective measure to remove a former concrete vault and surrounding LNAPL- and PCB-impacted soils. The Interim Correctives Measures Work Plan (Appendix D) has been submitted to, and currently being reviewed by, the MDEQ and USEPA for a coordinated approval.

5.6 Lower 1,4-Dioxine Groundwater Recirculation

Groundwater recirculation is the remedy selected to address the lower 1,4-dioxane plume because it is cost-effective and the most aggressive alternative and will remediate the plume in the shortest timeframe. The remedial objective of the groundwater recirculation system is to reduce groundwater concentrations of 1,4-dioxane in the aquifer on site to a concentration that will not migrate off site above the current Part 201 Criteria, unless restrictions are instituted. This objective is consistent with the corrective action objective for the Site of achieving industrial/commercial closure (i.e., non-residential closure per MDEQ standards) in accordance with the Settlement Agreement.

The remedy will consist of groundwater extraction from the plume via extraction wells and above-grade treatment of groundwater at a central location. Based on the contaminants present and geochemical conditions, the above-grade treatment system may include equalization, aeration, pH adjustment, filtration, air stripping, advanced oxidation, ion exchange, and granular-activated carbon. The treated groundwater will be re-injected back into the plume via injection wells. If the treated water cannot be re-injected, the excess groundwater will be discharged in accordance with a National Pollutant Discharge Elimination System permit or publicly owned treatment works permit.

Performance data associated with the groundwater recirculation system will be routinely evaluated so that ongoing optimization can be implemented during operation. The groundwater recirculation system will be designed to allow for adaptive operation over time.

Preliminary treatability testing has been completed to determine the appropriate advanced oxidation treatment technology to meet discharge standards (Appendix B). Treatability test results indicated that the advanced oxidation process can effectively reduce concentrations of 1,4-dioxane to less than 1 microgram per liter. Additional pre-design investigation and testing is currently planned to be completed in summer 2014.

The CMS was prepared based on the information available from the RFI. It was, therefore, assumed that no significant source mass was present in the perched zone soils near the coliseum (Plant 3, Area 11) that continues to contribute to the lower 1,4-dioxane plume. The initial phase of pre-design work involves additional characterization of the source area in Plant 3 to determine if a significant source remains in the perched zone. If perched source mass is present at concentrations high

enough to contribute to groundwater with the potential to migrate off site above residential criteria, other measures may be evaluated.

In addition, a successful remedy will largely depend on the size, depth, and accessibility of the 1,4-dioxane source mass present within the deep overburden and weathered bedrock zone and the ability to re-inject into the deep overburden and weathered bedrock. Additional characterization of the deep overburden and weathered bedrock zone will be completed to determine the size and hydraulic character of the lower 1,4-dioxane source mass. Assuming that the hydrogeology of the aquifer allows for adequate circulation of injected water, the source mass in the deep overburden and weathered bedrock would be incorporated into the recirculation system. Alternately, ISCO may be considered as a potential source treatment option if the source mass is small enough for ISCO to be cost effectively implemented.

In addition to the source area characterization, pumping tests and injection testing will be completed along the axis of the lower 1,4-dioxane plume to confirm conceptual groundwater recirculation design assumptions. Tests will be completed at two to three locations to assess the hydraulic variability along the lower 1,4-dioxane plume.

If the pre-design testing shows that groundwater recirculation is not a technically feasible and/or a cost effective remedy, the data collected during the pre-design characterization and testing will be utilized to re-evaluate potential corrective measures to address the lower 1,4-dioxane plume. Potential contingency measures are discussed in Section 5.8.

5.7 Five-Year Review

Initial analysis after the first full year of interim groundwater monitoring indicates groundwater impacts are generally stable (ARCADIS 2014b), with the possible exception of the lower 1,4-dioxane plume (ARCADIS 2014d). Interim groundwater monitoring is in progress and will continue to collect data required to verify plume stability per the *Revised Interim Groundwater Monitoring Work Plan* (ARCADIS 2014c), submitted on May 23, 2014.

In 2018, after 5 years of monitoring have been completed), the selected corrective measures alternative will be reviewed to verify and optimize performance. The 5-year review may include, but is not limited to the following:

- Evaluation of the caps to determine if they are effective and/or necessary in all areas to meet the corrective action objective.

- Review of the surface cover and cap inspection and maintenance plan.

- Review of storm sewer monitoring to determine if ongoing sampling is required to verify surface water is protected.

- Evaluate if Site redevelopment could result in changes to the Site-wide corrective measures and/or objectives.

- Assessment of the revised interim monitoring plan to determine if the frequency, analytes, and/or number of wells can be optimized during future routine sampling events.

5.8 Contingency Strategies

This RCRA CMS Report has been prepared based on the data currently available. A contingency remedy may be considered if:

- Ongoing plume stability evaluation shows that one or more groundwater plume(s) is not stable, is migrating off Site above Part 201 Criteria, and is attributable to the Site.

- Pre-design testing shows a perched zone source area near the coliseum (Plant 3 Area 11) is contributing to the lower 1,4-dioxane plume above the corrective action objectives.

- Pre-design testing shows that groundwater recirculation is not a feasible remedy for the lower 1,4-dioxane plume.

- Performance monitoring of the groundwater recirculation system shows that the corrective action objectives cannot be met technically and/or cost effectively.

If any of these triggers are met, further evaluation of alternative corrective measures included in this CMS or other measures identified as potentially applicable may be completed. The contingency remedy could consist of corrective measures evaluated in this CMS, as they are considered relevant and applicable methods to control the groundwater plume(s) and reduce source concentrations, if required, to meet the

corrective action objectives. Additional evaluation and pre-design activities will be required to determine the appropriate corrective measure(s). The evaluation may include one or more of the following:

- Feasibility of off-site groundwater restrictions or ordinances
- Investigation(s) to further refine potential excavation area(s)
- Investigation to further refine potential ISCO area(s)
- Implementation of field injection testing to understand the injection hydraulics for a potential injection-based remedy in the perched zone
- Implementation of the SVE pilot test to evaluate the feasibility of vapor extraction

6. Schedule

A Corrective Measures Implementation Work Plan will be submitted to the MDEQ within 90 days of approval of the corrective measures alternative. The work plan will include detailed descriptions of implementation activities and associated schedules.

7. References

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Tables

Table 1
RFI Screening Matrix and CMS Applicable Exceedances

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Subarea	Associated AOI	RFI Identified Exceedances	CMS Applicable Exceedances	Exceedances that do not Require a Corrective Measure
Lower 1,4-Dioxane Plants 2 and 3	NA	Lower 1,4-Dioxane Plants 2 and 3	GW: 1,4-dioxane and VOCs > DW Metals > DW	GW: 1,4-dioxane > Proposed DW (8.5 µg/L) and DW	• Metals > DW: Exceedances in groundwater are attributed to natural fluctuations in geochemical conditions; therefore, metals in this area will not be addressed as part of the CMS (ARCADIS 2014b).
Plant 2 AREA 1	NA	AOI 2-16	SOIL: SVOCs > GSIP Metals > DWP and GSIP	SOIL: SVOCs > GSIP Metals > DWP and GSIP	• NA
			GW: VOCs & SVOCs > GSI Metals > DW and GSI	GW: VOCs > GSI Metals > DW and GSI	• SVOCs > GSI: The SVOC exceedance(s) in this area were phthalates. Phthalates are a common laboratory contaminant and were detected in blanks. Therefore, evaluation of corrective measures for SVOCs in this area are not required (ARCADIS 2014c).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 2 AREA 2	NA	AOI 2-12 AOI 2-52 AOI ID 2-26	SOIL: VOCs > DWP, GSIP, and SVIIC Metals > DWP, GSIP, DC and PSIC	SOIL: VOCs > DWP, GSIP, and SVIIC Metals > DWP, GSIP, DC, and PSIC	• NA
			GW: VOCs > DW, GSI, and draft $GW_{VI\text{-}nr}$ Metals > DW	GW: VOCs > DW, GSI, and draft $GW_{VI\text{-}nr}$	• Metals > DW: Exceedances in groundwater are attributed to natural fluctuations in geochemical conditions; therefore, metals in this area will not be addressed as part of the CMS (ARCADIS 2014b).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 2 AREA 3	NA	AOI 2-11	SOIL: No constituents exceed Part 201 Criteria	SOIL: No applicable exceedances of Part 201 Criteria	• SOIL: No constituents exceed Part 201 Criteria.
			GW: 1,4-dioxane > Proposed DW (8.5 µg/L) Metals > DW and GSI	GW: No applicable exceedances of Part 201 Criteria	• 1,4-dioxane > Proposed DW (8.5 µg/L): Included in lower 1,4-Dioxane AOI (ARCADIS 2014a). • Metals > DW and GSI: Exceedances in groundwater are attributed to natural fluctuations in geochemical conditions; therefore, metals in this area will not be addressed as part of the CMS (ARCADIS, 2014b).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 2 AREA 4	NA	AOI 2-8	SOIL: Metals > DWP and GSIP	SOIL: Metals > DWP and GSIP	• NA
			GW: Metals > DW	GW: No applicable exceedances of Part 201 Criteria	• Metals > DW: Exceedances in groundwater are attributed to natural fluctuations in geochemical conditions; therefore, metals in this area will not be addressed as part of the CMS(ARCADIS 2014b).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 2 AREA 5-1	5-1	AOI 2-11 AOI ID 2-31 ID 2-32 ID 2-33 ID 2-34 ID 2-35 ID 2-49	SOIL: SVOCs > DWP, GSIP, and DC Metals > DWP and GSIP	SOIL: SVOCs > DWP, GSIP, and DC Metals > DWP and GSIP	• NA
			GW: VOCs > DW 1,4-dioxane > Proposed DW (8.5 µg/L) and DW SVOCs > DW Metals > DW and GSI	GW: VOCs > DW 1,4-dioxane > Proposed DW (8.5 µg/L) and DW	• SVOCs > DW: The SVOC exceedance(s) in this area were phthalates. Phthalates are a common laboratory contaminant and were detected in blanks. Therefore, evaluation of corrective measures for SVOCs in this area are not required (ARCADIS 2014c). • Metals > DW and GSI: Exceedances in groundwater are attributed to natural fluctuations in geochemical conditions; therefore, metals in this area will not be addressed as part of the CMS (ARCADIS 2014b).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 2 AREA 5-2	5-2	AOI 2-6 AOI 2-14 AOI ID 2-36	SOIL: VOCs > DWP, GSIP, and SVIIC SVOCs > DWP, GSIP, VSIC, and DC PCBs > DC Metals > DWP, GSIP, DC, and PSIC	SOIL: VOCs > DWP, GSIP, and SVIIC SVOCs > DWP, GSIP, and DC PCBs > DC Metals > DWP, GSIP, DC, and PSIC	• SVOCs > VSIC: The concentrations did not exceed the generic Infinite Source VSIC for a ½-acre source area and, therefore, will not be addressed as part of the CMS (ARCADIS 2013).
			GW: VOCs > DW and GSI 1,4-dioxane > Proposed DW (8.5 µg/L) and DW SVOCs > DW, GSI, GC, and Sol PCBs > DW, GSI, $GW_{VI\text{-}nr}$, GC, and Sol Metals > DW and GSI	GW: VOCs > DW and GSI 1,4-dioxane > Proposed DW (8.5 µg/L) and DW PCBs > DW, GC, and Sol	• SVOCs > DW, GSI, GC, and Sol: There has only been one historical SVOC exceedance in this area, the corrective measures driver in this area is LNAPL, 1,4-dioxane, and VOCs. Corrective measures implemented to address these drivers will address the SVOCs. Therefore, SVOCs are not separately evaluated in the CMS (ARCADIS 2014c). • Metals > DW and GSI: Exceedances in groundwater are attributed to natural fluctuations in geochemical conditions; therefore, metals in this area will not be addressed as part of the CMS (ARCADIS 2014b).
			LNAPL: Present	LNAPL: Present	• NA

See notes on page 5.

Table 1
RFI Screening Matrix and CMS Applicable Exceedances

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Subarea	Associated AOI	RFI Identified Exceedances	CMS Applicable Exceedances	Exceedances that do not Require a Corrective Measure
Plant 2 AREA 5-3	5-3	AOI 2-1 AOI ID 2-59 Miscellaneous Data Gap Borings	SOIL: VOCs > DWP, GSIP, and SVIIC SVOCs > DWP, GSIP, and DC Metals > DWP, GSIP, and PSIC	SOIL: VOCs > DWP, GSIP, and SVIIC SVOCs > DWP, GSIP, and DC Metals > DWP, GSIP, and PSIC	• NA
			GW: VOCs > GSI 1,4-dioxane > Proposed DW (8.5 µg/L) and DW Metals > DW and GSI	GW: VOCs > GSI 1,4-dioxane > Proposed DW (8.5 µg/L) and DW	• Metals > DW and GSI: Exceedances in groundwater are attributed to natural fluctuations in geochemical conditions; therefore, metals in this area will not be addressed as part of the CMS (ARCADIS 2014b).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 2 AREA 5-4	5-4	AOI ID 2-39	SOIL: No constituents exceed Part 201 Criteria	SOIL: No constituents exceed Part 201 Criteria	• SOIL: No constituents exceed Part 201 Criteria
			GW: Metals > DW and GSI	GW: No applicable exceedances of Part 201 Criteria	• Metals > DW and GSI: Exceedances in groundwater are attributed to natural fluctuations in geochemical conditions; therefore, metals in this area will not be addressed as part of the CMS (ARCADIS 2014b).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 2 AREA 5-5	5-5	AOI 2-15	SOIL: VOCs > DWP SVOCs > GSIP and DC Metals > DWP, GSIP, and PSIC	SOIL: VOCs > DWP SVOCs > GSIP and DC Metals > DWP and GSIP	• Metals > PSIC: Manganese exceedance of the PSIC is deep (56 to 57 feet) and, therefore, is not a concern, as soil this deep is not likely to be brought to the surface (ARCADIS 2013).
			GW: 1,4-dioxane > Prop DW (8.5 µg/L) SVOCs > DW Metals > DW and GSI	GW: 1,4-dioxane > Prop DW (8.5 µg/L) Metals > DW and GSI	• SVOCs > DW: The SVOC exceedance(s) in this area were phthalates. Phthalates are a common laboratory contaminant and were detected in blanks. Therefore, evaluation of corrective measures for SVOCs in this area are not required (ARCADIS 2014c).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 6 AREA 5-6	5-6	AOI 6-18 AOI 6-48	SOIL: VOCs > DWP and GSIP Metals > DWP, GSIP, and DC	SOIL: VOCs > DWP and GSIP Metals > DWP, GSIP, and DC	• NA
			GW: VOCs > DW and GSI 1,4-dioxane > Prop DW (8.5 µg/L) Metals > DW and GSI	GW: VOCs > DW and GSI 1,4-dioxane > Prop DW (8.5 µg/L) Metals > DW and GSI	• NA
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 6 AREA 5-7	5-7	AOI 6-43 AOI 6-88	SOIL: VOCs > DWP, GSIP, SVIIC, and VSIC Metals > DWP and GSIP	SOIL: VOCs > DWP, GSIP, and SVIIC Metals > DWP and GSIP	• VOCs > VSIC: The concentrations did not exceed the generic Infinite Source VSIC for a ½-acre source area and, therefore, are not likely to be a concern for the Site (ARCADIS 2013).
			GW: VOCs > DW, GSI, and $GW_{VI\text{-}nr}$ SVOCs > GSI 1,4-dioxane > Proposed DW (8.5 µg/L) Metals > DW and GSI	GW: VOCs > DW, GSI, and $GW_{VI\text{-}nr}$ 1,4-dioxane > Proposed DW (8.5 µg/L) Metals > DW and GSI	• SVOCs > GSI: The SVOC exceedance(s) in this area were phthalates. Phthalates are a common laboratory contaminant and were detected in blanks. Therefore, evaluation of corrective measures for SVOCs in this area are not required (ARCADIS 2014c).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 6 AREA 5-8	5-8	AOI 6-49 AOI 6-81	SOIL: Metals > GSIP and PSIC	SOIL: Metals > GSIP and PSIC	• NA
			GW: 1,4-dioxane > Proposed DW (8.5 µg/L) Metals > DW and GSI	GW: 1,4-dioxane > Proposed DW (8.5 µg/L) Metals > DW and GSI	• NA
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 6 AREA 6	NA	AOI 6-16/6-33 AOI 6-59 AOI ID 6-36 ID 6-38 ID 6-39 ID 6-75	SOIL: No constituents exceed Part 201 Criteria	SOIL: No constituents exceed Part 201 Criteria	• SOIL: No constituents exceed Part 201 Criteria
			GW: 1,4-dioxane > Prop DW (8.5 µg/L) Metals > DW and GSI	GW: Metals > DW and GSI	• 1,4-dioxane > Prop DW (8.5 µg/L): One historical detection of 1,4-dioxane was detected above the proposed drinking water standard at MWBP-12-UST5-6 at a concentration of 9 µg/L in October 2011. MWBP-UST5-6 has been sampled quarterly since October 2011 and no exceedances have been detected since that date.
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present

See notes on page 5.

Table 1
RFI Screening Matrix and CMS Applicable Exceedances

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Subarea	Associated AOI	RFI Identified Exceedances	CMS Applicable Exceedances	Exceedances that do not Require a Corrective Measure
Plant 6 AREA 7	NA	AOI 6-17 AOI 6-47	SOIL: VOCs > DWP, GSIP, SVIIC, DC, GCP, and C_{sat} SVOCs > GSIP and DC Metals > GSIP	SOIL: VOCs > DWP, GSIP, DC, SVIIC, and C_{sat} SVOCs > GSIP and DC Metals > GSIP	• VOCs > GCP: GCP is no longer an MDEQ criteria (ARCADIS 2014a).
			GW: VOCs > DW and GSI SVOCs > DW Metals > DW and GSI	GW: VOCs > DW and GSI Metals > DW and GSI	• SVOCs > DW: The SVOC exceedance(s) in this area were phthalates. Phthalates are a common laboratory contaminant and were detected in blanks. Therefore, evaluation of corrective measures for SVOCs in this area are not required (ARCADIS 2014c).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 2 AREA 8	NA	AOI 2-7 AOI ID 2-37 AOI ID 2-38	SOIL: SVOCs > DWP and GSIP Metals > DWP and GSIP	SOIL: SVOCs > DWP & GSIP Metals > DWP & GSIP	• NA
			GW: SVOCs > GSI Metals > DW and GSI	GW: No applicable exceedances of Part 201 Criteria	• SVOCs > GSI: The SVOC exceedance(s) in this area were phthalates. Phthalates are a common laboratory contaminant and were detected in blanks. Therefore, evaluation of corrective measures for SVOCs in this area are not required (ARCADIS 2014c). • Metals > DW and GSI: Exceedances in groundwater are attributed to natural fluctuations in geochemical conditions; therefore, metals in this area will not be addressed as part of the CMS (ARCADIS 2014b).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 6 AREA 9	NA	AOI 6-60 Miscellaneous data gap	SOIL: VOCs > DWP, GSIP, DC, SVIIC, GCP, and C_{sat} SVOCs > DWP, GSIP, VSIC, and DC	SOIL: VOCs > DWP, GSIP, DC, SVIIC, and C_{sat} SVOCs > DWP, GSIP, and DC	• VOCs > GCP: GCP is no longer an MDEQ criteria (ARCADIS 2013). • SVOCs > VSIC: The concentrations did not exceed the generic Infinite Source VSIC for a ½-acre source area and, therefore, are not likely to be a concern for the Site (ARCADIS 2013).
			GW: VOCs > DW, GSI, FESL, and $GW_{VI\text{-}nr}$ SVOCs > GSI Metals > DW and GSI	GW: VOCs > DW, GSI, FESL, and $GW_{VI\text{-}nr}$ Metals > DW & GSI	• SVOCs > GSI: The SVOC exceedance in this area were phthalates. Phthalates are a common laboratory contaminant and were detected in blanks. Therefore, evaluation of corrective measures for SVOCs in this area are not required (ARCADIS 2014c).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 6 AREA 10	NA	AOI 6-19 AOI 6-63 AOI 6-82	SOIL: Metals > GSIP and PSIC	SOIL: Metals > GSIP	• Metals > PSIC: Manganese (historical sample) exceeded the PSIC for a 100-acre source, but not a 5-acre source. Therefore, likely not a concern for the Site (ARCADIS 2013).
			GW: No constituents exceed Part 201 Criteria	GW: No constituents exceed Part 201 Criteria	• GW: No constituents exceed Part 201 Criteria.
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 3 AREA 11	NA	AOI ID 3-54	SOIL: VOCs > DWP, GSIP, and SVIIC SVOCs > GSIP Metals > DWP and GSIP	SOIL: VOCs > DWP, GSIP, and SVIIC SVOCs > GSIP Metals > DWP and GSIP	• NA
			GW: VOCs > DW and GSI 1,4-dioxane > Proposed DW (8.5 µg/L) and DW Metals > DW	GW: VOCs > DW and GSI 1,4-dioxane > Proposed DW (8.5 µg/L) and DW	• Metals > DW: Exceedances in groundwater are attributed to natural fluctuations in geochemical conditions; therefore, metals in this area will not be addressed as part of the CMS (ARCADIS 2014b).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 3 AREA 12	NA	MW-04-02 (TD=132.7') MW-04-03 (TD=88.25')	SOIL: No applicable exceedances of Part 201 Criteria	SOIL: No applicable exceedances of Part 201 Criteria	• SOIL: No applicable exceedances of Part 201 Criteria
			GW: VOCs > DW	GW: No applicable exceedances of Part 201 Criteria	• VOCs > DW: Based on the general lack of a chlorinated volatile organic compound (CVOC) source at Plant 3 and the known regional vinyl chloride impacts to bedrock, the vinyl chloride identified at Plant 3 is attributed to off-site source(s) and will not be addressed as part of the CMS (ARCADIS, 2014b).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 3 AREA 13	NA	Background Sample	SOIL: No applicable exceedances of Part 201 Criteria	SOIL: No constituents exceed Part 201 Criteria	• SOIL: No applicable exceedances of Part 201 Criteria
			GW: No applicable exceedances of Part 201 Criteria	GW: No applicable exceedances of Part 201 Criteria	• GW: No applicable exceedances of Part 201 Criteria
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 3 AREA 14	NA	AOI 3-10 Misc. Data Gap Borings	SOIL: Metals > DWP, GSIP, DC, and PSIC	SOIL: Metals > DWP and GSIP	• Metals > DC and PSIC: Arsenic exceeds the DC in the northern portion of Area 14 at a depth of 43.5 to 45 feet bgs, due to the depth of the exceedance exposure is not likely. Nickel did not exceed the PSIC for a ½-acre. Total chromium (as hexavalent chromium) did; however, it was determined that total chromium should be compared to chromium 3 and, therefore, it does not exceed PSIC (ARCADIS 2013).
			GW: Metals > DW and GSI	GW: Metals > DW and GSI	• NA
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present

See notes on page 5.

Table 1
RFI Screening Matrix and CMS Applicable Exceedances

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Subarea	Associated AOI	RFI Identified Exceedances	CMS Applicable Exceedances	Exceedances that do not Require a Corrective Measure
Plant 3 AREA 15	NA	AOI ID 3-15	SOIL: VOCs > DWP and VSIC SVOCs > GSIP Metals > GSIP	SOIL: VOCs > DWP SVOCs > GSIP Metals > GSIP	• VOCs > VSIC: The concentrations did not exceed the generic Infinite Source VSIC for a ½-acre source area and, therefore, are not likely to be a concern for the Site (ARCADIS 2013).
			GW: 1,4-dioxane > Proposed DW (8.5 µg/L) SVOCs > DW Metals > DW and GSI	GW: 1,4-dioxane > Proposed DW (8.5 µg/L)	• SVOCs > DW: The SVOC exceedance(s) in this area were phthalates. Phthalates are a common laboratory contaminant and were detected in blanks. Therefore, evaluation of corrective measures for SVOCs in this area are not required (ARCADIS 2014c). • Metals > DW & GSI: Exceedances in groundwater are attributed to natural fluctuations in geochemical conditions; therefore, metals in this area will not be addressed as part of the CMS (ARCADIS 2014b).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 3 AREA 16	NA	AOI 3-11	SOIL: SVOCs > DWP, GSIP, and DC Metals > DWP, GSIP, DC, and PSIC	SOIL: SVOCs > DWP, GSIP, and DC Metals > DWP, GSIP, and DC	• Metals > PSIC: The concentration did not exceed the 5-acre source area and, therefore, are not likely to be a concern for the Site (ARCADIS 2013).
			GW: Metals > DW and GSI	GW: No constituents exceed Part 201 Criteria	• Metals > DW and GSI: Exceedances in groundwater are attributed to natural fluctuations in geochemical conditions; therefore, metals in this area will not be addressed as part of the CMS (ARCADIS 2014b).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 3 AREA 17	NA	AOI 3-3 AOI 3-4 AOI 3-9	SOIL: VOCs > DWP, GSIP, and SVIIC SVOCs > GSIP Metals > GSIP	SOIL: VOCs > DWP, GSIP, and SVIIC SVOCs > GSIP Metals > GSIP	• NA
			GW: VOCs > DW, GSI, and $GW_{VI\text{-}nr}$ 1,4-dioxane > Proposed DW (8.5 µg/L) SVOCs > DW Metals > DW and GSI	GW: VOCs > DW, GSI, and $GW_{VI\text{-}nr}$ Metals > DW and GSI	• SVOCs > DW, GSI, GC, and Sol: There has only been one historical SVOC exceedance in this area, the corrective measures driver in this area is LNAPL and VOCs. Corrective measures implemented to address these drivers will address the SVOCs. Therefore, SVOCs are not separately evaluated in the CMS (ARCADIS 2014c).
			LNAPL: Present	LNAPL: Present	• NA
Plant 3 AREA 18	NA	AOI 3-2 AOI 3-6	SOIL: SVOCs > DWP, GSIP, and DC Metals > DW and GSI	SOIL: SVOCs > DWP, GSIP, and DC Metals > DWP and GSIP	• NA
			GW: 1,4-dioxane > Proposed DW (8.5 µg/L) Metals > DW and GSI	GW: 1,4-dioxane > Proposed DW (8.5 µg/L)	• Metals > DW and GSI: Exceedances in groundwater are attributed to natural fluctuations in geochemical conditions; therefore, metals in this area will not be addressed as part of the CMS (ARCADIS 2014b).
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 3 AREA 19	NA	AOI ID 3-17	SOIL: SVOCs > GSIP Metals > DWP, GSIP, and DC	SOIL: SVOCs > GSIP Metals > DWP, GISP, and DC	• NA
			GW: Metals > DW and GSI	GW: Metals > DW and GSI	• NA
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 3 AREA 20	NA	AOI 3-51	SOIL: SVOCs > GSIP Metals > DWP, GSIP, and PSIC	SOIL: SVOCs > GSIP Metals > DWP, GSIP, and PSIC	• NA
			GW: No constituents exceed Part 201 Criteria	GW: No constituents exceed Part 201 Criteria	• GW: No constituents exceed Part 201 Criteria
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present
Plant 3 AREA 21	NA	AOI 3-51	SOIL: Metals > DWP, GSIP, and DC	SOIL: Metals > DWP, GSIP, and DC	• NA
			GW: No constituents exceed Part 201 Criteria	GW: No constituents exceed Part 201 Criteria	• GW: No constituents exceed Part 201 Criteria
			LNAPL: NA, not present	LNAPL: NA, not present	• LNAPL: NA, not present

See notes on page 5.

Table 1
RFI Screening Matrix and CMS Applicable Exceedances

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Acronyms and Abbreviations:
> = greater than
AOI = area of interest
bgs = below ground surface
CMS = Corrective Measures Study
C_{sat} = Soil Saturation Concentration Criteria
DC = Direct Contact Criteria
DW = Residential Drinking Water Criteria
DWP = Drinking Water Protection Criteria
FESL = Flammability and Explosivity Screening Level
GC = groundwater contact
GCP = groundwater contact protection
GSI = Groundwater/Surface Water Interface
GSIP = Groundwater/Surface Water Interface Protection Criteria
GW = groundwater
GW_{VI-nr} = draft Groundwater Concentrations for Vapor Intrusion
LNAPL = light non-aqueous phase liquid
MDEQ = Michigan Department of Environmental Quality
NA = not applicable
Part 201 Criteria = Part 201 Generic Cleanup Criteria
PCB = polychlorinated biphenyl
Prop = proposed
PSIC = Particulate Soil Inhalation Criteria
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation
Sol = solubility
SVIIC = Soil Volatilization to Indoor Air Inhalation Criteria
SVOC = semivolatile organic compound
µg/L = micrograms per liter
VOC = volatile organic compound
VSIC = volatile soil inhalation criteria

References:

ARCADIS. 2013. Resource Conservation and Recovery Act Facility Investigation (RFI) Phase 2 Activities Summary Report. Michigan Plants 2, 3 & 6 Industrial Land. April.
ARCADIS. 2014a. RFI Supplemental Phase 2 Activities Summary Report. RACER Trust, Lansing, Michigan Plants 2, 3 & 6 Industrial Land. February 26.
ARCADIS. 2014b. Preliminary Groundwater Geochemical and Plume Stability Assessment. Plants 2, 3, and 6, Industrial Land, Lansing, Michigan. April 24.
ARCADIS. 2014c. Revised Interim Groundwater Monitoring Work Plan. RACER Trust, Plants 2, 3, & 6, Lansing, Michigan. May 23.

Table 2
Corrective Measures Alternatives Screening Matrix

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Subarea	Associated AOI	Summary of Applicable Exceedances	Identified Corrective Measures	Protective of Human Health and the Environment (Yes/No)	Attain Media Cleanup Objectives (Yes/No)	Control the Source or Demonstrate Plume Stability (Yes/No)	Potential Corrective Measures Alternatives for Further Evaluation
Lower 1,4-Dioxane Plants 2 and 3	NA	NA	GW: 1,4-dioxane > Proposed DW (8.5 µg/L) and DW	Groundwater Use Restrictions	Yes	Yes	No	1) Groundwater Use Restrictions, Monitored Plume Stability, and Source Area ISCO 2) Groundwater Use Restrictions, Monitored Plume Stability, and On-site Hydraulic Containment 3) Groundwater Use Restrictions, Monitored Plume Stability, and Aggressive Pump and Treat 4) Groundwater Use Restrictions, Monitored Plume Stability, and Groundwater Recirculation
				Monitored Plume Stability	Yes	No	Yes	
				Source Area ISCO	Yes	Yes	Yes	
				Hydraulic Containment	Yes	Yes	Yes	
				Aggressive Pump and Treat	Yes	Yes	Yes	
				Groundwater Recirculation	Yes	Yes	Yes	
Plant 2 AREA 1	NA	AOI 2-16	SOIL: SVOCs > GSIP Metals > DWP and GSIP	Land Use Restriction	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, and Monitored Plume Stability
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
			GW: VOCs > GSI Metals > DW and GSI	Groundwater Use Restrictions	Yes	Yes	No	1) Groundwater Use Restrictions and Monitored Plume Stability 2) Perched Hydraulic Control
				Monitored Plume Stability	Yes	No	Yes	
				Perched Hydraulic Control	Yes	Yes	Yes	
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 2 AREA 2	NA	AOI 2-12 AOI 2-52 AOI ID 2-26	SOIL: VOCs > DWP, GSIP, and SVIIC Metals > DWP, GSIP, DC, and PSIC	Land Use Restriction	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and a Cap 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and Targeted Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Cap	Yes	Yes	Yes	
				Targeted Excavation	Yes	Yes	Yes	
			GW: VOCs > DW, GSI, and draft $GW_{VI\text{-}nr}$	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, and Monitored Plume Stability 2) Perched Perched Hydraulic Control
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Perched Perched Hydraulic Control	Yes	Yes	Yes	
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 2 AREA 3	NA	AOI 2-11	SOIL: No constituents exceed Part 201 Criteria	NA	NA	NA	NA	NA
			GW: No applicable exceedances of Part 201 Criteria	NA	NA	NA	NA	NA
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 2 AREA 4	NA	AOI 2-8	SOIL: Metals > DWP & GSIP	Land Use Restriction	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, and Monitored Plume Stability
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
			GW: No applicable exceedances of Part 201 Criteria	NA	NA	NA	NA	NA
			LNAPL: NA, not present	NA	NA	NA	NA	NA

See notes on page 7.

Table 2
Corrective Measures Alternatives Screening Matrix

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Subarea	Associated AOI	Summary of Applicable Exceedances	Identified Corrective Measures	Protective of Human Health and the Environment (Yes/No)	Attain Media Cleanup Objectives (Yes/No)	Control the Source or Demonstrate Plume Stability (Yes/No)	Potential Corrective Measures Alternatives for Further Evaluation
Plant 2 AREA 5-1	5-1	AOI 2-11 AOI ID 2-31 ID 2-32 ID 2-33 ID 2-34 ID 2-35 ID 2-49	SOIL: SVOCS > DWP, GSIP, and DC Metals > DWP and GSIP	Land Use Restriction	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and a Cap 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and Targeted Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Cap	Yes	Yes	Yes	
				Targeted Excavation	Yes	Yes	Yes	
			GW: VOCs > DW 1,4-dioxane > Proposed DW (8.5 µg/L) and DW	Groundwater Use Restrictions	Yes	Yes	No	1) Groundwater Use Restrictions and Monitored Plume Stability 2) Perched Perched Hydraulic Control
				Monitored Plume Stability	Yes	No	Yes	
				Perched Hydraulic Control	Yes	Yes	Yes	
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 2 AREA 5-2	5-2	AOI 2-6 AOI 2-14 AOI ID 2-36	SOIL: VOCs > DWP, GSIP, and SVIIC SVOCs > DWP, GSIP, and DC PCBs > DC Metals > DWP, GSIP, DC, and PSIC	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and a Cap 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and Targeted Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Cap	Yes	Yes	Yes	
				Targeted Excavation	Yes	Yes	Yes	
			GW: VOCs > DW and GSI 1,4-dioxane > Proposed DW (8.5 µg/L) and DW PCBs > DW, GC, and Sol	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, and Monitored Plume Stability 2) Perched Hydraulic Control
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Perched Hydraulic Control	Yes	Yes	Yes	
			LNAPL: Present	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and a Cap 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, a Cap, and Targeted Excavation 3) LNAPL Recovery (Skimmers) 4) Multi-Phase Extraction 5) Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Cap	Yes	Yes	Yes	
				LNAPL Recovery (Skimmers)	Yes	Yes	Yes	
				Multi-Phase Extraction	Yes	Yes	Yes	
				Excavation	Yes	Yes	Yes	
Plant 2 AREA 5-3	5-3	AOI 2-1 AOI ID 2-59 Miscellaneous Data Gap Borings	SOIL: VOCs > DWP, GSIP, and SVIIC SVOCs > DWP, GSIP, and DC Metals > DWP, GSIP, and PSIC	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and a Cap 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and Targeted Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Cap	Yes	Yes	Yes	
				Targeted Excavation	Yes	Yes	Yes	
			GW: VOCs > GSI 1,4-dioxane > Proposed DW (8.5 µg/L) & DW	Groundwater Use Restrictions	Yes	Yes	No	1) Groundwater Use Restrictions and Monitored Plume Stability 2) Perched Hydraulic Control
				Monitored Plume Stability	Yes	No	Yes	
				Perched Hydraulic Control	Yes	Yes	Yes	
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 2 AREA 5-4	5-4	AOI ID 2-39	SOIL: No constituents exceed Part 201 Criteria	NA	NA	NA	NA	NA
			GW: No applicable exceedances of Part 201 Criteria	NA	NA	NA	NA	NA
			LNAPL: NA, not present	NA	NA	NA	NA	NA

See notes on page 7.

Table 2
Corrective Measures Alternatives Screening Matrix

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Subarea	Associated AOI	Summary of Applicable Exceedances	Identified Corrective Measures	Protective of Human Health and the Environment (Yes/No)	Attain Media Cleanup Objectives (Yes/No)	Control the Source or Demonstrate Plume Stability (Yes/No)	Potential Corrective Measures Alternatives for Further Evaluation
Plant 2 AREA 5-5	5-5	AOI 2-15	SOIL: VOCs > DWP SVOCs > GSIP and DC Metals > DWP and GSIP	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and a Cap 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and Targeted Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Cap	Yes	Yes	Yes	
				Targeted Excavation	Yes	Yes	Yes	
			GW: 1,4-dioxane > Prop DW (8.5 µg/L) Metals > DW and GSI	Groundwater Use Restrictions	Yes	Yes	No	1) Groundwater Use Restrictions and Monitored Plume Stability 2) Perched Hydraulic Control
				Monitored Plume Stability	Yes	No	Yes	
				Perched Hydraulic Control	Yes	Yes	Yes	
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 6 AREA 5-6	5-6	AOI 6-18 AOI 6-48	SOIL: VOCs > DWP and GSIP Metals > DWP, GSIP, and DC	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and a Cap 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and Targeted Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Cap	Yes	Yes	Yes	
				Targeted Excavation	Yes	Yes	Yes	
			GW: VOCs > DW and GSI 1,4-dioxane > Prop DW (8.5 µg/L) Metals > DW and GSI	Groundwater Use Restrictions	Yes	Yes	No	1) Groundwater Use Restrictions and Monitored Plume Stability 2) Perched Hydraulic Control
				Monitored Plume Stability	Yes	No	Yes	
				Perched Hydraulic Control	Yes	Yes	Yes	
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 6 AREA 5-7	5-7	AOI 6-43 AOI 6-88	SOIL: VOCs > DWP, GSIP, and SVIIC Metals > DWP and GSIP	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, and Monitored Plume Stability 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and Targeted Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Targeted Excavation	Yes	Yes	Yes	
			GW: VOCs > DW, GSI, and $GW_{VI\text{-}nr}$ 1,4-dioxane > Proposed DW (8.5 µg/L) Metals > DW and GSI	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, and Monitored Plume Stability 2) Perched Hydraulic Control
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Perched Hydraulic Control	Yes	Yes	Yes	
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 6 AREA 5-8	5-8	AOI 6-49 AOI 6-81	SOIL: Metals > GSIP and PSIC	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and a Cap 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and Targeted Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Cap	Yes	Yes	Yes	
				Targeted Excavation	Yes	Yes	Yes	
			GW: 1,4-dioxane > Proposed DW (8.5 µg/L) Metals > DW and GSI	Groundwater Use Restrictions	Yes	Yes	No	1) Groundwater Use Restrictions and Monitored Plume Stability 2) Perched Hydraulic Control
				Monitored Plume Stability	Yes	No	Yes	
				Perched Hydraulic Control	Yes	Yes	Yes	
			LNAPL: NA, not present	NA	NA	NA	NA	NA

See notes on page 7.

Table 2
Corrective Measures Alternatives Screening Matrix

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Subarea	Associated AOI	Summary of Applicable Exceedances	Identified Corrective Measures	Protective of Human Health and the Environment (Yes/No)	Attain Media Cleanup Objectives (Yes/No)	Control the Source or Demonstrate Plume Stability (Yes/No)	Potential Corrective Measures Alternatives for Further Evaluation
Plant 6 AREA 6	NA	AOI 6-16/6-33 AOI 6-59 AOI ID 6-36 ID 6-38 ID 6-39 ID 6-75	SOIL: No constituents exceed Part 201 Criteria	NA	NA	NA	NA	NA
			GW: Metals > DW and GSI	Groundwater Use Restrictions	Yes	Yes	No	1) Groundwater Use Restrictions and Monitored Plume Stability 2) Perched Hydraulic Control
				Monitored Plume Stability	Yes	No	Yes	
				Perched Hydraulic Control	Yes	Yes	Yes	
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 6 AREA 7	NA	AOI 6-17 AOI 6-47	SOIL: VOCs > DWP, GSIP, DC, SVIIC, and C_{sat} SVOCs > GSIP & DC Metals > GSIP	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and a Cap 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and Targeted Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Cap	Yes	Yes	Yes	
				Targeted Excavation	Yes	Yes	Yes	
			GW: VOCs > DW and GSI Metals > DW and GSI	Groundwater Use Restrictions	Yes	Yes	No	1) Groundwater Use Restrictions and Monitored Plume Stability 2) Perched Hydraulic Control
				Monitored Plume Stability	Yes	No	Yes	
				Perched Hydraulic Control	Yes	Yes	Yes	
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 2 AREA 8	NA	AOI 2-7 AOI ID 2-37 AOI ID 2-38	SOIL: SVOCs > DWP and GSIP Metals > DWP and GSIP	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, and Monitored Plume Stability
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
			GW: No applicable exceedances of Part 201 Criteria	NA	NA	NA	NA	NA
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 6 AREA 9	NA	AOI 6-60 Miscellaneous Data Gap	SOIL: VOCs > DWP, GSIP, DC, SVIIC, and C_{sat} SVOCs > DWP, GSIP, and DC	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and a Cap 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and Targeted Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Cap	Yes	Yes	Yes	
				Targeted Excavation	Yes	Yes	Yes	
			GW: VOCs > DW, GSI, FESL, and $GW_{VI\text{-}nr}$ Metals > DW and GSI	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, and Monitored Plume Stability 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and In-Situ Chemical Oxidation 3) Perched Hydraulic Control
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				In-Situ Chemical Oxidation	Yes	Yes	Yes	
				Perched Hydraulic Control	Yes	Yes	Yes	
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 6 AREA 10	NA	AOI 6-19 AOI 6-63 AOI 6-82	SOIL: Metals > GSIP	Monitored Plume Stability	Yes	No	Yes	1) Monitored Plume Stability
			GW: No constituents exceed Part 201 Criteria	NA	NA	NA	NA	NA
			LNAPL: NA, not present	NA	NA	NA	NA	NA

See notes on page 7.

Table 2
Corrective Measures Alternatives Screening Matrix

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Subarea	Associated AOI	Summary of Applicable Exceedances	Identified Corrective Measures	Protective of Human Health and the Environment (Yes/No)	Attain Media Cleanup Objectives (Yes/No)	Control the Source or Demonstrate Plume Stability (Yes/No)	Potential Corrective Measures Alternatives for Further Evaluation
Plant 3 AREA 11	NA	AOI ID 3-54	SOIL: VOCs > DWP, GSIP, and SVIIC SVOCs > GSIP Metals > DWP and GSIP	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, and Monitored Plume Stability 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and Targeted Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Targeted Excavation	Yes	Yes	Yes	
			GW: VOCs > DW and GSI	Groundwater Use Restrictions	Yes	Yes	No	1) Groundwater Use Restrictions and Monitored Plume Stability 2) Perched Hydraulic Control
				Monitored Plume Stability	Yes	No	Yes	
				Perched Hydraulic Control	Yes	Yes	Yes	
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 3 AREA 12	NA	MW-04-02 (TD=132.7') MW-04-03 (TD=88.25')	SOIL: No applicable exceedances of Part 201 Criteria	NA	NA	NA	NA	NA
			GW: No applicable exceedances of Part 201 Criteria	NA	NA	NA	NA	NA
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 3 AREA 13	NA	Background Sample	SOIL: No constituents exceed Part 201 Criteria	NA	NA	NA	NA	NA
			GW: No applicable exceedances of Part 201 Criteria	NA	NA	NA	NA	NA
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 3 AREA 14	NA	AOI 3-10 Misc. Data Gap Borings	SOIL: Metals > DWP and GSIP	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, and Monitored Plume Stability
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
			GW: Metals > DW & GSI	Groundwater Use Restrictions	Yes	Yes	No	1) Groundwater Use Restrictions and Monitored Plume Stability
				Monitored Plume Stability	Yes	No	Yes	
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 3 AREA 15	NA	AOI ID 3-15	SOIL: VOCs > DWP SVOCs > GSIP Metals > GSIP	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, and Monitored Plume Stability
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
			GW: 1,4-dioxane > Proposed DW (8.5 µg/L)	Groundwater Use Restrictions	Yes	Yes	No	1) Groundwater Use Restrictions and Monitored Plume Stability 2) Perched Hydraulic Control
				Monitored Plume Stability	Yes	No	Yes	
				Perched Hydraulic Control	Yes	Yes	Yes	
			LNAPL: NA, not present	NA	NA	NA	NA	NA

See notes on page 7.

Table 2
Corrective Measures Alternatives Screening Matrix

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Subarea	Associated AOI	Summary of Applicable Exceedances	Identified Corrective Measures	Protective of Human Health and the Environment (Yes/No)	Attain Media Cleanup Objectives (Yes/No)	Control the Source or Demonstrate Plume Stability (Yes/No)	Potential Corrective Measures Alternatives for Further Evaluation
Plant 3 AREA 16	NA	AOI 3-11	SOIL: SVOCs > DWP, GSIP, and DC Metals > DWP, GSIP, and DC	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and a Cap 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and Targeted Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Cap	Yes	Yes	Yes	
				Targeted Excavation	Yes	Yes	Yes	
			GW: No constituents exceed Part 201 Criteria	NA	NA	NA	NA	NA
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 3 AREA 17	NA	AOI 3-3 AOI 3-4 AOI 3-9	SOIL: VOCs > DWP, GSIP, and SVIIC SVOCs > GSIP Metals > GSIP	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, and Monitored Plume Stability
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
			GW: VOCs > DW, GSI, and GW_{VI-nr} Metals > DW & GSI	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions and Monitored Plume Stability 2) Perched Hydraulic Control
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Perched Hydraulic Control	Yes	Yes	Yes	
			LNAPL: Present	Land Use Restriction	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and a Cap 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, a Cap, and Targeted Excavation 3) Soil-Vapor Extraction 4) LNAPL Recovery (Skimmers) 5) Multi-Phase Extraction 6) Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Cap	Yes	Yes	Yes	
				Soil-Vapor Extraction	Yes	Yes	Yes	
				LNAPL Recovery (Skimmers)	Yes	Yes	Yes	
				Multi-Phase Extraction	Yes	Yes	Yes	
				Excavation	Yes	Yes	Yes	
Plant 3 AREA 18	NA	AOI 3-2 AOI 3-6	SOIL: SVOCs > DWP, GSIP, and DC Metals > DWP and GSIP	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and a Cap 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and Targeted Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Cap	Yes	Yes	Yes	
				Targeted Excavation	Yes	Yes	Yes	
			GW: No constituents exceed Part 201 Criteria	NA	NA	NA	NA	NA
			LNAPL: NA, not present	NA	NA	NA	NA	NA

See notes on page 7.

Table 2
Corrective Measures Alternatives Screening Matrix

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Subarea	Associated AOI	Summary of Applicable Exceedances	Identified Corrective Measures	Protective of Human Health and the Environment (Yes/No)	Attain Media Cleanup Objectives (Yes/No)	Control the Source or Demonstrate Plume Stability (Yes/No)	Potential Corrective Measures Alternatives for Further Evaluation
Plant 3 AREA 19	NA	AOI ID 3-17	SOIL: SVOCs > GSIP Metals > DWP, GISP, and DC	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and a Cap 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and Targeted Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Cap	Yes	Yes	Yes	
				Targeted Excavation	Yes	Yes	Yes	
			GW: Metals > DW and GSI	Groundwater Use Restrictions	Yes	Yes	No	1) Groundwater Use Restrictions and Monitored Plume Stability
				Monitored Plume Stability	Yes	No	Yes	
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 3 AREA 20	NA	AOI 3-51	SOIL: SVOCs > GSIP Metals > DWP, GSIP, and PSIC	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and a Cap 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and Targeted Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Cap	Yes	Yes	Yes	
				Targeted Excavation	Yes	Yes	Yes	
			GW: No constituents exceed Part 201 Criteria	NA	NA	NA	NA	NA
			LNAPL: NA, not present	NA	NA	NA	NA	NA
Plant 3 AREA 21	NA	AOI 3-51	SOIL: Metals > DWP, GSIP, and DC	Land Use Restrictions	Yes	Yes	No	1) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and a Cap 2) Land Use Restrictions, Groundwater Use Restrictions, Monitored Plume Stability, and Targeted Excavation
				Groundwater Use Restrictions	Yes	Yes	No	
				Monitored Plume Stability	Yes	No	Yes	
				Cap	Yes	Yes	Yes	
				Targeted Excavation	Yes	Yes	Yes	
			GW: No constituents exceed Part 201 Criteria	NA	NA	NA	NA	NA
			LNAPL: NA, not present	NA	NA	NA	NA	NA

Acronyms and Abbreviations:

> = greater than
AOI = area of interest
C_{sat} = Soil Saturation Concentration Criteria
DC = Direct Contact Criteria
DW = Residential Drinking Water Criteria
DWP = Drinking Water Protection Criteria
FESL = Flammability and Explosivity Screening Level
GC = Groundwater Contact
GSI = Groundwater/Surface Water Interface
GSIP = Groundwater/Surface Water Interface Protection
GW = groundwater
$GW_{vi\text{-}nr}$ = draft Groundwater Concentrations for Vapor Intrusion
ISCO = in-situ chemical oxidation
LNAPL = light non-aqueous phase liquid
NA = not applicable Not Applicable
Part 201 Criteria = Part 201 Generic Cleanup Criteria
PCB = polychlorinated biphenyl
Prop = proposed
PSIC = Particulate Soil Inhalation Criteria
RCRA = Resource Conservation and Recovery Act
Sol = solubility
SVIIC = Soil Volatilization to Indoor Air Inhalation Criteria
SVOC = semivolatile organic compound
µg/L = micrograms per liter
VOC = volatile organic compound

Table 3a
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Site-Wide			
Media	Soil, Groundwater, and LNAPL			Groundwater
Corrective Measures Alternative	Land Use Restrictions	Groundwater Use Restrictions	Monitored Plume Stability	Perched Hydraulic Control [1]
Description	• Land Use Restrictions: Includes limiting future use of the Site to commercial and/or industrial, Site-wide contaminated soil management, Site-wide vapor intrusion exposure restrictions, subgrade utility restrictions, and health and safety requirements for intrusive activities [2].	• Groundwater Use Restrictions: Includes prohibiting the construction and use of wells or other devices on the Site to extract groundwater for consumption, irrigation, or any other purpose, with the exception of evaluating groundwater, remediation of subsurface contamination, or short-term dewatering for construction purposes.	• Implementation of a Site-wide monitoring program that provides the data to continue to verify plume stability. In addition, surface cover will be maintained/retained (e.g., building slabs, asphalt, concrete) near soil and groundwater impacts to minimize infiltration and maximize the potential for the perched groundwater plume to remain stable and on site.	• Hydraulic control (i.e., pump and treat) is composed of pumping wells located near the property boundaries to prevent off-site migration of source mass. Extracted groundwater would be treated with an above-grade system, and treated water would be discharged to a POTW or surface water body.
Long-term Reliability and Effectiveness	• Restrictions are a reliable legal mechanism to restrict current and future land use at the Site.	• Restrictions are a reliable legal mechanism to restrict current and future groundwater use at the Site.	• A groundwater monitoring program would verify the stability of the groundwater plume over time. • Monitoring groundwater in the storm sewer during dry weather flow would verify that COCs leaving the Site do not exceed surface water quality standards at the Grand River. • The building slabs would minimize infiltration and maximize the potential for the groundwater plume to remain stable and on site.	• Due to the heterogeneities in the perched groundwater zone, it would be difficult to operate and maintain a reliable and effective system to contain Site groundwater; large variations in capture and flow rates are expected.
Reduction in the Toxicity, Mobility, or Volume of Waste	• Land use restrictions do not reduce the toxicity, mobility, or volume of waste at the Site.	• Groundwater use restrictions do not reduce the toxicity, mobility, or volume of waste at the Site.	• The groundwater monitoring program would monitor plume stability and the reduction in COC mass present at the Site from natural processes. • Monitoring groundwater in the storm sewer during dry weather flow would verify that COCs leaving the Site do not exceed surface water quality standards at the Grand River. • The preservation of existing building slabs would minimize infiltration and maximize the potential for the groundwater plume to remain stable and on site.	• Hydraulic control would reduce the toxicity, mobility, and volume of impacted groundwater at the Site by preventing off-site migration by extracting groundwater and treating the extracted groundwater with an above-grade system.
Short-term Effectiveness	• Restrictions are a reliable legal mechanism to restrict land use at the Site once they are registered.	• Restrictions are a reliable legal mechanism to restrict groundwater use at the Site once they are registered.	• Based on current data, the groundwater plume is stable. • The building slabs would minimize infiltration and maximize the potential for the groundwater plume to remain stable and on site.	• Due to the complexities in hydraulics and range of contaminants requiring treatment, multiple pumping tests and an extended field-scale pilot test would be conducted to verify long-term performance and cost.
Implementability	• Restrictions would be easy to implement, as RACER Trust currently owns the property that would be restricted.	• Restrictions would be easy to implement, as RACER Trust currently owns the property that would be restricted.	• Monitored plume stability would be easy to implement, as the existing monitoring well network would be used for groundwater monitoring.	• Hydraulic control would be very difficult to implement due to the following: • Interbedded lithology in some areas may not be conducive for a traditional pump and treat system. • Multiple pumping tests would be required to capture the heterogeneities associated with the range of flow, drawdown, and capture in the interbedded zone. • The extended field-scale pilot test would be required to verify long-term performance and cost.
Community Acceptance	• The restrictions are consistent with current zoning for the Site (heavy industrial). • Vapor intrusion exposure restrictions would eliminate the SVIIC exposure risk for future property owners.	• The restrictions are consistent with current zoning for the Site (heavy industrial) and are likely to be accepted by the community.	• Aesthetic upgrades to the building slabs and/or Site may be desired.	• Hydraulic control would prevent off-site migration, as well as control the horizontal and vertical migration of source area contamination; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• The restrictions are consistent with current zoning for the Site (heavy industrial) and are readily acceptable by the MDEQ. • Vapor intrusion exposure restrictions have been accepted by the MDEQ to address vapor intrusion exposure risk.	• Groundwater use restrictions in areas with municipal services are acceptable to the MDEQ.	• Data collected during groundwater monitoring would be provided to the MDEQ to show that the groundwater plume remains stable over time.	• Hydraulic control is widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• None	• None	• None	• Additional characterization to refine the areas that would require containment and/or source control. • Pumping tests to capture the heterogeneities associated with the range of flow, drawdown, and capture in the interbedded zone. • Treatability testing to determine the appropriate treatment technologies to meet the standards based on the range of contaminants at the Site. • Geochemical analysis of groundwater required for proper design of the above-grade treatment system. • Extended field-scale pilot test would be required to verify long-term performance and cost.
Sustainability	• Restrictions do not generate waste, have energy requirements, or increase emissions.	• Restrictions do not generate waste, have energy requirements, or increase emissions.	• The groundwater monitoring program would generate minimal waste.	• This option would generate waste, have long-term energy requirements, and emissions related to the construction and operation of the hydraulic control system.
Corrective Measure Area	Site-Wide	Site-Wide	Site-Wide	Site-Wide
Cost [3,4]	$94,000	$25,000	Cost for 30-Year Monitoring/Maintenance Duration: $4,124,000 Groundwater Sampling: $2,784,000 Initial Surface Cover and Vegetation Control and Surface Cover Maintenance : $1,218,000 Well Abandonment (year 30) $122,000	Cost for 30-Year O&M Duration: $21,800,000 Pilot Testing/Design/Full-Scale Installation: $3,374,000 Annual Performance Monitoring (annual cost): $96,000 Annual O&M (annual cost): $517,000

General Notes:

1. Current hydraulic control has been evaluated under the worse-case scenario that the perched plume does not remain stable. Actual implementation of hydraulic control would be limited to areas with plume(s) that are not stable.
2. Health and safety requirements for intrusive activities are only required in Areas 2, 5-1, 5-2, 5-3, 5-5, 5-6, 7, 9, 16, 17, 18, 19, 20, and 21. Subgrade utility restrictions are required in Areas 2, 5-1, 5-2, 5-5, 5-6, 5-8, and 17.
3. Major cost assumptions for hydraulic control include:
   - Long-term (approximately 1 year) treatability testing will be required.
   - Influent groundwater concentrations are summarized in Appendix E.
   - The treatment process will include equalization, aeration, pH adjustment, filtration, air stripping, advanced oxidation, ion exchange, and granular-activated carbon.
   - 30 years of system operation.
4. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.

Acronyms and Abbreviations:

COC = constituent of concern
LNAPL = light non-aqueous phase liquid
MDEQ = Michigan Department of Environmental Quality
O&M = operation and maintenance
POTW = publically owned treatment works
RACER = Revitalizing Auto Communities Environmental Response
SVIIC = Soil Volatilization to Indoor Air Inhalation Criteria

Table 3b
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	**Lower 1,4-Dioxane Plants 2 and 3**	
Media	**Groundwater**	
Corrective Measures Alternative [1]	**Source Area ISCO**	**Hydraulic Containment**
Description	• Injection of a chemical oxidant through injection wells to reduce source area 1,4-dioxane concentrations.	• Hydraulic containment would be composed of pumping wells located at Plant 2 near the downgradient (i.e., southern) edge of the lower 1,4-dioxane plume to prevent off-site migration. Based on the range of contaminants at the Site, treatment would require an above-grade treatment system that may include equalization, aeration, pH adjustment, filtration, air stripping, advanced oxidation, ion exchange, and granular-activated carbon. The treatment system effluent would be discharged in accordance with a National Pollutant Discharge Elimination System permit or publicly owned treatment works permit.
Long-term Reliability and Effectiveness	• ISCO injections would effectively reduce source mass contributing to the deep 1,4-dioxane plume.	• Hydraulic capture at the toe of the deep 1,4-dioxane plume would be a reliable and effective way to prevent off-site migration of impacted groundwater.
Reduction in the Toxicity, Mobility, or Volume of Waste	• This option does reduce the toxicity and volume of impacted groundwater at the Site in the source area. • ISCO in the source area will not prevent off-site migration at the toe of the plume.	• On-site hydraulic containment would reduce the toxicity, mobility, and volume of impacted groundwater at the Site by preventing off-site migration by extracting groundwater and treating the extracted groundwater with an above-grade system.
Short-term Effectiveness	• ISCO injections would be conducted to reduce source mass contributing to the deep 1,4-dioxane plume; however, in the short-term, rebound (the diffusion of COCs from the non-mobile to mobile pore space after treatment) is likely to occur, multiple injections may be required.	• Pumping tests will be required to ensure capture by pumping is feasible. • Once Implemented, hydraulic containment will be effective immediately.
Implementability	• MDEQ approval for injection would be required prior to implememtation. • Additional field pilot testing is required to verify feasibility prior to full-scale implementation.	• Hydraulic containment would be easily implementable at the toe of the plume.
Community Acceptance	• Reduction of source mass will be acceptable to the community.	• Hydraulic containment would prevent off-site migration; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• ISCO is widely accepted by the state as a remedial option; however, there may be additional requirements to obtain approval to complete injections in a well-head protection zone.	• Hydraulic containment is widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• Investigation to further define treatment area. • Field injection test to determine injection hydraulics and oxidant transport.	• Pumping tests would be required to verify performance and cost.
Sustainability	• Injection activities would generate minimal waste, have some energy requirements (electric/fuel consumption), and minor emissions related to the injection activities.	• This option would generate waste, have long-term energy requirements, and emissions related to the construction and operation of the hydraulic control system.
Treatment Area	4,100 ft^2	890,000 ft^2 (deep 1,4-dioxane > 8.5 ppb footprint)
Cost [3]	$2,720,000	Cost for 30-Year O&M Duration: Total: $12,912,000 Pilot Testing/Design/Full-Scale Installation: $1,092,000 Annual Performance Monitoring (annual cost): $72,000 Annual O&M (annual cost): $322,000

Notes:

1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Major cost assumptions for hydraulic containment, aggressive pump and treat, and groundwater recirculation are as follows:
   - No source mass is present in the perched zone in the vicnity of the colesium (Plant 3, Area 11) that is contributing to the lower 1,4-dioxane plume
   - The treatment process will include equalization, aeration, pH adjustment, filtration, air stripping, advanced oxidation, ion exchange, and granular-activated carbon.
   - Timeframe of operation for the hydraulic containment based on 30 years of system operation.
   - Estimated timerames for aggressive pump and treat (15 years) and groundwater recirculation (10 years) is based on the estimated timeframe to attain current drinking water standards for 1,4-dioxane by achieving 2-3 pore flushes throughout the lower 1,4-dioxane plume.
3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.

Acronyms and Abbreviations:
COC = constituent of concern
ft^2 = square feet
ISCO = in-situ chemical oxidation
MDEQ = Michigan Department of Environmental Quality
O&M = operation and maintenance
ppb = parts per billion
RCRA = Resource Conservation and Recovery Act

Table 3b
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	**Lower 1,4-Dioxane Plants 2 and 3**	
Media	**Groundwater**	
Corrective Measures Alternative [1]	**Aggressive Pump and Treat**	**Groundwater Recirculation**
Description	• Aggressive pump and treat would be composed of pumping wells located at Plant 2 near the downgradient edge of the lower 1,4-dioxane plume to prevent off-site migration. In addition, pumping wells would be located along the spine of the plume and in the source area located on Plant 3. Based on the range of contaminants at the Site, treatment would require an above-grade treatment system that may include equalization, aeration, pH adjustment, filtration, air stripping, advanced oxidation, ion exchange, and granular-activated carbon. The treatment system effluent would be discharged in accordance with a National Pollutant Discharge Elimination System permit or publicly owned treatment works permit.	• The remedy consists of extraction of groundwater from the plume via extraction wells, above-grade treatment of groundwater, and reinjection of treated groundwater back into the plume via injection wells. Based on the range of contaminants at the Site, treatment would require an above-grade treatment system that may include equalization, aeration, pH adjustment, filtration, air stripping, advanced oxidation, ion exchange, and granular-activated carbon. Any excess treatment system effluent that cannot be re-injected would be discharged in accordance with a National Pollutant Discharge Elimination System permit or publicly owned treatment works permit.
Long-term Reliability and Effectiveness	• Pumping at the toe and along the spine of the deep 1,4-dioxane plume would be a reliable and effective way to prevent off-site migration of impacted groundwater. • Pumping along the entire plume increases pore flushes and reduces concentrations more efficiently and effectively than hydraulic containment.	• Groundwater recirculation would be a reliable and effective way to prevent off-site migration of impacted groundwater. • Recirculation increases pore flushes and reduces concentrations more effectively and efficiently than pumping options.
Reduction in the Toxicity, Mobility, or Volume of Waste	• Aggressive pump and treat would reduce the toxicity, mobility, and volume of impacted groundwater at the Site by preventing off-site migration by extracting groundwater and treating the extracted groundwater with an above-grade system. • Aggressive pump and treat would reduce mass faster than the hydraulic containment option.	• Groundwater recirculation would reduce the toxicity, mobility, and volume of impacted groundwater at the Site by preventing off-site migration by extracting groundwater and treating the extracted groundwater with an above-grade system. • Groundwater recirculation reduces mass faster than pumping only options.
Short-term Effectiveness	• Pumping test will be required to ensure capture by pumping is feasible. • Once implemented aggressive pump and treat will be effective immediately.	• Pumping test will be required to ensure capture by pumping is feasible. • Injection test will be required to ensure reinjection of treated water is feasible. • Once implemented recirculation will be effective immediately.
Implementability	• Aggressive pump and treat will be moderately difficult to implement due to piping/trenching under Saginaw and through existing source areas.	• Groundwater recirculation will be moderately difficult to implement due to piping/trenching under Saginaw and through existing source areas. Special care/maintenance will be required to keep injection/extraction wells from fouling.
Community Acceptance	• Aggressive pump and treat would prevent off-site migration; therefore, it would likely be acceptable to the community.	• Groundwater recirculation would prevent off-site migration; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• Pump and treat is widely accepted by the MDEQ as a remedial option.	• Groundwater recirculation is acceptable to the MDEQ as a remedial option.
Pre-Design Testing	• Pumping tests would be required to verify performance and cost.	• Pumping and injection tests would be required to verify performance and cost.
Sustainability	• This option would generate waste, have long-term energy requirements, and emissions related to the construction and operation of the hydraulic control system.	• This option would generate waste, have long-term energy requirements, and emissions related to the construction and operation of the hydraulic control system.
Treatment Area	890,000 ft^2 (deep 1,4-dioxane > 8.5 ppb footprint)	890,000 ft^2 (deep 1,4-dioxane > 8.5 ppb footprint)
Cost [3]	Cost for 15-Year O&M Duration[2]:	Cost for 10-Year O&M Duration[2]:
	Total: $12,101,000	Total: $8,426,000
	Pilot Testing/Design/Full-Scale Installation: $2,411,000	Pilot Testing/Design/Full-Scale Installation: $2,706,000
	Annual Performance Monitoring (annual cost): $72,000	Annual Performance Monitoring (annual cost): $72,000
	Annual O&M (annual cost): $574,000	Annual O&M (annual cost): $500,000

General Notes:

1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Major cost assumptions for hydraulic containment, aggressive pump and treat, and groundwater recirculation are as follows:
   - No source mass is present in the perched zone in the vicnity of the colesium (Plant 3, Area 11) that is contributing to the lower 1,4-dioxane plume
   - The treatment process will include equalization, aeration, pH adjustment, filtration, air stripping, advanced oxidation, ion exchange, and granular-activated carbon.
   - Timeframe of operation for the hydraulic containment based on 30 years of system operation.
   - Estimated timerames for aggressive pump and treat (15 years) and groundwater recirculation (10 years) is based on the estimated timeframe to attain current drinking water standards for 1,4-dioxane by achieving 2-3 pore flushes throughout the lower 1,4-dioxane plume.
3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.

Acronyms and Abbreviations:
COC = constituent of concern
ft^2 = square feet
ISCO = in-situ chemical oxidation
MDEQ = Michigan Department of Environmental Quality
O&M = operation and maintenance
ppb = parts per billion
RCRA = Resource Conservation and Recovery Act

Table 3c
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	**Plant 2, Area 2**		
Media	**Soil**		
Corrective Measures Alternative [1]	**Cap[4]**	**Targeted Soil Excavation[5]**	
Description	• A cap would be implemented to cover DC and PSIC soil exceedances. • The cap would be constructed using clean surface cover (soil or gravel) or existing cover (concrete or asphalt). • An RC would be filed with the deed prohibiting the removal of the cap and requiring inspections and maintenance of the cap.	• Targeted excavations would be completed to remove soils exceeding DC, PSIC, and SVIIC near the property boundary. • Excavated soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.	
Long-term Reliability and Effectiveness	• A cap would effectively prevent particulate inhalation and direct contact with the impacted soils. • An RC would be filed with the deed prohibiting the removal of the cap to ensure long-term effectiveness.	• Targeted excavation would be a reliable and effective way to remove soils exceeding DC, PSIC, and SVIIC near the property boundary. • Removal of these soils will eliminate a potential long-term source to groundwater near the property boundary.	
Reduction in the Toxicity, Mobility, or Volume of Waste	• The cap would not reduce toxicity or volume of waste.	• Removal of impacted soil reduces the toxicity, mobility, and volume of impacted soils at the Site.	
Short-term Effectiveness	• A cap would effectively prevent particulate inhalation and direct contact with the impacted soils once construction was completed.	• Targeted excavation would be effective in removing soils exceeding DC, PSIC, and SVIIC once construction was completed.	
Implementability	• Placement of a clean surface cover (soil, gravel) or the utilization of existing cover (concrete or asphalt) to cover the DC and PSIC exceedances could be easily implemented.	• Based on estimated depth (up to 10 feet), excavation for DC and PSIC exceedances may require shoring, sloping, and/or benching but would be implementable. • Based on estimated depth (up to 25 feet), excavation to eliminate SVIIC exceedances would require shoring, sloping, and/or benching; non-traditional utility locating equipment; and potentially water management and soil solidification and could be difficult to implement.	
Community Acceptance	• None (see community acceptance for land use restrictions, groundwater use restrictions, and monitored plume stability)	• Targeted excavation would eliminate soil exceeding DC, PSIC, and SVIIC; therefore, it would likely be acceptable to the community.	
MDEQ Acceptance	• Caps have been accepted by the MDEQ to mitigate DC and PSIC risks in non-residential areas.	• Excavations are widely accepted by the MDEQ as a remedial option.	
Pre-Design Testing	• Evaluation of existing concrete and/or asphalt for potential use as a cap.	• Investigation to refine vertical and horizontal targeted excavation area.	
Sustainability	• Construction of the cap would not generate waste but would have some energy requirements (fuel consumption) and minor emissions related to the source of the cap material and the construction activities.	• Targeted excavation activities would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.	
Cap Area/Excavation Volume [2]	Cap Area: 800 ft^2	Targeted Excavation Volume for DC and PSIC: 200 cy Targeted Excavation Volume for SVIIC: 6,300 cy	
Cost [3]	$9,000	Excavation for DC and PSIC:	$34,000
		Excavation for SVIIC:	$473,000

Notes:

1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Excavation volumes are rounded estimates.
3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.
4. Major cost assumptions for a cap are:
   - The cap is constructed using clean surface cover (sand).
   - Area defined by on RFI investigation data. DC/PSIC exceedance location(s) to the next clean boring location.
5. Major cost assumptions for targeted excavation are:
   - Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
   - No shoring will be required and any materials removed for excavation benching, and sloping will not require off-site transport and disposal.
   - Benching, sloping, groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
   - DC/PSIC volume based on RFI investigation data, DC/PSIC exceedance location(s) to the next clean boring location.
   - SVIIC volume based on RFI investigation data, SVIIC exceedance location(s) to half-way to the next clean boring location. Cost also includes investigation to refine excavation.

Acronyms and Abbreviations:

cy = cubic yards
DC = Direct Contact Criteria
ft^2 = square feet
MDEQ = Michigan Department of Environmental Quality
PSIC = Particulate Soil Inhalation Criteria
RC = Restrictive Covenant
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation
SVIIC = Soil Volatilization to Indoor Air Inhalation Criteria

Table 3d
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	**Plant 2 Area, 5-1**	
Media	**Soil**	
Corrective Measures Alternative [1]	**Cap[4]**	**Targeted Soil Excavation[5]**
Description	• A cap would be implemented to cover DC soil exceedances. • An existing building slab covers the applicable DC exceedances and would serve as the cap for this area. • An RC would be filed with the deed prohibiting the removal of the cap and requiring inspections and maintenance of the cap.	• Targeted excavations would be completed to remove soils exceeding DC. • Excavated soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
Long-term Reliability and Effectiveness	• A cap would effectively prevent direct contact with the impacted soils. • An RC would be filed with the deed prohibiting the removal of the cap to ensure long-term effectiveness.	• Targeted excavation would be a reliable and effective way to remove soils exceeding DC.
Reduction in the Toxicity, Mobility, or Volume of Waste	• The cap would not reduce toxicity or volume of waste.	• Removal of impacted soil reduces the toxicity, mobility, and volume of impacted soils at the Site.
Short-term Effectiveness	• The existing building slab is effectively preventing direct contact with the impacted soils.	• Targeted excavation would be effective in removing soils exceeding DC once construction was completed.
Implementability	• A cap would be easy to implement, as there is an existing building slab that cover the DC exceedances and is currently preventing direct contact with the impacted soils.	• Based on estimated depth (5 feet), excavation may require shoring, sloping, and/or benching but would be implementable.
Community Acceptance	• None (see community acceptance for land use restrictions, groundwater use restrictions, and monitored plume stability)	• Targeted excavation would eliminate soil exceeding DC; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• Caps have been accepted by the MDEQ to mitigate DC risks in non-residential areas.	• Excavations are widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• None	• Investigation to refine vertical and horizontal targeted excavation area.
Sustainability	• There is an existing building slab in place; therefore, no waste or emissions would be generated.	• Targeted excavation activities would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.
Cap Area/Excavation Volume [2]	Cap Area: 4,900 ft^2	Targeted Excavation Volume: 1,000 cy
Cost [3]	$0	$150,000

Notes:

1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Excavation volumes are rounded estimates.
3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is n intended to be used for complying with financial reporting requirements associated with liability reserves.
4. Major cost assumptions for a cap are:
   - An existing building slab will serve as the cap.
   - Area defined by on RFI investigation data. DC exceedance location(s) to the next clean boring location.
5. Major cost assumptions for targeted excavation are:
   - Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
   - No shoring will be required and any materials removed for excavation benching and sloping will not require off-site transport and disposal.
   - Benching, sloping, groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
   - DC volume based on RFI investigation data, DC exceedance location(s) to the next clean boring location.

Acronyms and Abbreviations:
cy = cubic yards
DC = Direct Contact Criteria
ft^2 = square feet
MDEQ = Michigan Department of Environmental Quality
RC = Restrictive Covenant
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation

Table 3e
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Plant 2, Area 5-2			
Media	**Soil**		**LNAPL**	
Corrective Measures Alternative[1]	**Cap [5]**	**Targeted Soil Excavation [6]**	**LNAPL Cap [5]**	**Cap and Targeted LNAPL Excavation [5,6]**
Description	• A cap would be implemented to cover DC and PSIC soil exceedances (135,000 ft^2). • In the area where the existing building slab covers the applicable DC and PSIC exceedances, the building slab would serve as the cap (100,000 ft^2). • The existing building slab would be extended to cover the remaining green space area with applicable DC and PSIC exceedances (20,000 ft^2). • An RC would be filed with the deed prohibiting the removal of the cap and requiring inspections and maintenance of the cap.	• Targeted excavations would be completed to remove soils exceeding DC and PSIC. • Excavated soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.	• A cap would be implemented to cover the LNAPL plume (135,000 ft^2) [2]. • In the area where the existing building slab covers the LNAPL plume, the building slab would serve as the cap (100,000 ft^2). • The existing building slab would be extended over the remaining green space over the LNAPL footprint to prevent exposure and limit infiltration (20,000 ft^2). • An RC would be filed with the deed prohibiting the removal of the cap and requiring inspections and maintenance of the cap.	• Targeted excavations would be completed to remove LNAPL that has the highest fraction of VOCs to eliminate ongoing potential sources to groundwater. • Excavated soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
Long-term Reliability and Effectiveness	• A cap would effectively prevent particulate inhalation and direct contact with impacted soils. • An RC would be filed with the deed prohibiting the removal of the cap to ensure long-term effectiveness.	• Targeted excavation would be a reliable and effective way to remove soils exceeding DC and PSIC.	• LNAPL is defined and not migrating. • A cap would effectively prevent exposure to the LNAPL. • An RC would be filed with the deed prohibiting the removal of the cap to ensure long-term effectiveness.	• Targeted excavation would be a reliable and effective way to remove LNAPL that has the highest fraction of VOCs to eliminate potential ongoing sources to groundwater.
Reduction in the Toxicity, Mobility, or Volume of Waste	• The cap would not reduce toxicity or volume of waste.	• Removal of impacted soil reduces the toxicity, mobility, and volume of impacted soils at the Site.	• The cap would not reduce toxicity or volume of waste. • Mobility testing indicated the LNAPL plumes are not migrating.	• Removal of LNAPL via targeted excavations reduces the toxicity, mobility, or volume of LNAPL at the Site.
Short-term Effectiveness	• A cap would effectively prevent particulate inhalation and direct contact with the impacted soils once construction was completed.	• Targeted excavation would be effective in removing soils exceeding DC and PSIC once construction was completed.	• A cap would effectively prevent exposure to the LNAPL once construction was completed.	• Targeted excavation would be a reliable and effective way to remove LNAPL that has the highest fraction of VOCs to eliminate ongoing potential sources to groundwater.
Implementability	• A cap would be easy to implement, as there are existing building slabs that partially cover the DC and PSIC exceedances and is currently preventing particulate inhalation and direct contact with the impacted soils. • An extension of the existing building slab could be easily implemented.	• The depth of the majority of the excavation would be up to 5 feet and may require shoring, sloping, and/or benching but would be implementable. • One location would be up to 27 feet and would require shoring, sloping, and/or benching; non-traditional utility locating equipment; and potentially water management and soil solidification and could be difficult to implement.	• A cap would be easy to implement, as there is an existing building slab that partially covers the LNAPL plume and is currently preventing exposure to LNAPL. • An extension of the existing building slab could be easily implemented.	• Based on estimated depth (6 to 13 feet), excavation may require shoring, sloping, and/or benching; non-traditional utility locating equipment; and potentially LNAPL/water management and/or soil solidification, and could be difficult to implement.
Community Acceptance	• None (see community acceptance for land use restrictions, groundwater use restrictions, and monitored plume stability)	• Targeted excavation would eliminate soil exceeding DC and PSIC and would, therefore, likely be acceptable to the community.	• None (see community acceptance for land use restrictions, groundwater use restrictions, and monitored plume stability)	• Targeted excavation would remove impacted soils from the Site; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• Caps have been accepted by the MDEQ to mitigate DC and PSIC risks in non-residential areas.	• Excavations are widely accepted by the MDEQ as a remedial option.	• Caps are an acceptable way to mitigate LNAPL risks for plumes that are defined, not migrating, and have limited recoverability in non-residential areas.	• Excavations are widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• Evaluation of existing concrete and/or asphalt for potential use as a cap where the existing building slab is not present.	• Investigation to refine the vertical and horizontal targeted excavation area.	• Evaluation of existing concrete and/or asphalt for potential use as a cap where the existing building slab is not present.	• Investigation to refine the vertical and horizontal targeted excavation area.
Sustainability	• Construction of the cap would not generate waste but would have some energy requirements (fuel consumption) and minor emissions related to the source of the cap material and the construction activities.	• Targeted excavation activities would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.	• Construction of the cap would not generate waste, but would have some energy requirements (fuel consumption) and minor emissions related to the construction activities.	• Targeted excavation would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.
Cap/Treatment Area or Excavation Volume [3]	Total Cap Area: 135,000 ft^2	Targeted Excavation Volume: 27,200 cy	Total Cap Area: 135,000 ft^2	Total Cap Area: 135,000 ft^2 Targeted Excavation Volume: 3,700 cy
Cost [4]	$269,000	$2,606,000	$269,000	$666,000

See notes on page 3

Table 3e
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Plant 2 Area 5-2		
Media	**LNAPL**		
Corrective Measures Alternative[1]	**LNAPL Recovery (Skimmers)[7]**	**MPE[8]**	**Excavation[6]**
Description	• LNAPL skimming would involve installation of skimmers (belt skimmers or skimmer pumps) in permanent recovery wells to remove free-phase LNAPL that collected in wells. • LNAPL would be transferred to an above-grade storage tank or drum and removed and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.	• MPE would involve recovery of LNAPL and perched groundwater by pumping or high vacuum extraction. Soil vapor would also be removed to enhance recovery of LNAPL and promote volatilization and aerobic biodegradation, where applicable. • Extracted soil vapor would be treated with an above-grade system and discharged to the atmosphere. • Extracted groundwater would be treated with an above-grade system and discharged to a POTW or surface water body. • LNAPL would be separated from groundwater in an above-grade system, transferred to an above-grade storage tank, and removed and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.	• Excavation would be completed to remove LNAPL; excavated LNAPL-impacted soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
Long-term Reliability and Effectiveness	• LNAPL skimming would be a reliable way to remove recoverable LNAPL at the Site to the extent practicable. • Recoverability testing indicated LNAPL plumes have limited potential for recoverability; therefore, it would be difficult to design and implement an effective LNAPL skimming system to recover significant quantities of LNAPL.	• Interbedded and low permeability lithology would limit the long-term effectiveness of MPE in some areas of the LNAPL plume. • Mobility and recoverability testing indicated the LNAPL plume has limited potential for recoverability. • Due to the heterogeneities in the perched groundwater zone (most impacted), it would be difficult to operate and maintain a reliable and effective system to remove LNAPL; large variations in capture and flow rates are expected.	• Excavation would be a reliable and effective way to remove LNAPL from the Site.
Reduction in the Toxicity, Mobility, or Volume of Waste	• This option would, to the extent practicable, reduce the toxicity, mobility, and volume of LNAPL at the Site.	• This option does reduce the toxicity, mobility, and volume of LNAPL at the Site. • Mobility and recoverability testing indicated the LNAPL plumes are not migrating and have limited potential for recoverability.	• Removal of LNAPL via excavation reduces the toxicity, mobility, or volume of LNAPL at the Site.
Short-term Effectiveness	• Mobility and recoverability testing indicated the LNAPL plumes are not migrating and have limited potential for recoverability; therefore, the LNAPL recovery would be slow and have limited short-term effectiveness.	• Mobility and recoverability testing indicated the LNAPL plumes are not migrating and have limited potential for recoverability. • Due to the limited potential for recoverability, an extended field-scale pilot test would be conducted to verify long-term performance and cost.	• Excavation would be a reliable and effective way to remove LNAPL from the Site once construction was complete.
Implementability	• LNAPL skimming would be difficult to implement due to the following: - Mobility and recoverability testing indicated the LNAPL plumes have limited potential for recoverability; therefore, it would be difficult to design and implement an effective LNAPL skimming system to recover significant quantities of LNAPL. - Skimmers would have limited influence away from the recovery wells; therefore, a large number of wells would be required to be effective.	• MPE would be difficult to implement because: - Mobility and recoverability testing indicated the LNAPL plumes have limited potential for recoverability; therefore, it would be difficult to operate and maintain a reliable and effective system to remove LNAPL; large variations in capture and flow rates are expected. - Interbedded and low permeability lithology in some areas of the Site may not be conducive for a mass recovery via vapor extraction. - LNAPL present in the interbedded and/or lower permeability silts and clays would be minimally recovered by an MPE system. - Multiple extraction tests would be required to capture the heterogeneities associated with the range of flow, drawdown, and capture in the interbedded zone. - Treatability testing would be required to determine the appropriate treatment technologies to meet the standards based on the range of contaminants at the Site. - An extended field-scale pilot test would be required to verify long-term performance and cost.	• Based on estimated depth (up to 24 feet), excavation may require shoring, sloping, and/or benching; non-traditional utility locating equipment; and potentially LNAPL/water management and/or soil solidification, and could be difficult to implement.
Community Acceptance	• LNAPL skimming would remove LNAPL from the Site; therefore, it would likely be acceptable to the community.	• MPE would minimize LNAPL at the Site; therefore, it would likely be acceptable to the community. • The MPE system may generate nuisance noise.	• Excavation would remove LNAPL from the Site; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• LNAPL skimming is widely accepted by the MDEQ as a remedial option.	• MPE is widely accepted by the MDEQ as a remedial option for LNAPL.	• Excavation is widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• Additional characterization to refine the vertical and horizontal treatment area.	• Additional characterization to refine the vertical and horizontal treatment area. • MPE pilot testing to assess the feasibility of recovering free-phase LNAPL and reducing LNAPL mass via vapor extraction in interbedded zones and low-permeability silts and clays. • Treatability testing to determine the appropriate treatment technologies to meet the standards based on the range of contaminants at the Site. • Geochemical analysis of groundwater required for proper design of the above-grade treatment system. • An extended field-scale pilot test would be required to verify long-term performance and cost.	• Additional characterization to refine the vertical and horizontal excavation area.
Sustainability	• Installation of LNAPL skimmers and recovery wells would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction activities. • Operation of the LNAPL skimmers would generate LNAPL waste and minor emissions. • Solar-powered skimmers can be considered to minimize energy requirements.	• Installation and operation of an MPE system would generate waste, have energy requirements (fuel consumption/electrical), and emissions.	• Excavation would generate large quantities of waste, have large energy requirements (fuel consumption), and some emissions related to the construction and transport activities.
Cap/Treatment Area or Excavation Volume [3]	LNAPL Skimming Area: 50,000 ft^2	MPE Area: 50,000 ft^2	Excavation Volume: 27,800 cy
Cost [4]	Cost for 30 Year O&M Duration: $4,790,000 Pilot Testing/Design/Full-Scale Installation: $2,385,000 Annual O&M: $80,000	Cost for 15 Year O&M Duration: $17,400,000 Pilot Testing/Design/Full-Scale Installation: $3,100,000 Annual O&M: $949,000	$2,475,000

See notes on page 3

Table 3e
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Notes:

1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance costs are included with the monitored plume stability cost.
2. The LNAPL plume is within the cap area for DC and PSIC soil exceedances; therefore, an additional cap for LNAPL would be redundant and the cost is reflective of the cap area for DC and PSIC soil exceedances.
3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.
4. Cost estimates are rounded engineering estimates, +/- 30 to 50%.
5. Major cost assumptions for a cap are:
   - An existing building slab will serve as the cap for a portion of the area, in the remaining green space area the cap is constructed concrete.
   - Area defined by RFI investigation data. DC/PSIC exceedance location(s) to the next clean boring location.
6. Major cost assumptions for excavation are:
   - Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
   - No shoring will be required and any materials removed for excavation benching and sloping will not require off-site transport and disposal.
   - Benching, sloping, groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
   - DC/PSIC volume based on RFI investigation data, DC/PSIC exceedance location(s) to the next clean boring location.
   - Targeted excavation volume based on RFI investigation data, source location(s) half-way to the next clean boring location.
   - LNAPL plume excavation volume based on RFI investigation data, covers the approximate extent of LNAPL.
7. Major cost assumptions for LNAPL skimming are:
   - Full-scale installation of 160 recovery wells to a maximum depth of 24 feet with a 10 foot treatment interval.
   - Recovery wells installed on 20-foot centers, with a 10-foot radius of influence.
   - Skimmers to be installed in 80 recovery wells at a time and rotated around the Site as needed.
   - 30 years of skimmer operation.
8. Major cost assumptions for MPE are:
   - Full-scale installation of 56 recovery wells to a maximum depth of 24 feet with a 10-foot treatment interval.
   - Recovery wells installed on 30-oot centers, with a 15-foot radius of influence
   - Long-term (approximately 1 year) treatability testing will be required.
   - Influent groundwater concentrations are summarized in Appendix D.
   - The treatment process will include equalization, aeration, pH adjustment, filtration, air stripping, advanced oxidation, ion exchange, and granular-activated carbon.
   - 15 years of system operation

Acronyms and Abbreviations:
cy = cubic yard
DC = Direct Contact Criteria
ft^2 = square feet
LNAPL = light non-aqueous phase liquid
MDEQ = Michigan Department of Environmental Quality
MPE = multi-phase extraction
O&M = operation and maintenance
POTW = publically owned treatment works
PSIC = Particulate Soil Inhalation Criteria
RC = Restrictive Covenant
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation
VOC = volatile organic compound

Table 3f
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	**Plant 2, Area 5-3**	
Media	**Soil**	
Corrective Measures Alternative [1]	**Cap [4]**	**Targeted Soil Excavation [5]**
Description	• A cap would be implemented to cover DC and PSIC soil exceedances (3,300 ft^2). • In the area where the existing building slab covers the applicable DC and PSIC exceedances, the building slab would serve as the cap (2,500 ft^2). • The existing building slab would be extended to cover the remaining area with applicable DC and PSIC exceedances (800 ft^2). • An RC would be filed with the deed prohibiting the removal of the cap and requiring inspections and maintenance of the cap.	• Targeted excavations would be completed to remove soils exceeding DC and PSIC. • Excavated soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
Long-term Reliability and Effectiveness	• A cap would effectively prevent particulate inhalation and direct contact with the impacted soils. • An RC would be filed with the deed prohibiting the removal of the cap to ensure long-term effectiveness.	• Targeted excavation would be a reliable and effective way to remove soils exceeding DC and PSIC.
Reduction in the Toxicity, Mobility, or Volume of Waste	• The cap would not reduce toxicity or volume of waste.	• Removal of impacted soil reduces the toxicity, mobility, and volume of impacted soils at the Site.
Short-term Effectiveness	• A cap would effectively prevent particulate inhalation and direct contact with the impacted soils once construction was completed.	• Targeted excavation would be effective in removing soils exceeding DC and PSIC once construction was completed.
Implementability	• A cap would be easy to implement, as there are existing building slabs that partially cover the DC and PSIC exceedances and is currently preventing particulate inhalation and direct contact with the impacted soils. • An extension of the existing building slab slabs could be easily implemented.	• Based on estimated depth (2 feet), excavation could be easily implemented.
Community Acceptance	• None (see community acceptance for land use restrictions, groundwater use restrictions, and monitored plume stability)	• Targeted excavation would eliminate soil exceeding DC; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• Caps have been accepted by the MDEQ to mitigate DC and PSIC risks in non-residential areas.	• Excavations are widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• Evaluation of existing concrete and/or asphalt for potential use as a cap where the existing building slab is not present.	• Investigation to refine vertical and horizontal targeted excavation area.
Sustainability	• Construction of the cap would not generate waste but would have some energy requirements (fuel consumption) and minor emissions related to the source of the cap material and the construction activities.	• Targeted excavation activities would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.
Cap Area/Excavation Volume [2]	Cap Area: 3,300 ft^2 (Extension Area 800 ft^2)	Targeted Excavation Volume: 300 cy
Cost [3]	$11,000	$61,000

Notes:
1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Excavation volumes are rounded estimates.

3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.

4. Major cost assumptions for a cap are:
   - An existing building slab will serve as the cap for a portion of the area, in the remaining area the cap is constructed using clean surface cover (sand).
   - Area defined by on RFI investigation data. DC/PSIC exceedance location(s) to the next clean boring location.
5. Major cost assumptions for targeted excavation are:
   - Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
   - No shoring will be required and any materials removed for excavation benching and sloping will not require off-site transport and disposal.
   - Benching, sloping, groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
   - DC/PSIC volume based on RFI investigation data, DC/PSIC exceedance location(s) to the next clean boring location.

Acronyms and Abbreviations:
cy = cubic yards
DC = Direct Contact Criteria
ft^2 = square feet
MDEQ = Michigan Department of Environmental Quality
PSIC = Particulate Soil Inhalation Criteria
RC = Restrictive Covenant
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation

Table 3g
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	**Plant 2, Area 5-5**	
Media	**Soil**	
Corrective Measures Alternative [1]	**Cap[4]**	**Targeted Soil Excavation[5]**
Description	• A cap would be implemented to cover DC soil exceedances. • The cap would be constructed using clean surface cover (soil or gravel) or existing cover (concrete or asphalt). • An RC would be filed with the deed prohibiting the removal of the cap and requiring inspections and maintenance of the cap.	• Targeted excavations would be completed to remove soils exceeding DC. • Excavated soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
Long-term Reliability and Effectiveness	• A cap would effectively prevent direct contact with the impacted soils. • An RC would be filed with the deed prohibiting the removal of the cap to ensure long-term effectiveness.	• Targeted excavation would be a reliable and effective way to remove soils exceeding DC.
Reduction in the Toxicity, Mobility, or Volume of Waste	• The cap would not reduce toxicity or volume of waste.	• Removal of impacted soil reduces the toxicity, mobility, and volume of impacted soils at the Site.
Short-term Effectiveness	• A cap would effectively prevent direct contact with the impacted soils once construction was completed.	• Targeted excavation would be effective in removing soils exceeding DC once construction was completed.
Implementability	• Placement of a clean surface cover (soil, gravel) or the utilization of existing cover (concrete or asphalt) to cover the DC exceedances could be easily implemented.	• Based on estimated depth (10 feet), excavation may require shoring, sloping, and/or benching but would be implementable.
Community Acceptance	• None (see community acceptance for land use restrictions, groundwater use restrictions, and monitored plume stability)	• Targeted excavation would eliminate soil exceeding DC; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• Caps have been accepted by the MDEQ to mitigate DC risks in non-residential areas.	• Excavations are widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• Evaluation of existing concrete and/or asphalt for potential use as a cap.	• None
Sustainability	• Construction of the cap would not generate waste but would have some energy requirements (fuel consumption) and minor emissions related to the source of the cap material and the construction activities.	• Targeted excavation activities would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.
Cap Area/Excavation Volume [2]	Cap Area: 2,200 ft^2	Targeted Excavation Volume: 300 cy
Cost [3]	$11,000	$28,000

Notes:
1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Excavation volumes are rounded estimates.

3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.

4. Major cost assumptions for a cap are:
   - The cap is constructed using clean surface cover (sand).
   - Area defined by on RFI investigation data. DC exceedance location(s) to the next clean boring location.

5. Major cost assumptions for targeted excavation are:
   - Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
   - No shoring will be required and any materials removed for excavation benching and sloping will not require off-site transport and disposal.
   - Benching, sloping, groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
   - DC volume based on RFI investigation data, DC exceedance location(s) to the next clean boring location.

Acronyms and Abbreviations:
cy = cubic yards
DC = Direct Contact Criteria
ft^2 = square feet
MDEQ = Michigan Department of Environmental Quality
RC = Restrictive Covenant
RFI = RCRA Facility Investigation

Table 3h
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	**Plant 6, Area 5-6**	
Media	**Soil**	
Corrective Measures Alternative [1]	**Cap[4]**	**Targeted Soil Excavation[5]**
Description	• A cap would be implemented to cover DC soil exceedances. • The cap would be constructed using clean surface cover (soil or gravel) or existing cover (concrete or asphalt). • An RC would be filed with the deed prohibiting the removal of the cap and requiring inspections and maintenance of the cap.	• Targeted excavations would be completed to remove soils exceeding DC. • Excavated soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
Long-term Reliability and Effectiveness	• A cap would effectively prevent direct contact with the impacted soils. • An RC would be filed with the deed prohibiting the removal of the cap to ensure long-term effectiveness.	• Targeted excavation would be a reliable and effective way to remove soils exceeding DC.
Reduction in the Toxicity, Mobility, or Volume of Waste	• The cap would not reduce toxicity or volume of waste.	• Removal of impacted soil reduces the toxicity, mobility, and volume of impacted soils at the Site.
Short-term Effectiveness	• A cap would effectively prevent direct contact with the impacted soils once construction was completed.	• Targeted excavation would be effective in removing soils exceeding DC once construction was completed.
Implementability	• Placement of a clean surface cover (soil, gravel) or the utilization of existing cover (concrete or asphalt) to cover the DC exceedances could be easily implemented.	• Based on estimated depth (6 feet), excavation may require shoring, sloping, and/or benching but woul be implementable.
Community Acceptance	• None (see community acceptance for land use restrictions, groundwater use restrictions, and monitored plume stability)	• Targeted excavation would eliminate soil exceeding DC; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• Caps have been accepted by the MDEQ to mitigate DC risks in non-residential areas.	• Excavations are widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• Evaluation of existing concrete and/or asphalt for potential use as a cap.	• Investigation to refine vertical and horizontal targeted excavation area.
Sustainability	• Construction of the cap would not generate waste but would have some energy requirements (fuel consumption) and minor emissions related to the source of the cap material and the construction activities.	• Targeted excavation activities would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.
Cap Area/Excavation Volume [2]	Cap Area: 20,000 ft^2	Targeted Excavation Volume: 5,200 cy
Cost [3]	$72,000	$416,000

Notes:
1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Excavation volumes are rounded estimates.
3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.
4. Major cost assumptions for a cap are:
   - The cap is constructed using clean surface cover (sand).
   - Area defined by on RFI investigation data. DC exceedance location(s) to the next clean boring location.
5. Major cost assumptions for targeted excavation are:
   - Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
   - No shoring will be required and any materials removed for excavation benching and sloping will not require off-site transport and disposal.
   - Benching, sloping, groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
   - DC volume based on RFI investigation data, DC exceedance location(s) to the next clean boring location.

Acronyms and Abbreviations:
cy = cubic yards
DC = Direct Contact Criteria
ft^2 = square feet
MDEQ = Michigan Department of Environmental Quality
RC = Restrictive Covenant
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation square feet

Table 3i
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	**Plant 6, Area 5-7**
Media	**Soil**
Corrective Measures Alternative [1]	**Targeted Soil Excavation**[4]
Description	• Targeted excavations would be completed to remove soils exceeding SVIIC near the property boundary. • Excavated soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
Long-term Reliability and Effectiveness	• Targeted excavation would be a reliable and effective way to remove soils exceeding SVIIC near the property boundary. • Removal of these soils will eliminate a potential long-term source to groundwater near the property boundary.
Reduction in the Toxicity, Mobility, or Volume of Waste	• Removal of impacted soil reduces the toxicity, mobility, and volume of impacted soils at the Site.
Short-term Effectiveness	• Targeted excavation would be effective in removing soils exceeding SVIIC once construction was completed.
Implementability	• Based on estimated depth (12 feet), excavation may require shoring, sloping, and/or benching but would be implementable.
Community Acceptance	• Targeted excavation would eliminate soil exceeding SVIIC; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• Excavations are widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• Investigation to refine vertical and horizontal targeted excavation area.
Sustainability	• Targeted excavation activities would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.
Cap Area/Excavation Volume [2]	Targeted Excavation Volume for SVIIC: 800 cy
Cost [3]	$73,000

General Notes:
1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Excavation volumes are rounded estimates.

3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.

4. Major cost assumptions for targeted excavation are:
- Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
- No shoring will be required and any materials removed for excavation benching and sloping will not require off-site transport and disposal.
- Benching, sloping, groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
- SVIIC volume based on RFI investigation data, SVIIC exceedance location(s) to half way to the next clean boring location. Cost also includes investigation to refine excavation.

Acronyms and Abbreviations:
cy = cubic yards
MDEQ = Michigan Department of Environmental Quality
RCRA = Resource Conservation and Recovery Act
SVIIC = Soil Volatilization to Indoor Air Inhalation Criteria

Table 3j
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	**Plant 6, Area 5-8**	
Media	**Soil**	
Corrective Measures Alternative [1]	**Cap[4]**	**Targeted Soil Excavation[5]**
Description	• A cap would be implemented to cover PSIC soil exceedances. • An existing building slab covers the applicable PSIC exceedances and would serve as the cap for this area. • An RC would be filed with the deed prohibiting the removal of the cap and requiring inspections and maintenance of the cap.	• Targeted excavations would be completed to remove soils exceeding PSIC. • Excavated soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
Long-term Reliability and Effectiveness	• A cap would effectively prevent particulate inhalation of the impacted soils. • An RC would be filed with the deed prohibiting the removal of the cap to ensure long-term effectiveness.	• Targeted excavation would be a reliable and effective way to remove soils exceeding PSIC.
Reduction in the Toxicity, Mobility, or Volume of Waste	• The cap would not reduce toxicity or volume of waste.	• Removal of impacted soil reduces the toxicity, mobility, and volume of impacted soils at the Site.
Short-term Effectiveness	• The existing building slab is effectively preventing particulate inhalation of the impacted soils.	• Targeted excavation would be effective in removing soils exceeding PSIC once construction was completed.
Implementability	• A cap would be easy to implement, as there is an existing building slab that cover the PSIC exceedances and is currently preventing particulate inhalation of the impacted soils.	• Based on estimated depth (3 feet), excavation could be easily implemented.
Community Acceptance	• None (see community acceptance for land use restrictions, groundwater use restrictions, and monitored plume stability)	• Targeted excavation would eliminate soil exceeding PSIC; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• Caps have been accepted by the MDEQ to mitigate PSIC risks in non-residential areas.	• Excavations are widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• None	• None
Sustainability	• There is an existing building slab in place; therefore, no waste or emissions would be generated.	• Targeted excavation activities would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.
Cap Area/Excavation Volume [2]	Cap Area: 2,200 ft^2	Targeted Excavation Volume: 300 cy
Cost [3]	$0	$61,000

Notes:
1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Excavation volumes are rounded estimates.

3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.

4. Major cost assumptions for a cap are:
   • An existing building slab will serve as the cap.
   • Area defined by on RFI investigation data. PSIC exceedance location(s) to the next clean boring location.
5. Major cost assumptions for targeted excavation are:
   • Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
   • No shoring will be required and any materials removed for excavation benching and sloping will not require off-site transport and disposal.
   • Benching, sloping, groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
   • PSIC volume based on RFI investigation data, PSIC exceedance location(s) to the next clean boring location.

Acronyms and Abbreviations:
cy = cubic yards
ft^2 = square feet
MDEQ = Michigan Department of Environmental Quality
PSIC = Particulate Soil Inhalation Criteria
RC = Restrictive Covenant
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation

Table 3k
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	**Plant 6, Area 7**			
Media	**Soil**			
Corrective Measures Alternative [1]	**Cap[4]**		**Targeted Soil Excavation[5]**	
Description	• A cap would be implemented to cover DC soil exceedances. • The cap would be constructed using clean surface cover (soil or gravel) or existing cover (concrete or asphalt). • An RC would be filed with the deed prohibiting the removal of the cap and requiring inspections and maintenance of the cap.		• Targeted excavations would be completed to remove soils exceeding DC and SVIIC near the property boundary. • Excavated soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.	
Long-term Reliability and Effectiveness	• A cap would effectively prevent direct contact with the impacted soils. • An RC would be filed with the deed prohibiting the removal of the cap to ensure long-term effectiveness.		• Targeted excavation would be a reliable and effective way to remove soils exceeding DC and SVIIC near the property boundary. • Removal of these soils will eliminate a potential long-term source to groundwater near the property boundary.	
Reduction in the Toxicity, Mobility, or Volume of Waste	• The cap would not reduce toxicity or volume of waste.		• Removal of impacted soil reduces the toxicity, mobility, and volume of impacted soils at the Site.	
Short-term Effectiveness	• A cap would effectively prevent direct contact with the impacted soils once construction was completed.		• Targeted excavation would be effective in removing soils exceeding DC and SVIIC once construction was completed.	
Implementability	• Placement of a clean surface cover (soil, gravel) or the utilization of existing cover (concrete or asphalt) to cover the DC exceedances could be easily implemented.		• Based on estimated depth (up to 12 feet), excavation may require shoring, sloping, and/or benching but would be implementable.	
Community Acceptance	• None (see community acceptance for land use restrictions, groundwater use restrictions, and monitored plume stability)		• Targeted excavation would eliminate soil exceeding DC and SVIIC; therefore, it would likely be acceptable to the community.	
MDEQ Acceptance	• Caps have been accepted by the MDEQ to mitigate DC risks in non-residential areas.		• Excavations are widely accepted by the MDEQ as a remedial option.	
Pre-Design Testing	• Evaluation of existing concrete and/or asphalt for potential use as a cap.		• Investigation to refine vertical and horizontal targeted excavation area.	
Sustainability	• Construction of the cap would not generate waste but would have some energy requirements (fuel consumption) and minor emissions related to the source of the cap material and the construction activities.		• Targeted excavation activities would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.	
Cap Area/Excavation Volume [2]	West Cap Area: 400 ft^2 East Cap Area: 2,300 ft^2		Targeted Excavation Volume for DC: 900 cy Targeted Excavation Volume for SVIIC: 800 cy	
Cost [3]	West Cap:	$10,000	Excavation for DC and SVIIC:	$134,000
	East Cap:	$13,000	Excavation for SVIIC Only:	$114,000

Notes:
1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Excavation volumes are rounded estimates.
3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.
4. Major cost assumptions for a cap are:
   - The cap is constructed using clean surface cover (sand).
   - Area defined by on RFI investigation data. DC exceedance location(s) to the next clean boring location.
5. Major cost assumptions for targeted excavation are:
   - Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
   - No shoring will be required and any materials removed for excavation benching and sloping will not require off-site transport and disposal.
   - Groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
   - DC volume based on RFI investigation data, DC exceedance location(s) to the next clean boring location.
   - SVIIC volume based on RFI investigation data, SVIIC exceedance location(s) to half way to the next clean boring location. Cost also includes investigation to refine excavation.

Acronyms and Abbreviations:
cy = cubic yards
DC = Direct Contact Criteria
ft^2 = square feet
MDEQ = Michigan Department of Environmental Quality
RC = Restrictive Covenant
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation
SVIIC = Soil Volatilization to Indoor Air Inhalation Criteria

Table 3l
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Plant 6, Area 9		
Media	**Soil**		**Groundwater**
Corrective Measures Alternative [1]	**Cap[4]**	**Targeted Soil Excavation[5]**	**In-Situ Chemical Oxidation[6]**
Description	• A cap would be implemented to cover DC soil exceedances. • Existing soil/gravel that covers the applicable DC exceedances would serve as the cap for this area. • An RC would be filed with the deed prohibiting the removal of the cap and requiring inspections and maintenance of the cap.	• Targeted excavations would be completed to remove soils exceeding DC and SVIIC near the property boundary. • Excavated soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.	• Injection of a chemical oxidant through injection wells to reduce groundwater concentrations to below the FESL.
Long-term Reliability and Effectiveness	• A cap would effectively prevent direct contact with the impacted soils. • An RC would be filed with the deed prohibiting the removal of the cap to ensure long-term effectiveness.	• Targeted excavation would be a reliable and effective way to remove soils exceeding DC and SVIIC near the property boundary. • Removal of these soils will eliminate a potential long-term source to groundwater near the property boundary.	• ISCO injections would be conducted until groundwater no longer exceeded FESL and is, therefore, an effective long-term strategy.
Reduction in the Toxicity, Mobility, or Volume of Waste	• The cap would not reduce toxicity or volume of waste.	• Removal of impacted soil reduces the toxicity, mobility, and volume of impacted soils at the Site.	• This option does reduce the toxicity, mobility, and volume of impacted groundwater at the Site in the area of the ISCO injections.
Short-term Effectiveness	• The existing soil/gravel is effectively preventing direct contact with the impacted soils.	• Targeted excavation would be effective in removing soils exceeding DC and SVIIC once construction was completed.	• ISCO injections would be conducted until groundwater no longer exceeded FESL; however, in the short-term, rebound (the diffusion of COCs from the non-mobile to mobile pore space after treatment) is likely to occur; multiple injections may be required.
Implementability	• A cap would be easy to implement, as there is sufficient existing soil/gravel that would serve as the cap and is currently preventing direct contact with the impacted soils.	• Based on estimated depth (up to 12 feet), excavation may require shoring, sloping, and/or benching but would be implementable.	• ISCO injections would be moderately difficult to implement due to the following: - Additional field pilot testing is required to verify feasibility prior to full-scale implementation. - Injections cannot be completed where subgrade utilities below the water table may be contacted. - MDEQ approval for injection would be required.
Community Acceptance	• None (see community acceptance for land use restrictions, groundwater use restrictions, and monitored plume stability)	• Targeted excavation would eliminate soil exceeding DC and SVIIC; therefore, it would likely be acceptable to the community.	• Reduction of source mass would likely be acceptable to the community.
MDEQ Acceptance	• Caps have been accepted by the MDEQ to mitigate DC risks in non-residential areas.	• Excavations are widely accepted by the MDEQ as a remedial option.	• ISCO is widely accepted by the state as a remedial option; however, there may be additional requirements to obtain approval to complete injections in a well head protection zone.
Pre-Design Testing	• None	• Investigation to refine vertical and horizontal targeted excavation area.	• Investigation to further define vertical and horizontal treatment area. • Field injection test to determine injection hydraulics and oxidant transport.
Sustainability	• Existing soil/gravel would serve as the cap; therefore, no waste or emissions would be generated.	• Targeted excavation activities would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.	• Injection activities would generate minimal waste, have some energy requirements (electric/fuel consumption), and minor emissions related to the injection activities.
Cap/Treatment Area or Excavation Volume [2]	Cap Area: 4,200 ft^2	Targeted Excavation Volume for DC and SVIIC: 700 cy	4,200 ft^2
Cost [3]	$0	Excavation for DC and SVIIC: $129,000	$390,000

General Notes:
1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Excavation volumes are rounded estimates.
3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.
4. Major cost assumptions for a cap are:
   • Existing soil/gravel will serve as the cap.
   • Area defined by on RFI investigation data. PSIC/DC exceedance location(s) to the next clean boring location.
5. Major cost assumptions for targeted excavation are:
   • Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
   • No shoring will be required and any materials removed for excavation benching and sloping will not require off-site transport and disposal.
   • Benching, sloping, groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
   • DC volume based on RFI investigation data, DC exceedance location(s) to the next clean boring location.
   • SVIIC volume based on RFI investigation data, SVIIC exceedance location(s) to half way to the next clean boring location. Cost also includes investigation to refine excavation.
6. Major cost assumptions for ISCO are:
   • Full-scale installation of 12 injection wells to a maximum depth of 10 feet with a 5-foot treatment interval.
   • Injection wells installed on 20-foot centers, with a 10-foot radius of influence.
   • Mobile porosity of 0.1 (injection volume of 1,175 gallons per well), injection flow rate of 3 gallons per minute per well.
   • Two injections to reach treatment objectives.

Acronyms and Abbreviations:
COC = constituent of concern
cy = cubic yards
DC = Direct Contact Criteria
FESL = Flammability and Explosivity Screening Level
ft^2 = square feet feet
ISCO = in-situ chemical oxidation
MDEQ = Michigan Department of Environmental Quality
RC = Restrictive Covenant
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation
SVIIC = Soil Volatilization to Indoor Air Inhalation Criteria

Table 3m
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	**Plant 3, Area 11**
Media	**Soil**
Corrective Measures Alternative [1]	**Targeted Soil Excavation**[4]
Description	• Targeted excavations would be completed to remove soils exceeding SVIIC near the property boundary. • Excavated soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
Long-term Reliability and Effectiveness	• Targeted excavation would be a reliable and effective way to remove soils exceeding SVIIC near the property boundary. • Removal of these soils will eliminate a potential long-term source to groundwater near the property boundary.
Reduction in the Toxicity, Mobility, or Volume of Waste	• Removal of impacted soil reduces the toxicity, mobility, and volume of impacted soils at the Site.
Short-term Effectiveness	• Targeted excavation would be effective in removing soils exceeding SVIIC once construction was completed.
Implementability	• Based on estimated depth (15 feet), excavation to eliminate SVIIC exceedances would require shoring, sloping, and/or benching; non-traditional utility locating equipment; and potentially water management and soil solidification and could be difficult to implement.
Community Acceptance	• Targeted excavation would eliminate soil exceeding SVIIC; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• Excavations are widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• Investigation to refine vertical and horizontal targeted excavation area.
Sustainability	• Targeted excavation activities would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.
Excavation Volume [2] **or Treatment Area**	Targeted Excavation Volume for SVIIC: 1,400 cy
Cost [3]	$134,000

General Notes:
1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Excavation volumes are rounded estimates.
3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.
4. Major cost assumptions for targeted excavation are:
   • Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
   • No shoring will be required and any materials removed for excavation benching and sloping will not require off-site transport and disposal.
   • Benching, sloping, groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
   • SVIIC volume based on RFI investigation data, SVIIC exceedance location(s) to half way to the next clean boring location. Cost also includes investigation to refine excavation.

Acronyms and Abbreviations:
cy = cubic yards
MDEQ = Michigan Department of Environmental Quality
RCRA = Resource Conservation and Recovery Act
SVIIC = Soil Volatilization to Indoor Air Inhalation Criteria
RFI = RCRA Facility Investigation

Table 3n
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	**Plant 3 Area 16**	
Media	**Soil**	
Corrective Measures Alternative [1]	**Cap[4]**	**Targeted Soil Excavation[5]**
Description	• A cap would be implemented to cover DC soil exceedances. • Existing soil/gravel that covers the applicable DC exceedances would serve as the cap for this area. • An RC would be filed with the deed prohibiting the removal of the cap and requiring inspections and maintenance of the cap.	• Targeted excavations would be completed to remove soils exceeding DC. • Excavated soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
Long-term Reliability and Effectiveness	• A cap would effectively prevent direct contact with the impacted soils. • An RC would be filed with the deed prohibiting the removal of the cap to ensure long-term effectiveness.	• Targeted excavation would be a reliable and effective way to remove soils exceeding DC.
Reduction in the Toxicity, Mobility, or Volume of Waste	• The cap would not reduce toxicity or volume of waste.	• Removal of impacted soil reduces the toxicity, mobility, and volume of impacted soils at the Site.
Short-term Effectiveness	• The existing soil/gravel is effectively preventing direct contact with the impacted soils.	• Targeted excavation would be effective in removing soils exceeding DC once construction was completed.
Implementability	• A cap would be easy to implement, as there is sufficient existing soil/gravel that would serve as the cap and is currently preventing direct contact with the impacted soils.	• Based on estimated depth (10 feet), excavation may require shoring, sloping, and/or benching but would be implementable.
Community Acceptance	• None (see community acceptance for land use restrictions, groundwater use restrictions, and monitored plume stability)	• Targeted excavation would eliminate soil exceeding DC; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• Caps have been accepted by the MDEQ to mitigate DC risks in non-residential areas.	• Excavations are widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• None	• Investigation to refine vertical and horizontal targeted excavation area.
Sustainability	• Existing soil/gravel would serve as the cap; therefore, no waste or emissions would be generated.	• Targeted excavation activities would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.
Cap Area/Excavation Volume [2]	Cap Area: 3,500 ft^2	Targeted Excavation Volume: 1,200 cy
Cost [3]	$0	$92,000

Notes:
1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Excavation volumes are rounded estimates.
3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.
4. Major cost assumptions for a cap are:
   • Existing soil/gravel will serve as the cap.
   • Area defined by on RFI investigation data. DC exceedance location(s) to the next clean boring location.
5. Major cost assumptions for targeted excavation are:
   • Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
   • No shoring will be required and any materials removed for excavation benching and sloping will not require off-site transport and disposal.
   • Benching, sloping, groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
   • DC volume based on RFI investigation data, DC exceedance location(s) to the next clean boring location.

Acronyms and Abbreviations:
cy = cubic yards
DC = Direct Contact Criteria
ft^2 = square feet
MDEQ = Michigan Department of Environmental Quality
RC = Restrictive Covenant
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation

Table 3o
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Plant 3 Area 17		
Media	LNAPL		
Corrective Measures Alternative[1]	LNAPL Cap [4]	Cap and Targeted LNAPL Excavation [4,5]	SVE[6]
Description	• A cap would be implemented to cover the LNAPL plumes. • The cap would be constructed using concrete or existing cover (concrete or asphalt). • An RC would be filed with the deed prohibiting the removal of the cap and requiring inspections and maintenance of the cap.	• Targeted excavations would be completed to remove LNAPL that has the highest fraction of VOCs to eliminate ongoing potential sources to groundwater. • Excavated soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.	• SVE would involve installation of extraction wells to volatilize contaminants, including free-phase LNAPL, and enhanced aerobic degradation of the LNAPL. • Extracted soil vapor would be treated with an above-grade system and would be discharged to the atmosphere.
Long-term Reliability and Effectiveness	• LNAPL is defined and not migrating. • A cap would effectively prevent exposure to the LNAPL. • An RC would be filed with the deed prohibiting the removal of the cap to ensure long-term effectiveness.	• Targeted excavation would be a reliable and effective way to remove LNAPL that has the highest fraction of VOCs to eliminate potential ongoing sources to groundwater.	• SVE would be a reliable and effective long-term strategy to volatilize contaminants, including free-phase LNAPL, and enhanced aerobic degradation of the LNAPL to the extent practicable at the Site. • Interbedded and low-permeability lithology would limit the long-term effectiveness of SVE in some areas where LNAPL is present.
Reduction in the Toxicity, Mobility, or Volume of Waste	• The cap would not reduce toxicity or volume of waste. • Mobility testing indicated the LNAPL plumes are not migrating.	• Removal of LNAPL via targeted excavations reduces the toxicity, mobility, and volume of LNAPL at the Site.	• This option does reduce the toxicity, mobility, and volume of LNAPL at the Site. • Mobility testing indicated the LNAPL plumes are not migrating.
Short-term Effectiveness	• A cap would effectively prevent exposure to the LNAPL once construction was completed.	• Targeted excavation would be a reliable and effective way to remove LNAPL that has the highest fraction of VOCs to eliminate ongoing potential sources to groundwater.	• SVE would be an effective short-term to way volatilize contaminants, including free-phase LNAPL, and enhanced aerobic degradation in higher permeability soils once construction was completed. • Interbedded lithology may limit the short-term effectiveness of SVE in low-permeability areas of the LNAPL plumes.
Implementability	• Construction of a concrete cap or use of existing cover (concrete or asphalt) could be easily implemented.	• Based on estimated depth (5 feet), excavation may require shoring, sloping, and/or benching but would be implementable.	• SVE may be difficult to implement due to the following: - Interbedded and low-permeability lithology in some areas may not be conducive for mass recovery via vapor extraction. - LNAPL present in the interbedded and/or lower permeability silts and clays would be minimally affected by an SVE system. - In areas with interbedded and/or low-permeability lithology, extraction wells would need to be spaced closer together to effectively volatilize contaminants, including free-phase LNAPL, and enhanced aerobic degradation of the LNAPL.
Community Acceptance	• None (see community acceptance for land use restrictions, groundwater use restrictions, and monitored plume stability)	• Targeted excavation would remove LNAPL impacted soils from the Site; therefore, it would likely be acceptable to the community.	• SVE would reduce LNAPL at the Site; therefore, it would likely be acceptable to the community. • The SVE system may generate nuisance noise.
MDEQ Acceptance	• Caps are an acceptable way to mitigate LNAPL risks for plumes that are defined, not migrating, and have limited recoverability in non-residential areas.	• Excavations are widely accepted by the MDEQ as a remedial option.	• SVE is widely accepted by the state as a remedial option.
Pre-Design Testing	• Evaluation of existing concrete and/or asphalt for potential use as a cap.	• Investigation to refine vertical and horizontal targeted excavation area.	• Additional characterization to refine the vertical and horizontal treatment area. • SVE pilot testing to assess the feasibility of reducing LNAPL via vapor extraction in interbedded zones and low-permeability silts and clays.
Sustainability	• Construction of the cap would not generate waste, but would have some energy requirements (fuel consumption) and minor emissions related to the construction activities.	• Targeted excavation would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.	• Installation of an SVE system would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction activities. • Operation of the SVE system would generate waste, have energy requirements, and air emissions.
Cap/Treatment Area or Excavation Volume [2]	Cap Area: 3,800 ft^2	Cap Area: 3,800 ft^2 Targeted Excavation Volume: 800 cy	SVE Area: 3,800 ft^2
Cost [3]	$54,000	$168,000	Cost for 15 Year O&M Duration: $1,530,000 Pilot Testing/Design/Full-Scale Installation: $454,000 Annual O&M: $71,100

See notes on page 3.

Table 3o
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	Plant 3 Area 17		
Media	LNAPL		
Corrective Measures Alternative[1]	LNAPL Recovery (Skimmers)[7]	MPE[8]	Excavation[5]
Description	• LNAPL skimming would involve installation of skimmers (belt skimmers or skimmer pumps) in permanent recovery wells to remove free-phase LNAPL that collected in wells. • LNAPL would be transferred to an above-grade storage tank or drum and removed and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.	• MPE would involve recovery of LNAPL and perched groundwater by pumping or high vacuum extraction. Soil vapor would also be removed to enhance recovery of the LNAPL and promote volatilization and aerobic biodegradation, where applicable. • Extracted soil vapor would be treated with an above-grade system and discharged to the atmosphere. • Extracted groundwater would be treated with an above-grade system and discharged to a POTW or surface water body. • LNAPL would be separated from groundwater in an above-grade system, transferred to an above-grade storage tank, and removed and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.	• Excavation would be completed to remove LNAPL; excavated LNAPL-impacted soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
Long-term Reliability and Effectiveness	• LNAPL skimming would be a reliable way to remove recoverable LNAPL at the Site to the extent practicable. • Recoverability testing indicated the LNAPL plumes have limited potential for recoverability; therefore, it would be difficult to design and implement an effective LNAPL skimming system to recover significant quantities of LNAPL.	• Interbedded and low-permeability lithology would limit the long-term effectiveness of MPE in some areas of the LNAPL plumes. • Mobility and recoverability testing indicated the LNAPL plumes have limited potential for recoverability. • Due to the heterogeneities in the perched groundwater zone (most impacted), it would be difficult to operate and maintain a reliable and effective system to remove LNAPL; large variations in capture and flow rates are expected.	• Excavation would be a reliable and effective way to remove LNAPL from the Site.
Reduction in the Toxicity, Mobility, or Volume of Waste	• This option would, to the extent practicable, reduce the toxicity, mobility, and volume of LNAPL at the Site.	• This option does reduce the toxicity, mobility, and volume of LNAPL at the Site. • Mobility and recoverability testing indicated the LNAPL plumes are not migrating and have limited potential for recoverability.	• Removal of LNAPL via excavation reduces the toxicity, mobility, and volume of LNAPL at the Site.
Short-term Effectiveness	• Mobility and recoverability testing indicated the LNAPL plumes are not migrating and have limited potential for recoverability; therefore, the LNAPL recovery would be slow and have limited short-term effectiveness.	• Mobility and recoverability testing indicated the LNAPL plumes are not migrating and have limited potential for recoverability. • Due to the limited potential for recoverability, an extended field-scale pilot test would be conducted to verify long-term performance and cost.	• Excavation would be a reliable and effective way to remove LNAPL from the Site once construction was complete.
Implementability	• LNAPL skimming would be difficult to implement due to the following: - Mobility and recoverability testing indicated the LNAPL plumes have limited potential for recoverability; therefore, it would be difficult to design and implement an effective LNAPL skimming system to recover significant quantities of LNAPL. - Skimmers would have limited influence away from the recovery wells; therefore, a large number of wells would be required to be effective.	• MPE would be difficult to implement due to the following: - Mobility and recoverability testing indicated the LNAPL plumes have limited potential for recoverability; therefore, it would be difficult to operate and maintain a reliable and effective system to remove LNAPL; large variations in capture and flow rates are expected. - Interbedded and low-permeability lithology in some areas of the Site may not be conducive for a mass recovery via vapor extraction. - LNAPL present in the interbedded and/or lower permeability silts and clays would be minimally recovered by an MPE system. - Multiple extraction tests would be required to capture the heterogeneities associated with the range of flow, drawdown, and capture in the interbedded zone. - Treatability testing would be required to determine the appropriate treatment technologies to meet the standards based on the range of contaminants at the Site. - An extended field-scale pilot test would be required to verify long-term performance and cost.	• Based on estimated depth (up to 22 feet), excavation may require shoring, sloping, and/or benching; non-traditional utility locating equipment; and potentially LNAPL/water management and/or soil solidification, and could be difficult to implement.
Community Acceptance	• LNAPL skimming would reduce LNAPL from the Site; therefore, it would likely be acceptable to the community.	• MPE would reduce LNAPL at the Site; therefore, it would likely be acceptable to the community. • The MPE system may generate nuisance noise.	• Excavation would remove LNAPL from the Site; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• LNAPL skimming is widely accepted by the MDEQ as a remedial option.	• MPE is widely accepted by the MDEQ as a remedial option for LNAPL.	• Excavation is widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• Additional characterization to refine the vertical and horizontal treatment area.	• Additional characterization to refine the vertical and horizontal treatment area. • MPE pilot testing to assess the feasibility of recovering free-phase LNAPL and reducing LNAPL mass via vapor extraction in interbedded zones and low permeability silts and clays. • Treatability testing to determine the appropriate treatment technologies to meet the standards based on the range of contaminants at the Site. • Geochemical analysis of groundwater required for proper design of the above-grade treatment system. • An extended field-scale pilot test would be required to verify long-term performance and cost.	• Additional characterization to refine the vertical and horizontal excavation areas.
Sustainability	• Installation of LNAPL skimmers and recovery wells would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction activities. • Operation of the LNAPL skimmers would generate LNAPL waste and minor emissions. • Solar powered skimmers can be considered to minimize energy requirements.	• Installation and operation of an MPE system would generate waste, have energy requirements (fuel consumption/electrical), and emissions.	• Excavation would generate large quantities of waste, have large energy requirements (fuel consumption), and some emissions related to the construction and transport activities.
Cap/Treatment Area or Excavation Volume [2]	LNAPL Skimming Area: 3,800 ft^2	MPE Area: 3,800 ft^2	Excavation Volume: 4,100 cy
Cost [3]	Cost for 30-Year O&M Duration: $2,430,000 Pilot Testing/Design/Full-Scale Installation: $390,000 Annual O&M: $68,000	Cost for 15 -ear O&M Duration: $2,970,000 Pilot Testing/Design/Full-Scale Installation: $731,000 Annual O&M: $149,000	$396,000

See notes on page 3.

Table 3o
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Notes:

1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Excavation volumes are rounded estimates.
3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.
4. Major cost assumptions for a cap are:
   - The cap is constructed using concrete.
   - Area defined by on RFI investigation data. PSIC/DC exceedance location(s) to the next clean boring location.
5. Major cost assumptions for excavation are:
   - Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
   - No shoring will be required and any materials removed for excavation benching and sloping will not require offsite transport and disposal.
   - Benching, sloping, groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
   - Targeted excavation volume based on RFI investigation data, source location(s) half way to the next clean boring location.
   - LNAPL plume excavation volume based on RFI investigation data, covers the approximate extent of LNAPL.
6. Major cost assumptions for SVE are:
   - Full-scale installation of 6 SVE wells to a maximum depth of 22 feet with a 10-foot treatment interval.
   - Recovery wells installed on 40-foot centers, with a 20-foot radius of influence
   - The treatment process will include an air-water separator and granular-activated carbon.
   - 15 years of system operation.
7. Major cost assumptions for LNAPL skimming are:
   - Full-scale installation of 49 recovery wells to a maximum depth of 22 feet with a 10-foot treatment interval.
   - Recovery wells installed on 20-foot centers, with a 10-foot radius of influence
   - Skimmers to be installed in 25 recovery wells at time and rotated around the Site as needed.
   - 30 years of skimmer operation.
8. Major cost assumptions for MPE are:
   - Full-scale installation of 9 recovery wells to a maximum depth of 22 feet with a 10-foot treatment interval.
   - Recovery wells installed on 30-foot centers, with a 15-foot radius of influence.
   - The treatment process will include an oil water separator, air stripping, filtration, and granular activated carbon.
   - 15 years of system operation

Acronyms and Abbreviations:
cy = cubic yards
DC = Direct Contact Criteria
ft^2 = square feet
LNAPL = light non-aqueous phase liquid
MDEQ = Michigan Department of Environmental Quality
MPE = multi-phase extraction
O&M = operation and maintenance
POTW = publically owned treatment works
PSIC = Particulate Soil Inhalation Criteria
RC = Restrictive Covenant
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation
SVE = soil vapor extraction
VOC = volatile organic compound

Table 3p
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	**Plant 3, Area 18**	
Media	**Soil**	
Corrective Measures Alternative [1]	**Cap[4]**	**Targeted Soil Excavation[5]**
Description	• A cap would be implemented to cover DC soil exceedances. • The cap would be constructed using clean surface cover (soil or gravel) or existing cover (concrete or asphalt). • An RC would be filed with the deed prohibiting the removal of the cap and requiring inspections and maintenance of the cap.	• Targeted excavations would be completed to remove soils exceeding DC. • Excavated soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
Long-term Reliability and Effectiveness	• A cap would effectively prevent direct contact with the impacted soils. • An RC would be filed with the deed prohibiting the removal of the cap to ensure long-term effectiveness.	• Targeted excavation would be a reliable and effective way to remove soils exceeding DC.
Reduction in the Toxicity, Mobility, or Volume of Waste	• The cap would not reduce toxicity or volume of waste.	• Removal of impacted soil reduces the toxicity, mobility, and volume of impacted soils at the Site.
Short-term Effectiveness	• A cap would effectively prevent direct contact with the impacted soils once construction was completed.	• Targeted excavation would be effective in removing soils exceeding DC once construction was completed.
Implementability	• Placement of a clean surface cover (soil, gravel) or the utilization of existing cover (concrete or asphalt) to cover the DC exceedances could be easily implemented.	• Based on estimated depth (2 feet), excavation could be easily implemented.
Community Acceptance	• None (see community acceptance for land use restrictions, groundwater use restrictions, and monitored plume stability)	• Targeted excavation would eliminate soil exceeding DC; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• Caps have been accepted by the MDEQ to mitigate DC risks in non-residential areas.	• Excavations are widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• Evaluation of existing concrete and/or asphalt for potential use as a cap.	• Investigation to refine vertical and horizontal targeted excavation area.
Sustainability	• Construction of the cap would not generate waste but would have some energy requirements (fuel consumption) and minor emissions related to the source of the cap material and the construction activities.	• Targeted excavation activities would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.
Cap Area/Excavation Volume [2]	Cap Area: 8,300 ft^2	Targeted Excavation Volume: 700 cy
Cost [3]	$33,000	$75,000

Notes:
1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Excavation volumes are rounded estimates.
3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.
4. Major cost assumptions for a cap are:
   • The cap is constructed using clean surface cover (sand).
   • Area defined by on RFI investigation data. DC exceedance location(s) to the next clean boring location.
5. Major cost assumptions for targeted excavation are:
   • Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
   • No shoring will be required and any materials removed for excavation benching and sloping will not require off-site transport and disposal.
   • Benching, sloping, groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
   • DC volume based on RFI investigation data, DC exceedance location(s) to the next clean boring location.

Acronyms and Abbreviations:
cy = cubic yards
DC = Direct Contact Criteria
ft^2 = square feet
MDEQ = Michigan Department of Environmental Quality
RC = Restrictive Covenant
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation

Table 3q
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	**Plant 3, Area 19**	
Media	**Soil**	
Corrective Measures Alternative [1]	**Cap [4]**	**Targeted Soil Excavation [5]**
Description	• A cap would be implemented to cover DC soil exceedances. • An existing building slab covers the applicable DC exceedances and would serve as the cap for this area. • An RC would be filed with the deed prohibiting the removal of the cap and requiring inspections and maintenance of the cap.	• Targeted excavations would be completed to remove soils exceeding DC. • Excavated soils would be transported and disposed of in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
Long-term Reliability and Effectiveness	• A cap would effectively prevent direct contact with the impacted soils. • An RC would be filed with the deed prohibiting the removal of the cap to ensure long-term effectiveness.	• Targeted excavation would be a reliable and effective way to remove soils exceeding DC.
Reduction in the Toxicity, Mobility, or Volume of Waste	• The cap would not reduce toxicity or volume of waste.	• Removal of impacted soil reduces the toxicity, mobility, and volume of impacted soils at the Site.
Short-term Effectiveness	• The existing building slab is effectively preventing direct contact with the impacted soils.	• Targeted excavation would be effective in removing soils exceeding DC once construction was completed.
Implementability	• A cap would be easy to implement, as there is an existing building slabs that cover the DC exceedances and is currently preventing direct contact with the impacted soils.	• Based on estimated depth (10 feet), excavation may require shoring, sloping, and/or benching but would be implementable.
Community Acceptance	• None (see community acceptance for land use restrictions, groundwater use restrictions, and monitored plume stability)	• Targeted excavation would eliminate soil exceeding DC; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• Caps have been accepted by the MDEQ to mitigate DC risks in non-residential areas.	• Excavations are widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• None	• Investigation to refine vertical and horizontal targeted excavation area.
Sustainability	• There is an existing building slab in place; therefore, no waste or emissions would be generated.	• Targeted excavation activities would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.
Cap Area/Excavation Volume [2]	Cap Area: 3,400 ft^2	Targeted Excavation Volume: 1,300 cy
Cost [3]	$0	$140,000

Notes:
1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Excavation volumes are rounded estimates.
3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.
4. Major cost assumptions for a cap are:
   • An existing building slab will serve as the cap.
   • Area defined by on RFI investigation data. DC exceedance location(s) to the next clean boring location.
5. Major cost assumptions for targeted excavation are:
   • Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
   • No shoring will be required and any materials removed for excavation benching and sloping will not require off-site transport and disposal.
   • Benching, sloping, groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
   • DC volume based on RFI investigation data, DC exceedance location(s) to the next clean boring location.

Acronyms and Abbreviations:
cy = cubic yards
DC = Direct Contact Criteria
ft^2 = square feet
MDEQ = Michigan Department of Environmental Quality
RC = Restrictive Covenant
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation

Table 3r
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	**Plant 3, Area 20**	
Media	**Soil**	
Corrective Measures Alternative [1]	**Cap[4]**	**Targeted Soil Excavation[5]**
Description	• A cap would be implemented to cover PSIC soil exceedances. • Existing soil/gravel that covers the applicable PSIC exceedances would serve as the cap for this area. • An RC would be filed with the deed prohibiting the removal of the cap and requiring inspections and maintenance of the cap.	• Targeted excavations would be completed to remove soils exceeding PSIC. • Excavated soils would be transported and disposed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
Long-term Reliability and Effectiveness	• A cap would effectively prevent particulate inhalation. • An RC would be filed with the deed prohibiting the removal of the cap to ensure long-term effectiveness.	• Targeted excavation would be a reliable and effective way to remove soils exceeding PSIC.
Reduction in the Toxicity, Mobility, or Volume of Waste	• The cap would not reduce toxicity or volume of waste.	• Removal of impacted soil reduces the toxicity, mobility, and volume of impacted soils at the Site.
Short-term Effectiveness	• The existing soil/gravel is effectively preventing particulate inhalation.	• Targeted excavation would be effective in removing soils exceeding PSIC once construction was completed.
Implementability	• A cap would be easy to implement, as there is sufficient existing soil/gravel that would serve as the cap and is currently preventing particulate inhalation.	• Based on estimated depth (up to 18 feet), excavation may require shoring, sloping, and/or benching; non-traditional utility locating equipment; and potentially water management and soil solidification and could be difficult to implement.
Community Acceptance	• None (see community acceptance for land use restrictions, groundwater use restrictions, and monitored plume stability)	• Targeted excavation would eliminate soil exceeding PSIC; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• Caps have been accepted by the MDEQ to mitigate PSIC risks in non-residential areas.	• Excavations are widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• None	• Investigation to refine vertical and horizontal targeted excavation area.
Sustainability	• Existing soil/gravel would serve as the cap; therefore, no waste or emissions would be generated.	• Targeted excavation activities would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.
Cap Area/Excavation Volume [2]	Cap Area: 4,700 ft^2	Targeted Excavation Volume: 3,200 cy
Cost [3]	$0	$269,000

Notes:
1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Excavation volumes are rounded estimates.
3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.
4. Major cost assumptions for a cap are:
   • Existing soil/gravel will serve as the cap.
   • Area defined by on RFI investigation data. PSIC exceedance location(s) to the next clean boring location.
5. Major cost assumptions for targeted excavation are:
   • Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
   • No shoring will be required and any materials removed for excavation benching and sloping will not require off-site transport and disposal.
   • Benching, sloping, groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
   • PSIC volume based on RFI investigation data, PSIC exceedance location(s) to the next clean boring location.

Acronyms and Abbreviations:
cy = cubic yards
ft^2 = square feet
MDEQ = Michigan Department of Environmental Quality
PSIC = Particulate Soil Inhalation Criteria
RC = Restrictive Covenant
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation

Table 3s
Evaluation of Corrective Measures Alternatives

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant and Investigation Area	**Plant 3, Area 21**	
Media	**Soil**	
Corrective Measures Alternative [1]	**Cap[4]**	**Targeted Soil Excavation[5]**
Description	• A cap would be implemented to cover DC soil exceedances. • An existing building slab covers the applicable DC exceedances and would serve as the cap for this area. • An RC would be filed with the deed prohibiting the removal of the cap.	• Targeted excavations would be completed to remove soils exceeding DC. • Excavated soils would be transported and disposed of in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
Long-term Reliability and Effectiveness	• A cap would effectively prevent direct contact with the impacted soils. • An RC would be filed with the deed prohibiting the removal of the cap and requiring inspections and maintenance of the cap.	• Targeted excavation would be a reliable and effective way to remove soils exceeding DC.
Reduction in the Toxicity, Mobility, or Volume of Waste	• The cap would not reduce toxicity or volume of waste.	• Removal of impacted soil reduces the toxicity, mobility, and volume of impacted soils at the Site.
Short-term Effectiveness	• The existing building slab is effectively preventing direct contact with the impacted soils.	• Targeted excavation would be effective in removing soils exceeding DC once construction was completed.
Implementability	• A cap would be easy to implement, as there is an existing building slabs that cover the DC exceedances and is currently preventing direct contact with the impacted soils.	• Based on estimated depth (5 feet), excavation may require shoring, sloping, and/or benching but would be implementable.
Community Acceptance	• None (see community acceptance for land use restrictions, groundwater use restrictions, and monitored plume stability)	• Targeted excavation would eliminate soil exceeding DC; therefore, it would likely be acceptable to the community.
MDEQ Acceptance	• Caps have been accepted by the MDEQ to mitigate DC risks in non-residential areas.	• Excavations are widely accepted by the MDEQ as a remedial option.
Pre-Design Testing	• None	• None
Sustainability	• There is an existing building slab in place; therefore, no waste or emissions would be generated.	• Targeted excavation activities would generate waste, have some energy requirements (fuel consumption), and minor emissions related to the construction and transport activities.
Cap Area/Excavation Volume [2]	Cap Area: 1,000 ft^2	Targeted Excavation Volume: 200 cy
Cost [3]	$0	$26,000

Notes:
1. Corrective measures alternatives also include land use restrictions, groundwater use restrictions, and monitored plume stability as evaluated in Table 3a. Cap inspection and maintenance cost are included with the monitored plume stability cost.
2. Excavation volumes are rounded estimates.
3. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within -30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.
4. Major cost assumptions for a cap are:
   • An existing building slab will serve as the cap.
   • Area defined by on RFI investigation data. DC exceedance location(s) to the next clean boring location.
5. Major cost assumptions for targeted excavation are:
   • Excavated material is not classified as a Listed or Characteristically Hazardous Waste.
   • No shoring will be required and any materials removed for excavation benching and sloping will not require off-site transport and disposal.
   • Benching, sloping, groundwater management/disposal activities are incidental to the project and are not subject to unit rates.
   • DC volume based on RFI investigation data, DC exceedance location(s) to the next clean boring location.

Acronyms and Abbreviations:
cy = cubic yards
DC = Direct Contact Criteria
ft^2 = square feet
MDEQ = Michigan Department of Environmental Quality
RC = Restrictive Covenant
RCRA = Resource Conservation and Recovery Act
RFI = RCRA Facility Investigation

Table 4
Proposed Final Corrective Measures Alternative for Soil, Groundwater and LNAPL

DRAFT

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Cost Estimate [1]	Plant 2	Plant 3	Plant 6	GRAND TOTAL
Land Use Restrictions:	$29,300	$23,400	$41,000	$94,000
Groundwater Use Restrictions:	$8,300	$8,300	$8,300	$25,000
Monitored Plume Stability (30-year):	**$1,497,000**	**$1,590,000**	**$1,037,000**	**$4,124,000**
Groundwater Sampling:	$696,000	$1,092,000	$996,000	$2,784,000
Initial Surface Cover and Vegetation Control and Surface Cover Maintenance :	$775,000	$443,000	-	$1,218,000
Well Abandonment (year 30)	$26,000	$55,000	$41,000	$122,000
Caps (Areas 2, 5-1, 5-2, 5-3, 5-5, 5-6, 5-8, 7, 16, 17, 18, 19, 20, and 21):	$300,000	$82,000	$87,000	$469,000
Targeted Excavation (Areas 5-7, 7, 9, and Plant 2 PCB Interim Measure):	$134,000	$0	$187,000	$321,000
Groundwater Recirculation:	**$4,200,000**	**$4,200,000**	**-**	**$8,400,000**
Treatability Testing, Design, and Capital	$1,300,000	$1,300,000	-	$2,600,000
System Startup	$53,000	$53,000	-	$106,000
Annual O&M (years 1 to 10)	$250,000	$250,000	-	$500,000
Annual Groundwater Performance Monitoring (years 1 to 10)	$36,000	$36,000	-	$72,000
Subtotal:	**$6,169,000**	**$5,904,000**	**$1,361,000**	**$13,400,000**

Notes:

1. All cost estimates presented have been prepared for the purposes of comparing potential remedial alternatives. The information in this cost estimate is based on the available information regarding the Site investigation and the anticipated scope of the remedial alternative. Changes in the cost elements are likely to occur as a result of new information and data collected during the engineering design of the remedial alternative. This cost estimate is expected to be within –30% to +50% of the actual project cost. Utilization of this cost estimate information beyond the stated purpose is not recommended. ARCADIS is not licensed to provide financial or legal consulting services; as such, this cost estimate information is not intended to be used for complying with financial reporting requirements associated with liability reserves.

2. Plant 2 PCB excavation based on costs provided by PM Environmental.

Acronyms and Abbreviations:

O&M = operations and maintenance

PCB = polychlorinated biphenyl

ARCADIS

Figures

DRAFT

AREA 13
AREA 18
AREA 12
AREA 14
AREA 17
AREA 20
AREA 21
AREA 15
AREA 16
AREA 11
AREA 19
AREA 3
AREA 8
AREA 5-4
AREA 5-1
AREA 5-7
AREA 4
AREA 5-2
AREA 5-6
AREA 5-8
AREA 5-5
AREA 5-3
AREA 2
AREA 10
AREA 1
AREA 9
AREA 6
AREA 7

NOTES:

* - AREAS OF RISK DENOTE AREAS WITH BOTH POTENTIALLY COMPLETE EXPOSURE PATHWAYS AND EXCEEDANCES OF RELEVANT CRITERIA

EXTENT OF IMPACTS BASED ON RFI PHASE 1 AND 2 SOIL AND GROUNDWATER DATA, AS WELL AS SOIL METALS DATA COLLECTED HISTORICALLY AT THE SITE.

ADDITIONAL PROPOSED CORRECTIVE MEASURES FOR PLANTS 2, 3, AND 6 INCLUDE SITE-WIDE LAND USE AND GROUNDWATER USE RESTRICTIONS.

PLUME STABILITY WILL BE MONITORED THROUGH THE IMPLEMENTATION OF A MONITORING PROGRAM AND RETAINING EXISTING COVER IN SELECT AREAS FOR INFILTRATION REDUCTION BARRIER.

THE PROPOSED DRINKING WATER CRITERIA FOR 1,4-DIOXANE IS 8.5 MICROGRAMS PER LITER.

RFI: RESOURCE CONSERVATION AND RECOVERY ACT FACILITY INVESTIGATION
VOCs: VOLATILE ORGANIC COMPOUNDS
GW: GROUNDWATER
LNAPL: LIGHT NON-AQUEOUS PHASE LIQUID

LEGEND

- AREA TO MAINTAIN SLAB OVER LNAPL/VOC SOURCE AREAS
- AREA TO RETAIN EXISTING COVER FOR POTENTIAL REDEVELOPMENT BENEFIT, SITE ACCESS, AND INFILTRATION REDUCTION BARRIER
- EXCAVATION AREA
- CAP AREA
- APPROXIMATE EXTENT LNAPL
- VOCs IN PERCHED GROUNDWATER ABOVE DRINKING WATER CRITERIA
- 1,4-DIOXANE IN PERCHED GW ABOVE PROPOSED DRINKING WATER CRITERIA
- PROPERTY BOUNDARY

AREAS OF RISK*

- PARTICULATE SOIL INHALATION
- DIRECT CONTACT
- SOIL VOLATILIZATION TO INDOOR AIR
- DIRECT CONTACT AND PARTICULATE SOIL INHALATION
- DIRECT CONTACT AND SOIL VOLATILIZATION TO INDOOR AIR
- DIRECT CONTACT, SOIL VOLATILIZATION TO INDOOR AIR, AND EXPLOSIVITY

0 400 800
SCALE IN FEET

RACER TRUST
PLANTS 2, 3, AND 6
LANSING, MICHIGAN

PROPOSED PERCHED ZONE CORRECTIVE MEASURES

ARCADIS

FIGURE
ES-1

CITY: BRIGHTON DIV: ENV DB: D. OLEXA PIC: CHRIS PETERS PM: AMY HOEKSEMA TM: RANDY CHRISTENSEN
G:\GIS\Project Files\MotorsLiquidationCompany\Lansing\Docs\CMS Report Figures\FIG ES-1 - Corrective Measures Summary.mxd PLOTTED: 6/3/2014 11:16:31 AM BY: dolexa
TR: JACKIE SALING PROJECT NUMBER: B0064479.2013 COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl

DRAFT

AREA 13
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AREA 14
AREA 18
AREA 17
AREA 20
AREA 21
AREA 15
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AREA 19
AREA 3
AREA 8
AREA 5-1
AREA 5-4
AREA 5-7
AREA 4
AREA 5-2
AREA 5-5
AREA 5-6
AREA 5-8
AREA 5-3
AREA 2
AREA 10
AREA 1
AREA 9
AREA 6
AREA 7

LEGEND

- 1,4-DIOXANE IN LOWER AQUIFER ABOVE PROPOSED DW CRITERIA
- GROUNDWATER RECIRCULATION EXTRACTION WELL
- GROUNDWATER RECIRCULATION INJECTION WELL
- INJECTION PIPING
- RECOVERY PIPING
- AREA TO MAINTAIN SLAB OVER LNAPL/VOC SOURCE AREAS
- AREA TO RETAIN EXISTING COVER FOR POTENTIAL REDEVELOPMENT BENEFIT, SITE ACCESS, AND INFILTRATION REDUCTION BARRIER
- TREATMENT BUILDING
- PROPERTY BOUNDARY

NOTES:

EXTENT OF IMPACTS BASED ON RFI PHASE 1 & 2 SOIL AND GROUNDWATER DATA, AS WELL AS SOIL METALS DATA COLLECTED HISTORICALLY AT THE SITE.

ADDITIONAL PROPOSED CORRECTIVE MEASURES FOR PLANTS 2, 3, AND 6 INCLUDE SITE-WIDE LAND USE AND GROUNDWATER USE RESTRICTIONS.

PLUME STABILITY WILL BE MONITORED THROUGH THE IMPLEMENTATION OF A GROUNDWATER MONITORING PROGRAM AND RETAINING EXISTING COVER IN SELECT AREAS FOR INFILTRATION REDUCTION BARRIER.

0 400 800
SCALE IN FEET

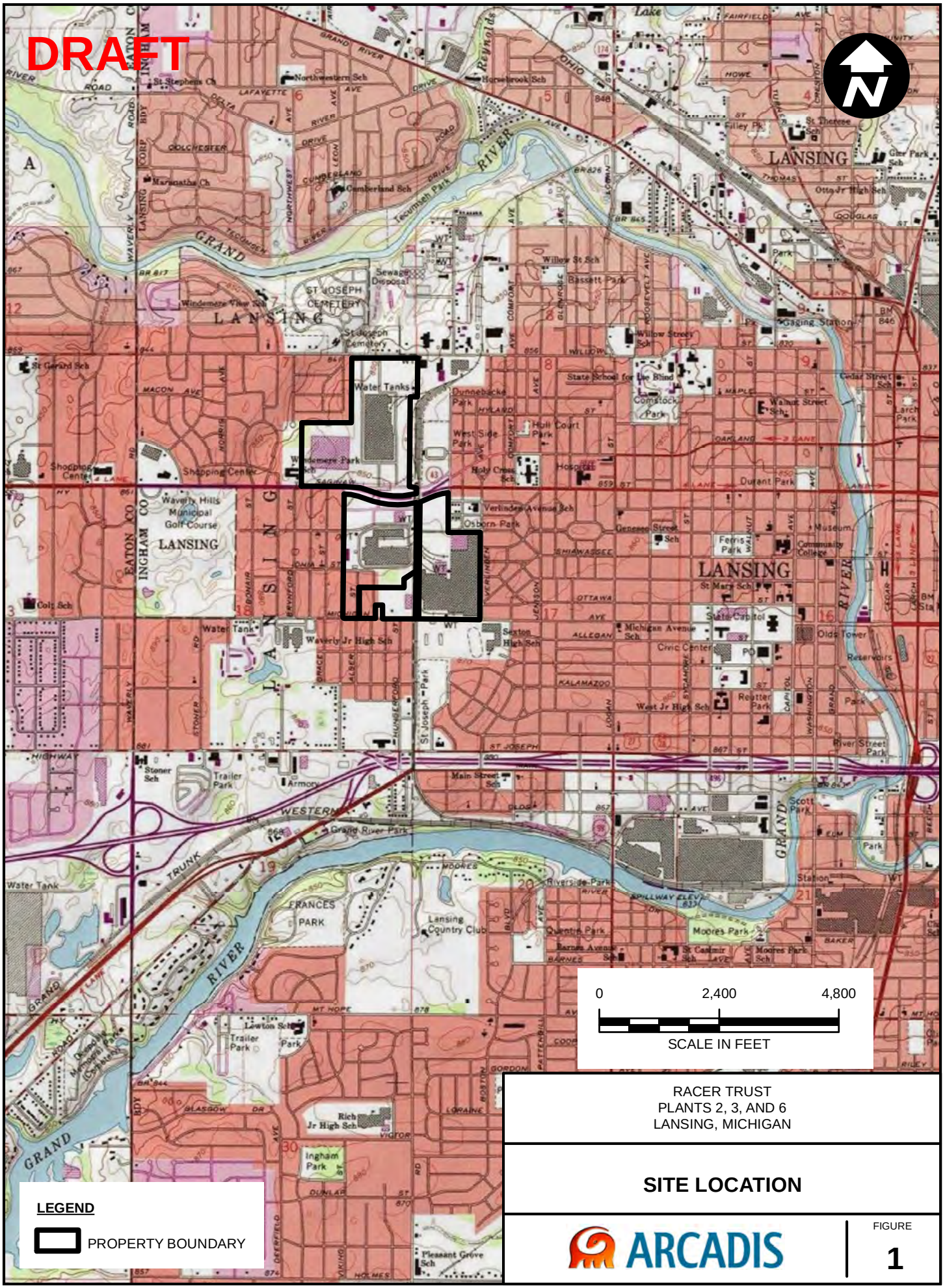
RACER TRUST
PLANTS 2, 3, AND 6
LANSING, MICHIGAN

PROPOSED LOWER 1,4-DIOXANE CORRECTIVE MEASURES

ARCADIS

FIGURE
ES-2

CITY: BRIGHTON DIV: ENV DB: D. OLEXA PIC: CHRIS PETERS PM: AMY HOEKSEMA TM: RANDY CHRISTENSEN TR: JACKIE SALING PROJECT NUMBER: B0064479.2013 COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
G:\GIS\Project Files\MotorsLiquidationCompany\Lansing\Docs\CMS Report Figures\FIG ES-2 - Corrective Measures Summary Deep OB.mxd PLOTTED: 6/3/2014 11:15:13 AM BY: dolexa



LEGEND

PROPERTY BOUNDARY

RACER TRUST
PLANTS 2, 3, AND 6
LANSING, MICHIGAN

SITE LOCATION

ARCADIS

FIGURE
1

CITY: BRIGHTON DIV: ENV DB: D. OLEXA PIC: CHRIS PETERS PM: AMY HOEKSEMA TM: RANDY CHRISTENSEN TR: JACKIE SALING PROJECT NUMBER: B00644479.2013 COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
G:\GIS\Project Files\MotorsLiquidationCompany\Lansing\Docs\CMS Report Figures\FIG 1 - SITE LOCATION.mxd PLOTTED: 6/3/2014 10:28:14 AM BY: dolexa

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AREA 13
AREA 12
AREA 14
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AREA 17
AREA 20
AREA 21
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AREA 16
AREA 11
AREA 19
AREA 3
AREA 8
AREA 5-4
AREA 5-1
AREA 5-7
AREA 4
AREA 5-2
AREA 5-5
AREA 5-6
AREA 5-8
AREA 2
AREA 5-3
AREA 10
AREA 1
AREA 9
AREA 6
AREA 7

0 400 800
SCALE IN FEET

LEGEND

PROPERTY BOUNDARY

RACER TRUST
PLANTS 2, 3, AND 6
LANSING, MICHIGAN

SITE LAYOUT

ARCADIS

FIGURE
2

CITY: BRIGHTON DIV: ENV DB: D. OLEXA PIC: CHRIS PETERS PM: AMY HOEKSEMA TM: RANDY CHRISTENSEN TR: JACKIE SALING PROJECT NUMBER: B0064479.2013 COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
G:\GIS\Project Files\MotorsLiquidationCompany\Lansing\Docs\CMS Report Figures\FIG 2 - AREA LOCATIONS.mxd PLOTTED: 6/3/2014 10:30:30 AM BY: dolexa

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AREA 13
AREA 12
AREA 14
AREA 18
AREA 17
AREA 20
AREA 21
AREA 11
AREA 15
AREA 19
AREA 16
AREA 3
AREA 8
AREA 5-1
AREA 5-4
AREA 5-7
AREA 4
AREA 5-2
AREA 5-6
AREA 5-5
AREA 5-8
AREA 5-3
AREA 2
AREA 10
AREA 1
AREA 9
AREA 6
AREA 7

LEGEND

- CAP AREA
- EXCAVATION AREA
- AREA TO MAINTAIN SLAB OVER LNAPL/VOC SOURCE AREAS
- AREA TO RETAIN EXISTING COVER AS AN INFILTRATION REDUCTION BARRIER
- PARTICULATE SOIL INHALATION
- DIRECT CONTACT
- SOIL VOLATILIZATION TO INDOOR AIR
- DIRECT CONTACT AND PARTICULATE SOIL INHALATION
- DIRECT CONTACT AND SOIL VOLATILIZATION TO INDOOR AIR
- DIRECT CONTACT, SOIL VOLATILIZATION TO INDOOR AIR, AND EXPLOSIVITY
- PROPERTY BOUNDARY

NOTES:

ADDITIONAL PROPOSED SOIL CORRECTIVE MEASURES FOR PLANTS 2, 3, AND 6 INCLUDE SITE-WIDE LAND USE AND GROUNDWATER USE RESTRICTIONS.

PLUME STABILITY WILL BE MONITORED THROUGH THE IMPLEMENTATION OF A GROUNDWATER MONITORING PROGRAM AND RETAINING EXISTING COVER IN SELECT AREAS AS AN INFILTRATION REDUCTION BARRIER.

LNAPL: LIGHT NON-AQUEOUS PHASE LIQUID
VOC: VOLATILE ORGANIC COMPOUND

0 400 800
SCALE IN FEET

RACER TRUST
PLANTS 2, 3, AND 6
LANSING, MICHIGAN

POTENTIAL SOIL CORRECTIVE MEASURES FOR PLANTS 2, 3, AND 6

ARCADIS

FIGURE
3

CITY: BRIGHTON DIV: ENV DB: D. OLEXA PIC: CHRIS PETERS PM: AMY HOEKSEMA TM: RANDY CHRISTENSEN TR: JACKIE SALING PROJECT NUMBER: B0064479.2013 COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
G:\GIS\Project Files\MotorsLiquidationCompany\Lansing\Docs\CMS Report Figures\FIG 3 - Potential Soil CMs.mxd PLOTTED: 6/3/2014 10:34:04 AM BY: dolexa

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AREA 13
AREA 12
AREA 14
AREA 18
AREA 17
AREA 20
AREA 21
AREA 11
AREA 15
AREA 19
AREA 16
AREA 8
AREA 3
AREA 5-1
AREA 5-4
AREA 4
AREA 5-2
AREA 5-3
AREA 5-5
AREA 5-7
AREA 5-6
AREA 5-8
AREA 2
AREA 10
AREA 1
AREA 9
AREA 6
AREA 7

LEGEND

- VOCs IN PERCHED GROUNDWATER ABOVE DRINKING WATER CRITERIA
- 1,4-DIOXANE IN PERCHED GW ABOVE PROPOSED DRINKING WATER CRITERIA
- ISCO AREA
- AREA TO MAINTAIN SLAB OVER LNAPL/VOC SOURCE AREAS
- AREA TO RETAIN EXISTING COVER AS AN INFILTRATION REDUCTION BARRIER
- PROPERTY BOUNDARY

NOTES:

ADDITIONAL PROPOSED GROUNDWATER CORRECTIVE MEASURES FOR PLANTS 2, 3, AND 6 INCLUDE SITE-WIDE GROUNDWATER USE RESTRICTIONS.

PLUME STABILITY WILL BE MONITORED THROUGH THE IMPLEMENTATION OF A GROUNDWATER MONITORING PROGRAM AND RETAINING EXISTING COVER IN SELECT AREAS AS AN INFILTRATION REDUCTION BARRIER.

THE PROPOSED DRINKING WATER CRITERIA FOR 1,4-DIOXANE IS 8.5 MICROGRAMS PER LITER.

VOCs: VOLATILE ORGANIC COMPOUNDS
GW: GROUNDWATER
ISCO: IN SITU CHEMICAL OXIDATION
LNAPL: LIGHT NON-AQUEOUS PHASE LIQUID

0 400 800
SCALE IN FEET

RACER TRUST
PLANTS 2, 3, AND 6
LANSING, MICHIGAN

POTENTIAL GROUNDWATER CORRECTIVE MEASURES FOR PLANTS 2, 3, AND 6 - IN SITU CHEMICAL OXIDATION

ARCADIS

FIGURE
4

CITY: BRIGHTON DIV: ENV DB: D. OLEXA PIC: CHRIS PETERS PM: AMY HOEKSEMA TM: RANDY CHRISTENSEN TR: JACKIE SALING PROJECT NUMBER: B0064479.2013 COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
G:\GIS\Project Files\MotorsLiquidationCompany\Lansing\Docs\CMS Report Figures\FIG 4 - In Situ Chemical Oxidation.mxd PLOTTED: 6/3/2014 10:45:29 AM BY: dolexa

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AREA 13
AREA 12
AREA 14
AREA 18
AREA 17
AREA 20
AREA 21
AREA 15
AREA 16
AREA 19
AREA 11
AREA 8
AREA 3
AREA 5-4
AREA 5-1
AREA 4
AREA 5-7
AREA 5-2
AREA 5-5
AREA 5-6
AREA 5-8
AREA 5-3
AREA 2
AREA 10
AREA 1
AREA 9
AREA 6
AREA 7

LEGEND

- ON-SITE HYDRAULIC CONTAINMENT EXTRACTION WELL
- RECOVERY PIPING
- TREATMENT BUILDING
- AREA TO MAINTAIN SLAB OVER LNAPL/VOC SOURCE AREAS
- AREA TO RETAIN EXISTING COVER AS AN INFILTRATION REDUCTION BARRIER
- 1,4-DIOXANE IN LOWER AQUIFER ABOVE PROPOSED DW CRITERIA
- PROPERTY BOUNDARY

NOTES:

ADDITIONAL PROPOSED GROUNDWATER CORRECTIVE MEASURES FOR PLANTS 2, 3, AND 6 INCLUDE SITE-WIDE GROUNDWATER USE RESTRICTIONS.

PLUME STABILITY WILL BE MONITORED THROUGH THE IMPLEMENTATION OF A GROUNDWATER MONITORING PROGRAM AND RETAINING EXISTING COVER IN SELECT AREAS AS AN INFILTRATION REDUCTION BARRIER.

THE PROPOSED DRINKING WATER CRITERIA FOR 1,4-DIOXANE IS 8.5 MICROGRAMS PER LITER.

LNAPL: LIGHT NON-AQUEOUS PHASE LIQUID
VOC: VOLATILE ORGANIC COMPOUND
DW: DRINKING WATER

0 400 800
SCALE IN FEET

RACER TRUST
PLANTS 2, 3, AND 6
LANSING, MICHIGAN

POTENTIAL GROUNDWATER CORRECTIVE MEASURES FOR PLANTS 2 AND 3 - LOWER 1,4-DIOXANE HYDRAULIC CONTAINMENT

ARCADIS

FIGURE
5

CITY: BRIGHTON DIV: ENV DB: D. OLEXA PIC: CHRIS PETERS PM: AMY HOEKSEMA TM: RANDY CHRISTENSEN TR: JACKIE SALING PROJECT NUMBER: B0064479.2013 COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
G:\GIS\Project Files\MotorsLiquidationCompany\Lansing\Docs\CMS Report Figures\FIG 5 - Onsite Hydraulic Containment.mxd PLOTTED: 6/3/2014 10:46:26 AM BY: dolexa

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AREA 13
AREA 12
AREA 14
AREA 18
AREA 17
AREA 20
AREA 21
AREA 15
AREA 16
AREA 11
AREA 19
AREA 3
AREA 8
AREA 5-4
AREA 5-1
AREA 4
AREA 5-7
AREA 5-2
AREA 5-6
AREA 5-5
AREA 5-8
AREA 5-3
AREA 2
AREA 10
AREA 1
AREA 9
AREA 6
AREA 7

LEGEND

- AGGRESSIVE PUMP AND TREAT EXTRACTION WELL
- RECOVERY PIPING
- TREATMENT BUILDING
- AREA TO MAINTAIN SLAB OVER LNAPL/VOC SOURCE AREAS
- AREA TO RETAIN EXISTING COVER AS AN INFILTRATION REDUCTION BARRIER
- 1,4-DIOXANE IN LOWER AQUIFER ABOVE PROPOSED DW CRITERIA
- PROPERTY BOUNDARY

NOTES:

ADDITIONAL PROPOSED GROUNDWATER CORRECTIVE MEASURES FOR PLANTS 2, 3, AND 6 INCLUDE SITE-WIDE GROUNDWATER USE RESTRICTIONS.

PLUME STABILITY WILL BE MONITORED THROUGH THE IMPLEMENTATION OF A GROUNDWATER MONITORING PROGRAM AND RETAINING EXISTING COVER IN SELECT AREAS AS AN INFILTRATION REDUCTION BARRIER.

THE PROPOSED DRINKING WATER CRITERIA FOR 1,4-DIOXANE IS 8.5 MICROGRAMS PER LITER.

LNAPL: LIGHT NON-AQUEOUS PHASE LIQUID
VOC: VOLATILE ORGANIC COMPOUND

0 400 800
SCALE IN FEET

RACER TRUST
PLANTS 2, 3, AND 6
LANSING, MICHIGAN

POTENTIAL GROUNDWATER CORRECTIVE MEASURES FOR PLANTS 2 AND 3 - LOWER 1,4-DIOXANE AGGRESSIVE PUMP AND TREAT

ARCADIS

FIGURE
6

CITY: BRIGHTON DIV: ENV DB: D. OLEXA PIC: CHRIS PETERS PM: AMY HOEKSEMA TM: RANDY CHRISTENSEN TR: JACKIE SALING PROJECT NUMBER: B0064479.2013 COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
G:\GIS\Project Files\MotorsLiquidationCompany\Lansing\Docs\CMS Report Figures\FIG 6 - Aggressive Pump Treat.mxd PLOTTED: 6/3/2014 10:49:05 AM BY: dolexa

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AREA 13
AREA 12
AREA 14
AREA 18
AREA 17
AREA 20
AREA 21
AREA 15
AREA 16
AREA 11
AREA 19
AREA 3
AREA 8
AREA 5-4
AREA 5-1
AREA 4
AREA 5-7
AREA 5-2
AREA 5-5
AREA 5-6
AREA 5-8
AREA 5-3
AREA 2
AREA 10
AREA 1
AREA 9
AREA 6
AREA 7

LEGEND

- GROUNDWATER RECIRCULATION EXTRACTION WELL
- GROUNDWATER RECIRCULATION INJECTION WELL
- INJECTION PIPING
- RECOVERY PIPING
- TREATMENT BUILDING
- AREA TO MAINTAIN SLAB OVER LNAPL/VOC SOURCE AREAS
- AREA TO RETAIN EXISTING COVER AS AN INFILTRATION REDUCTION BARRIER
- 1,4-DIOXANE IN LOWER AQUIFER ABOVE PROPOSED DW CRITERIA
- PROPERTY BOUNDARY

0 400 800
SCALE IN FEET

NOTES:

ADDITIONAL PROPOSED GROUNDWATER CORRECTIVE MEASURES FOR PLANTS 2, 3, AND 6 INCLUDE SITE-WIDE GROUNDWATER USE RESTRICTIONS.

PLUME STABILITY WILL BE MONITORED THROUGH THE IMPLEMENTATION OF A GROUNDWATER MONITORING PROGRAM AND RETAINING EXISTING COVER IN SELECT AREAS AS AN INFILTRATION REDUCTION BARRIER.

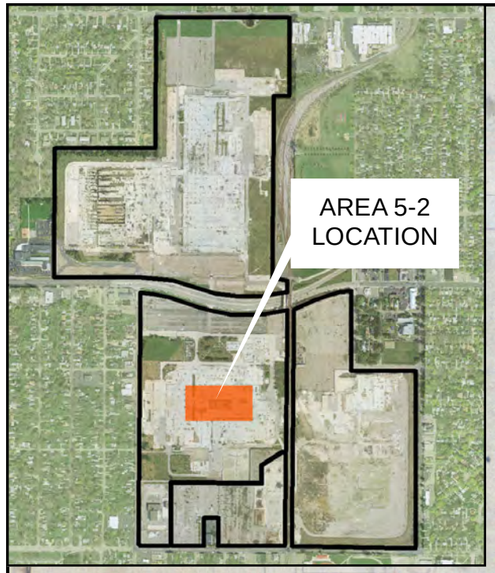
RACER TRUST
PLANTS 2, 3, AND 6
LANSING, MICHIGAN

POTENTIAL GROUNDWATER CORRECTIVE MEASURES FOR PLANTS 2 AND 3 - LOWER 1,4-DIOXANE GROUNDWATER RECIRCULATION

ARCADIS

FIGURE
7

CITY: BRIGHTON DIV: ENV DB: D. OLEXA PIC: CHRIS PETERS PM: AMY HOEKSEMA TM: RANDY CHRISTENSEN TR: JACKIE SALING PROJECT NUMBER: B0064479.2013 COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
G:\GIS\Project Files\MotorsLiquidationCompanyLansing\Docs\CMS Report Figures\FIG 7 - GW Recirculation.mxd PLOTTED: 6/3/2014 10:51:50 AM BY: dolexa



Proposed Vault/PCB Excavation
50' X 90' X 10' deep (Interim Measure)

Concrete Vault Location
25' X 4' X 4' deep

0 50 100
SCALE IN FEET

LEGEND

- LIF BORING
- SOIL BORING 2011-2012
- LNAPL CORRECTIVE MEASURES AREA (LNAPL SKIMMING, MPE, AND/OR EXCAVATION)
- CAP EXTENDED TO COVER GRASSY AREA
- CAP UTILIZING EXISTING SURFACE COVER
- TARGETED EXCAVATION (CVOCs / 1,1,1-TCA)
- PCB SOIL & VAULT EXCAVATION (INTERIM MEASURE)

NOTES:

ADDITIONAL PROPOSED LNAPL CORRECTIVE MEASURES FOR PLANTS 2, 3, AND 6 INCLUDE SITE-WIDE GROUNDWATER USE RESTRICTIONS.

PLUME STABILITY WILL BE MONITORED THROUGH THE IMPLEMENTATION OF AN LNAPL MONITORING PROGRAM AND MAINTAINING EXISTING COVER OVER THE LNAPL PLUME AS AN INFILTRATION REDUCTION BARRIER.

LNAPL: LIGHT NON-AQUEOUS PHASE LIQUID
MPE: MULTI-PHASE EXTRACTION
CVOCs: CHLORINATED VOLATILE ORGANIC COMPOUNDS
1,1,1-TCA: 1,1,1-TRICHLOROETHANE
PCB: POLYCHLORINATED BIPHENYL

RACER TRUST
PLANTS 2, 3, AND 6
LANSING, MICHIGAN

POTENTIAL LNAPL CORRECTIVE MEASURES FOR PLANT 2

ARCADIS

FIGURE
8

CITY: BRIGHTON DIV: ENV DB: D. OLEXA PIC: CHRIS PETERS PM: AMY HOEKSEMA TM: RANDY CHRISTENSEN TR: JACKIE SALING PROJECT NUMBER: B0064479.2013 COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
G:\GIS\Project Files\MotorsLiquidationCompany\Lansing\Docs\CMS Report Figures\Fig 8 - LNAPL P2.mxd PLOTTED: 6/3/2014 10:57:01 AM BY: dolexa

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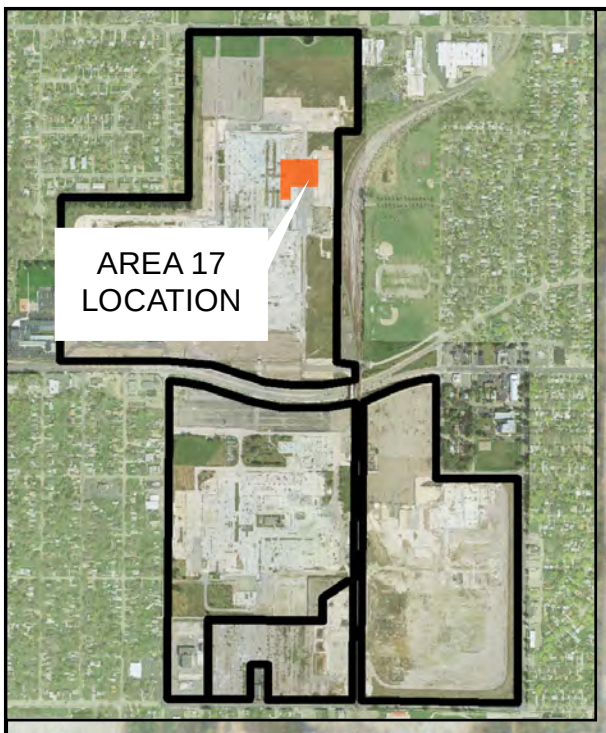

LEGEND

- LIF BORING
- SOIL BORING 2011-2012
- CAP UTILIZING EXISTING SURFACE COVER
- LNAPL CORRECTIVE MEASURES AREA (LNAPL SKIMMING, SVE, MPE, AND/OR EXCAVATION)

NOTES:

ADDITIONAL PROPOSED LNAPL CORRECTIVE MEASURES FOR PLANTS 2, 3, AND 6 INCLUDE SITE-WIDE GROUNDWATER USE RESTRICTIONS.

PLUME STABILITY WILL BE MONITORED THROUGH THE IMPLEMENTATION OF AN LNAPL MONITORING PROGRAM AND MAINTAINING EXISTING COVER OVER THE LNAPL PLUME FOR INFILTRATION REDUCTION.

LNAPL: LIGHT NON-AQUEOUS PHASE LIQUID
SVE: SOIL VAPOR EXTRACTION
MPE: MULTI-PHASE EXTRACTION

0 30 60
SCALE IN FEET

RACER TRUST
PLANTS 2, 3, AND 6
LANSING, MICHIGAN

POTENTIAL LNAPL CORRECTIVE MEASURES FOR PLANT 3

ARCADIS

FIGURE
9

CITY: BRIGHTON DIV: ENV DB: D. OLEXA PIC: CHRIS PETERS PM: AMY HOEKSEMA TM: RANDY CHRISTENSEN TR: JACKIE SALING PROJECT NUMBER: B0064479.2013 COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
G:\GIS\Project Files\MotorsLiquidationCompany\Lansing\Docs\CMS Report Figures\FIG 9 - LNAPL P3.mxd PLOTTED: 6/3/2014 11:03:35 AM BY: dolexa

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AREA 13
AREA 14
AREA 12
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AREA 20
AREA 21
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AREA 3
AREA 5-1
AREA 5-4
AREA 5-7
AREA 4
AREA 5-2
AREA 5-5
AREA 5-6
AREA 5-8
AREA 5-3
AREA 2
AREA 10
AREA 1
AREA 9
AREA 6
AREA 7

LEGEND

- GROUNDWATER RECIRCULATION EXTRACTION WELL
- GROUNDWATER RECIRCULATION INJECTION WELL
- INJECTION PIPING
- RECOVERY PIPING
- TREATMENT BUILDING
- AREA TO MAINTAIN SLAB OVER LNAPL/VOC SOURCE AREAS
- AREA TO RETAIN EXISTING COVER AS AN INFILTRATION REDUCTION BARRIER
- EXCAVATION AREA
- CAP AREA
- PROPERTY BOUNDARY

NOTES:

ADDITIONAL PROPOSED CORRECTIVE MEASURES FOR PLANTS 2, 3, AND 6 INCLUDE SITE-WIDE LAND USE AND GROUNDWATER USE RESTRICTIONS.

PLUME STABILITY WILL BE MONITORED THROUGH THE IMPLEMENTATION OF A GROUNDWATER MONITORING PROGRAM AND RETAINING EXISTING COVER IN SELECT AREAS.

LNAPL: LIGHT NON-AQUEOUS PHASE LIQUID
VOC: VOLATILE ORGANIC COMPOUND

0 400 800
SCALE IN FEET

RACER TRUST
PLANTS 2, 3, AND 6
LANSING, MICHIGAN

PROPOSED CORRECTIVE MEASURES

ARCADIS

FIGURE
10

CITY: BRIGHTON DIV: ENV DB: D. OLEXA PIC: CHRIS PETERS PM: AMY HOEKSEMA TM: RANDY CHRISTENSEN TR: JACKIE SALING PROJECT NUMBER: B0064479.2013 COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
G:\GIS\Project Files\MotorsLiquidationCompany\Lansing\Docs\CMS Report Figures\FIG 10 - Proposed CMs.mxd PLOTTED: 6/3/2014 11:04:57 AM BY: dolexa

Appendix A

RFI Figure and Table References

A
Northwest

Area 11

A’
Southeast

W. Saginaw Ave

Coliseum

SB-A11-HC24 (5-9’): <5

Area of Soil and GW CVOC impacts

SB-A11-HE23 (19-23’): 82

Perched Zone

GW Recharge

DRY

DRY

MW-12-21: 500

MW-13-29: 31

MW-13-48: 34

VAP: MW-13-29 (76-80’):130

TILL

MW-13-34: 99

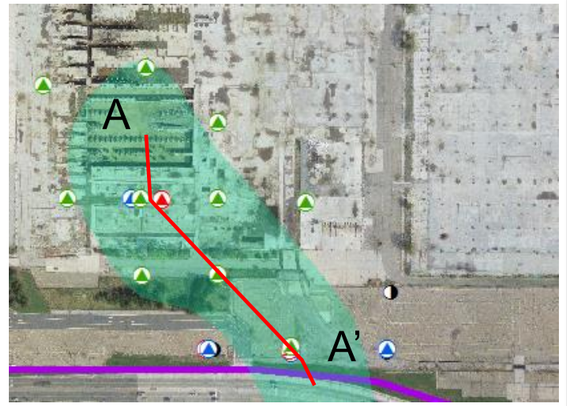
Weathered Bedrock

MW-13-22: 270

MW-13-28: <5

Bedrock: Grand River Formation

MW-13-47: <5



STRATIGRAPHIC UNIT

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY SAND
- SAND
- SANDY SILT/SILT
- SILTY/SANDY/GRAVELLY CLAY
- CLAY
- PEAT
- BEDROCK-SANDSTONE
- BEDROCK-SHALE
- NO RECOVERY

35 1,4-Dioxane in Groundwater (µg/L) (12/2013)

Approximate Monitoring Well Screen Interval
Green - Deep Overburden
Blue- Weathered Bedrock
Red- Bedrock

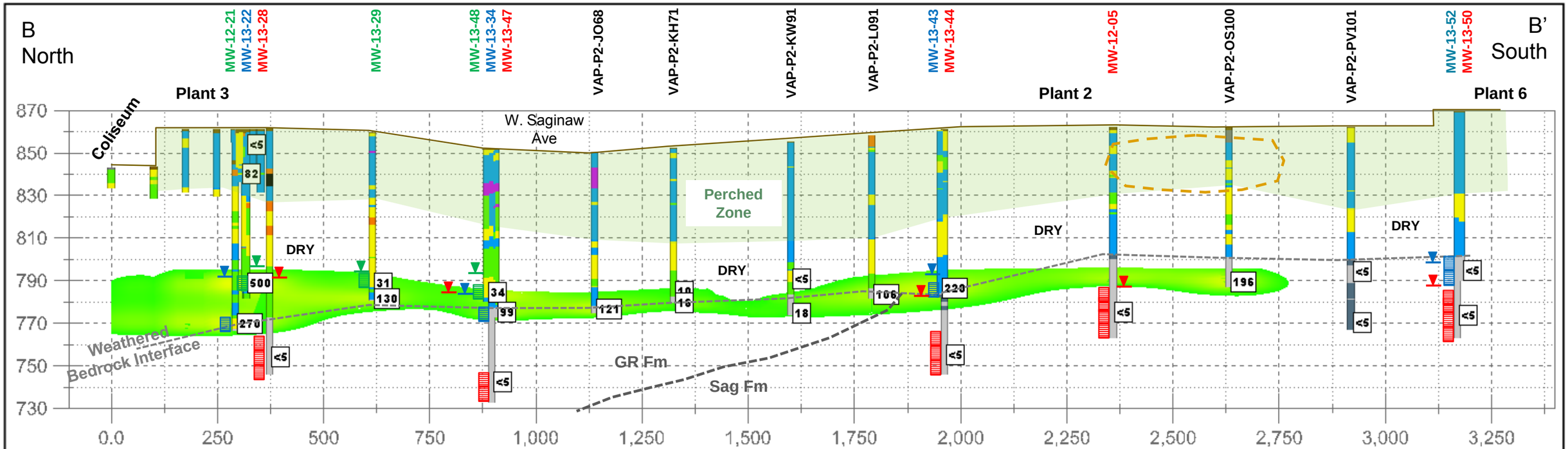
Approximate Groundwater Elevation (12/2013)
(color coded for depth)

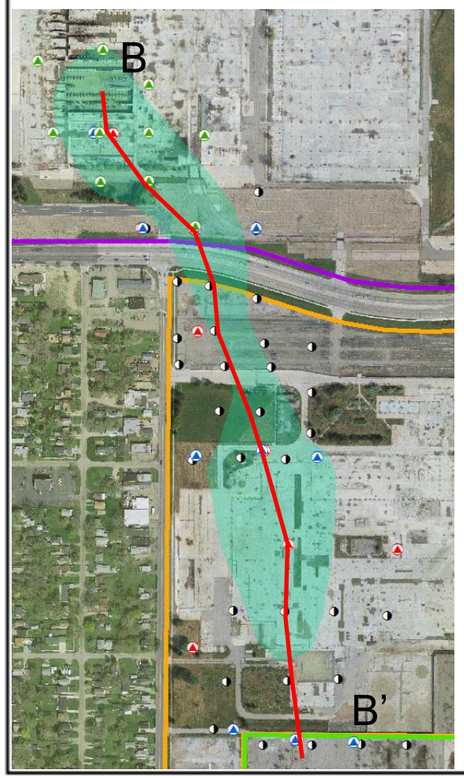
RACER TRUST
PLANTS 2, 3, & 6
LANSING, MICHIGAN

LOWER 1,4-DIOXANE SOURCE AREA CROSS SECTION A-A’

ARCADIS

FIGURE
4





LEGEND

106 — 1,4-dioxane concentration in groundwater (µg/L)

GR Fm – Grand River Formation – fine to medium grained sandstone

Sag Fm – Saginaw Formation - fine sandstone interbedded with shale

1,4-dioxane in perched groundwater

Approximate Monitoring Well Screen Interval
Green - Deep Overburden
Blue - Weathered Bedrock
Red - Bedrock

Approximate Groundwater Elevation - 12/2013 (color coded for depth)

1,4-DIOXANE PLUME

- 500 ug/L
- 300 ug/L
- 100 ug/L
- 30 ug/L
- 10 ug/L
- <5 ug/L

STRATIGRAPHY

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY SAND
- SAND
- SANDY SILT/SILT
- SILTY/SANDY/GRAVELLY CLAY
- CLAY
- PEAT
- BEDROCK-SANDSTONE
- BEDROCK-SHALE
- NO RECOVERY

RACER TRUST
PLANTS 2, 3, & 6
LANSING, MICHIGAN

LOWER 1,4-DIOXANE PLUME CROSS SECTION B-B'

ARCADIS

FIGURE 8

AREA 13
K'
AREA 12
AREA 14
AREA 18
B'
I
I'
F'
AREA 20
AREA 17
B
AREA 16
AREA 21
AREA 15
J
AREA 19
AREA 11
J'
F
K
AREA 8
H'
AREA 3
AREA 5
AREA 5-1
AREA 5-4
AREA 5-7
D'
AREA 4
D
AREA 5-8
AREA 5-5
G'
G
A
A'
AREA 5-2
AREA 5-6
AREA 2
C
C'
AREA 10
AREA 5-3
AREA 1
E'
AREA 9
AREA 6
AREA 7
H
E

LEGEND

- APPROXIMATE CROSS-SECTION LOCATION
- APPROXIMATE EXTENT OF LNAPL
- RFI PHASE 2 INVESTIGATION AREAS
- PLANT 2
- PLANT 3
- PLANT 6

0 390 780

SCALE IN FEET

RACER TRUST
PLANTS 2, 3 & 6
LANSING, MICHIGAN

CROSS-SECTION LOCATION MAP

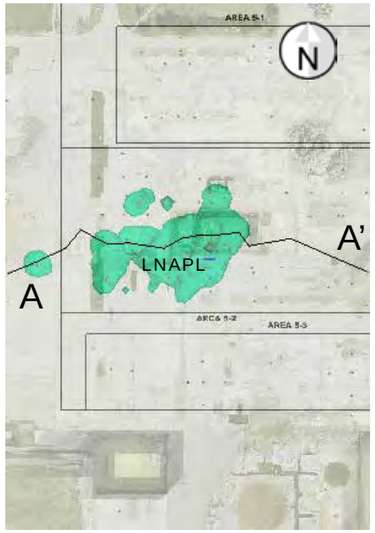
ARCADIS

FIGURE
C-1

CITY: KNOXVILLE DIV: ENV DB: A.SMITH PIC: PM: TM: TR: PROJECT NUMBER: COORDINATE SYSTEM: NAD 1983 StatePlane Michigan South FIPS 2113 Feet Intl
G:\GIS\Project Files\MotorsLiquidationCompany\Lansing\Docs\Phase 2 RFI Report Figs\FIG C-1 - Cross-section locations.mxd PLOTTED: 3/28/2013 10:17:37 AM BY: PCurry

Figure C-2
Plant 2, Area 5.2 Cross Section (Groundwater)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan

Plant 2, Area 5.2



Total VOCs

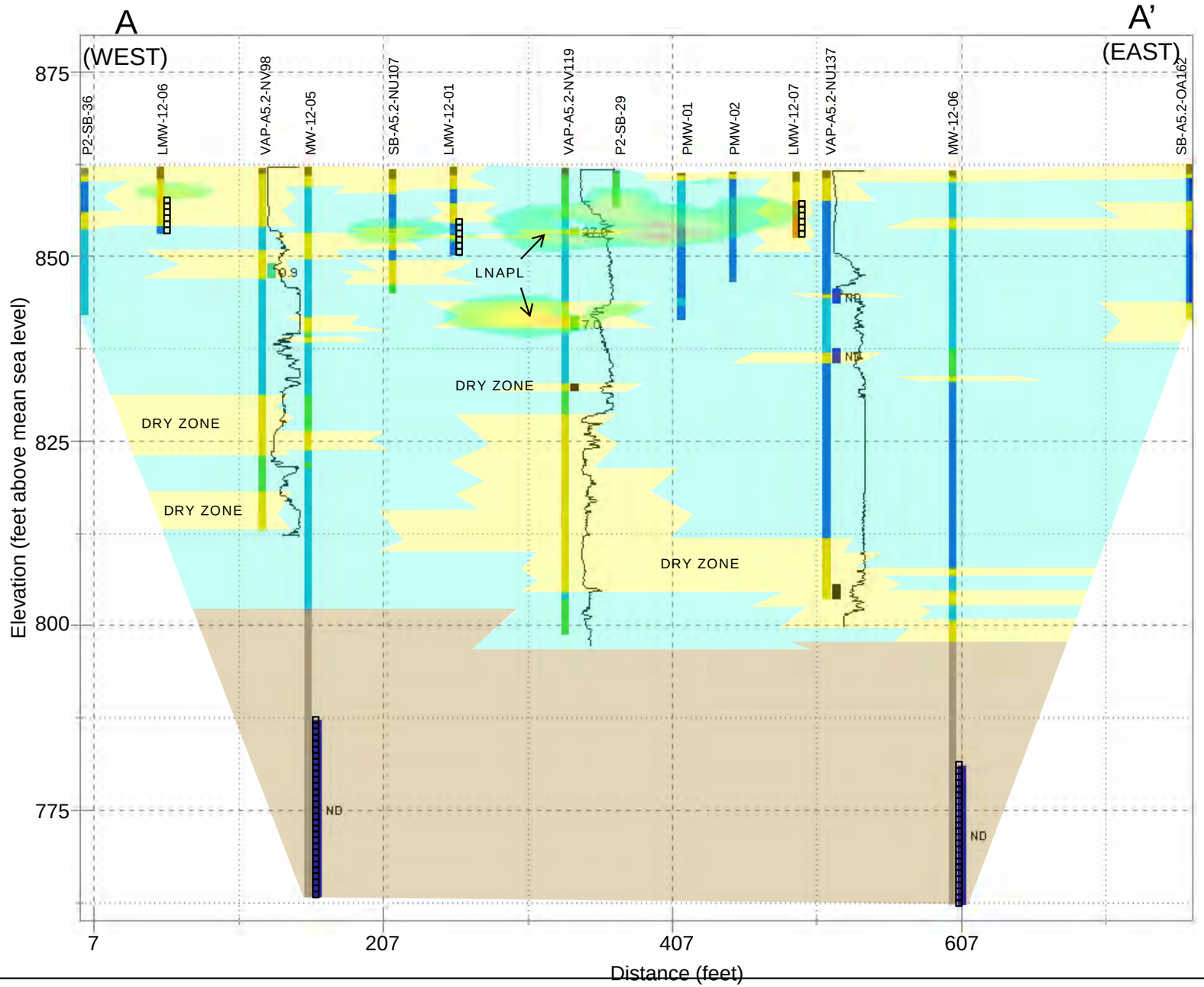
- Above 100 X Criteria
- 10-100 X Criteria
- 1-10 X Criteria
- Below Criteria
- ND

General Hydrostratigraphy

- Higher Permeability (Sand/Gravel)
- Lower Permeability (Silt/Clay)
- Bedrock

Boring Log Lithology

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY_SAND
- SAND
- SANDY_SILT/SILT
- SILTY/SANDY/GRAVELLY_CLAY
- CLAY
- PEAT
- BEDROCK
- NO_RECOVERY



Notes:

1. VOC concentrations represent normalized totals and are presented as multiples of criteria. See Appendix B for discussion of the normalization process.
2. VOCs normalized to lowest applicable criteria (typically Michigan Part 201 GSI/GSIP or DW/DWP Criteria).
3. Dry zones are generally noted in zones were sample collected was attempted, but the interval was noted as dry (gray boxes), or noted as dry on the boring log.
4. Actual compound concentrations can be found on Tables 12 through 17.
5. HPT pressure profile represented by black lines. Pressure increasing to right.

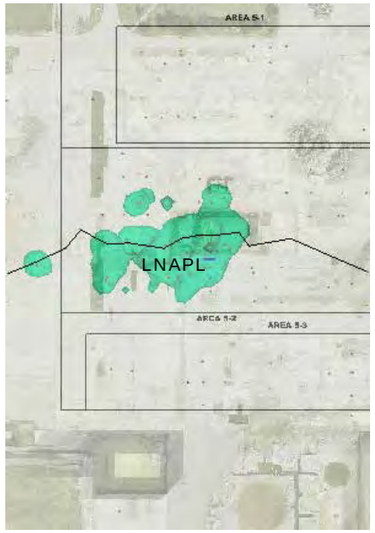
Source:

Project Number

ARCADIS

Figure C-3
Plant 2, Area 5.2 Cross Section (Soil)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan

Plant 2, Area 5.2



Total VOCs

- Above 100 X Criteria
- 10-100 X Criteria
- 1-10 X Criteria
- Below Criteria
- ND

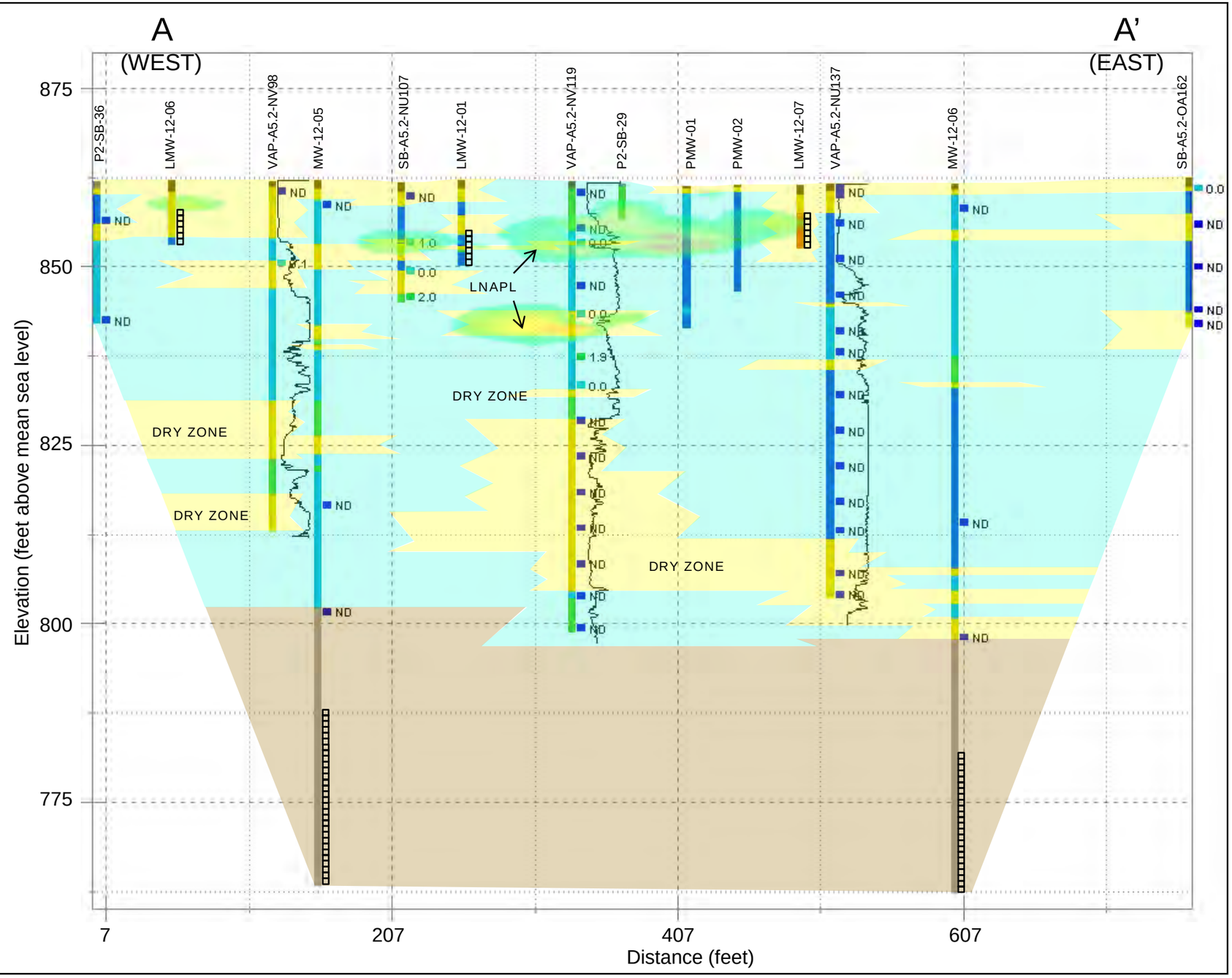
General Hydrostratigraphy

- Higher Permeability (Sand/Gravel)
- Lower Permeability (Silt/Clay)
- Bedrock

Boring Log Lithology

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY_SAND
- SAND
- SANDY_SILT/SILT
- SILTY/SANDY/GRAVELLY_CLAY
- CLAY
- PEAT
- BEDROCK
- NO_RECOVERY

Notes:
1. VOC concentrations represent normalized totals and are presented as multiples of criteria. See Appendix B for discussion of the normalization process.
2. VOCs normalized to lowest applicable criteria (typically Michigan Part 201 GSI/GSIP or DW/DWP Criteria).
3. Dry zones are generally noted in zones were sample collected was attempted, but the interval was noted as dry (gray boxes), or noted as dry on the boring log.
4. Actual compound concentrations can be found on Tables 12 through 17.
5. HPT pressure profile represented by black lines. Pressure increasing to right.



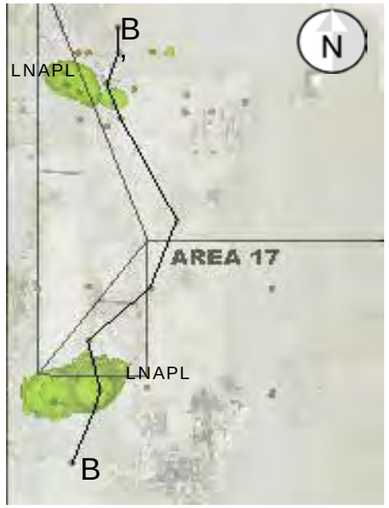
Source:

Project Number

ARCADIS

Figure C-4
Plant 3, Area 17 Cross Section
(Groundwater)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan

Plant 3, Area 17



Total VOCs

- Above 100 X Criteria
- 10-100 X Criteria
- 1-10 X Criteria
- Below Criteria
- ND

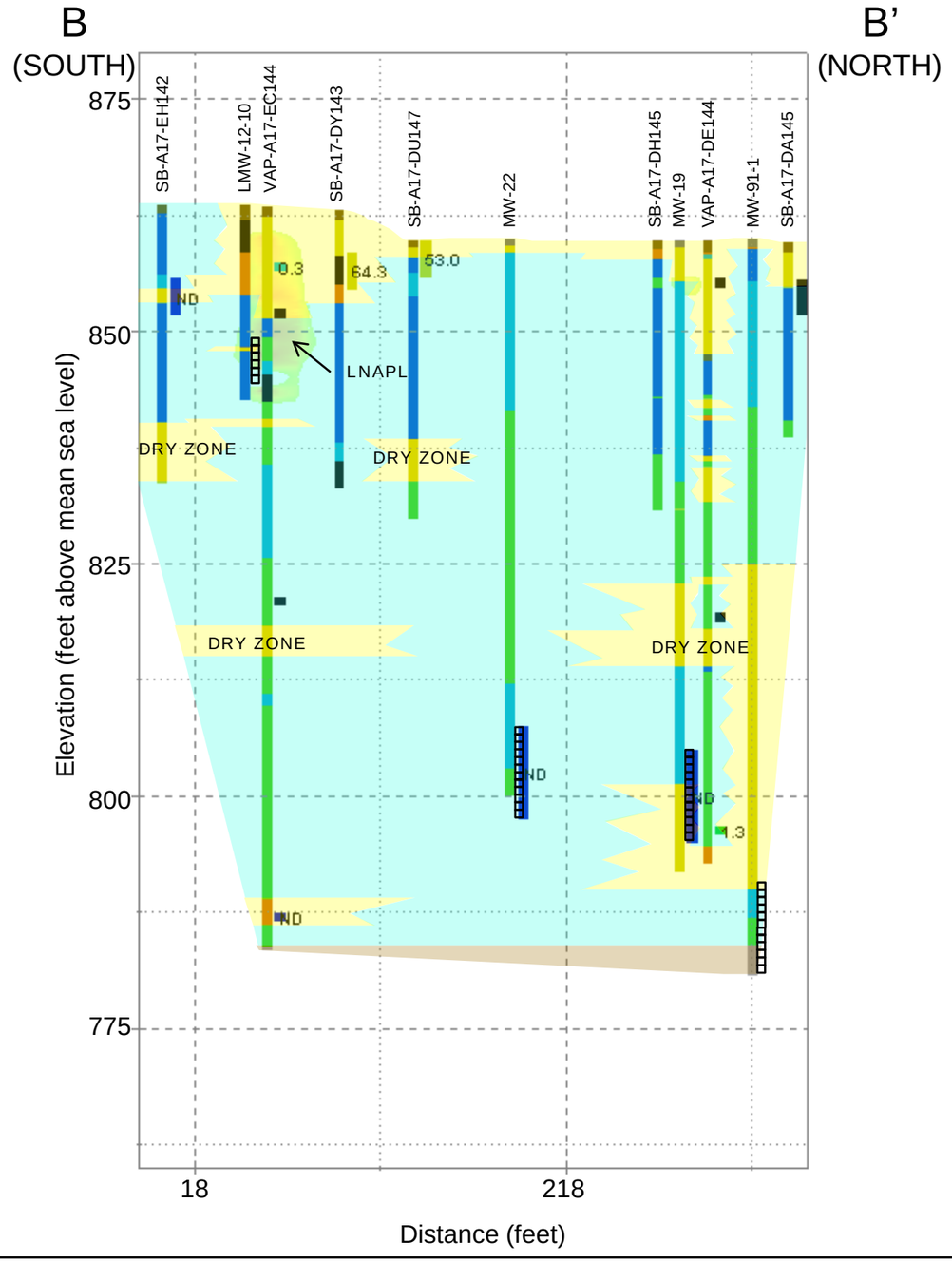
General Hydrostratigraphy

- Higher Permeability (Sand/Gravel)
- Lower Permeability (Silt/Clay)
- Bedrock

Boring Log Lithology

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY_SAND
- SAND
- SANDY_SILT/SILT
- SILTY/SANDY/GRAVELLY_CLAY
- CLAY
- PEAT
- BEDROCK
- NO_RECOVERY

Notes:
1. VOC concentrations represent normalized totals and are presented as multiples of criteria. See Appendix B for discussion of the normalization process.
2. VOCs normalized to lowest applicable criteria (typically Michigan Part 201 GSI/GSIP or DW/DWP Criteria).
3. Dry zones are generally noted in zones were sample collected was attempted, but the interval was noted as dry (gray boxes), or noted as dry on the boring log.
4. Actual compound concentrations can be found on Tables 12 through 17.

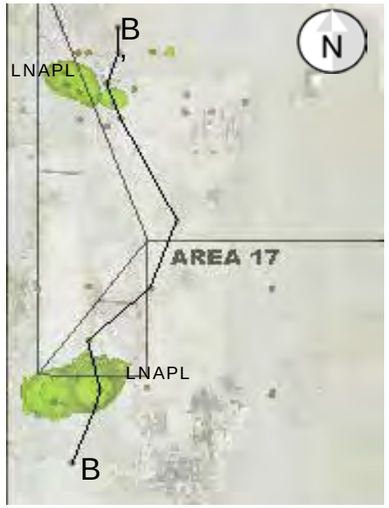


Source:

Project Number

Figure C-5
Plant 3, Area 17 Cross Section (Soil)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan

Plant 3, Area 17



Total VOCs

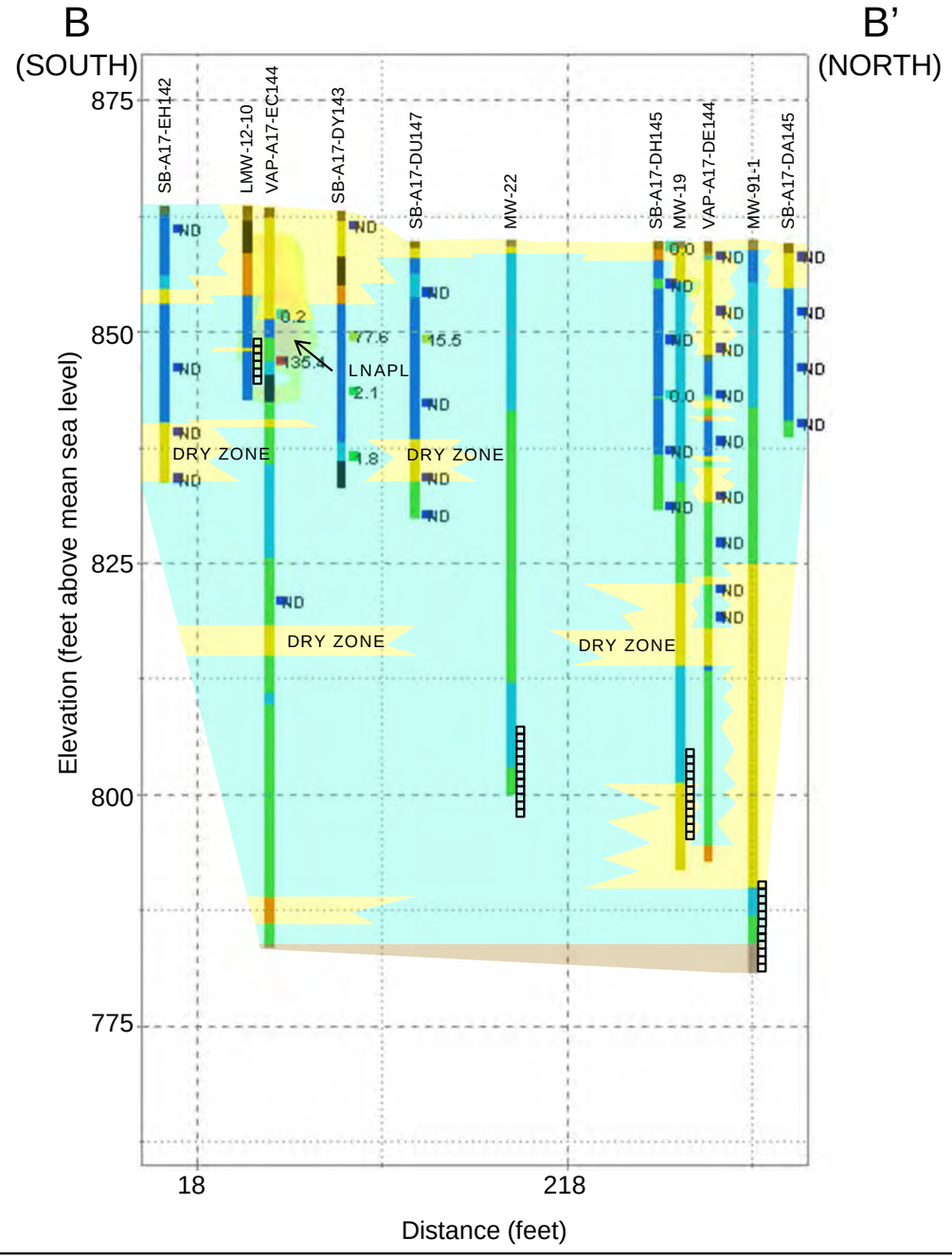
- Above 100 X Criteria
- 10-100 X Criteria
- 1-10 X Criteria
- Below Criteria
- ND

General Hydrostratigraphy

- Higher Permeability (Sand/Gravel)
- Lower Permeability (Silt/Clay)
- Bedrock

Boring Log Lithology

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY_SAND
- SAND
- SANDY_SILT/SILT
- SILTY/SANDY/GRAVELLY_CLAY
- CLAY
- PEAT
- BEDROCK
- NO_RECOVERY



Notes:

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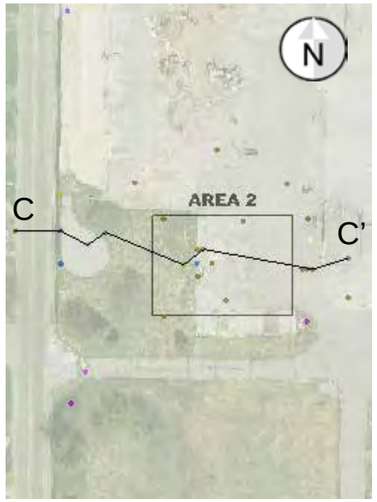
2. VOCs normalized to lowest applicable criteria (typically Michigan Part 201 GSI/GSIP or DW/DWP Criteria).
3. Dry zones are generally noted in zones were sample collected was attempted, but the interval was noted as dry (gray boxes), or noted as dry on the boring log.
4. Actual compound concentrations can be found on Tables 12 through 17.

Source:

Project Number

Figure C-6
Plant 2, Area 2 Cross Section (Groundwater)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan

Plant 2, Area 2



Total VOCs

- Above 100 X Criteria
- 10-100 X Criteria
- 1-10 X Criteria
- Below Criteria
- ND

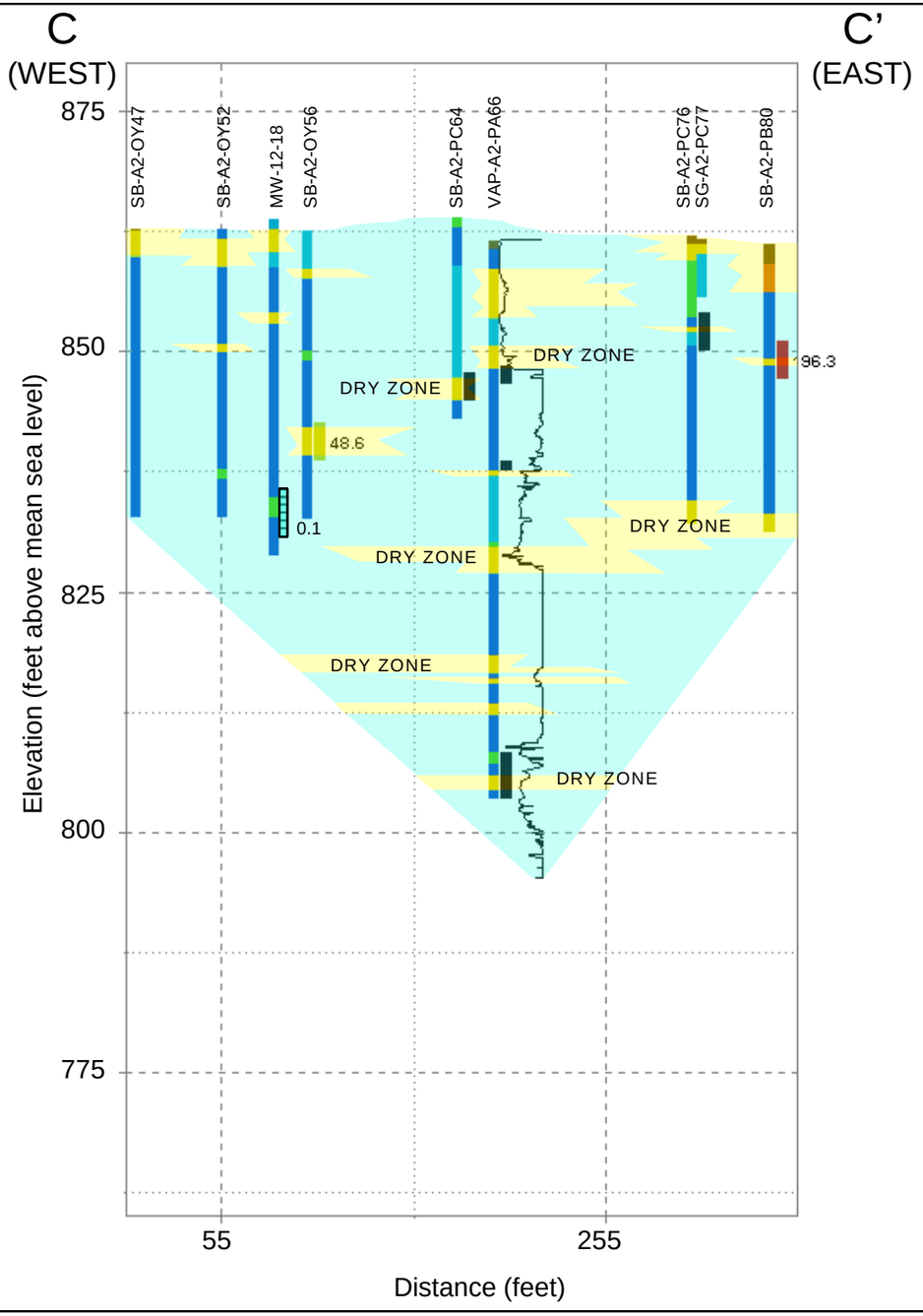
General Hydrostratigraphy

- Higher Permeability (Sand/Gravel)
- Lower Permeability (Silt/Clay)
- Bedrock

Boring Log Lithology

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY_SAND
- SAND
- SANDY_SILT/SILT
- SILTY/SANDY/GRAVELLY_CLAY
- CLAY
- PEAT
- BEDROCK
- NO_RECOVERY

Notes:
1. VOC concentrations represent normalized totals and are presented as multiples of criteria. See Appendix B for discussion of the normalization process.
2. VOCs normalized to lowest applicable criteria (typically Michigan Part 201 GSI/GSIP or DW/DWP Criteria).
3. Dry zones are generally noted in zones were sample collected was attempted, but the interval was noted as dry (gray boxes), or noted as dry on the boring log.
4. Actual compound concentrations can be found on Tables 12 through 17.
5. HPT pressure profile represented by black lines. Pressure increasing to right.



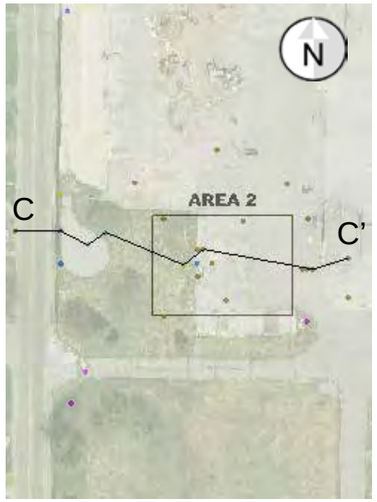
Source:

Project Number

ARCADIS

Figure C-7
Plant 2, Area 2 Cross Section (Soil)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan

Plant 2, Area 2



Total VOCs

- Above 100 X Criteria
- 10-100 X Criteria
- 1-10 X Criteria
- Below Criteria
- ND

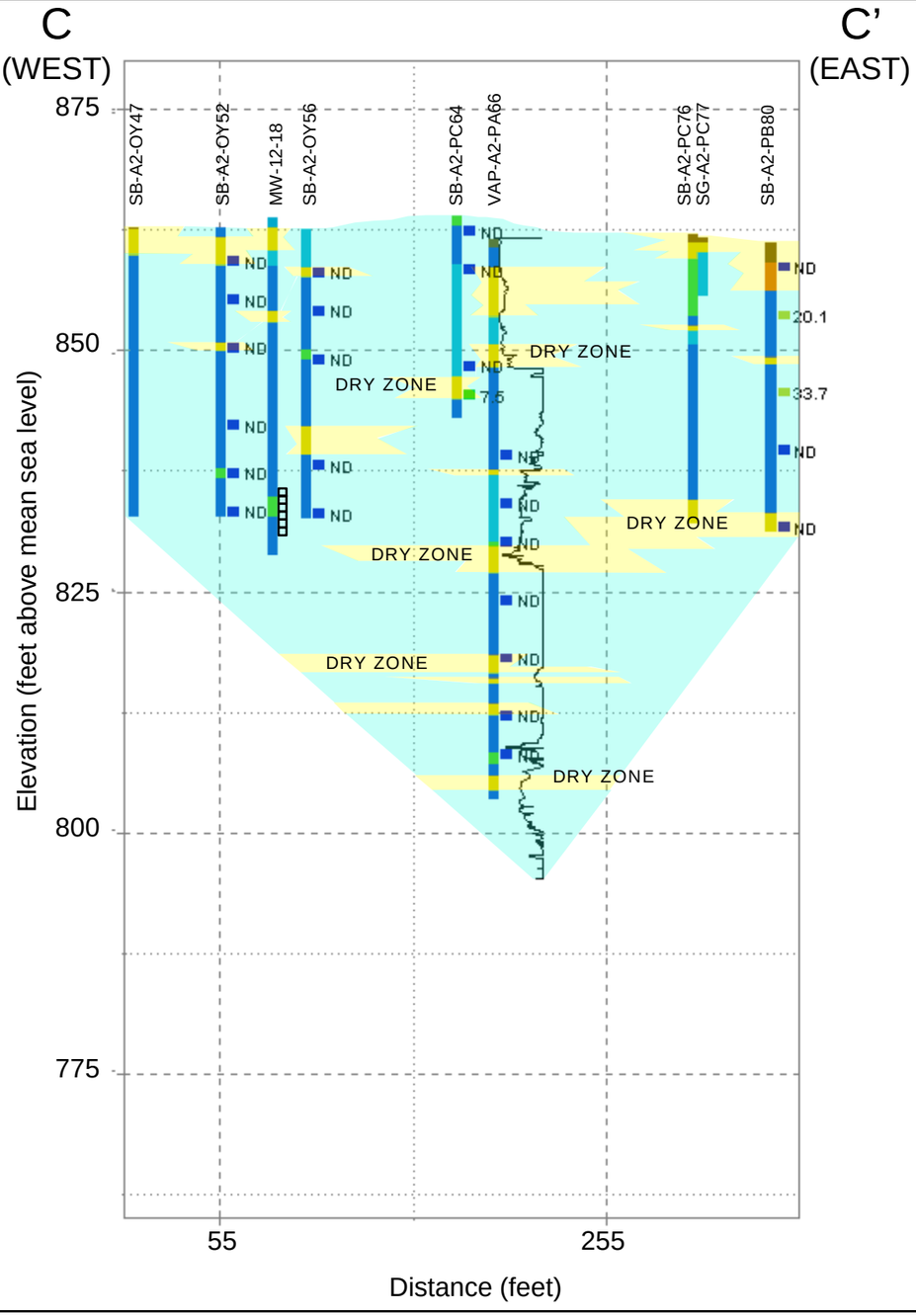
General Hydrostratigraphy

- Higher Permeability (Sand/Gravel)
- Lower Permeability (Silt/Clay)
- Bedrock

Boring Log Lithology

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY_SAND
- SAND
- SANDY_SILT/SILT
- SILTY/SANDY/GRAVELLY_CLAY
- CLAY
- PEAT
- BEDROCK
- NO_RECOVERY

Notes:
1. VOC concentrations represent normalized totals and are presented as multiples of criteria. See Appendix B for discussion of the normalization process.
2. VOCs normalized to lowest applicable criteria (typically Michigan Part 201 GSI/GSIP or DW/DWP Criteria).
3. Dry zones are generally noted in zones were sample collected was attempted, but the interval was noted as dry (gray boxes), or noted as dry on the boring log.
4. Actual compound concentrations can be found on Tables 12 through 17.
5. HPT pressure profile represented by black lines. Pressure increasing to right.



Source:

Project Number

Figure C-8
Plant 6, Area 5.7 Cross Section (Groundwater)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan

Plant 6, Area 5.7

Total VOCs

- Above 100 X Criteria
- 10-100 X Criteria
- 1-10 X Criteria
- Below Criteria
- ND

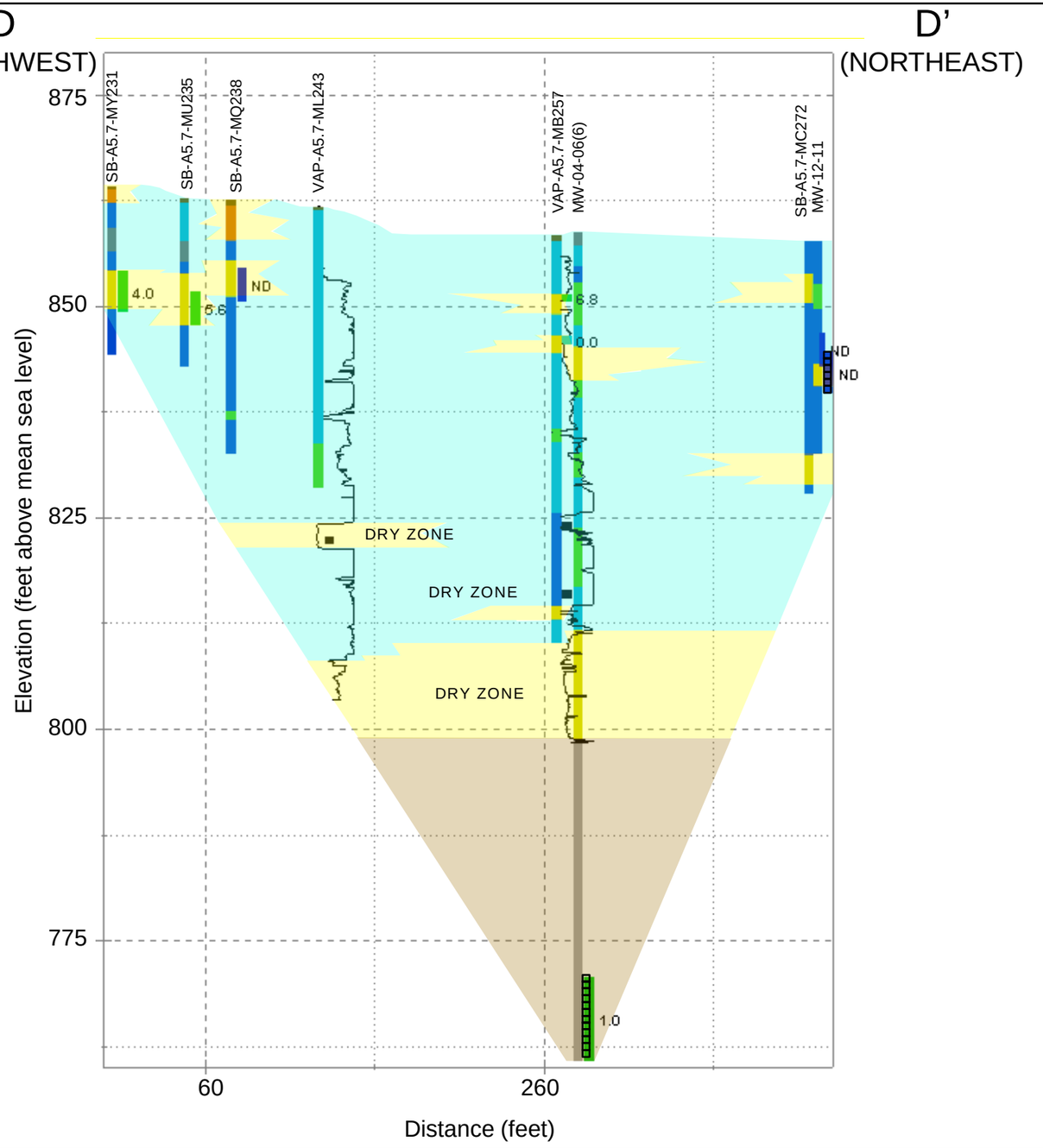
General Hydrostratigraphy

- Higher Permeability (Sand/Gravel)
- Lower Permeability (Silt/Clay)
- Bedrock

Boring Log Lithology

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY_SAND
- SAND
- SANDY_SILT/SILT
- SILTY/SANDY/GRAVELLY_CLAY
- CLAY
- PEAT
- BEDROCK
- NO_RECOVERY

Notes:
1. VOC concentrations represent normalized totals and are presented as multiples of criteria. See Appendix B for discussion of the normalization process.
2. VOCs normalized to lowest applicable criteria (typically Michigan Part 201 GSI/GSIP or DW/DWP Criteria).
3. Dry zones are generally noted in zones were sample collected was attempted, but the interval was noted as dry (gray boxes), or noted as dry on the boring log.
4. Actual compound concentrations can be found on Tables 12 through 17.
5. HPT pressure profile represented by black lines. Pressure increasing to right.



Source:

Project Number

ARCADIS

Figure C-9
Plant 6, Area 5.7 Cross Section (Soil)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan

Plant 6, Area 5.7

Total VOCs

- Above 100 X Criteria
- 10-100 X Criteria
- 1-10 X Criteria
- Below Criteria
- ND

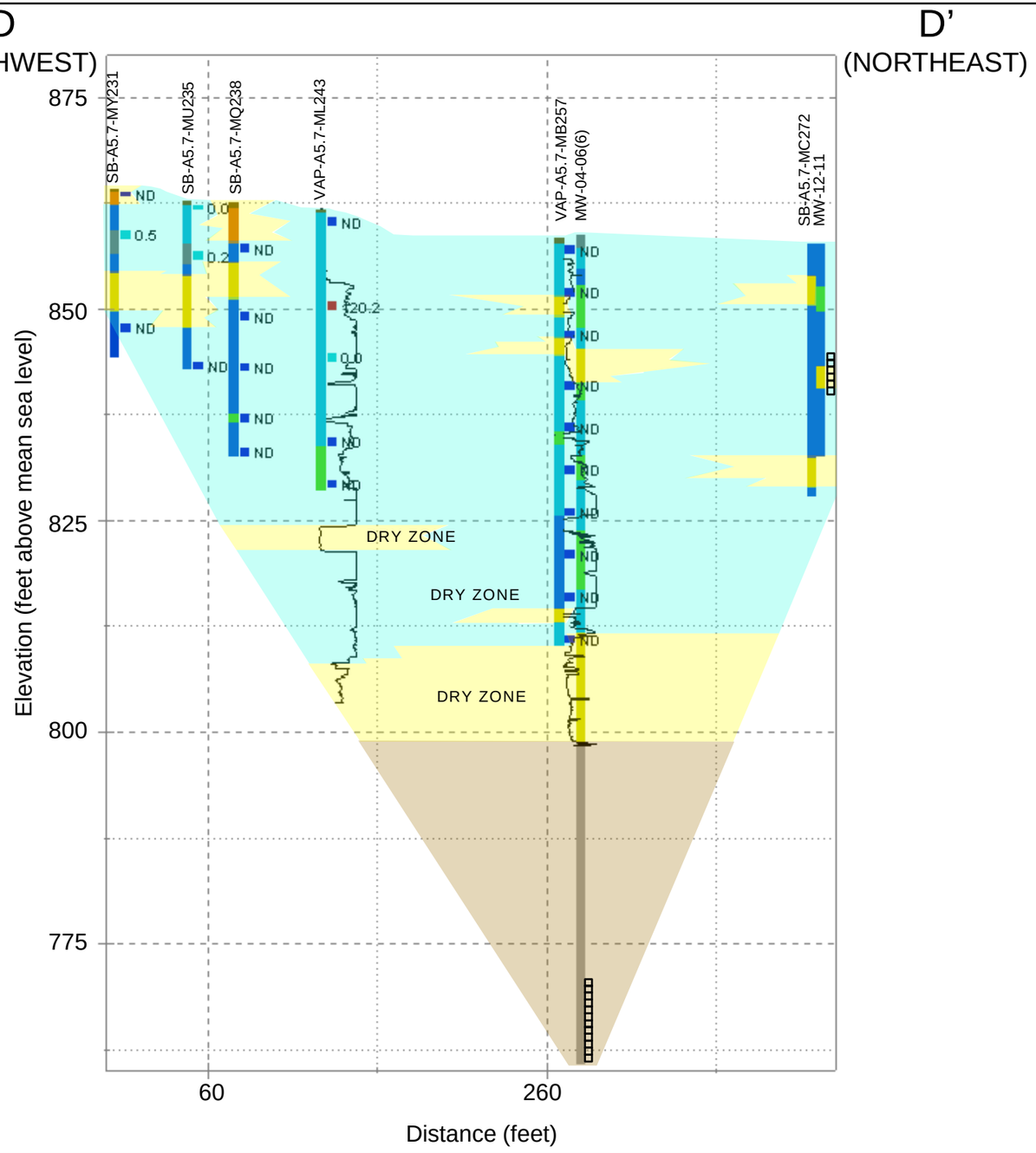
General Hydrostratigraphy

- Higher Permeability (Sand/Gravel)
- Lower Permeability (Silt/Clay)
- Bedrock

Boring Log Lithology

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY_SAND
- SAND
- SANDY_SILT/SILT
- SILTY/SANDY/GRAVELLY_CLAY
- CLAY
- PEAT
- BEDROCK
- NO_RECOVERY

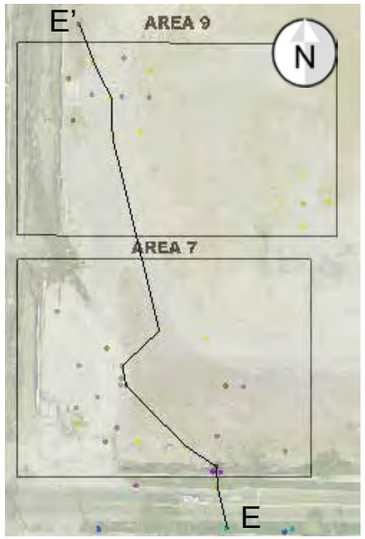
Notes:
1. VOC concentrations represent normalized totals and are presented as multiples of criteria. See Appendix B for discussion of the normalization process.
2. VOCs normalized to lowest applicable criteria (typically Michigan Part 201 GSI/GSIP or DW/DWP Criteria).
3. Dry zones are generally noted in zones were sample collected was attempted, but the interval was noted as dry (gray boxes)
4. Actual compound concentrations can be found on Tables 12 through 17.
5. HPT pressure profile represented by black lines. Pressure increasing to right.



Source:

Figure C-10
Plant 6, Area 7/9 Cross Section (Groundwater)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan

Plant 6, Area 7/9



Total VOCs

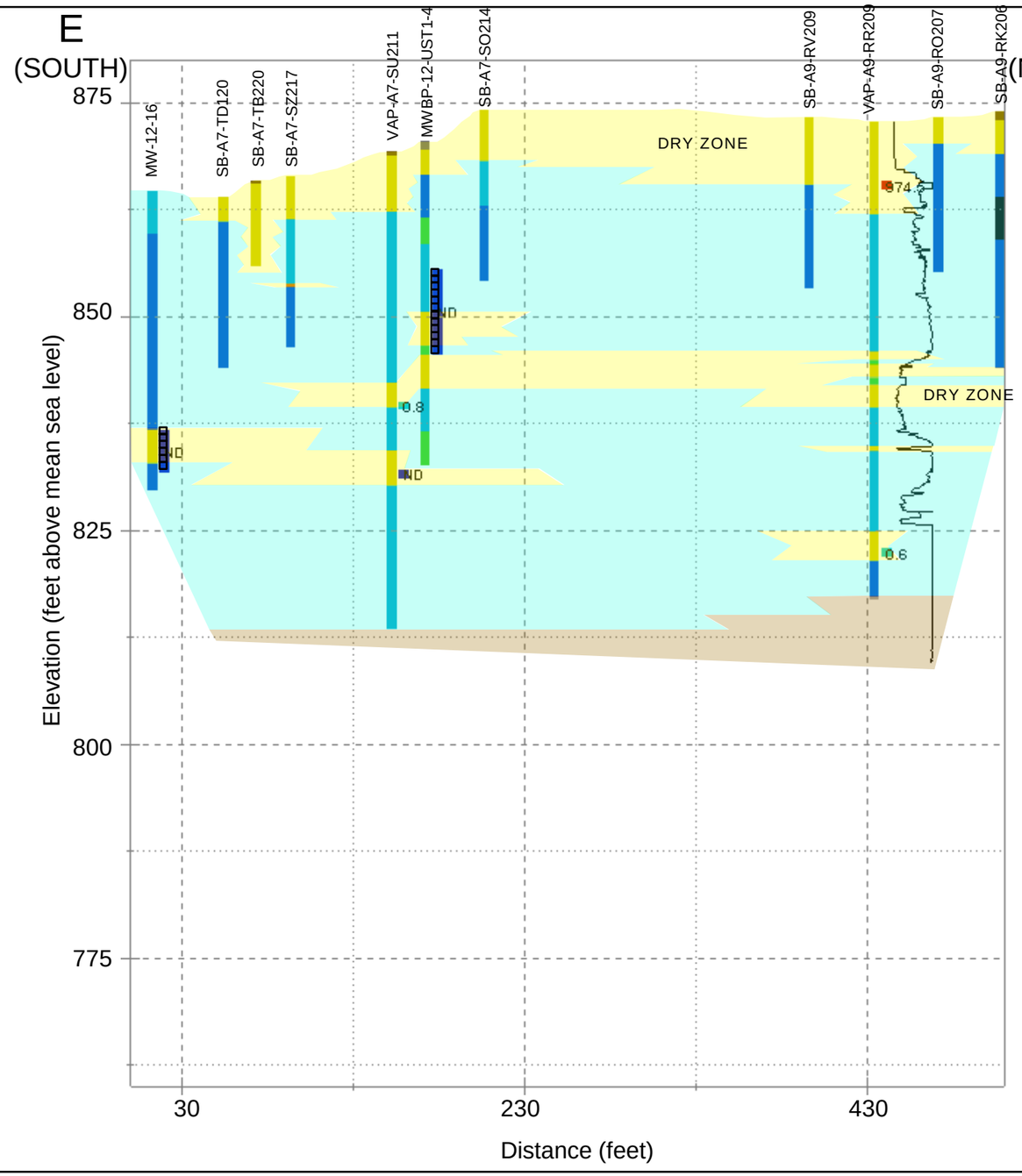
- Above 100 X Criteria
- 10-100 X Criteria
- 1-10 X Criteria
- Below Criteria
- ND

General Hydrostratigraphy

- Higher Permeability (Sand/Gravel)
- Lower Permeability (Silt/Clay)
- Bedrock

Boring Log Lithology

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY_SAND
- SAND
- SANDY_SILT/SILT
- SILTY/SANDY/GRAVELLY_CLAY
- CLAY
- PEAT
- BEDROCK
- NO_RECOVERY



Notes:

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2. VOCs normalized to lowest applicable criteria (typically Michigan Part 201 GSI/GSIP or DW/DWP Criteria).
3. Dry zones are generally noted in zones were sample collected was attempted, but the interval was noted as dry (gray boxes), or noted as dry on the boring log.
4. Actual compound concentrations can be found on Tables 12 through 17.
5. HPT pressure profile represented by black lines. Pressure increasing to right.

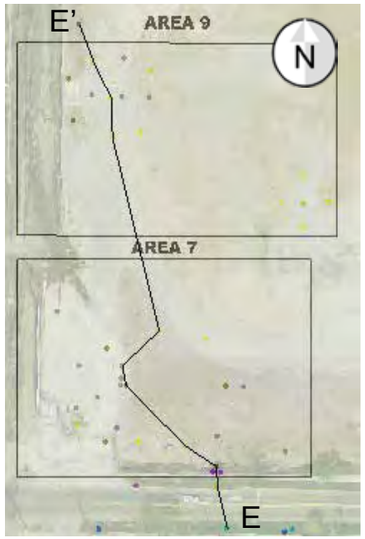
Source:

Project Number

ARCADIS

Figure C-11
Plant 6, Area 7/9 Cross Section (Soil)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan

Plant 6, Area 7/9



Total VOCs

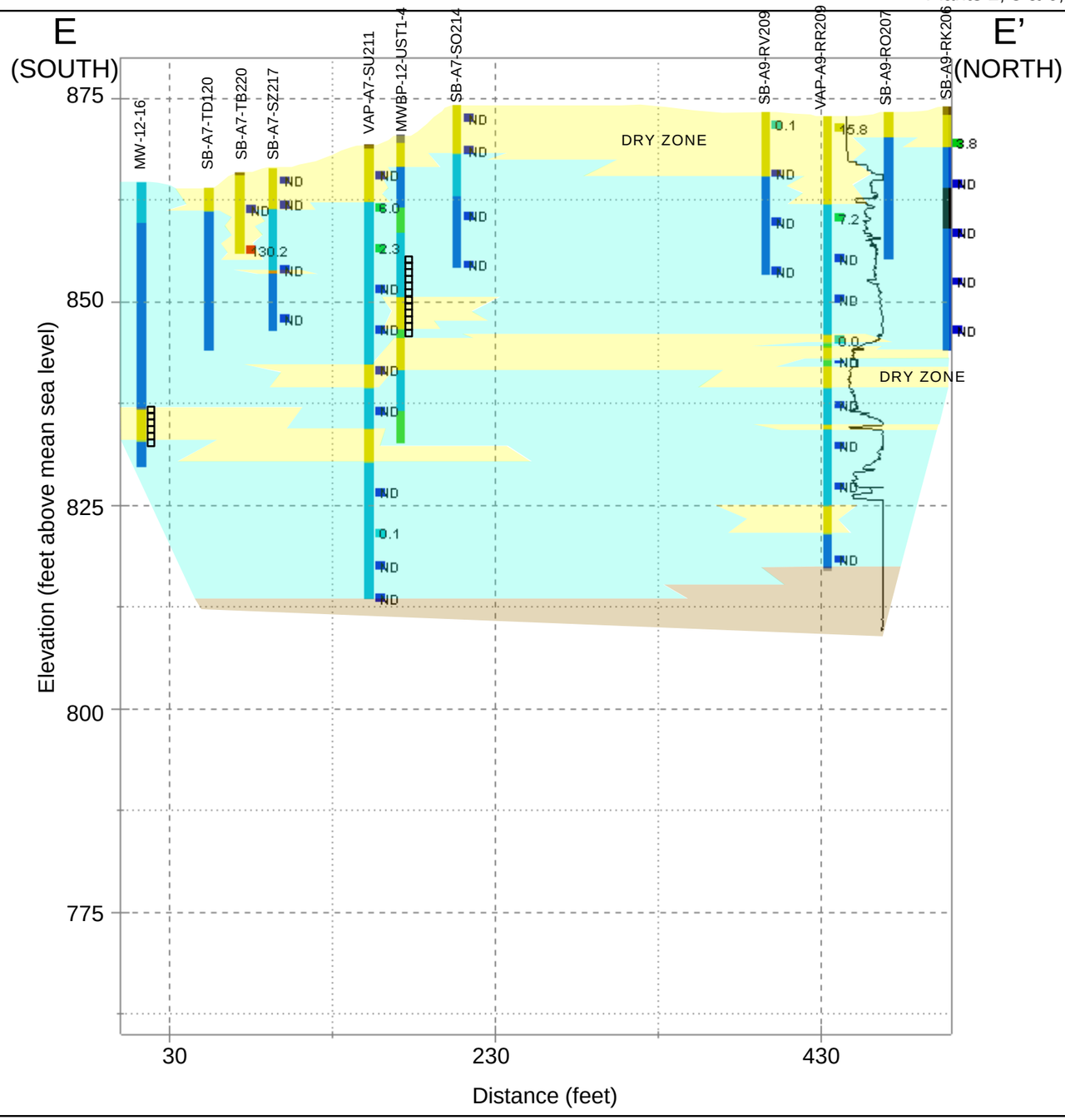
- Above 100 X Criteria
- 10-100 X Criteria
- 1-10 X Criteria
- Below Criteria
- ND

General Hydrostratigraphy

- Higher Permeability (Sand/Gravel)
- Lower Permeability (Silt/Clay)
- Bedrock

Boring Log Lithology

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY_SAND
- SAND
- SANDY_SILT/SILT
- SILTY/SANDY/GRAVELLY_CLAY
- CLAY
- PEAT
- BEDROCK
- NO_RECOVERY



Notes:

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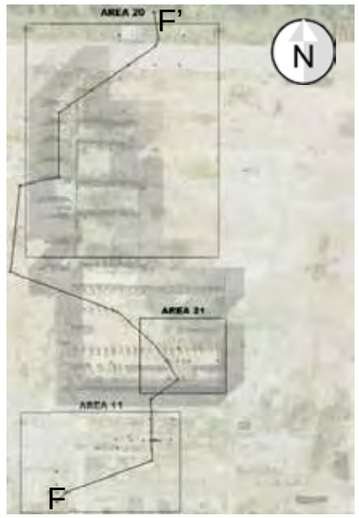
2. VOCs normalized to lowest applicable criteria (typically Michigan Part 201 GSI/GSIP or DW/DWP Criteria).
3. Dry zones are generally noted in zones were sample collected was attempted, but the interval was noted as dry (gray boxes), or noted as dry on the boring log.
4. Actual compound concentrations can be found on Tables 12 through 17.
5. HPT pressure profile represented by black lines. Pressure increasing to right.

Source:

ARCADIS

Figure C-12
Plant 3, Area 11/20/21 Cross Section (Groundwater)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan

Plant 3, Area 11/20/21



Total VOCs

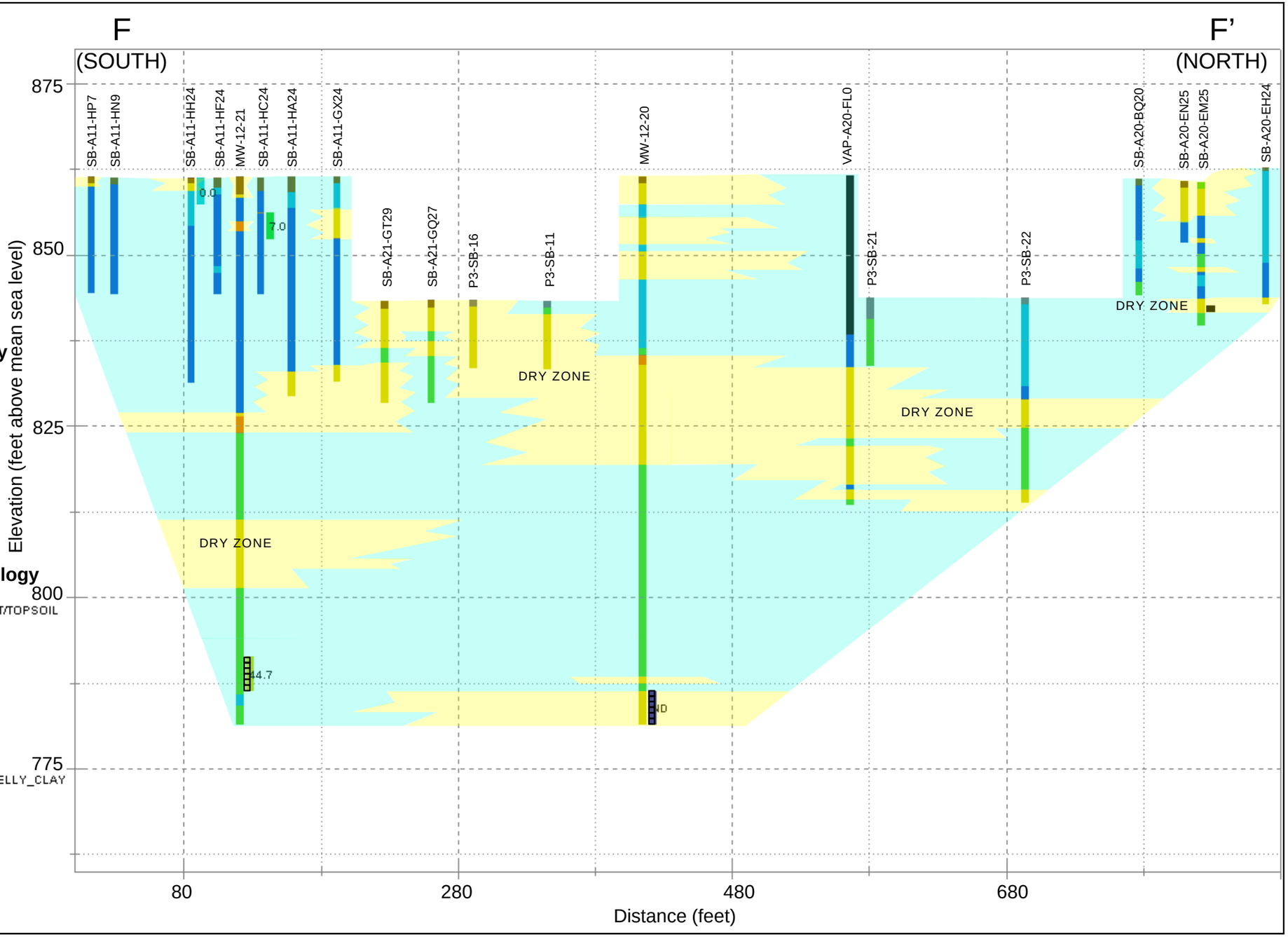
- Above 100 X Criteria
- 10-100 X Criteria
- 1-10 X Criteria
- Below Criteria
- ND

General Hydrostratigraphy

- Higher Permeability (Sand/Gravel)
- Lower Permeability (Silt/Clay)
- Bedrock

Boring Log Lithology

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY_SAND
- SAND
- SANDY_SILT/SILT
- SILTY/SANDY/GRAVELLY_CLAY
- CLAY
- PEAT
- BEDROCK
- NO_RECOVERY



Notes:

1. VOC concentrations represent normalized totals and are presented as multiples of criteria. See Appendix B for discussion of the normalization process.
2. VOCs normalized to lowest applicable criteria (typically Michigan Part 201 GSI/GSIP or DW/DWP Criteria).
3. Dry zones are generally noted in zones were sample collected was attempted, but the interval was noted as dry (gray boxes), or noted as dry on the boring log.
4. Actual compound concentrations can be found on Tables 12 through 17.

Source:

Project Number

ARCADIS

Figure C-13
Plant 3, Area 11/20/21 Cross Section (Soil)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan

Plant 3, Area 11/20/21

Total VOCs

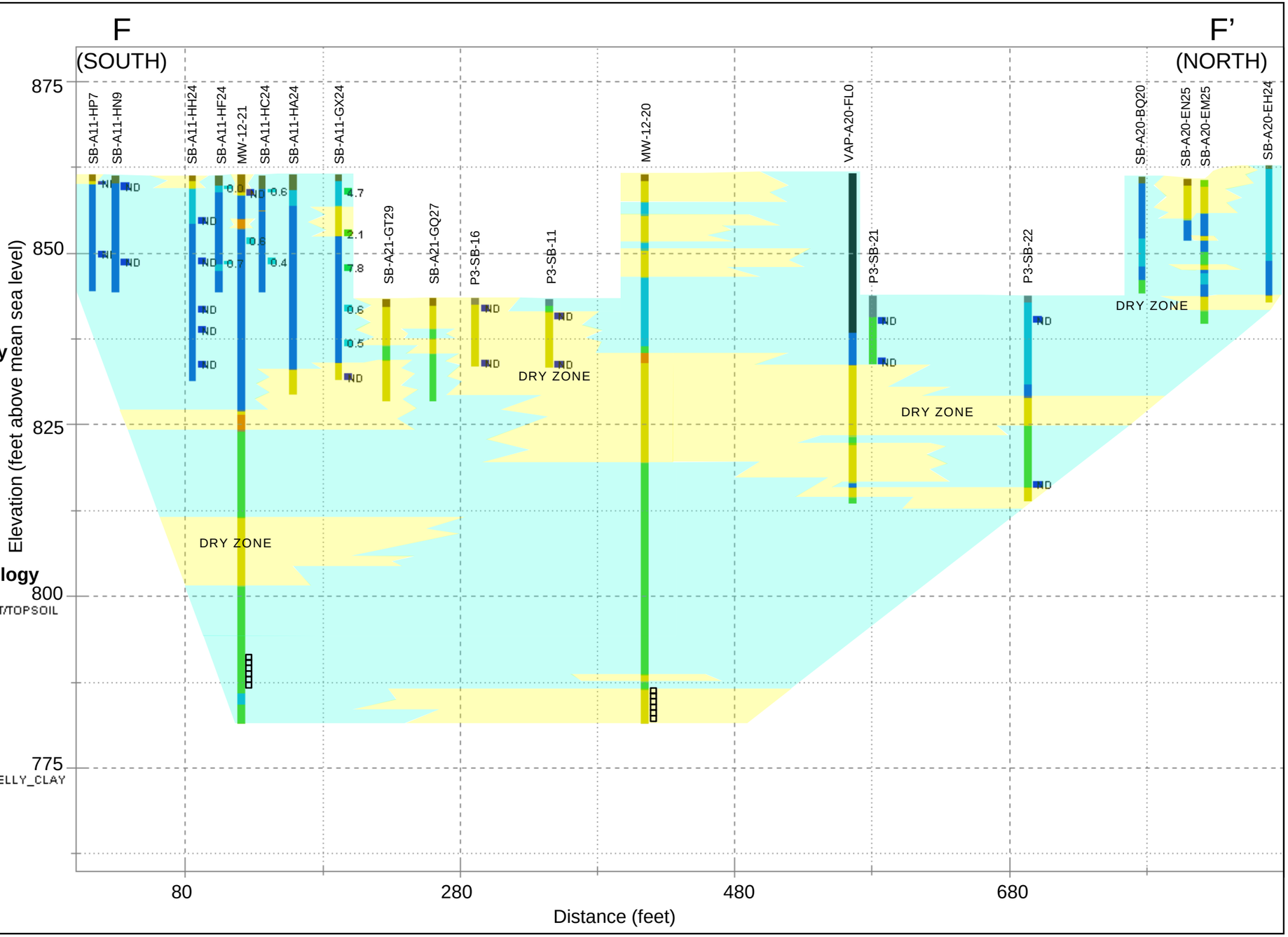
- Above 100 X Criteria
- 10-100 X Criteria
- 1-10 X Criteria
- Below Criteria
- ND

General Hydrostratigraphy

- Higher Permeability (Sand/Gravel)
- Lower Permeability (Silt/Clay)
- Bedrock

Boring Log Lithology

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY_SAND
- SAND
- SANDY_SILT/SILT
- SILTY/SANDY/GRAVELLY_CLAY
- CLAY
- PEAT
- BEDROCK
- NO_RECOVERY



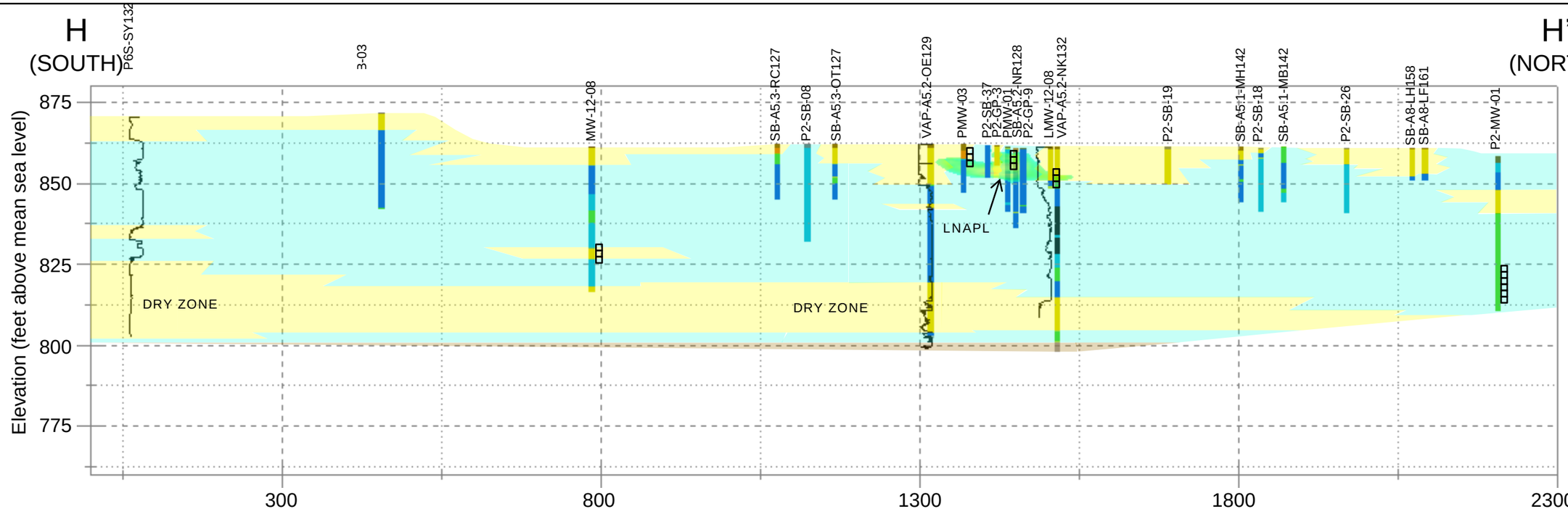
Notes:

1. VOC concentrations represent normalized totals and are presented as multiples of criteria. See Appendix B for discussion of the normalization process.
2. VOCs normalized to lowest applicable criteria (typically Michigan Part 201 GSI/GSIP or DW/DWP Criteria).
3. Dry zones are generally noted in zones were sample collected was attempted, but the interval was noted as dry (gray boxes), or noted as dry on the boring log.
4. Actual compound concentrations can be found on Tables 12 through 17.

Source:

Project Number

Figure C-15
Plant 2/6 Cross Section
(South – North)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan



Plant 2/6

Boring Log Lithology

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY_SAND
- SAND
- SANDY_SILT/SILT
- SILTY/SANDY/GRAVELLY_CLAY
- CLAY
- PEAT
- BEDROCK
- NO_RECOVERY

General Hydrostratigraphy

- Higher Permeability (Sand/Gravel)
- Lower Permeability (Silt/Clay)
- Bedrock

Notes:
1. HPT pressure profile represented by black lines. Pressure increasing to right.

Source:

Project Number

Figure C-16
Plant 3, Area 14/17 Cross Section (Groundwater)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan

Plant 3, Area 14/17

Total VOCs

- Above 100 X Criteria
- 10-100 X Criteria
- 1-10 X Criteria
- Below Criteria
- ND

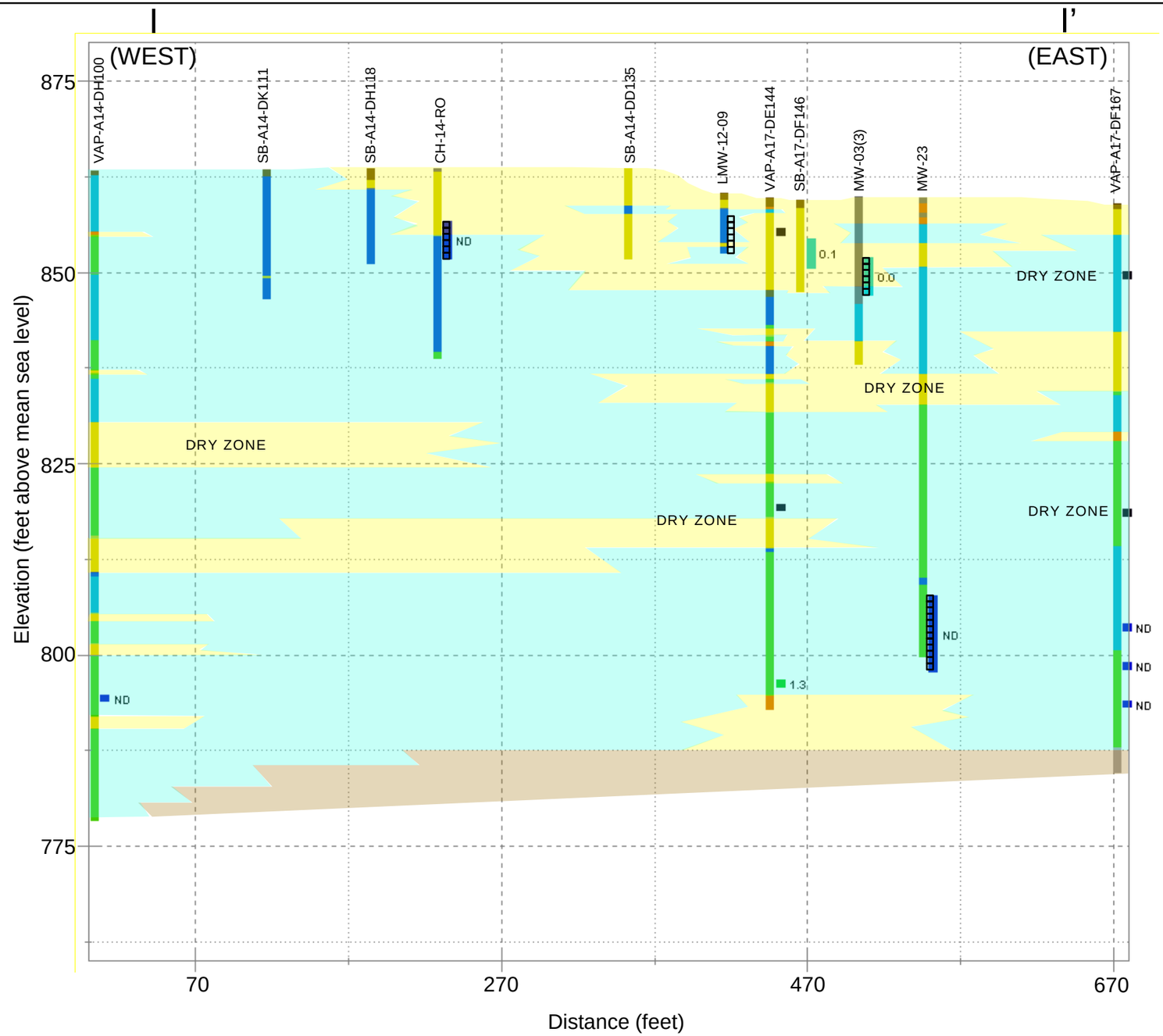
General Hydrostratigraphy

- Higher Permeability (Sand/Gravel)
- Lower Permeability (Silt/Clay)
- Bedrock

Boring Log Lithology

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY_SAND
- SAND
- SANDY_SILT/SILT
- SILTY/SANDY/GRAVELLY_CLAY
- CLAY
- PEAT
- BEDROCK
- NO_RECOVERY

Notes:
1. VOC concentrations represent normalized totals and are presented as multiples of criteria. See Appendix B for discussion of the normalization process.
2. VOCs normalized to lowest applicable criteria (typically Michigan Part 201 GSI/GSIP or DW/DWP Criteria).
3. Dry zones are generally noted in zones were sample collected was attempted, but the interval was noted as dry (gray boxes), or noted as dry on the boring log.
4. Actual compound concentrations can be found on Tables 12 through 17.



Source:

Project Number

Figure C-17
Plant 3, Area 14/17 Cross Section (Soil)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan

Plant 3, Area 14/17

Total VOCs

- Above 100 X Criteria
- 10-100 X Criteria
- 1-10 X Criteria
- Below Criteria
- ND

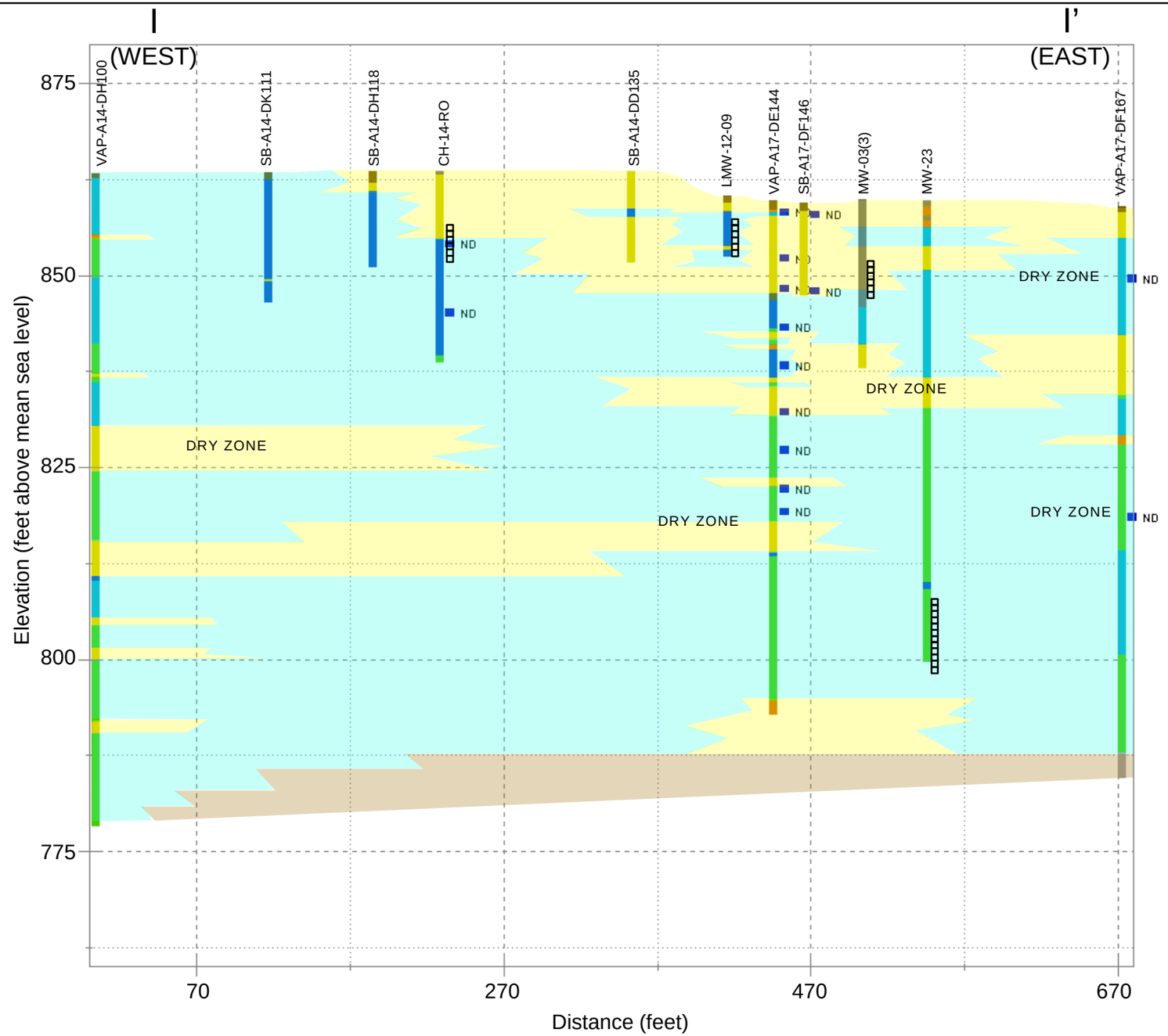
General Hydrostratigraphy

- Higher Permeability (Sand/Gravel)
- Lower Permeability (Silt/Clay)
- Bedrock

Boring Log Lithology

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY_SAND
- SAND
- SANDY_SILT/SILT
- SILTY/SANDY/GRAVELLY_CLAY
- CLAY
- PEAT
- BEDROCK
- NO_RECOVERY

Notes:
1. VOC concentrations represent normalized totals and are presented as multiples of criteria. See Appendix B for discussion of the normalization process.
2. VOCs normalized to lowest applicable criteria (typically Michigan Part 201 GSI/GSIP or DW/DWP Criteria).
3. Dry zones are generally noted in zones were sample collected was attempted, but the interval was noted as dry (gray boxes), or noted as dry on the boring log.
4. Actual compound concentrations can be found on Tables 12 through 17.

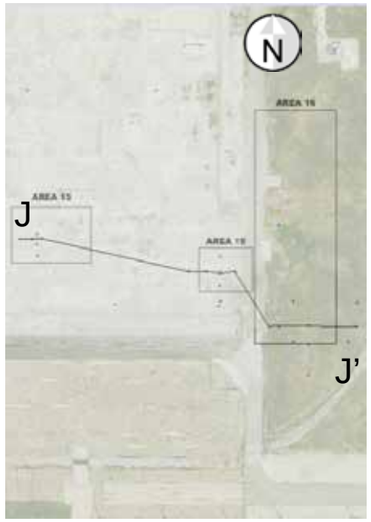


Source:

Project Number

Figure C-18
Plant 3, Area 15/19/16 Cross Section
(Groundwater/Metals)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan

Plant 3, Area 15/19/16



Total Metals

Above Criteria

Below Criteria

General Hydrostratigraphy

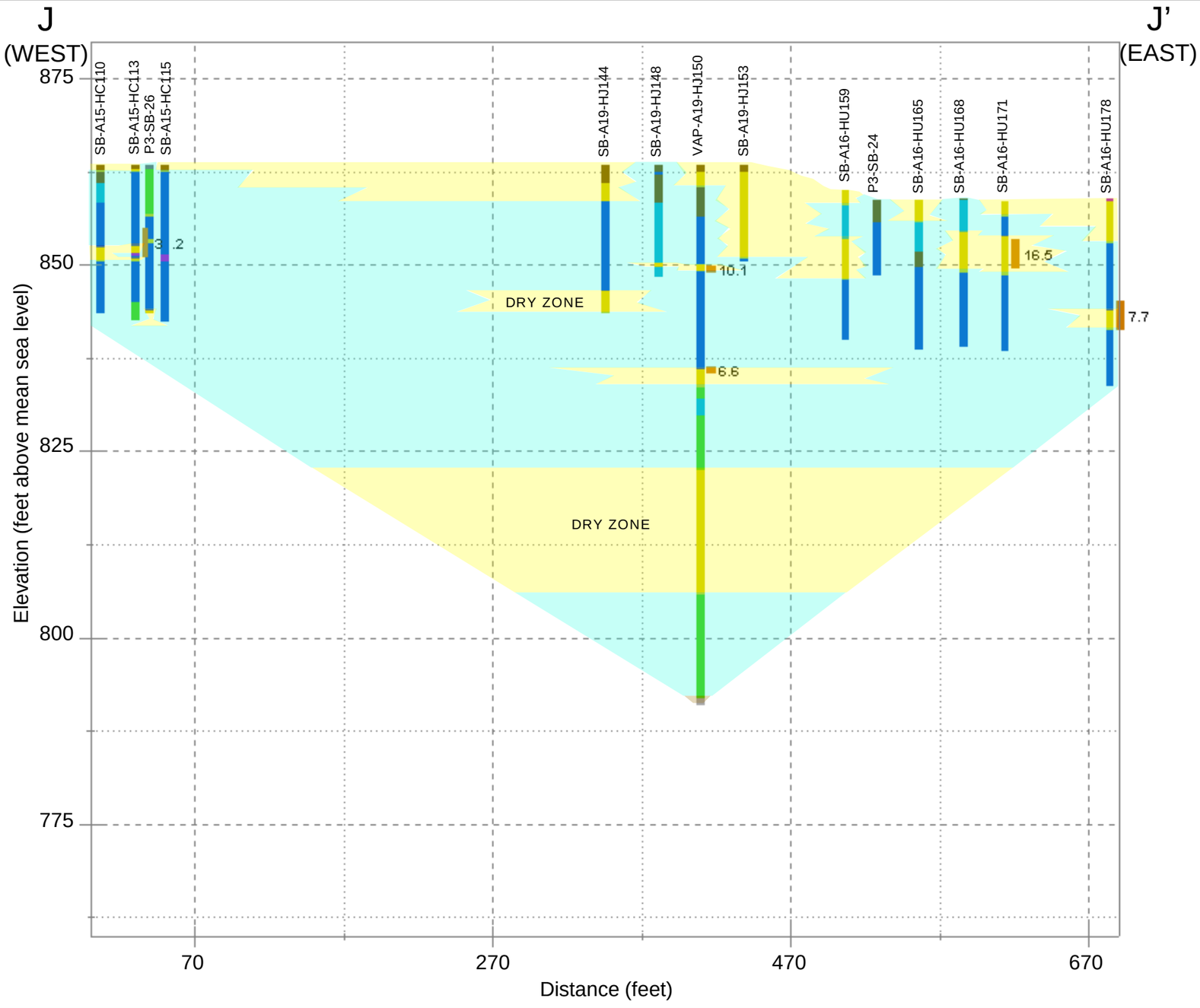
Higher Permeability (Sand/Gravel)

Lower Permeability (Silt/Clay)

Bedrock

Boring Log Lithology

CONCRETE/ASPHALT/TOPSOIL
FILL
GRAVELLY_SAND
SAND
SANDY_SILT/SILT
SILTY/SANDY/GRAVELLY_CLAY
CLAY
PEAT
BEDROCK
NO_RECOVERY



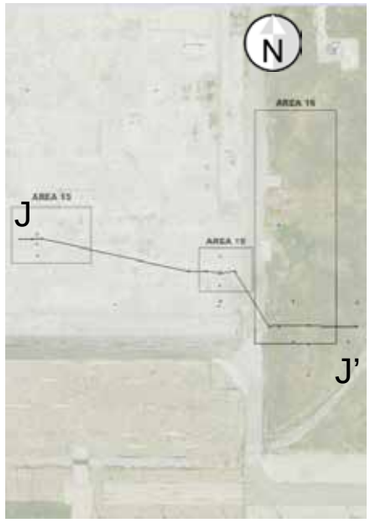
Notes:

1. Metals concentrations represent normalized totals and displayed as above (>1) or below (<1) Criteria. See Appendix B for discussion of the normalization process.
2. Metals normalized to lowest applicable criteria (typically Michigan Part 201 GSI/GSIP or DW/DWP Criteria).
3. Dry zones are generally noted in zones were sample collected was attempted, but the interval was noted as dry (gray boxes), or noted as dry on the boring log.
4. Actual compound concentrations can be found on Tables 12 through 17.

Source:

Figure C-19
Plant 3, Area 15/19/16 Cross Section (Soil/Metals)
RACER Trust
Plants 2, 3 & 6, Lansing, Michigan

Plant 3, Area 15/19/16



Total Metals

- Above Criteria
- Below Criteria

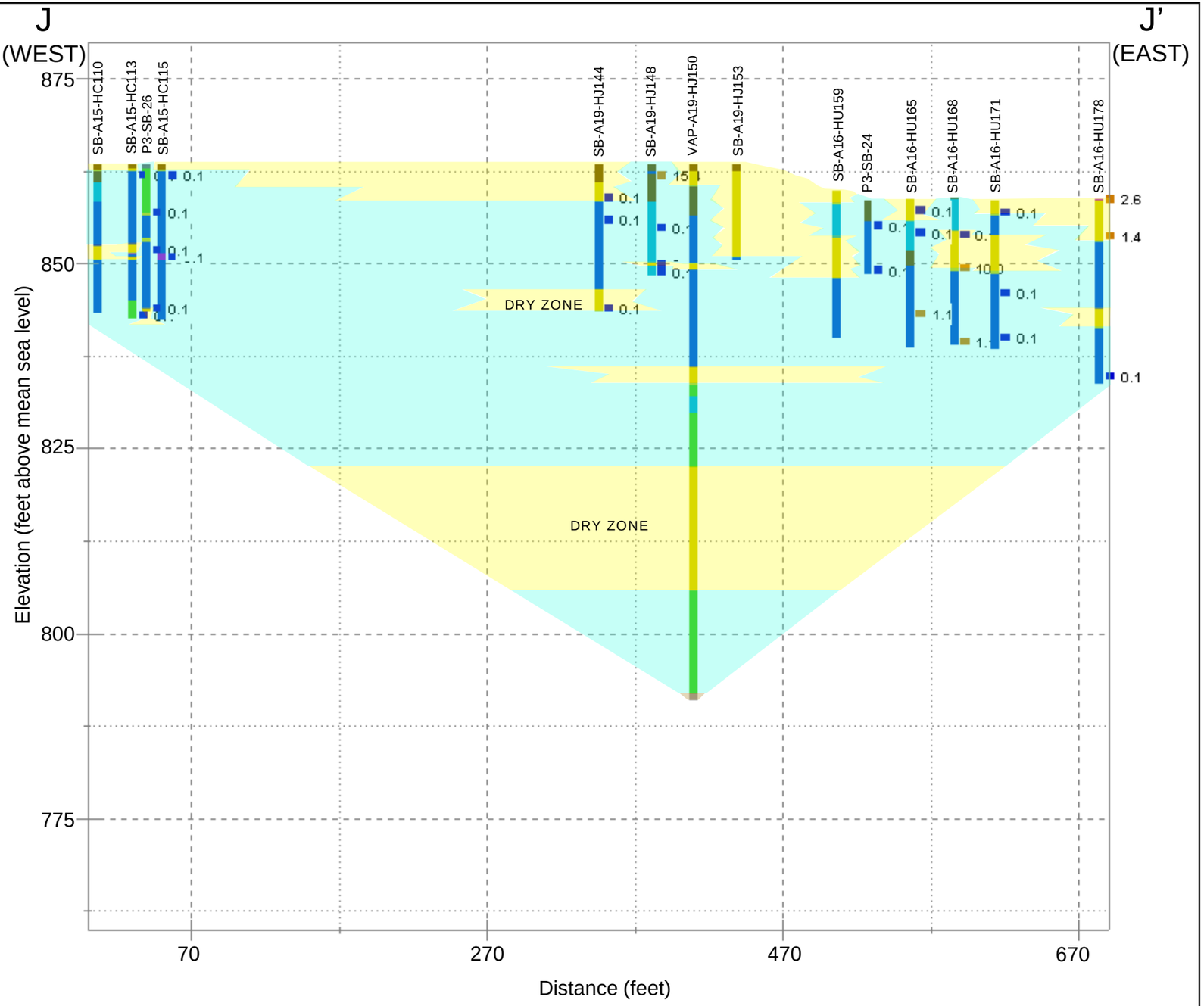
General Hydrostratigraphy

- Higher Permeability (Sand/Gravel)
- Lower Permeability (Silt/Clay)
- Bedrock

Boring Log Lithology

- CONCRETE/ASPHALT/TOPSOIL
- FILL
- GRAVELLY_SAND
- SAND
- SANDY_SILT/SILT
- SILTY/SANDY/GRAVELLY_CLAY
- CLAY
- PEAT
- BEDROCK
- NO_RECOVERY

Notes:
1. Metals concentrations represent normalized totals and displayed as above (>1) or below (<1) Criteria. See Appendix B for discussion of the normalization process.
2. Metals normalized to lowest applicable criteria (typically Michigan Part 201 GSI/GSIP or DW/DWP Criteria).
3. Dry zones are generally noted in zones were sample collected was attempted, but the interval was noted as dry (gray boxes), or noted as dry on the boring log.
4. Actual compound concentrations can be found on Tables 12 through 17.



Source:

Project Number

ARCADIS

Appendix B

Advanced Oxidation Process
Treatability Test Results

HiPOx® Bench-Scale Treatability Report

For The Treatment of 1,4-dioxane

At The

Racer Trust – Lansing, MI Site

APT Proposal: P3453

Revision: DRAFT

Prepared for:

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Submitted on

3/26/2014

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www.ulturawater.com

TABLE OF CONTENTS

1. PROJECT SPECIFIC BENCH TEST INFORMATION

1.1 Background Information

The HiPOx treatment system is being evaluated for use to treat 1,4-dioxane and VOCs in groundwater from the Racer Trust Site near Lansing, MI (Site).

This bench test study was performed to determine the efficacy of treatment of 1,4-dioxane and VOCs using the ULTURA HiPOx advanced oxidation process (AOP) technology as a key treatment process. The following is background information regarding this project:

- Expected treatment flow rate of the location is projected to be 10 to 60 gpm.
- The 1,4-dioxane discharge limit is to be treated to < 3.2 µg/L ;
- VOCs need to be reduced;
- Bromide conversion to Bromate needs to be maintained below 10 ug/L;

1.2 Objective of Evaluation

The bench test study was performed to evaluate, with a high level of accuracy, the ozone and hydrogen peroxide dose required for 1,4-dioxane and VOC's treatment. The primary objectives of this evaluation are as listed:

- To reduce the 1,4-dioxane concentration in the water from the Racer Trust site to < 3.2 ug/L;
- To reduce selected VOC concentrations in water at the Racer Trust Site;
- To project full scale ozone dose requirements to treat up to 150 ug/L 1,4-dioxane;
- To evaluate Bromide oxidation to Bromate;
- To model oxidant dose and reactor configuration for contaminant destruction and Bromate control at full scale.

1.3 Process Water Information

Groundwater samples from the Racer Trust Site were collected by Arcadis on February 20, 2014 and were received at the ULTURA facility on February 21, 2014. The bench testing was conducted in two steps, the first (Destruction Tests) to establish oxidant dose for contaminant destruction and the second (Bromate Control Tests) to refine conditions necessary to control the formation of Bromate.

These samples were analyzed by ULTURA using standard methods and/or Hach methods for the listed parameters before treatment. Each successive treatment experiment was sampled for 1,4-dioxane and VOC analysis and the listed parameters analyzed by ULTURA. Samples from the Destruction Tests were sent to Merit Laboratories in Lansing, Michigan for analyses of 1,4-dioxane, VOCs, TOCs and metals. Additional samples sent to Underwriter Laboratories in South Bend, Indiana for low concentrations analysis of bromide, bromate. From these results the appropriate ozone treatment dose was determined and then bromate formation modeling was performed based on those parameters. As before samples were taken and sent to Merit Laboratories, located in Lansing, Michigan for the analysis of 1,4-dioxane, VOCs, and metals, with additional samples sent to Underwriters Laboratories in South Bend, Indiana for low concentration bromide and bromate analysis.

2. RESULTS

The Racer Trust water samples were effectively treated with ozone – hydrogen peroxide. The destruction tests were conducted at variable ozone doses and constant hydrogen peroxide : ozone mole ratio of 2.5. The 1,4-dioxane was treated from the influent concentrations of 104 ug/L in the MW-13-22 well and 148 ug/L in the Composite sample to less than 1 ug/L.

The bromate formation was controlled to less than 10 ug/L. Tests were done using the ozone dose of 15.1 mg/L based on the preliminary destruction test results. This dose was estimated to treat the 1,4-dioxane to less than 3.2 ug/L. Various mole ratios and injection points were used to determine bromate formation parameters. All tests conducted for the bromate control tests were controlled to less than 10 ug/L bromate.

There were no VOCs identified in the raw water at the Racer Trust Site. However low levels acetone was identified in the effluent. The acetone is a result of the oxidation of TOC.

2.1 1,4-Dioxane Destruction Test Results

The data from the Destruction Tests for the MW13-22 and Composite samples show that 1,4-dioxane was treated at an applied rate of 13 mg/L ozone to less than 5 ug/L . The selected test ozone doses for Destruction Tests ranged from 8.0 to 33.0 mg/l. The hydrogen peroxide mole ratio was kept at 2.5 for this range of ozone applications. The initial 1,4-dioxane concentrations were found to be 104 ug/L and 148 ug/l in MW-13-22 and the Composite samples respectively.

The untreated water sample MW13-22 was identified as P3453-SP-0. The initial trial of P3453-SP-1 used ozone dosing at 8 mg/L with a hydrogen peroxide to ozone mole ratio of 2.5, resulting in a 1,4-dioxane concentration of 16 ug/L. The successive trials P3453-SP-2, 3, and 4 preceded using ozone dosing of 13, 21 and 30 mg/L respectively and maintaining a consistent hydrogen peroxide to ozone mole ratio of 2.5 for all trials. These trials showed reductions of each 1,4-dioxane concentrations to <5ug/L. A revised analysis report showed the 1,4-dioxane concentrations of 3, < 1 and < 1 respectively.

The composite of untreated water sample from selected wells labeled composite was identified as P3453-SP-10. The initial trial of P3453-SP-11 used ozone dosing at 8 mg/L with a hydrogen peroxide to ozone mole ratio of 2.5 resulting in a 1,4-dioxane concentration of 21 ug/L. The successive trials P3453-SP-12, 13, and 14 preceded using ozone dosing of 13, 22 and 33 mg/L respectively and maintaining a consistent hydrogen peroxide to ozone mole ratio of 2.5 for all trials. These trials each showed reductions of 1,4-dioxane concentrations to < 5 ug/L. A revised analysis report showed the 1,4-dioxane concentrations of 5, < 1 and < 1 ug/L respectively.

Figure 1 below shows the destruction of the 1,4-dioxane versus applied ozone in both samples.

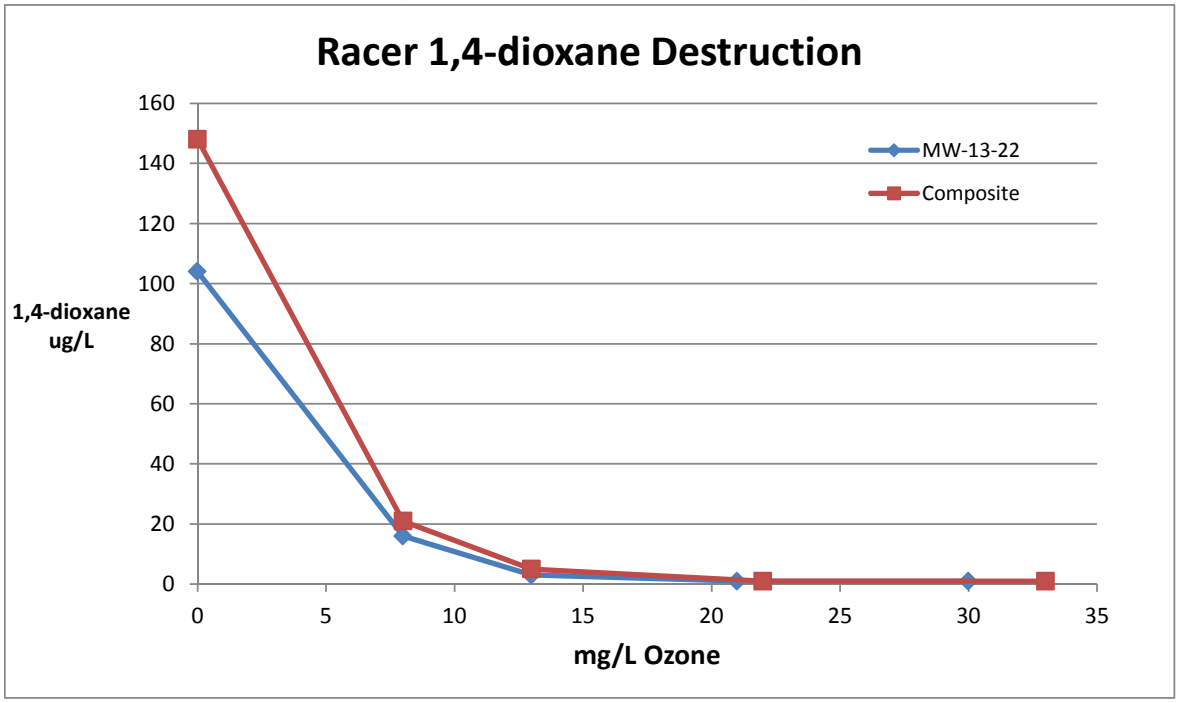

Figure 1: 1,4-dioxane Dose Response Curve

Conditions	Destruction Test Results MW13-22					
	Samples					
	Sample ID#	P3453-SP-0	P3453-SP-1	P3453-SP-2	P3453-SP-3	P3453-SP-4
	Run#	0	1	2	3	4
	Ozone Dose (mg/L)	-	8.0	13.0	21.0	30.0
	H2O2:O3 Mole Ratio	-	2.5	2.5	2.5	2.5
ULTURA Lab	pH	6.98	7.11	7.55	7.23	7.21
	Alkalinity (mg/L)	340	400	540	450	400
	Turbidity (NTU)	54.9	75.1	45.1	49.1	50
	Temperature (deg C)	17.6	20.2	20.1	21	20.3
	UVT (cm-1)	68.5	68.7	88.5	84.5	84.1
	O3 Residual-DPD (mg/L)	0.0	0.0	0.1	0.3	0.3
	H2O2 Residual-Hach (mg/L)	0.0	10	10	15	30
	H2O2 Residual-Strips (mg/L)	0.0	11	15	23	33
	COD (mg/L)	13	9	9	8	9
3rd Party Labs	TOC (mg/L)	4.7	na	na	4.7	na
	1,4-dioxane (ug/L)	104	16	< 5	< 5	< 5
	1,4-dioxane (ug/L)*	104	16	3	< 1	< 1
	Bromide (ug/L)	71	71	72	73	67
	Bromate (ug/L)	1	9.4	1.2	1.3	2.9

*revised at lower detection

Table 1a: Analytic Results for Destruction Tests

	Destruction Test Results Composite					
	Samples					
Conditions	Sample ID#	P3453-SP-10	P3453-SP-11	P3453-SP-12	P3453-SP-13	P3453-SP-14
	Run#	10	11	12	13	14
	Ozone Dose (mg/L)	-	8.0	13.0	22.0	33.0
	H2O2:O3 Mole Ratio	-	2.5	2.5	2.5	2.5
ULTURA Lab	pH	7.11	7.51	7.63	7.64	7.64
	Alkalinity (mg/L)	360	460	500	420	500
	Turbidity (NTU)	134	135	104	104	97.2
	UVT (cm-1)	46.5	46.4	52.6	53	52.2
	O3 Residual-DPD (mg/L)	na	0.05	0.1	0.15	0.15
	H2O2 Residual-Hach (mg/L)	na	9	13	18	34
	H2O2 Residual-Strips (mg/L)	na	10	10	15	25
	COD (mg/L)	30	13	14	10	25
3rd Party Lab	TOC (mg/L)	6	na	na	5.9	na
	1,4-dioxane (ug/L)	148	21	< 5	< 5	< 5
	1,4-dioxane (ug/L)*	148	21	5	< 1	< 1
	Bromide (ug/L)	140	130	130	130	130
	Bromate (ug/L)	1	1.6	5.7	6.6	13

*revised at lower detection

Table 1b: Analytic Results for Destruction Tests

2.2 VOC Destruction Test Results

There were no VOCs detected in the MW-13-22 and composite samples. The treated samples had traces of acetone. Acetone can be formed from the oxidation of TOC in the water. MW-13-22 water contained 4.7 mg/L of TOC and the Composite water contained 6.0 mg/L TOC.

	VOC Analysis MW13-22									
	Samples									
Conditions	Sample ID#	P3453-SP-0	P3453-SP-1	P3453-SP-2	P3453-SP-3	P3453-SP-4	P3453-SP-5	P3453-SP-6	P3453-SP-7	P3453-SP-8
	Run#	0	1	2	3	4	5	6	7	8
	Ozone Dose (mg/L)	-	8	13	21	30	15.1	15.1	15.1	15.1
	H2O2:O3 Mole Ratio	-	2.5	2.5	2.5	2.5	3.2	2.5	2	2.0
Merit	Acetone	<1	13	14	21	18	15	15	15	18

Table 2a: VOC Analytic Results

	VOC Analysis Composite									
	Samples									
Conditions	Sample ID#	P3453-SP-10	P3453-SP-11	P3453-SP-12	P3453-SP-13	P3453-SP-14	P3453-SP-15	P3453-SP-16	P3453-SP-17	P3453-SP-18
	Run#	10	11	12	13	14	15	16	17	18
	Ozone Dose (mg/L)	-	8	13	21	30	15.1	15.1	15.1	15.1
	H2O2:O3 Mole Ratio	-	2.5	2.5	2.5	2.5	3.2	2.5	2.0	2.0
Merit	Acetone	<10	12	15	18	15	15	15	16	15

Table 2b: VOC Analytic Results

2.3 Bromate Control Test Results

Based on the preliminary analytic results from the destruction testing samples, an ozone dosing of 15.1 mg/L was estimated to be effective at treating 1,4-dioxane to less than 3.2 ug/L of 1,4-dioxane in both MW 13-22 and Composite water samples. For this reason, the bromate control testing proceeded at an ozone dose rate of 15.1 mg/L for both test cases. Testing was

conducted using 10 and 15 injectors along with varied mole ratios of hydrogen peroxide to ozone to minimize bromate formation. Refer to table 3a and 3b for injector detail.

The untreated MW13-22 raw water was found to have a 1,4-dioxane concentration of 104 ug/L and a concentration of 71 ug/L for Bromide and levels of less than 1 ug/L Bromate. The bromate control tests were conducted with a 15.1 mg/L ozone dose with mole ratios of ozone to hydrogen peroxide of 3.0, 2.5, 2.0 and 2.0. This resulted in reducing the 1,4-dioxane to below detection level of less than 1 ug/L in all tests. The resulting bromate concentrations were found to be 2.2, 2.9, 2.9 and 7.6 ug/L.

The untreated Composite raw water was found to have a 1,4-dioxane concentration of 148 ug/L and a concentration of 140 ug/L for Bromide and levels of less than 1 ug/L Bromate. The bromate control tests were conducted with 15.1 mg/l ozone dose and mole ratios of ozone to hydrogen peroxide of 3.2, 2.5, 2.7 and 2.2. This resulted in reducing the 1,4-dioxane to below detection level of less than 1ug/L in all tests. The resulting bromate concentrations were found to be 1.6, 8.4, 8.5 and 9.6 ug/L.

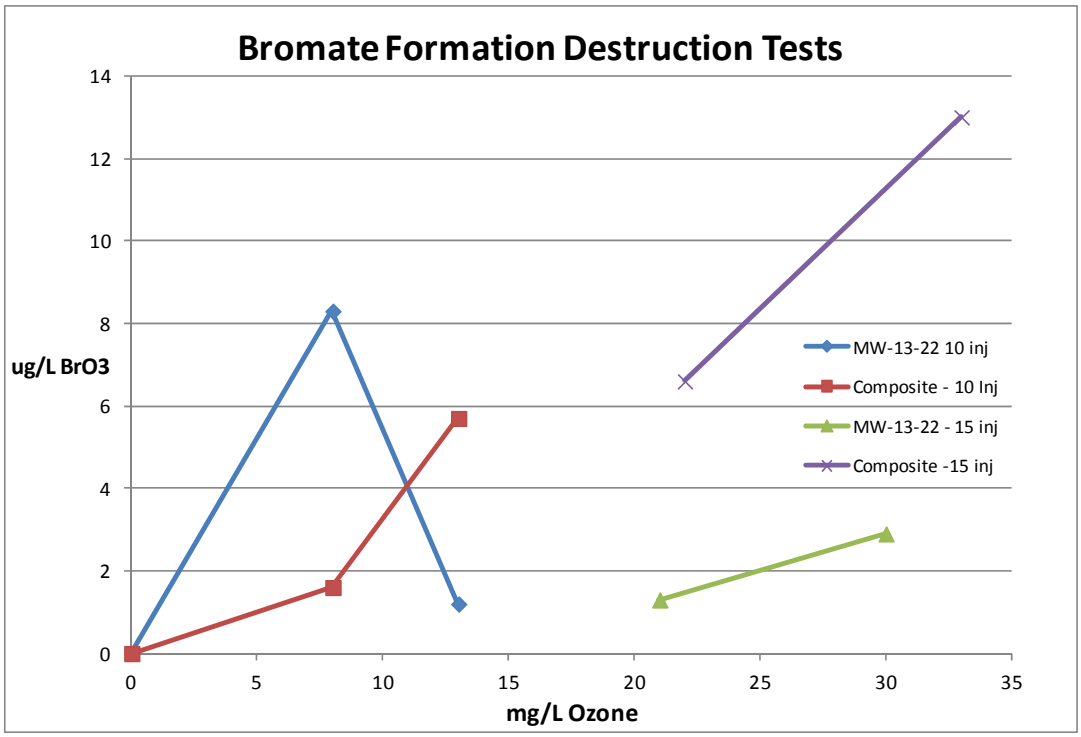

Figure 2 : Bromate Formation versus Ozone

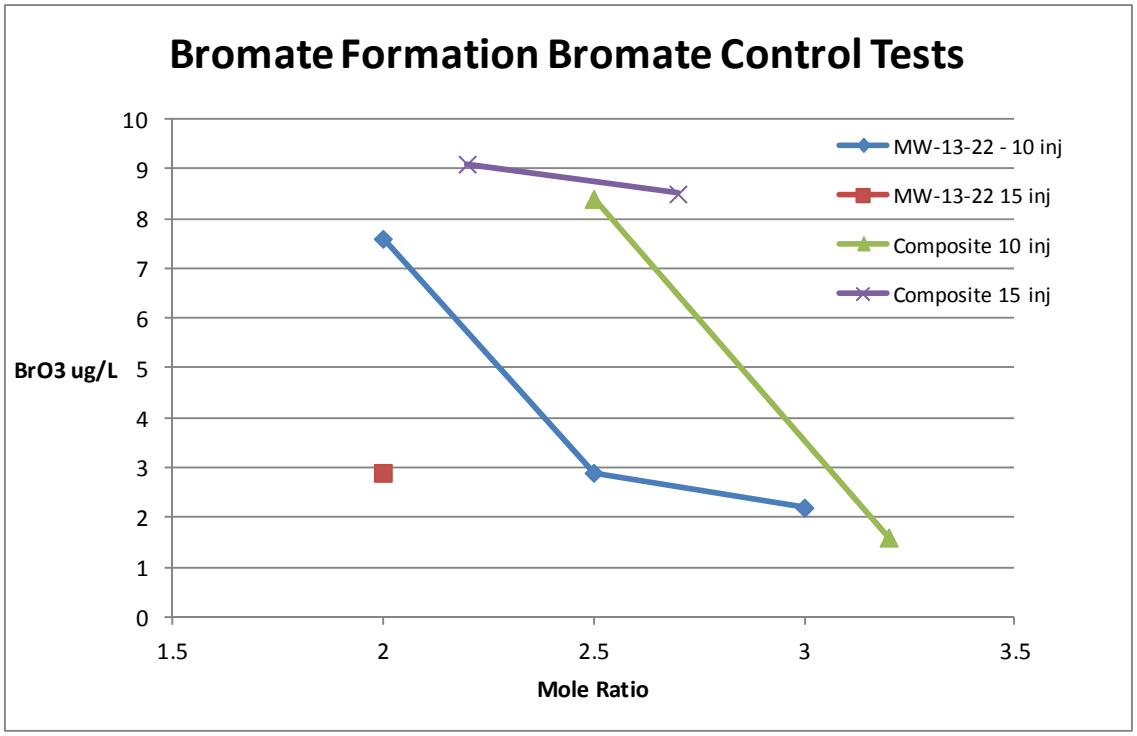

Figure 3 : Bromate Formation versus Mole Ratio at Constant Ozone Dose

	Bromate Control Test Results MW13-22				
	Samples				
Conditions	Sample ID#	P3453-SP-5	P3453-SP-6	P3453-SP-7	P3453-SP-8
	Run#	5	6	7	8
	Ozone Dose (mg/L)	15.1	15.1	15.1	15.1
	H2O2:O3 Mole Ratio	3.0	2.5	2.0	2.0
	# of injectors	10	10	15	10
ULTURA Lab	pH	7.14	7.22	7.26	7.22
	Alkalinity (mg/L)	440	420	420	400
	Turbidity (NTU)	187	152	150	178
	Temperature (deg C)	16.5	16.1	16.4	15.6
	UVT (cm-1)	58.8	62.5	63	64.2
	O3 Residual-DPD (mg/L)	0.05	0.01	0.01	0.02
	H2O2 Residual-Hach (mg/L)	22	17	10	11
	H2O2 Residual-Strips (mg/L)	10-30	10-30	10	10
	COD (mg/L)	na	na	8	na
3rd Party Lab	1,4-dioxane (ug/L)	<1	<1	<1	<1
	Bromide (ug/L)	65	74	70	67
	Bromate (ug/L)	1.6	8.4	8.4	9.1

Table 3a: Analytic Results for Bromate Control Tests

	Bromate Control Test Results Composite				
		Samples			
Conditions	Sample ID#	P3453-SP-15	P3453-SP-16	P3453-SP-17	P3453-SP-18
	Run#	15	16	17	18
	Ozone Dose (mg/L)	15.1	15.1	15.1	15.1
	H2O2:O3 Mole Ratio	3.0	2.5	2.7	2.2
	# of injectors	10	10	15	15
ULTURA Lab	pH	7.29	7.54	7.55	7.61
	Alkalinity (mg/L)	380	400	400	420
	Turbidity (NTU)	162	153	117	100
	Temperature (deg C)	16.2	15.8	15.9	16.3
	UVT (cm-1)	63.5	57.6	49.2	51.1
	O3 Residual-DPD (mg/L)	0.01	0.01	0.01	0.01
	H2O2 Residual-Hach (mg/L)	20	20	16	20
	H2O2 Residual-Strips (mg/L)	10-30	10-30	10-30	10-30
	COD (mg/L)			12	
3rd Party Lab	1,4-dioxane (ug/L)	<1	<1	<1	<1
	Bromide (ug/L)	65	130	130	130
	Bromate (ug/L)	1.6	8.4	8.5	9.1

Table 3b: Analytic Results for Bromate Control Tests

	Metals Analysis MW13-22								
		Samples							
Conditions	Sample ID#	P3453-SP-0	P3453-SP-1	P3453-SP-2	P3453-SP-3	P3453-SP-4	P3453-SP-5	P3453-SP-6	P3453-SP-7
	Run#	0	1	2	3	4	0	1	2
	Ozone Dose (mg/L)	-	8	13	21	30	15.1	15.1	15.1
	H2O2:O3 Mole Ratio	-	2.5	2.5	2.5	2.5	3.0	2.5	2.0
Merit Laboratories	Antimony(mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	Arsenic(mg/L)	0.006	0.006	0.005	0.005	0.009	0.007	0.006	0.006
	Barium(mg/L)	0.031	0.078	0.038	0.032	0.036	0.048	0.034	0.032
	Boron(mg/L)	0.33	0.32	0.33	0.33	0.33	0.26	0.26	0.27
	Cadmium(mg/L)	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Chromium(mg/L)	<0.005	0.055	<0.005	<0.005	0.005	0.048	0.013	<0.005
	Cobalt(mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	Copper(mg/L)	<0.005	0.013	0.25	0.006	0.02	0.016	0.009	0.007
	Iron(mg/L)* report(2)	11.1	na	na	na	na	15.4	12.3	13.1
	Lead(mg/L)	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
	Manganese(mg/L)	0.099	0.126	0.094	0.093	0.097	0.102	0.097	0.097
	Mercury(mg/L)	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
	Nickel(mg/L)	0.019	0.184	0.029	0.021	0.31	0.072	0.028	0.019
	Selenium(mg/L)	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	Silver(mg/L)	<0.0005	<0.0005	<0.0005	<0.0005	0.0013	<0.0005	<0.0005	<0.0005
	Vanadium(mg/L)	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004
	Zinc(mg/L)	0.006	0.015	0.01	0.008	0.064	0.011	0.008	0.008

Table 4a: Analytic Results for Metals in MW 13-22

	Metals Analysis Composite							
	Samples							
Conditions	Sample ID#	P3453-SP-10	P3453-SP-11	P3453-SP-12	P3453-SP-13	P3453-SP-14	P3453-SP-15	P3453-SP-16	P3453-SP-17
	Run#	10	11	12	13	14	15	16	17
	Ozone Dose (mg/L)	-	8	13	21	30	15.1	15.1	15.1
	H2O2:O3 Mole Ratio	-	2.5	2.5	2.5	2.5	3.0	2.5	2.7
Merit Laboratories	Arsenic(mg/L)	0.004	0.005	0.005	0.005	0.004	0.007	0.006	0.005
	Barium(mg/L)	0.226	0.215	0.224	0.229	0.226	0.033	0.221	0.232
	Boron(mg/L)	0.2	0.2	0.2	0.2	0.2	0.28	0.16	0.16
	Cadmium(mg/L)	0.0012	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
	Chromium(mg/L)	<0.005	0.005	<0.005	<0.005	<0.005	0.01	0.009	0.013
	Copper(mg/L)	<0.005	0.006	0.006	0.005	0.005	0.007	0.007	0.006
	Iron(mg/L)	13	na	na	na	na	13.5	7.57	8.23
	Manganese(mg/L)	0.133	0.104	0.102	0.104	0.1	0.097	0.101	0.103
	Nickel(mg/L)	0.015	0.017	0.016	0.015	0.015	0.023	0.018	0.016
	Zinc	0.013	0.026	0.016	0.014	0.016	0.008	0.014	0.017

Table 4b: Analytic Results for Metals in Composite Sample

3. DISCUSSION

3.1 HiPOx Treatment

The tests described in this report demonstrate the suitability of the HiPOx process to treat 1,4-dioxane to target effluent goals of less than 3.2 ug/L at the Racer Trust Site.

Bromate formation was controlled below the 10 ug/L limit with and ozone dose of 15.1 mg/L. The MW-13-22 well required a hydrogen peroxide:ozone mole ratio of 2.0 or higher, and 10 ozone injectors. The Composite sample required a hydrogen peroxide:ozone mole ratio of 2.5 or higher, and 10 ozone injectors.

3.2 HiPOx Dosing Projections for Full-Scale System

Destruction models were generated within the limitations of the data to extrapolate ozone and hydrogen peroxide dosing levels to meet the treatment objectives assuming the current sample water constituent concentrations. Table 5 a and 5b presents the destruction model dosing levels recommended to meet the design 1,4-dioxane and bromate limits for discharge.

Parameter	Design Influent	Effluent Limit
Ozone	15.0 mg/L	NA
Hydrogen Peroxide	21.3 mg/L	NA
O3/H2O2 mole ratio	2.0	NA
1,4-Dioxane	150 ug/L	< 3.2 ug/L
Bromide	71 ug/L	NA
BrO3	<1 ug/L	< 10 ug/L

Table 5a: Recommended Full Scale MW-13-22

Parameter	Design Influent	Effluent Limit
Ozone	15.0 mg/L	NA
Hydrogen Peroxide	26.6 mg/L	NA
O3/H2O2 mole ratio	2.5	NA
1,4-Dioxane	150 ug/L	< 3.2 ug/L
Bromide	130 ug/L	NA
BrO3	<1 ug/L	< 10 ug/L

Table 5b: Recommended Full Scale Composite

3.3 Recommendations

The full scale HiPOx system to treat 150 ug/l of 1,4-dioxane to less than 3.2 ug/l should be configured to deliver a minimum of 15.0 mg/L ozone, 26.6 mg/L hydrogen peroxide for the Composite water. The MW-13-22 water the system should be configured to deliver a minimum of 15.0 mg/L ozone and 21.3 mg/L hydrogen peroxide.

4. ATTACHMENTS

ATTACHMENT 1 3rd Party Analytical Reports

LABORATORY REPORT

This report contains 16 pages.
(including the cover page)

If you have any questions concerning this report, please do not hesitate to call us at (800) 332-4345 or (574) 233-4777.

UL LLC
110 S. Hill St., South Bend, IN 46617-2702 USA
T: 800.332.4345 / F: 574.233.8207 / W: UL.com

Laboratory Report

Client: Ultura

Attn: Douglas Gustafson
2516 Verne Roberts Circle Suite H-102
Antioch, CA 94509

Report: 312512
Priority: Immediate Verbal
Status: Final
PWS ID: Not Supplied

Copies to: None

Sample Information

UL ID #	Client ID	Method	Collected Date / Time	Collected By:	Received Date / Time
2980183	P-3453-SP-0	300.0	02/24/14 08:30	Client	02/25/14 09:15
2980193	P-3453-SP-0	317.0	02/24/14 08:30	Client	02/25/14 09:15
2980184	P-3453-SP-1	300.0	02/24/14 09:30	Client	02/25/14 09:15
2980194	P-3453-SP-1	317.0	02/24/14 09:30	Client	02/25/14 09:15
2980185	P-3453-SP-2	300.0	02/24/14 10:30	Client	02/25/14 09:15
2980195	P-3453-SP-2	317.0	02/24/14 10:30	Client	02/25/14 09:15
2980186	P-3453-SP-3	300.0	02/24/14 11:00	Client	02/25/14 09:15
2980196	P-3453-SP-3	317.0	02/24/14 11:00	Client	02/25/14 09:15
2980187	P-3453-SP-4	300.0	02/24/14 11:30	Client	02/25/14 09:15
2980197	P-3453-SP-4	317.0	02/24/14 11:30	Client	02/25/14 09:15
2980188	P-3453-SP-10	300.0	02/24/14 12:10	Client	02/25/14 09:15
2980198	P-3453-SP-10	317.0	02/24/14 12:10	Client	02/25/14 09:15
2980189	P-3453-SP-11	300.0	02/24/14 12:30	Client	02/25/14 09:15
2980199	P-3453-SP-11	317.0	02/24/14 12:30	Client	02/25/14 09:15
2980190	P-3453-SP-12	300.0	02/24/14 12:50	Client	02/25/14 09:15
2980200	P-3453-SP-12	317.0	02/24/14 12:50	Client	02/25/14 09:15
2980191	P-3453-SP-13	300.0	02/24/14 13:10	Client	02/25/14 09:15
2980201	P-3453-SP-13	317.0	02/24/14 13:10	Client	02/25/14 09:15
2980192	P-3453-SP-14	300.0	02/24/14 13:45	Client	02/25/14 09:15
2980202	P-3453-SP-14	317.0	02/24/14 13:45	Client	02/25/14 09:15

Report Summary

Detailed quantitative results are presented on the following pages. The results presented relate only to the samples provided for analysis.

We appreciate the opportunity to provide you with this analysis. If you have any questions concerning this report, please do not hesitate to call James Van Fleit at (574) 233-4777.

UL LLC
110 S. Hill St., South Bend, IN 46617-2702 USA
T: 800.332.4345 / F: 574.233.8207 / W: UL.com

Authorized Signature Title Date

Client Name: Ultura
Report #: 312512

Client Name: Ultura Report #: 312512

Sampling Point: P-3453-SP-0 PWS ID: Not Supplied

General Chemistry									
Analyte ID #	Analyte	Method	Reg Limit	MRL†	Result	Units	Preparation Date	Analyzed Date	UL ID #
24959-67-9	Bromide	300.0	---	0.010	**0.071**	mg/L	---	02/26/14 14:06	2980183
15541-45-4	Bromate	317.0	10 *	1.0	< 1.0	ug/L	---	02/27/14 01:40	2980193

Sampling Point: P-3453-SP-1 PWS ID: Not Supplied

General Chemistry									
Analyte ID #	Analyte	Method	Reg Limit	MRL†	Result	Units	Preparation Date	Analyzed Date	UL ID #
24959-67-9	Bromide	300.0	---	0.010	**0.071**	mg/L	---	02/26/14 15:14	2980184
15541-45-4	Bromate	317.0	10 *	1.0	**9.4**	ug/L	---	02/27/14 02:43	2980194

Sampling Point: P-3453-SP-2 PWS ID: Not Supplied

General Chemistry									
Analyte ID #	Analyte	Method	Reg Limit	MRL†	Result	Units	Preparation Date	Analyzed Date	UL ID #
24959-67-9	Bromide	300.0	---	0.010	**0.072**	mg/L	---	02/26/14 15:36	2980185
15541-45-4	Bromate	317.0	10 *	1.0	**1.2**	ug/L	---	02/27/14 03:04	2980195

Sampling Point: P-3453-SP-3 PWS ID: Not Supplied

General Chemistry									
Analyte ID #	Analyte	Method	Reg Limit	MRL†	Result	Units	Preparation Date	Analyzed Date	UL ID #
24959-67-9	Bromide	300.0	---	0.010	**0.073**	mg/L	---	02/26/14 15:59	2980186
15541-45-4	Bromate	317.0	10 *	1.0	**1.3**	ug/L	---	02/27/14 03:25	2980196

Sampling Point: P-3453-SP-4 PWS ID: Not Supplied

General Chemistry									
Analyte ID #	Analyte	Method	Reg Limit	MRL†	Result	Units	Preparation Date	Analyzed Date	UL ID #
24959-67-9	Bromide	300.0	---	0.010	**0.067**	mg/L	---	02/26/14 16:21	2980187
15541-45-4	Bromate	317.0	10 *	1.0	**2.9**	ug/L	---	02/27/14 03:46	2980197

Client Name: Ultura Report #: 312512

Sampling Point: P-3453-SP-10 PWS ID: Not Supplied

General Chemistry									
Analyte ID #	Analyte	Method	Reg Limit	MRL†	Result	Units	Preparation Date	Analyzed Date	UL ID #
24959-67-9	Bromide	300.0	---	0.010	**0.14**	mg/L	---	02/26/14 16:44	2980188
15541-45-4	Bromate	317.0	10 *	1.0	< 1.0	ug/L	---	02/27/14 04:07	2980198

Sampling Point: P-3453-SP-11 PWS ID: Not Supplied

General Chemistry									
Analyte ID #	Analyte	Method	Reg Limit	MRL†	Result	Units	Preparation Date	Analyzed Date	UL ID #
24959-67-9	Bromide	300.0	---	0.010	**0.13**	mg/L	---	02/26/14 17:06	2980189
15541-45-4	Bromate	317.0	10 *	1.0	**1.6**	ug/L	---	02/27/14 04:28	2980199

Sampling Point: P-3453-SP-12 PWS ID: Not Supplied

General Chemistry									
Analyte ID #	Analyte	Method	Reg Limit	MRL†	Result	Units	Preparation Date	Analyzed Date	UL ID #
24959-67-9	Bromide	300.0	---	0.010	**0.13**	mg/L	---	02/26/14 17:29	2980190
15541-45-4	Bromate	317.0	10 *	1.0	**5.7**	ug/L	---	02/27/14 04:49	2980200

Sampling Point: P-3453-SP-13 PWS ID: Not Supplied

General Chemistry									
Analyte ID #	Analyte	Method	Reg Limit	MRL†	Result	Units	Preparation Date	Analyzed Date	UL ID #
24959-67-9	Bromide	300.0	---	0.010	**0.13**	mg/L	---	02/26/14 18:36	2980191
15541-45-4	Bromate	317.0	10 *	1.0	**6.6**	ug/L	---	02/27/14 05:10	2980201

Sampling Point: P-3453-SP-14 PWS ID: Not Supplied

General Chemistry									
Analyte ID #	Analyte	Method	Reg Limit	MRL†	Result	Units	Preparation Date	Analyzed Date	UL ID #
24959-67-9	Bromide	300.0	---	0.010	**0.13**	mg/L	---	02/26/14 18:59	2980192
15541-45-4	Bromate	317.0	10 *	1.0	**13**	ug/L	---	02/27/14 05:31	2980202

† UL has demonstrated it can achieve these report limits in reagent water, but can not document them in all sample matrices.

Reg Limit Type:	MCL	SMCL	AL
Symbol:	*	^	!

Lab Definitions

Continuing Calibration Check Standard (CCC) / Continuing Calibration Verification (CCV) / Initial Calibration Verification Standard (ICV) / Initial Performance Check (IPC) - is a standard containing one or more of the target analytes that is prepared from the same standards used to calibrate the instrument. This standard is used to verify the calibration curve at the beginning of each analytical sequence, and may also be analyzed throughout and at the end of the sequence. The concentration of continuing standards may be varied, when prescribed by the reference method, so that the range of the calibration curve is verified on a regular basis.

Internal Standards (IS) - are pure compounds with properties similar to the analytes of interest, which are added to field samples or extracts, calibration standards, and quality control standards at a known concentration. They are used to measure the relative responses of the analytes of interest and surrogates in the sample, calibration standard or quality control standard.

Laboratory Duplicate (LD) - is a field sample aliquot taken from the same sample container in the laboratory and analyzed separately using identical procedures. Analysis of laboratory duplicates provides a measure of the precision of the laboratory procedures.

Laboratory Fortified Blank (LFB) / Laboratory Control Sample (LCS) - is an aliquot of reagent water to which known concentrations of the analytes of interest are added. The LFB is analyzed exactly the same as the field samples. LFBs are used to determine whether the method is in control.

Laboratory Method Blank (LMB) / Laboratory Reagent Blank (LRB) - is a sample of reagent water included in the sample batch analyzed in the same way as the associated field samples. The LMB is used to determine if method analytes or other background contamination have been introduced during the preparation or analytical procedure. The LMB is analyzed exactly the same as the field samples.

Laboratory Trip Blank (LTB) / Field Reagent Blank (FRB) - is a sample of laboratory reagent water placed in a sample container in the laboratory and treated as a field sample, including storage, preservation, and all analytical procedures. The FRB/LTB container follows the collection bottles to and from the collection site, but the FRB/LTB is not opened at any time during the trip. The FRB/LTB is primarily a travel blank used to verify that the samples were not contaminated during shipment.

Matrix Spike Duplicate Sample (MSD) / Laboratory Fortified Sample Matrix Duplicate (LFSMD) - is a sample aliquot taken from the same field sample source as the Matrix Spike Sample to which known quantities of the analytes of interest are added in the laboratory. The MSD is analyzed exactly the same as the field samples. Analysis of the MSD provides a measure of the precision of the laboratory procedures in a specific matrix.

Matrix Spike Sample (MS) / Laboratory Fortified Sample Matrix (LFSM) - is a sample aliquot taken from field sample source to which known quantities of the analytes of interest are added in the laboratory. The MS is analyzed exactly the same as the field samples. The purpose is to demonstrate recovery of the analytes from a sample matrix to determine if the specific matrix contributes bias to the analytical results.

Quality Control Standard (QCS) / Second Source Calibration Verification (SSCV) - is a solution containing known concentrations of the analytes of interest prepared from a source different from the source of the calibration standards. The solution is obtained from a second manufacturer or lot if the lot can be demonstrated by the manufacturer as prepared independently from other lots. The QCS sample is analyzed using the same procedures as field samples. The QCS is used as a check on the calibration standards used in the method on a routine basis.

Reporting Limit Check (RLC) / Initial Calibration Check Standard (ICCS) - is a procedural standard that is analyzed each day to evaluate instrument performance at or below the minimum reporting limit (MRL).

Surrogate Standard (SS) / Surrogate Analyte (SUR) - is a pure compound with properties similar to the analytes of interest, which is highly unlikely to be found in any field sample, that is added to the field samples, calibration standards, blanks and quality control standards before sample preparation. The SS is used to evaluate the efficiency of the sample preparation process.

110 S. Hill Street
South Bend, IN 46617
T: 1.800.332.4345
F: 1.574.233.8207

Order # 250986

Batch # 312512

www.ul.com/water

CHAIN OF CUSTODY RECORD

Page 1 of 13 (35) 2-25-14

REPORT TO: dgustafson@ultrawater.com
Randy.Christensen@Arcadis.com

BILL TO: Arcadis
10559 Citation Drive Suite 100
Brighton MI 48116

SAMPLER (Signature):

COMPLIANCE MONITORING	Yes	No
		X

PWS ID #:

STATE (sample origin): MI

POPULATION SERVED:

SOURCE WATER: Ground Water

PROJECT NAME: P-3453

PO#: B0064480, 0014, 00501

	LAB Number (For UL use only)	COLLECTION DATE	TIME	AM	PM	SAMPLING SITE	TEST NAME	SAMPLE REMARKS	CHLORINATED YES	CHLORINATED NO	# OF CONTAINERS	MATRIX CODE	TURNAROUND TIME
1	2980183	2-24-14	8:30	X		P-3459 - SP-0	Bromide 300.0 / Bromate 317			X	2	GW	IV
2	184	"	9:30	X		P-3459 - SP-1	"			X	2	GW	IV
3	185	"	10:30	X		P-3459 - SP-2	"			X	2	GW	IV
4	186	"	11:00	X		P-3459 - SP-3	"			X	2	GW	IV
5	187	"	11:30	X		P-3459 - SP-4	"			X	2	GW	IV
6													
7	188	2-24-14	12:10			P-3459 - SP-10	Bromide 300.0 / Bromate 317			X	2	GW	IV
8	189	"	12:30			P-3459 - SP-11	"			X	2	GW	IV
9	190	"	12:50			P-3453 - SP-12	"			X	2	GW	IV
10	191	"	13:10			P-3453 - SP-13	"			X	2	GW	IV
11	192	"	13:45			P-3453 - SP-14	"			X	2	GW	IV
12													
13													
14													

Immediate Verbal

RELINQUISHED BY:(Signature)	DATE	TIME	RECEIVED BY:(Signature)	DATE	TIME
	2/24/14	1500 AM PM	V.P.S.		AM PM
RELINQUISHED BY:(Signature)	DATE	TIME	RECEIVED BY:(Signature)	DATE	TIME
		AM PM			AM PM
RELINQUISHED BY:(Signature)	DATE	TIME	RECEIVED FOR LABORATORY BY:	DATE	TIME
		AM PM		2.25.14	0915 AM PM

LAB RESERVES THE RIGHT TO RETURN UNUSED PORTIONS OF NON-AQUEOUS SAMPLES TO CLIENT

LAB COMMENTS (For UL use only)

IV TAT noted per Doug Gustafson. JM

CONDITIONS UPON RECEIPT (check one):

___ Iced: Wet/Blue X Ambient ___ °C Upon Receipt X N/A

MATRIX CODES:

DW-DRINKING WATER
RW-REAGENT WATER
GW-GROUND WATER
EW-EXPOSURE WATER
SW-SURFACE WATER
PW-POOL WATER
WW-WASTE WATER

TURN-AROUND TIME (TAT) - SURCHARGES

SW = Standard Written: (15 working days)	0%	IV* = Immediate Verbal: (3 working days)	100%
RV* = Rush Verbal: (5 working days)	50%	IW* = Immediate Written: (3 working days)	125%
RW* = Rush Written: (5 working days)	75%	SP* = Weekend, Holiday	CALL
		STAT* = Less than 48 hours	CALL

* Please call, expedited service not available for all testing

06-LO-F0435 Issue 3.0 Effective Date: 2013-09-11

Samples received unannounced with less than 48 hours holding time remaining may be subject to additional charges.

110 S. Hill Street
South Bend, IN 46617
T: 1.800.332.4345
F: 1.574.233.8207

250986
Order #
Batch #

www.ul.com/water

CHAIN OF CUSTODY RECORD

Page 1 of 2

REPORT TO: dgustafson@ultrawater.com
Randy.Christensen@Arcadis.com

BILL TO: Arcadis
10559 Citation Drive Suite 100
Brighton MI 48116

SAMPLER (Signature)

COMPLIANCE MONITORING: Yes — No: X

PWS ID #:

POPULATION SERVED:

STATE (sample origin): MI

SOURCE WATER: Ground Water

PROJECT NAME: P-3453

PO#: B0064480, 0014, 00501

SS 2-25-14

	LAB Number (For UL use only)	COLLECTION DATE	TIME	AM	PM	SAMPLING SITE	TEST NAME	SAMPLE REMARKS	CHLORINATED YES	CHLORINATED NO	# OF CONTAINERS	MATRIX CODE	TURNAROUND TIME
1	2980193	2-24-14	8:30	X		P-3459 - SP-0	Bromide 300.0 / Bromate 317			X	2	GW	IV
2	194	"	9:30	X		P-3459 - SP-1	"			X	2	GW	IV
3	195	"	10:30	X		P-3459 - SP-2	"			X	2	GW	IV
4	196	"	11:00	X		P-3459 - SP-3	"			X	2	GW	IV
5	197	"	11:30	X		P-3459 - SP-4	"			X	2	GW	IV
6													
7	198	2-24-14	12:10			P-3459 - SP-10	Bromide 300.0 / Bromate 317			X	2	GW	IV
8	199	"	12:30			P-3459 - SP-11	"			X	2	GW	IV
9	200	"	12:50			P-3453 - SP-12	"			X	2	GW	IV
10	201	"	13:10			P-3453 - SP-13	"			X	2	GW	IV
11	202	"	13:45			P-3453 - SP-14	"			X	2	GW	IV
12													
13													
14													

Immediate Verbal

RELINQUISHED BY:(Signature)	DATE	TIME	RECEIVED BY:(Signature)	DATE	TIME
	2/24/14	1500 AM PM	V.P.S.		AM PM
RELINQUISHED BY:(Signature)	DATE	TIME	RECEIVED BY:(Signature)	DATE	TIME
		AM PM			AM PM
RELINQUISHED BY:(Signature)	DATE	TIME	RECEIVED FOR LABORATORY BY	DATE	TIME
		AM PM		2-25-14	0915 AM PM

LAB RESERVES THE RIGHT TO RETURN UNUSED PORTIONS OF NON-AQUEOUS SAMPLES TO CLIENT

LAB COMMENTS (For UL use only)
IV TAT noted per Doug Gustafson. JM

CONDITIONS UPON RECEIPT (check one):
___ Iced: Wet/Blue X Ambient ___ °C Upon Receipt X N/A

MATRIX CODES:
DW-DRINKING WATER
RW-REAGENT WATER
GW-GROUND WATER
EW-EXPOSURE WATER
SW-SURFACE WATER
PW-POOL WATER
WW-WASTE WATER

TURN-AROUND TIME (TAT) - SURCHARGES

SW = Standard Written: (15 working days)	0%
RV* = Rush Verbal: (5 working days)	50%
RW* = Rush Written: (5 working days)	75%
IV* = Immediate Verbal: (3 working days)	100%
IW* = Immediate Written: (3 working days)	125%
SP* = Weekend, Holiday	CALL
STAT* = Less than 48 hours	CALL

* Please call, expedited service not available for all testing

Samples received unannounced with less than 48 hours holding time remaining may be subject to additional charges.

Change Bill to:
ULTORA
100 West Broadway
Suite 200
Long Beach, CA 90802

110 S. Hill Street
South Bend, IN 46617
T: 1.800.332.4345
F: 1.574.233.8207

250988
Order #
Batch #

www.ul.com/water

CHAIN OF CUSTODY RECORD

Page 1 of 1

REPORT TO:
dgustafson@ultrawater.com
Randy.Christensen@Arcadis.com

BILL TO:
Arcadis
10559 Citation Drive Suite 100
Brighton MI 48116

SAMPLER (Signature)

COMPLIANCE MONITORING	Yes	No
		X

PWS ID #	STATE (sample origin)	PROJECT NAME	PO#
	MI	P-3453	B0064486
POPULATION SERVED	SOURCE WATER		ODM o
	Ground Water		005010

LAB Number (For UL use only)	COLLECTION DATE	TIME	AM	PM	SAMPLING SITE	TEST NAME	SAMPLE REMARKS	CHLORINATED YES	CHLORINATED NO	# OF CONTAINERS	MATRIX CODE	TURNAROUND TIME
1	2-24-14	8:30	X		P-3453 - SP-0	Bromide 300.0 / Bromate 317			X	2	GW	IV
2	"	9:30	X		P-3453 - SP-1	" "			X	2	GW	IV
3	"	10:30	X		P-3453 - SP-2	" "			X	2	GW	IV
4	"	11:00	X		P-3453 - SP-3	" "			X	2	GW	IV
5	"	11:30	X		P-3453 - SP-4	" "			X	2	GW	IV
6												
7	2-24-14	12:10			P-3453 - SP-10	Bromide 300.0 / Bromate 317			X	2	GW	IV
8	"	12:30			P-3453 - SP-11	" "			X	2	GW	IV
9	"	12:50			P-3453 - SP-12	" "			X	2	GW	IV
10	"	13:10			P-3453 - SP-13	" "			X	2	GW	IV
11	"	13:45			P-3453 - SP-14	" "			X	2	GW	IV
12												
13												
14												

RELINQUISHED BY:(Signature)	DATE	TIME	RECEIVED BY:(Signature)	DATE	TIME
	2/24/14	1500 AM PM	VPS.		AM PM
RELINQUISHED BY:(Signature)	DATE	TIME	RECEIVED BY:(Signature)	DATE	TIME
		AM PM			AM PM
RELINQUISHED BY:(Signature)	DATE	TIME	RECEIVED FOR LABORATORY BY:	DATE	TIME
		AM PM			AM PM

LAB RESERVES THE RIGHT TO RETURN UNUSED PORTIONS OF NON-AQUEOUS SAMPLES TO CLIENT

LAB COMMENTS (For UL use only)

CONDITIONS UPON RECEIPT (check one):
____ Iced: Wet/Blue ____ Ambient ____ °C Upon Receipt ____ N/A

MATRIX CODES:
DW DRINKING WATER
RW-REAGENT WATER
GW-GROUND WATER
EW-EXPOSURE WATER
SW-SURFACE WATER
PW-POOL WATER
WW WASTE WATER

TURN-AROUND TIME (TAT) - SURCHARGES

SW = Standard Written (15 working days)	0%	IV* = Immediate Verbal (3 working days)	100%
RV* = Rush Verbal (5 working days)	50%	IW* = Immediate Written (3 working days)	125%
RW* = Rush Written (5 working days)	75%	SP* = Weekend, Holiday	CALL
		STAT* = Less than 48 hours	CALL

* Please call, expedited service not available for all testing

Samples received unannounced with less than 48 hours holding time remaining may be subject to additional charges.

VanFleit, James A

From: Douglas Gustafson <dgustafson@ulturawater.com>
Sent: Tuesday, February 25, 2014 12:44 PM
To: VanFleit, James A
Cc: Christensen, Randy (Randy.Christensen@arcadis-us.com); Hartz, Matthew W; Peter Herlihy
Subject: RE: Bromate / Bromide Testing
Attachments: 02251402.PDF

Follow Up Flag: Follow up
Flag Status: Completed

Jim

Attached is a change to the COC to be billed to Ultura. APTwater changed its name to Ultura on Monday 2-24-14. The billing address is still the same. If you have any questions let me know.

Doug Gustafson
Senior Design Specialist

ULTURA™

M: (925)759-1191
T: (562) 661- 4999
E: dgustafson@ulturawater.com
W: www.ulturawater.com
ULTURA™ Inc. 2516 Verne Roberts Circle, Suite H-102, Antioch, CA 94509

Our brands APTwater ROCHEM sepro HiPOx

From: VanFleit, James A [mailto:James.A.VanFleit@ul.com]
Sent: Tuesday, February 25, 2014 9:22 AM
To: Douglas Gustafson
Cc: Christensen, Randy (Randy.Christensen@arcadis-us.com); Hartz, Matthew W
Subject: Bromate / Bromide Testing

Doug,

In speaking with you earlier today and just recently with Randy Christensen, it is now my understanding that UL will perform the analysis on the samples received today and report and bill direct to APT Water.

Since the COC says to report and bill to Arcadis, can you please respond via email that my understanding is correct and we are to bill and report direct to APT Water only.

Thanks,
Jim

Jim Van Fleit
Project Manager
Water Quality Laboratory

UL LLC
110 South Hill Street
South Bend, IN 46617
Main: 800-332-4345 ext. 45535
Direct: 574-472-5535
Cell: 574-210-9679
Fax: 847-513-7887

Website
http://www.ul.com/global/eng/pages/offerings/industries/waterandfood/water/

Drinking Water Certifications
www.ul.com/watercertifications

Online Schedule of Services
http://www.ulwaterschedule.com/cgi-bin/WebObjects/ScheduleofServices

UL Drinking Water Laboratory

Run Log

Run ID: **188437** Method: **300.0**

Type	Sample Id	Sample Site	Matrix	Instrument ID	Analysis Date	Calibration File
ICB	2980387		RW	BK	02/24/2014 11:08	
LRB	2980410		RW	BK	02/26/2014 11:51	
LFB	2980413		RW	BK	02/26/2014 12:36	
IPC	2980419		RW	BK	02/26/2014 12:59	
FS	2980183	P-3453-SP-0	GW	BK	02/26/2014 14:06	
MS	2982445	P-3453-SP-0	GW	BK	02/26/2014 14:29	
MSD	2982446	P-3453-SP-0	GW	BK	02/26/2014 14:51	
FS	2980184	P-3453-SP-1	GW	BK	02/26/2014 15:14	
FS	2980185	P-3453-SP-2	GW	BK	02/26/2014 15:36	
FS	2980186	P-3453-SP-3	GW	BK	02/26/2014 15:59	
FS	2980187	P-3453-SP-4	GW	BK	02/26/2014 16:21	
FS	2980188	P-3453-SP-10	GW	BK	02/26/2014 16:44	
FS	2980189	P-3453-SP-11	GW	BK	02/26/2014 17:06	
FS	2980190	P-3453-SP-12	GW	BK	02/26/2014 17:29	
IPC	2980423		RW	BK	02/26/2014 17:51	
LRB	2980422		RW	BK	02/26/2014 18:14	
FS	2980191	P-3453-SP-13	GW	BK	02/26/2014 18:36	
FS	2980192	P-3453-SP-14	GW	BK	02/26/2014 18:59	
IPC	2980428		RW	BK	02/26/2014 23:06	
LRB	2980425		RW	BK	02/26/2014 23:29	

QC Summary Report

Sample Type	Analyte	Method	MRL	Client ID	Result Flag	Amount	Target	Units	% Recovery	Recovery Limits	RPD	RPD Limit	Dil Factor	Extracted	Analyzed	UL ID #
ICB	Bromide	300.0	10	---	<	10		ug/L	---	---	---	---	1.0	---	02/24/2014 11:08	2980387
LRB	Bromide	300.0	10	---	<	10		ug/L	---	---	---	---	1.0	---	02/26/2014 11:51	2980410
LFB	Bromide	300.0	10	---		97.5300	100	ug/L	98	90 - 110	---	---	1.0	---	02/26/2014 12:36	2980413
IPC	Bromide	300.0	10	---		96.2400	100	ug/L	96	90 - 110	---	---	1.0	---	02/26/2014 12:59	2980419
FS	Bromide	300.0	10	P-3453-SP-0		71		ug/L	---	---	---	---	1.0	---	02/26/2014 14:06	2980183
MS	Bromide	300.0	10	P-3453-SP-0		309.1500	320.59	ug/L	95	90 - 110	---	---	1.0	---	02/26/2014 14:29	2982445
MSD	Bromide	300.0	10	P-3453-SP-0		319.7700	320.59	ug/L	100	90 - 110	3.4	20	1.0	---	02/26/2014 14:51	2982446
FS	Bromide	300.0	10	P-3453-SP-1		71		ug/L	---	---	---	---	1.0	---	02/26/2014 15:14	2980184
FS	Bromide	300.0	10	P-3453-SP-2		72		ug/L	---	---	---	---	1.0	---	02/26/2014 15:36	2980185
FS	Bromide	300.0	10	P-3453-SP-3		73		ug/L	---	---	---	---	1.0	---	02/26/2014 15:59	2980186
FS	Bromide	300.0	10	P-3453-SP-4		67		ug/L	---	---	---	---	1.0	---	02/26/2014 16:21	2980187
FS	Bromide	300.0	10	P-3453-SP-10		140		ug/L	---	---	---	---	1.0	---	02/26/2014 16:44	2980188
FS	Bromide	300.0	10	P-3453-SP-11		130		ug/L	---	---	---	---	1.0	---	02/26/2014 17:06	2980189
FS	Bromide	300.0	10	P-3453-SP-12		130		ug/L	---	---	---	---	1.0	---	02/26/2014 17:29	2980190
IPC	Bromide	300.0	10	---		104.4100	100	ug/L	104	90 - 110	---	---	1.0	---	02/26/2014 17:51	2980423
LRB	Bromide	300.0	10	---	<	10		ug/L	---	---	---	---	1.0	---	02/26/2014 18:14	2980422
FS	Bromide	300.0	10	P-3453-SP-13		130		ug/L	---	---	---	---	1.0	---	02/26/2014 18:36	2980191
FS	Bromide	300.0	10	P-3453-SP-14		130		ug/L	---	---	---	---	1.0	---	02/26/2014 18:59	2980192
IPC	Bromide	300.0	10	---		92.5400	100	ug/L	93	90 - 110	---	---	1.0	---	02/26/2014 23:06	2980428
LRB	Bromide	300.0	10	---	<	10		ug/L	---	---	---	---	1.0	---	02/26/2014 23:29	2980425

UL Drinking Water Laboratory

Run Log

Run ID: **188424** Method: **317.0**

Type	Sample Id	Sample Site	Matrix	Instrument ID	Analysis Date	Calibration File
ICB	2981738		RW	DT	02/26/2014 17:37	
LRB	2981744		RW	DT	02/26/2014 19:43	
LFB	2981745		RW	DT	02/26/2014 20:04	
IPC	2981746		RW	DT	02/26/2014 20:25	
QCS	2981747		RW	DT	02/26/2014 20:46	
CCC	2974873		RW	DT	02/27/2014 01:19	
FS	2980193	P-3453-SP-0	GW	DT	02/27/2014 01:40	
MS	2981750	P-3453-SP-0	GW	DT	02/27/2014 02:01	
MSD	2981751	P-3453-SP-0	GW	DT	02/27/2014 02:22	
FS	2980194	P-3453-SP-1	GW	DT	02/27/2014 02:43	
FS	2980195	P-3453-SP-2	GW	DT	02/27/2014 03:04	
FS	2980196	P-3453-SP-3	GW	DT	02/27/2014 03:25	
FS	2980197	P-3453-SP-4	GW	DT	02/27/2014 03:46	
FS	2980198	P-3453-SP-10	GW	DT	02/27/2014 04:07	
FS	2980199	P-3453-SP-11	GW	DT	02/27/2014 04:28	
FS	2980200	P-3453-SP-12	GW	DT	02/27/2014 04:49	
FS	2980201	P-3453-SP-13	GW	DT	02/27/2014 05:10	
FS	2980202	P-3453-SP-14	GW	DT	02/27/2014 05:31	
CCC	2981752		RW	DT	02/27/2014 05:52	

QC Summary Report

Sample Type	Analyte	Method	MRL	Client ID	Result Flag	Amount	Target	Units	% Recovery	Recovery Limits	RPD	RPD Limit	Dil Factor	Extracted	Analyzed	UL ID #
ICB	Bromate	317.0	1.0	---	<	1.0		ug/L	---	---	---	---	1.0	---	02/26/2014 17:37	2981738
LRB	Bromate	317.0	1.0	---	<	1.0		ug/L	---	---	---	---	1.0	---	02/26/2014 19:43	2981744
LFB	Bromate	317.0	1.0	---		4.8687	5.0	ug/L	97	85 - 115	---	---	1.0	---	02/26/2014 20:04	2981745
IPC	Bromate	317.0	1.0	---		1.0314	1.0	ug/L	103	75 - 125	---	---	1.0	---	02/26/2014 20:25	2981746
QCS	Bromate	317.0	1.0	---		5.0367	5.0	ug/L	101	85 - 115	---	---	1.0	---	02/26/2014 20:46	2981747
CCC	Bromate	317.0	1.0	---		11.3081	10.0	ug/L	113	85 - 115	---	---	1.0	---	02/27/2014 01:19	2974873
FS	Bromate	317.0	1.0	P-3453-SP-0	<	1.0		ug/L	---	---	---	---	1.0	---	02/27/2014 01:40	2980193
MS	Bromate	317.0	1.0	P-3453-SP-0		4.3075	5.0	ug/L	86	75 - 125	---	---	1.0	---	02/27/2014 02:01	2981750
MSD	Bromate	317.0	1.0	P-3453-SP-0		4.0308	5.0	ug/L	81	75 - 125	6.6	10	1.0	---	02/27/2014 02:22	2981751
FS	Bromate	317.0	1.0	P-3453-SP-1		9.4		ug/L	---	---	---	---	1.0	---	02/27/2014 02:43	2980194
FS	Bromate	317.0	1.0	P-3453-SP-2		1.2		ug/L	---	---	---	---	1.0	---	02/27/2014 03:04	2980195
FS	Bromate	317.0	1.0	P-3453-SP-3		1.3		ug/L	---	---	---	---	1.0	---	02/27/2014 03:25	2980196
FS	Bromate	317.0	1.0	P-3453-SP-4		2.9		ug/L	---	---	---	---	1.0	---	02/27/2014 03:46	2980197
FS	Bromate	317.0	1.0	P-3453-SP-10	<	1.0		ug/L	---	---	---	---	1.0	---	02/27/2014 04:07	2980198
FS	Bromate	317.0	1.0	P-3453-SP-11		1.6		ug/L	---	---	---	---	1.0	---	02/27/2014 04:28	2980199
FS	Bromate	317.0	1.0	P-3453-SP-12		5.7		ug/L	---	---	---	---	1.0	---	02/27/2014 04:49	2980200
FS	Bromate	317.0	1.0	P-3453-SP-13		6.6		ug/L	---	---	---	---	1.0	---	02/27/2014 05:10	2980201
FS	Bromate	317.0	1.0	P-3453-SP-14		13		ug/L	---	---	---	---	1.0	---	02/27/2014 05:31	2980202
CCC	Bromate	317.0	1.0	---		16.7072	15.0	ug/L	111	85 - 115	---	---	1.0	---	02/27/2014 05:52	2981752

Sample Type Key

Type (Abbr.)	Sample Type	Type (Abbr.)	Sample Type
CCC	Continuing Calibration Check		
FS	Field Sample		
ICB	Initial Calibration Blank		
IPC	Instrument Performance Check		
LFB	Laboratory Fortified Blank		
LRB	Laboratory Reagent Blank		
MS	Matrix Spike		
MSD	Matrix Spike Duplicate		
QCS	Quality Control Sample		

Analytical Laboratory Report

Supplemental Report

Report ID: S60126.01(02)
Generated on 03/04/2014
Replaces report S60126.01(01) generated on 02/27/2014

Report to

Attention: Randy Christensen
Arcadis
10559 Citation Drive
Suite 100
Brighton, MI 48116

Phone: 810-225-1940 FAX: 810-229-8837
Email: Randy.Christensen@arcadis-us.com

Addtional Contacts: Sarah Carman, Doug Gustafson

Report produced by

Merit Laboratories, Inc.
2680 East Lansing Drive
East Lansing, MI 48823

Phone: (517) 332-0167 FAX: (517) 332-6333

Contacts for report questions:
Kevin George (kgeorge@meritlabs.com)
Barbara Ball (bball@meritlabs.com)

Report Summary

Lab Sample ID(s): S60126.01-S60126.10
Project: B0064480.0014.00501 / RACER Lansing Plt 3
Collected Date: 02/24/2014
Submitted Date/Time: 02/26/2014 10:20
Sampled by: Unknown
P.O. #: B0064480.0014.00501

Reporting limits for 1,4-Dioxane changed per client request.

Report Notes

Results relate only to items tested as received by the laboratory.
Methods may be modified for improved performance.
Results reported on a dry weight basis where applicable.
'Not detected' indicates that parameter was not found at a level equal to or greater than the reporting limit (RL).
Samples are held by the lab for 30 days from the final report date unless a written request to hold longer is provided by the client.

Laboratory Certifications:
Michigan DNRE (#9956), DOD/ISO 17025 (#69699), WBENC (#2005110032), Ohio EPA (#CL0002)
IN Drinking Water (#C-MI-07), NELAC NY (#11814), NCDENR (#680), NC Drinking Water (#26702)
Some analytes reported may not be certified. Full certification lists are available upon request.

Violetta F. Murshak
Laboratory Director

Sample Summary (10 samples)

Sample ID	Sample Tag	Matrix	Collected Date/Time
S60126.01	P3453-SP-0	Groundwater	02/24/2014 08:30
S60126.02	P-3453-SP-1	Groundwater	02/24/2014 09:30
S60126.03	P-3453-SP-2	Groundwater	02/24/2014 10:30
S60126.04	P-3453-SP-3	Groundwater	02/24/2014 11:00
S60126.05	P-3453-SP-4	Groundwater	02/24/2014 11:30
S60126.06	P3453-SP-10	Groundwater	02/24/2014 12:10
S60126.07	P-3453-SP-11	Groundwater	02/24/2014 12:30
S60126.08	P-3453-SP-12	Groundwater	02/24/2014 12:50
S60126.09	P-3453-SP-13	Groundwater	02/24/2014 13:10
S60126.10	P-3453-SP-14	Groundwater	02/24/2014 13:45

Lab Sample ID: S60126.01
Sample Tag: P3453-SP-0
Collected Date/Time: 02/24/2014 08:30
Matrix: Groundwater
COC Reference: 76463

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	6.0	IR
1	125ml Plastic	HNO3	Yes	6.0	IR
2	40ml Glass	H2SO4	Yes	6.0	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	02/26/14 11:55	CCM		
Metal Digestion	Completed			SW3015A	02/26/14 11:36	PER		
pH check for VOCs	<2	STD Units		N/A	02/27/14 10:25	LBR		
Inorganics								
TOC	5.2	mg/L	1	SM 5310C	02/26/14 16:26	JKB		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	02/26/14 13:20	PER	0.00042	
Arsenic	0.006	mg/L	0.002	SW6020A	02/26/14 13:20	PER	0.000052	
Barium	0.031	mg/L	0.005	SW6020A	02/26/14 13:20	PER	0.00022	
Boron	0.33	mg/L	0.04	SW6020A	02/26/14 16:21	PER	0.00032	
Cadmium	Not detected	mg/L	0.0005	SW6020A	02/26/14 13:20	PER	0.000067	
Chromium	Not detected	mg/L	0.005	SW6020A	02/26/14 13:20	PER	0.00013	
Cobalt	Not detected	mg/L	0.005	SW6020A	02/26/14 13:20	PER	0.000050	
Copper	Not detected	mg/L	0.005	SW6020A	02/26/14 13:20	PER	0.00006	
Lead	Not detected	mg/L	0.003	SW6020A	02/26/14 13:20	PER	0.000043	
Manganese	0.095	mg/L	0.005	SW6020A	02/26/14 13:20	PER	0.000060	
Mercury	Not detected	mg/L	0.0001	SW7471B	02/26/14 15:57	CCM	0.000008	
Nickel	0.019	mg/L	0.005	SW6020A	02/26/14 13:20	PER	0.000036	
Selenium	Not detected	mg/L	0.005	SW6020A	02/26/14 13:20	PER	0.00027	
Silver	Not detected	mg/L	0.0005	SW6020A	02/26/14 13:20	PER	0.000018	
Vanadium	Not detected	mg/L	0.004	SW6020A	02/26/14 13:20	PER	0.000025	
Zinc	0.006	mg/L	0.005	SW6020A	02/26/14 13:20	PER	0.00014	
Organics - Volatiles								
1,4-Dioxane	104	ug/L	1	SW8260B - SIM	02/26/14 12:55	WAT	0.79	M
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.18	
Acetone	Not detected	ug/L	10	SW8260C	02/26/14 13:32	WAT	0.56	
Carbon disulfide	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.24	
Methyl Acetate	Not detected	ug/L	10	SW8260C	02/26/14 13:32	WAT	0.25	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.19	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	02/26/14 13:32	WAT	0.26	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.50	
Chloromethane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.26	
Vinyl chloride	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.31	
Bromomethane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.32	
Chloroethane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.34	

M-Result reported to MDL not RDL

Lab Sample ID: S60126.01 (continued)
Sample Tag: P3453-SP-0

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.33	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.27	
Methylene chloride	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.29	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.20	
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.20	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.26	
Chloroform	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.21	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.28	
Cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.29	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	02/26/14 13:32	WAT	0.14	
2-Hexanone	Not detected	ug/L	10	SW8260C	02/26/14 13:32	WAT	0.29	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.20	
Benzene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.20	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.16	
Trichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.23	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.20	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.23	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.21	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.19	
Toluene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.25	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.25	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.28	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.20	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.24	
Chlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.17	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.18	
Ethylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.26	
p,m-Xylene	Not detected	ug/L	2	SW8260C	02/26/14 13:32	WAT	0.41	
o-Xylene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.25	
Styrene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.18	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.25	
Bromoform	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.22	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.24	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.23	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.28	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.19	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.30	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	02/26/14 13:32	WAT	0.47	

Lab Sample ID: S60126.02
Sample Tag: P-3453-SP-1
Collected Date/Time: 02/24/2014 09:30
Matrix: Groundwater
COC Reference: 76463

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	6.0	IR
1	125ml Plastic	HNO3	Yes	6.0	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	02/26/14 11:55	CCM		
Metal Digestion	Completed			SW3015A	02/26/14 11:36	PER		
pH check for VOCs	<2	STD Units		N/A	02/27/14 10:25	LBR		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	02/26/14 13:32	PER	0.00042	
Arsenic	0.006	mg/L	0.002	SW6020A	02/26/14 13:32	PER	0.000052	
Barium	0.078	mg/L	0.005	SW6020A	02/26/14 13:32	PER	0.00022	
Boron	0.32	mg/L	0.04	SW6020A	02/26/14 16:23	PER	0.00032	
Cadmium	Not detected	mg/L	0.0005	SW6020A	02/26/14 13:32	PER	0.000067	
Chromium	0.055	mg/L	0.005	SW6020A	02/26/14 13:32	PER	0.00013	
Cobalt	Not detected	mg/L	0.005	SW6020A	02/26/14 13:32	PER	0.000050	
Copper	0.013	mg/L	0.005	SW6020A	02/26/14 13:32	PER	0.00006	
Lead	Not detected	mg/L	0.003	SW6020A	02/26/14 13:32	PER	0.000043	
Manganese	0.126	mg/L	0.005	SW6020A	02/26/14 13:32	PER	0.000060	
Mercury	Not detected	mg/L	0.0001	SW7471B	02/26/14 15:59	CCM	0.000008	
Nickel	0.184	mg/L	0.005	SW6020A	02/26/14 13:32	PER	0.000036	
Selenium	Not detected	mg/L	0.005	SW6020A	02/26/14 13:32	PER	0.00027	
Silver	Not detected	mg/L	0.0005	SW6020A	02/26/14 13:32	PER	0.000018	
Vanadium	Not detected	mg/L	0.004	SW6020A	02/26/14 13:32	PER	0.000025	
Zinc	0.015	mg/L	0.005	SW6020A	02/26/14 13:32	PER	0.00014	
Organics - Volatiles								
1,4-Dioxane	16	ug/L	1	SW8260B - SIM	02/26/14 13:13	WAT	0.79	M
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.18	
Acetone	13	ug/L	10	SW8260C	02/26/14 13:54	WAT	0.56	
Carbon disulfide	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.24	
Methyl Acetate	Not detected	ug/L	10	SW8260C	02/26/14 13:54	WAT	0.25	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.19	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	02/26/14 13:54	WAT	0.26	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.50	
Chloromethane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.26	
Vinyl chloride	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.31	
Bromomethane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.32	
Chloroethane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.34	
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.33	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.27	
Methylene chloride	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.29	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.20	

M-Result reported to MDL not RDL

Lab Sample ID: S60126.02 (continued)
Sample Tag: P-3453-SP-1

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.20	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.26	
Chloroform	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.21	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.28	
Cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.29	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	02/26/14 13:54	WAT	0.14	
2-Hexanone	Not detected	ug/L	10	SW8260C	02/26/14 13:54	WAT	0.29	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.20	
Benzene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.20	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.16	
Trichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.23	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.20	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.23	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.21	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.19	
Toluene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.25	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.25	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.28	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.20	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.24	
Chlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.17	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.18	
Ethylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.26	
p,m-Xylene	Not detected	ug/L	2	SW8260C	02/26/14 13:54	WAT	0.41	
o-Xylene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.25	
Styrene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.18	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.25	
Bromoform	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.22	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.24	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.23	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.28	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.19	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.30	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	02/26/14 13:54	WAT	0.47	

Lab Sample ID: S60126.03
Sample Tag: P-3453-SP-2
Collected Date/Time: 02/24/2014 10:30
Matrix: Groundwater
COC Reference: 76463

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	6.0	IR
1	125ml Plastic	HNO3	Yes	6.0	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	02/26/14 11:55	CCM		
Metal Digestion	Completed			SW3015A	02/26/14 11:36	PER		
pH check for VOCs	<2	STD Units		N/A	02/27/14 10:25	LBR		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	02/26/14 13:34	PER	0.00042	
Arsenic	0.005	mg/L	0.002	SW6020A	02/26/14 13:34	PER	0.000052	
Barium	0.038	mg/L	0.005	SW6020A	02/26/14 13:34	PER	0.00022	
Boron	0.33	mg/L	0.04	SW6020A	02/26/14 16:25	PER	0.00032	
Cadmium	Not detected	mg/L	0.0005	SW6020A	02/26/14 13:34	PER	0.000067	
Chromium	Not detected	mg/L	0.005	SW6020A	02/26/14 13:34	PER	0.00013	
Cobalt	Not detected	mg/L	0.005	SW6020A	02/26/14 13:34	PER	0.000050	
Copper	0.250	mg/L	0.005	SW6020A	02/26/14 13:34	PER	0.00006	
Lead	Not detected	mg/L	0.003	SW6020A	02/26/14 13:34	PER	0.000043	
Manganese	0.094	mg/L	0.005	SW6020A	02/26/14 13:34	PER	0.000060	
Mercury	Not detected	mg/L	0.0001	SW7471B	02/26/14 16:11	CCM	0.000008	
Nickel	0.029	mg/L	0.005	SW6020A	02/26/14 13:34	PER	0.000036	
Selenium	Not detected	mg/L	0.005	SW6020A	02/26/14 13:34	PER	0.00027	
Silver	Not detected	mg/L	0.0005	SW6020A	02/26/14 13:34	PER	0.000018	
Vanadium	Not detected	mg/L	0.004	SW6020A	02/26/14 13:34	PER	0.000025	
Zinc	0.010	mg/L	0.005	SW6020A	02/26/14 13:34	PER	0.00014	
Organics - Volatiles								
1,4-Dioxane	3	ug/L	1	SW8260B - SIM	02/26/14 13:31	WAT	0.79	JM
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.18	
Acetone	14	ug/L	10	SW8260C	02/26/14 14:16	WAT	0.56	
Carbon disulfide	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.24	
Methyl Acetate	Not detected	ug/L	10	SW8260C	02/26/14 14:16	WAT	0.25	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.19	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	02/26/14 14:16	WAT	0.26	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.50	
Chloromethane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.26	
Vinyl chloride	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.31	
Bromomethane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.32	
Chloroethane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.34	
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.33	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.27	
Methylene chloride	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.29	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.20	

J-Estimated value less than reporting limit, but greater than MDL M-Result reported to MDL not RDL

Lab Sample ID: S60126.03 (continued)
Sample Tag: P-3453-SP-2

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.20	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.26	
Chloroform	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.21	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.28	
Cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.29	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	02/26/14 14:16	WAT	0.14	
2-Hexanone	Not detected	ug/L	10	SW8260C	02/26/14 14:16	WAT	0.29	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.20	
Benzene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.20	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.16	
Trichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.23	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.20	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.23	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.21	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.19	
Toluene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.25	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.25	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.28	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.20	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.24	
Chlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.17	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.18	
Ethylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.26	
p,m-Xylene	Not detected	ug/L	2	SW8260C	02/26/14 14:16	WAT	0.41	
o-Xylene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.25	
Styrene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.18	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.25	
Bromoform	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.22	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.24	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.23	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.28	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.19	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.30	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	02/26/14 14:16	WAT	0.47	

Lab Sample ID: S60126.04
Sample Tag: P-3453-SP-3
Collected Date/Time: 02/24/2014 11:00
Matrix: Groundwater
COC Reference: 76463

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	6.0	IR
1	125ml Plastic	HNO3	Yes	6.0	IR
2	40ml Glass	H2SO4	Yes	6.0	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	02/26/14 11:55	CCM		
Metal Digestion	Completed			SW3015A	02/26/14 11:36	PER		
pH check for VOCs	<2	STD Units		N/A	02/27/14 10:25	LBR		
Inorganics								
TOC	4.7	mg/L	1	SM 5310C	02/26/14 16:46	JKB		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	02/26/14 13:36	PER	0.00042	
Arsenic	0.005	mg/L	0.002	SW6020A	02/26/14 13:36	PER	0.000052	
Barium	0.032	mg/L	0.005	SW6020A	02/26/14 13:36	PER	0.00022	
Boron	0.33	mg/L	0.04	SW6020A	02/26/14 16:26	PER	0.00032	
Cadmium	Not detected	mg/L	0.0005	SW6020A	02/26/14 13:36	PER	0.000067	
Chromium	Not detected	mg/L	0.005	SW6020A	02/26/14 13:36	PER	0.00013	
Cobalt	Not detected	mg/L	0.005	SW6020A	02/26/14 13:36	PER	0.000050	
Copper	0.006	mg/L	0.005	SW6020A	02/26/14 13:36	PER	0.00006	
Lead	Not detected	mg/L	0.003	SW6020A	02/26/14 13:36	PER	0.000043	
Manganese	0.093	mg/L	0.005	SW6020A	02/26/14 13:36	PER	0.000060	
Mercury	Not detected	mg/L	0.0001	SW7471B	02/26/14 16:13	CCM	0.000008	
Nickel	0.021	mg/L	0.005	SW6020A	02/26/14 13:36	PER	0.000036	
Selenium	Not detected	mg/L	0.005	SW6020A	02/26/14 13:36	PER	0.00027	
Silver	Not detected	mg/L	0.0005	SW6020A	02/26/14 13:36	PER	0.000018	
Vanadium	Not detected	mg/L	0.004	SW6020A	02/26/14 13:36	PER	0.000025	
Zinc	0.008	mg/L	0.005	SW6020A	02/26/14 13:36	PER	0.00014	
Organics - Volatiles								
1,4-Dioxane	Not detected	ug/L	1	SW8260B - SIM	02/26/14 13:50	WAT	0.79	M
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.18	
Acetone	21	ug/L	10	SW8260C	02/26/14 14:38	WAT	0.56	
Carbon disulfide	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.24	
Methyl Acetate	Not detected	ug/L	10	SW8260C	02/26/14 14:38	WAT	0.25	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.19	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	02/26/14 14:38	WAT	0.26	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.50	
Chloromethane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.26	
Vinyl chloride	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.31	
Bromomethane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.32	
Chloroethane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.34	

M-Result reported to MDL not RDL

Lab Sample ID: S60126.04 (continued)
Sample Tag: P-3453-SP-3

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.33	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.27	
Methylene chloride	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.29	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.20	
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.20	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.26	
Chloroform	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.21	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.28	
Cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.29	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	02/26/14 14:38	WAT	0.14	
2-Hexanone	Not detected	ug/L	10	SW8260C	02/26/14 14:38	WAT	0.29	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.20	
Benzene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.20	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.16	
Trichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.23	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.20	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.23	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.21	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.19	
Toluene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.25	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.25	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.28	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.20	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.24	
Chlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.17	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.18	
Ethylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.26	
p,m-Xylene	Not detected	ug/L	2	SW8260C	02/26/14 14:38	WAT	0.41	
o-Xylene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.25	
Styrene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.18	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.25	
Bromoform	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.22	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.24	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.23	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.28	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.19	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.30	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	02/26/14 14:38	WAT	0.47	

Lab Sample ID: S60126.05
Sample Tag: P-3453-SP-4
Collected Date/Time: 02/24/2014 11:30
Matrix: Groundwater
COC Reference: 76463

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	6.0	IR
1	125ml Plastic	HNO3	Yes	6.0	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	02/26/14 11:55	CCM		
Metal Digestion	Completed			SW3015A	02/26/14 11:36	PER		
pH check for VOCs	<2	STD Units		N/A	02/27/14 10:25	LBR		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	02/26/14 14:08	PER	0.00042	
Arsenic	0.009	mg/L	0.002	SW6020A	02/26/14 14:08	PER	0.000052	
Barium	0.036	mg/L	0.005	SW6020A	02/26/14 14:08	PER	0.00022	
Boron	0.33	mg/L	0.04	SW6020A	02/26/14 16:27	PER	0.00032	
Cadmium	Not detected	mg/L	0.0005	SW6020A	02/26/14 14:08	PER	0.000067	
Chromium	0.005	mg/L	0.005	SW6020A	02/26/14 14:08	PER	0.00013	
Cobalt	Not detected	mg/L	0.005	SW6020A	02/26/14 14:08	PER	0.000050	
Copper	0.020	mg/L	0.005	SW6020A	02/26/14 14:08	PER	0.00006	
Lead	Not detected	mg/L	0.003	SW6020A	02/26/14 14:08	PER	0.000043	
Manganese	0.097	mg/L	0.005	SW6020A	02/26/14 14:08	PER	0.000060	
Mercury	Not detected	mg/L	0.0001	SW7471B	02/26/14 16:15	CCM	0.000008	
Nickel	0.031	mg/L	0.005	SW6020A	02/26/14 14:08	PER	0.000036	
Selenium	Not detected	mg/L	0.005	SW6020A	02/26/14 14:08	PER	0.00027	
Silver	0.0013	mg/L	0.0005	SW6020A	02/26/14 14:08	PER	0.000018	
Vanadium	Not detected	mg/L	0.004	SW6020A	02/26/14 14:08	PER	0.000025	
Zinc	0.064	mg/L	0.005	SW6020A	02/26/14 14:08	PER	0.00014	
Organics - Volatiles								
1,4-Dioxane	Not detected	ug/L	1	SW8260B - SIM	02/26/14 14:08	WAT	0.79	M
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.18	
Acetone	18	ug/L	10	SW8260C	02/26/14 15:00	WAT	0.56	
Carbon disulfide	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.24	
Methyl Acetate	Not detected	ug/L	10	SW8260C	02/26/14 15:00	WAT	0.25	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.19	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	02/26/14 15:00	WAT	0.26	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.50	
Chloromethane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.26	
Vinyl chloride	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.31	
Bromomethane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.32	
Chloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.34	
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.33	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.27	
Methylene chloride	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.29	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.20	

M-Result reported to MDL not RDL

Lab Sample ID: S60126.05 (continued)
Sample Tag: P-3453-SP-4

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.20	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.26	
Chloroform	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.21	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.28	
Cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.29	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	02/26/14 15:00	WAT	0.14	
2-Hexanone	Not detected	ug/L	10	SW8260C	02/26/14 15:00	WAT	0.29	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.20	
Benzene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.20	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.16	
Trichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.23	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.20	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.23	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.21	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.19	
Toluene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.25	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.25	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.28	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.20	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.24	
Chlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.17	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.18	
Ethylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.26	
p,m-Xylene	Not detected	ug/L	2	SW8260C	02/26/14 15:00	WAT	0.41	
o-Xylene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.25	
Styrene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.18	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.25	
Bromoform	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.22	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.24	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.23	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.28	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.19	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.30	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	02/26/14 15:00	WAT	0.47	

Lab Sample ID: S60126.06
Sample Tag: P3453-SP-10
Collected Date/Time: 02/24/2014 12:10
Matrix: Groundwater
COC Reference: 76463

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	6.0	IR
1	125ml Plastic	HNO3	Yes	6.0	IR
2	40ml Glass	H2SO4	Yes	6.0	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	02/26/14 11:55	CCM		
Metal Digestion	Completed			SW3015A	02/26/14 11:36	PER		
pH check for VOCs	<2	STD Units		N/A	02/27/14 10:25	LBR		
Inorganics								
TOC	6.0	mg/L	1	SM 5310C	02/26/14 17:05	JKB		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	02/26/14 13:48	PER	0.00042	
Arsenic	0.004	mg/L	0.002	SW6020A	02/26/14 13:48	PER	0.000052	
Barium	0.226	mg/L	0.005	SW6020A	02/26/14 13:48	PER	0.00022	
Boron	0.20	mg/L	0.04	SW6020A	02/26/14 16:29	PER	0.00032	
Cadmium	Not detected	mg/L	0.0005	SW6020A	02/26/14 13:48	PER	0.000067	
Chromium	Not detected	mg/L	0.005	SW6020A	02/26/14 13:48	PER	0.00013	
Cobalt	Not detected	mg/L	0.005	SW6020A	02/26/14 13:48	PER	0.000050	
Copper	Not detected	mg/L	0.005	SW6020A	02/26/14 13:48	PER	0.00006	
Lead	Not detected	mg/L	0.003	SW6020A	02/26/14 13:48	PER	0.000043	
Manganese	0.102	mg/L	0.005	SW6020A	02/26/14 13:48	PER	0.000060	
Mercury	Not detected	mg/L	0.0001	SW7471B	02/26/14 16:17	CCM	0.000008	
Nickel	0.015	mg/L	0.005	SW6020A	02/26/14 13:48	PER	0.000036	
Selenium	Not detected	mg/L	0.005	SW6020A	02/26/14 13:48	PER	0.00027	
Silver	Not detected	mg/L	0.0005	SW6020A	02/26/14 13:48	PER	0.000018	
Vanadium	Not detected	mg/L	0.004	SW6020A	02/26/14 13:48	PER	0.000025	
Zinc	0.013	mg/L	0.005	SW6020A	02/26/14 13:48	PER	0.00014	
Organics - Volatiles								
1,4-Dioxane	148	ug/L	1	SW8260B - SIM	02/26/14 14:26	WAT	0.79	M
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.18	
Acetone	Not detected	ug/L	10	SW8260C	02/26/14 15:22	WAT	0.56	
Carbon disulfide	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.24	
Methyl Acetate	Not detected	ug/L	10	SW8260C	02/26/14 15:22	WAT	0.25	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.19	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	02/26/14 15:22	WAT	0.26	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.50	
Chloromethane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.26	
Vinyl chloride	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.31	
Bromomethane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.32	
Chloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.34	

M-Result reported to MDL not RDL

Lab Sample ID: S60126.06 (continued)
Sample Tag: P3453-SP-10

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.33	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.27	
Methylene chloride	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.29	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.20	
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.20	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.26	
Chloroform	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.21	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.28	
Cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.29	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	02/26/14 15:22	WAT	0.14	
2-Hexanone	Not detected	ug/L	10	SW8260C	02/26/14 15:22	WAT	0.29	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.20	
Benzene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.20	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.16	
Trichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.23	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.20	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.23	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.21	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.19	
Toluene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.25	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.25	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.28	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.20	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.24	
Chlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.17	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.18	
Ethylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.26	
p,m-Xylene	Not detected	ug/L	2	SW8260C	02/26/14 15:22	WAT	0.41	
o-Xylene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.25	
Styrene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.18	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.25	
Bromoform	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.22	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.24	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.23	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.28	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.19	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.30	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	02/26/14 15:22	WAT	0.47	

Lab Sample ID: S60126.07
Sample Tag: P-3453-SP-11
Collected Date/Time: 02/24/2014 12:30
Matrix: Groundwater
COC Reference: 76463

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	6.0	IR
1	125ml Plastic	HNO3	Yes	6.0	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	02/26/14 11:55	CCM		
Metal Digestion	Completed			SW3015A	02/26/14 11:36	PER		
pH check for VOCs	<2	STD Units		N/A	02/27/14 10:25	LBR		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	02/26/14 13:50	PER	0.00042	
Arsenic	0.005	mg/L	0.002	SW6020A	02/26/14 13:50	PER	0.000052	
Barium	0.215	mg/L	0.005	SW6020A	02/26/14 13:50	PER	0.00022	
Boron	0.20	mg/L	0.04	SW6020A	02/26/14 16:30	PER	0.00032	
Cadmium	Not detected	mg/L	0.0005	SW6020A	02/26/14 13:50	PER	0.000067	
Chromium	0.005	mg/L	0.005	SW6020A	02/26/14 13:50	PER	0.00013	
Cobalt	Not detected	mg/L	0.005	SW6020A	02/26/14 13:50	PER	0.000050	
Copper	0.006	mg/L	0.005	SW6020A	02/26/14 13:50	PER	0.00006	
Lead	Not detected	mg/L	0.003	SW6020A	02/26/14 13:50	PER	0.000043	
Manganese	0.104	mg/L	0.005	SW6020A	02/26/14 13:50	PER	0.000060	
Mercury	Not detected	mg/L	0.0001	SW7471B	02/26/14 16:19	CCM	0.000008	
Nickel	0.017	mg/L	0.005	SW6020A	02/26/14 13:50	PER	0.000036	
Selenium	0.005	mg/L	0.005	SW6020A	02/26/14 13:50	PER	0.00027	
Silver	Not detected	mg/L	0.0005	SW6020A	02/26/14 13:50	PER	0.000018	
Vanadium	Not detected	mg/L	0.004	SW6020A	02/26/14 13:50	PER	0.000025	
Zinc	0.026	mg/L	0.005	SW6020A	02/26/14 13:50	PER	0.00014	
Organics - Volatiles								
1,4-Dioxane	21	ug/L	1	SW8260B - SIM	02/26/14 14:44	WAT	0.79	M
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.18	
Acetone	12	ug/L	10	SW8260C	02/26/14 15:44	WAT	0.56	
Carbon disulfide	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.24	
Methyl Acetate	Not detected	ug/L	10	SW8260C	02/26/14 15:44	WAT	0.25	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.19	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	02/26/14 15:44	WAT	0.26	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.50	
Chloromethane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.26	
Vinyl chloride	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.31	
Bromomethane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.32	
Chloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.34	
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.33	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.27	
Methylene chloride	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.29	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.20	

M-Result reported to MDL not RDL

Lab Sample ID: S60126.07 (continued)
Sample Tag: P-3453-SP-11

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.20	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.26	
Chloroform	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.21	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.28	
Cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.29	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	02/26/14 15:44	WAT	0.14	
2-Hexanone	Not detected	ug/L	10	SW8260C	02/26/14 15:44	WAT	0.29	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.20	
Benzene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.20	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.16	
Trichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.23	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.20	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.23	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.21	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.19	
Toluene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.25	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.25	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.28	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.20	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.24	
Chlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.17	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.18	
Ethylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.26	
p,m-Xylene	Not detected	ug/L	2	SW8260C	02/26/14 15:44	WAT	0.41	
o-Xylene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.25	
Styrene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.18	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.25	
Bromoform	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.22	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.24	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.23	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.28	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.19	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.30	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	02/26/14 15:44	WAT	0.47	

Lab Sample ID: S60126.08
Sample Tag: P-3453-SP-12
Collected Date/Time: 02/24/2014 12:50
Matrix: Groundwater
COC Reference: 76463

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	6.0	IR
1	125ml Plastic	HNO3	Yes	6.0	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	02/26/14 11:55	CCM		
Metal Digestion	Completed			SW3015A	02/26/14 11:36	PER		
pH check for VOCs	<2	STD Units		N/A	02/27/14 10:25	LBR		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	02/26/14 13:52	PER	0.00042	
Arsenic	0.005	mg/L	0.002	SW6020A	02/26/14 13:52	PER	0.000052	
Barium	0.224	mg/L	0.005	SW6020A	02/26/14 13:52	PER	0.00022	
Boron	0.20	mg/L	0.04	SW6020A	02/26/14 16:31	PER	0.00032	
Cadmium	Not detected	mg/L	0.0005	SW6020A	02/26/14 13:52	PER	0.000067	
Chromium	Not detected	mg/L	0.005	SW6020A	02/26/14 13:52	PER	0.00013	
Cobalt	Not detected	mg/L	0.005	SW6020A	02/26/14 13:52	PER	0.000050	
Copper	0.006	mg/L	0.005	SW6020A	02/26/14 13:52	PER	0.00006	
Lead	Not detected	mg/L	0.003	SW6020A	02/26/14 13:52	PER	0.000043	
Manganese	0.102	mg/L	0.005	SW6020A	02/26/14 13:52	PER	0.000060	
Mercury	Not detected	mg/L	0.0001	SW7471B	02/26/14 16:21	CCM	0.000008	
Nickel	0.016	mg/L	0.005	SW6020A	02/26/14 13:52	PER	0.000036	
Selenium	Not detected	mg/L	0.005	SW6020A	02/26/14 13:52	PER	0.00027	
Silver	Not detected	mg/L	0.0005	SW6020A	02/26/14 13:52	PER	0.000018	
Vanadium	Not detected	mg/L	0.004	SW6020A	02/26/14 13:52	PER	0.000025	
Zinc	0.016	mg/L	0.005	SW6020A	02/26/14 13:52	PER	0.00014	
Organics - Volatiles								
1,4-Dioxane	5	ug/L	1	SW8260B - SIM	02/26/14 15:02	WAT	0.79	JM
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.18	
Acetone	15	ug/L	10	SW8260C	02/26/14 16:05	WAT	0.56	
Carbon disulfide	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.24	
Methyl Acetate	Not detected	ug/L	10	SW8260C	02/26/14 16:05	WAT	0.25	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.19	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	02/26/14 16:05	WAT	0.26	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.50	
Chloromethane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.26	
Vinyl chloride	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.31	
Bromomethane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.32	
Chloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.34	
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.33	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.27	
Methylene chloride	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.29	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.20	

J-Estimated value less than reporting limit, but greater than MDL M-Result reported to MDL not RDL

Lab Sample ID: S60126.08 (continued)
Sample Tag: P-3453-SP-12

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.20	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.26	
Chloroform	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.21	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.28	
Cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.29	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	02/26/14 16:05	WAT	0.14	
2-Hexanone	Not detected	ug/L	10	SW8260C	02/26/14 16:05	WAT	0.29	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.20	
Benzene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.20	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.16	
Trichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.23	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.20	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.23	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.21	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.19	
Toluene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.25	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.25	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.28	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.20	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.24	
Chlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.17	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.18	
Ethylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.26	
p,m-Xylene	Not detected	ug/L	2	SW8260C	02/26/14 16:05	WAT	0.41	
o-Xylene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.25	
Styrene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.18	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.25	
Bromoform	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.22	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.24	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.23	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.28	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.19	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.30	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	02/26/14 16:05	WAT	0.47	

Lab Sample ID: S60126.09
Sample Tag: P-3453-SP-13
Collected Date/Time: 02/24/2014 13:10
Matrix: Groundwater
COC Reference: 76463

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	6.0	IR
1	125ml Plastic	HNO3	Yes	6.0	IR
2	40ml Glass	H2SO4	Yes	6.0	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	02/26/14 11:55	CCM		
Metal Digestion	Completed			SW3015A	02/26/14 11:36	PER		
pH check for VOCs	<2	STD Units		N/A	02/27/14 10:25	LBR		
Inorganics								
TOC	5.9	mg/L	1	SM 5310C	02/26/14 17:25	JKB		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	02/26/14 13:54	PER	0.00042	
Arsenic	0.005	mg/L	0.002	SW6020A	02/26/14 13:54	PER	0.000052	
Barium	0.229	mg/L	0.005	SW6020A	02/26/14 13:54	PER	0.00022	
Boron	0.20	mg/L	0.04	SW6020A	02/26/14 16:33	PER	0.00032	
Cadmium	Not detected	mg/L	0.0005	SW6020A	02/26/14 13:54	PER	0.000067	
Chromium	Not detected	mg/L	0.005	SW6020A	02/26/14 13:54	PER	0.00013	
Cobalt	Not detected	mg/L	0.005	SW6020A	02/26/14 13:54	PER	0.000050	
Copper	0.005	mg/L	0.005	SW6020A	02/26/14 13:54	PER	0.00006	
Lead	Not detected	mg/L	0.003	SW6020A	02/26/14 13:54	PER	0.000043	
Manganese	0.104	mg/L	0.005	SW6020A	02/26/14 13:54	PER	0.000060	
Mercury	Not detected	mg/L	0.0001	SW7471B	02/26/14 16:23	CCM	0.000008	
Nickel	0.015	mg/L	0.005	SW6020A	02/26/14 13:54	PER	0.000036	
Selenium	Not detected	mg/L	0.005	SW6020A	02/26/14 13:54	PER	0.00027	
Silver	Not detected	mg/L	0.0005	SW6020A	02/26/14 13:54	PER	0.000018	
Vanadium	Not detected	mg/L	0.004	SW6020A	02/26/14 13:54	PER	0.000025	
Zinc	0.014	mg/L	0.005	SW6020A	02/26/14 13:54	PER	0.00014	
Organics - Volatiles								
1,4-Dioxane	Not detected	ug/L	1	SW8260B - SIM	02/26/14 15:21	WAT	0.79	M
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.18	
Acetone	17	ug/L	10	SW8260C	02/26/14 16:27	WAT	0.56	
Carbon disulfide	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.24	
Methyl Acetate	Not detected	ug/L	10	SW8260C	02/26/14 16:27	WAT	0.25	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.19	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	02/26/14 16:27	WAT	0.26	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.50	
Chloromethane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.26	
Vinyl chloride	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.31	
Bromomethane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.32	
Chloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.34	

M-Result reported to MDL not RDL

Lab Sample ID: S60126.09 (continued)
Sample Tag: P-3453-SP-13

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.33	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.27	
Methylene chloride	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.29	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.20	
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.20	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.26	
Chloroform	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.21	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.28	
Cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.29	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	02/26/14 16:27	WAT	0.14	
2-Hexanone	Not detected	ug/L	10	SW8260C	02/26/14 16:27	WAT	0.29	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.20	
Benzene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.20	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.16	
Trichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.23	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.20	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.23	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.21	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.19	
Toluene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.25	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.25	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.28	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.20	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.24	
Chlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.17	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.18	
Ethylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.26	
p,m-Xylene	Not detected	ug/L	2	SW8260C	02/26/14 16:27	WAT	0.41	
o-Xylene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.25	
Styrene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.18	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.25	
Bromoform	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.22	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.24	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.23	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.28	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.19	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.30	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	02/26/14 16:27	WAT	0.47	

Lab Sample ID: S60126.10
Sample Tag: P-3453-SP-14
Collected Date/Time: 02/24/2014 13:45
Matrix: Groundwater
COC Reference: 76463

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	6.0	IR
1	125ml Plastic	HNO3	Yes	6.0	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	02/26/14 11:55	CCM		
Metal Digestion	Completed			SW3015A	02/26/14 11:36	PER		
pH check for VOCs	<2	STD Units		N/A	02/27/14 10:30	LBR		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	02/26/14 14:15	PER	0.00042	
Arsenic	0.004	mg/L	0.002	SW6020A	02/26/14 14:15	PER	0.000052	
Barium	0.226	mg/L	0.005	SW6020A	02/26/14 14:15	PER	0.00022	
Boron	0.20	mg/L	0.04	SW6020A	02/26/14 16:34	PER	0.00032	
Cadmium	Not detected	mg/L	0.0005	SW6020A	02/26/14 14:15	PER	0.000067	
Chromium	Not detected	mg/L	0.005	SW6020A	02/26/14 14:15	PER	0.00013	
Cobalt	Not detected	mg/L	0.005	SW6020A	02/26/14 14:15	PER	0.000050	
Copper	0.005	mg/L	0.005	SW6020A	02/26/14 14:15	PER	0.00006	
Lead	Not detected	mg/L	0.003	SW6020A	02/26/14 14:15	PER	0.000043	
Manganese	0.100	mg/L	0.005	SW6020A	02/26/14 14:15	PER	0.000060	
Mercury	Not detected	mg/L	0.0001	SW7471B	02/26/14 16:25	CCM	0.000008	
Nickel	0.015	mg/L	0.005	SW6020A	02/26/14 14:15	PER	0.000036	
Selenium	Not detected	mg/L	0.005	SW6020A	02/26/14 14:15	PER	0.00027	
Silver	Not detected	mg/L	0.0005	SW6020A	02/26/14 14:15	PER	0.000018	
Vanadium	Not detected	mg/L	0.004	SW6020A	02/26/14 14:15	PER	0.000025	
Zinc	0.016	mg/L	0.005	SW6020A	02/26/14 14:15	PER	0.00014	
Organics - Volatiles								
1,4-Dioxane	Not detected	ug/L	1	SW8260B - SIM	02/26/14 15:39	WAT	0.79	M
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.18	
Acetone	18	ug/L	10	SW8260C	02/26/14 16:49	WAT	0.56	
Carbon disulfide	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.24	
Methyl Acetate	Not detected	ug/L	10	SW8260C	02/26/14 16:49	WAT	0.25	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.19	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	02/26/14 16:49	WAT	0.26	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.50	
Chloromethane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.26	
Vinyl chloride	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.31	
Bromomethane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.32	
Chloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.34	
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.33	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.27	
Methylene chloride	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.29	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.20	

M-Result reported to MDL not RDL

Lab Sample ID: S60126.10 (continued)
Sample Tag: P-3453-SP-14

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	MDL	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.20	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.26	
Chloroform	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.21	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.28	
Cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.29	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	02/26/14 16:49	WAT	0.14	
2-Hexanone	Not detected	ug/L	10	SW8260C	02/26/14 16:49	WAT	0.29	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.20	
Benzene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.20	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.16	
Trichloroethene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.23	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.20	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.23	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.21	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.19	
Toluene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.25	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.25	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.28	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.20	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.24	
Chlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.17	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.18	
Ethylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.26	
p,m-Xylene	Not detected	ug/L	2	SW8260C	02/26/14 16:49	WAT	0.41	
o-Xylene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.25	
Styrene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.18	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.25	
Bromoform	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.22	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.24	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.23	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.28	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.19	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.30	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	02/26/14 16:49	WAT	0.47	

Merit Laboratories, Inc.

2680 East Lansing Dr., East Lansing, MI 48823
Phone (517) 332-0167 Fax (517) 332-4034
www.meritlabs.com

C.O.C. PAGE # _____ OF _____

76463

CHAIN OF CUSTODY RECORD

REPORT TO

CONTACT NAME: Randy Christensen
COMPANY: Arcadis
ADDRESS: 10559 Citation Drive Suite 100
CITY: Brighton STATE: MI ZIP CODE: 48116
PHONE NO.: 810-225-1940 FAX NO.: 810-229-8837 P.O. NO.: B0064480.0014.00501
E-MAIL ADDRESS: Randy.Christensen@arcadis.com QUOTE NO.:

INVOICE TO

CONTACT NAME: Lacy Gustafson ☐ SAME
COMPANY: Ultora
ADDRESS: 2516 Verne Roberts Circle Suite H102
CITY: Antioch, CA STATE: CA ZIP CODE: 94509
PHONE NO.: 925-759-1191 E-MAIL ADDRESS: dgustafson@ultorawater.com

PROJECT NO./NAME: B0064480.0014.00501 / Racer Lansing Plt 3
SAMPLER(S) - PLEASE PRINT/SIGN NAME:

TURNAROUND TIME REQUIRED ☐ 1 DAY ☒ 2 DAYS ☐ 3 DAYS ☐ STANDARD ☐ OTHER _____

DELIVERABLES REQUIRED ☒ STD ☐ LEVEL II ☐ LEVEL III ☐ LEVEL IV ☐ EDD ☐ OTHER _____

MATRIX CODE: GW=GROUNDWATER WW=WASTEWATER S=SOIL L=LIQUID SD=SOLID SL=SLUDGE DW=DRINKING WATER O=OIL WP=WIPE A=AIR W=WASTE

ANALYSIS (ATTACH LIST IF MORE SPACE IS REQUIRED)

Certifications: ☐ OHIO VAP ☐ Drinking Water ☐ DoD ☐ NPDES

Project Locations: ☐ Detroit ☐ New York ☐ Other _____

Special Instructions

MERIT LAB NO. (FOR LAB USE ONLY)	YEAR DATE	YEAR TIME	SAMPLE TAG IDENTIFICATION-DESCRIPTION	MATRIX	# OF BOTTLES	# Containers & Preservatives: NONE	HCl	HNO_3	H_2SO_4	NaOH	MeOH	OTHER	8260 VOC	8260 1,4-dioxane SIMS	Metals	TOC
60126.01	2-24-14	8:30	P3453-SP-0	GW	6		3	1	2				X	X	X	X
.02	"	9:30	P-3453-SP-1	GW	4		3	1					X	X	X	
.03	"	10:30	P-3453-SP-2	GW	4		3	1					X	X	X	
.04	"	11:00	P-3453-SP-3	GW	6		3	1	2				X	X	X	X
.05	"	11:30	P-3453-SP-4	GW	4		3	1					X	X	X	
.06	2-24-14	12:10	P3453-SP-10	GW	6		3	1	2				X	X	X	X
.07	"	12:30	P-3453-SP-11	GW	4		3	1					X	X	X	
.08	"	12:50	P-3453-SP-12	GW	4		3	1					X	X	X	
.09	"	13:10	P-3453-SP-13	GW	6		3	1	2				X	X	X	X
.10	"	13:45	P-3453-SP-14	GW	4		3	1					X	X	X	

RELINQUISHED BY: SIGNATURE/ORGANIZATION ☒ Sampler DATE 2/24/14 TIME 1500
RECEIVED BY: SIGNATURE/ORGANIZATION DATE TIME
RELINQUISHED BY: SIGNATURE/ORGANIZATION DATE TIME
RECEIVED BY: SIGNATURE/ORGANIZATION DATE TIME

RELINQUISHED BY: SIGNATURE/ORGANIZATION UPS DATE 2/26/14 TIME 1020
RECEIVED BY: SIGNATURE/ORGANIZATION Kevin George DATE 2/26/14 TIME 1020

SEAL NO. SEAL INTACT YES ☐ NO ☐ INITIALS
SEAL NO. SEAL INTACT YES ☐ NO ☐ INITIALS

NOTES: TEMP. ON ARRIVAL 6.0

PLEASE NOTE: SIGNING ACKNOWLEDGES ADHERENCE TO MERIT'S SAMPLE ACCEPTANCE POLICY ON REVERSE SIDE

Rev. 5.18.12

Analytical Laboratory Report

Report ID: S60177.01(01)
Generated on 03/07/2014

Report to

Attention: Randy Christensen
Arcadis
10559 Citation Drive
Suite 100
Brighton, MI 48116

Phone: 810-225-1940 FAX: 810-229-8837
Email: Randy.Christensen@arcadis-us.com

Addtional Contacts: Sarah Carman, Doug Gustafson

Report produced by

Merit Laboratories, Inc.
2680 East Lansing Drive
East Lansing, MI 48823

Phone: (517) 332-0167 FAX: (517) 332-6333

Contacts for report questions:
Kevin George (kgeorge@meritlabs.com)
Barbara Ball (bball@meritlabs.com)

Report Summary

Lab Sample ID(s): S60177.01-S60177.10
Project: B0064480.0014.00501 / RACER Lansing Plt 3
Collected Date: 03/03/2014
Submitted Date/Time: 03/04/2014 09:35
Sampled by: Tim Hofieth
P.O. #: B0064480.0014.00501

Report Notes

Results relate only to items tested as received by the laboratory.
Methods may be modified for improved performance.
Results reported on a dry weight basis where applicable.
'Not detected' indicates that parameter was not found at a level equal to or greater than the reporting limit (RL).
Samples are held by the lab for 30 days from the final report date unless a written request to hold longer is provided by the client.

Laboratory Certifications:
Michigan DNRE (#9956), DOD/ISO 17025 (#69699), WBENC (#2005110032), Ohio EPA (#CL0002)
IN Drinking Water (#C-MI-07), NELAC NY (#11814), NCDENR (#680), NC Drinking Water (#26702)
Some analytes reported may not be certified. Full certification lists are available upon request.

Violetta F. Murshak
Laboratory Director

Sample Summary (10 samples)

Sample ID	Sample Tag	Matrix	Collected Date/Time
S60177.01	P-3453-SP-0	Liquid	03/03/2014 09:15
S60177.02	P 3453-SP-10	Liquid	03/03/2014 12:40
S60177.03	P 3453-SP-5	Liquid	03/03/2014 09:15
S60177.04	P 3453-SP-6	Liquid	03/03/2014 09:40
S60177.05	P-3453-SP-7	Liquid	03/03/2014 10:10
S60177.06	P-3453-SP-8	Liquid	03/03/2014 10:30
S60177.07	P-3453-SP-15	Liquid	03/03/2014 11:15
S60177.08	P-3453-SP-16	Liquid	03/03/2014 11:40
S60177.09	P-3453-SP-17	Liquid	03/03/2014 12:05
S60177.10	P-3453-SP-18	Liquid	03/03/2014 12:40

Analytical Laboratory Report

Lab Sample ID: S60177.01
Sample Tag: P-3453-SP-0
Collected Date/Time: 03/03/2014 09:15
Matrix: Liquid
COC Reference: 76466

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
1	125ml Plastic	HNO3	Yes	1.2	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	03/04/14 11:35	CCM		
Metal Digestion	Completed			SW3015A	03/06/14 12:00	PER		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	03/06/14 16:11	PER	7440-36-0	
Arsenic	0.005	mg/L	0.002	SW6020A	03/06/14 16:11	PER	7440-38-2	
Barium	0.031	mg/L	0.005	SW6020A	03/06/14 16:11	PER	7440-39-3	
Boron	0.26	mg/L	0.04	SW6020A	03/06/14 16:11	PER	7440-42-8	
Cadmium	Not detected	mg/L	0.0005	SW6020A	03/06/14 16:11	PER	7440-43-9	
Chromium	Not detected	mg/L	0.005	SW6020A	03/06/14 16:11	PER	7440-47-3	
Cobalt	Not detected	mg/L	0.005	SW6020A	03/06/14 16:11	PER	7440-48-4	
Copper	Not detected	mg/L	0.005	SW6020A	03/06/14 16:11	PER	7440-50-8	
Iron	11.1	mg/L	0.02	SW6020A	03/07/14 12:29	PER	7439-89-6	
Lead	Not detected	mg/L	0.003	SW6020A	03/06/14 16:11	PER	7439-92-1	
Manganese	0.099	mg/L	0.005	SW6020A	03/06/14 16:11	PER	7439-96-5	
Mercury	Not detected	mg/L	0.0001	SW7471B	03/04/14 16:23	CCM	7439-97-6	
Nickel	0.017	mg/L	0.005	SW6020A	03/06/14 16:11	PER	7440-02-0	
Selenium	Not detected	mg/L	0.005	SW6020A	03/06/14 16:11	PER	7782-49-2	
Silver	Not detected	mg/L	0.0005	SW6020A	03/06/14 16:11	PER	7440-22-4	
Vanadium	Not detected	mg/L	0.004	SW6020A	03/06/14 16:11	PER	7440-62-2	
Zinc	0.006	mg/L	0.005	SW6020A	03/06/14 16:11	PER	7440-66-6	

Analytical Laboratory Report

Lab Sample ID: S60177.02
Sample Tag: P 3453-SP-10
Collected Date/Time: 03/03/2014 12:40
Matrix: Liquid
COC Reference: 76466

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
1	125ml Plastic	HNO3	Yes	1.2	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	03/04/14 11:35	CCM		
Metal Digestion	Completed			SW3015A	03/06/14 12:00	PER		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	03/06/14 16:18	PER	7440-36-0	
Arsenic	0.007	mg/L	0.002	SW6020A	03/06/14 16:18	PER	7440-38-2	
Barium	0.260	mg/L	0.005	SW6020A	03/06/14 16:18	PER	7440-39-3	
Boron	0.15	mg/L	0.04	SW6020A	03/06/14 16:18	PER	7440-42-8	
Cadmium	0.0012	mg/L	0.0005	SW6020A	03/06/14 16:18	PER	7440-43-9	
Chromium	0.010	mg/L	0.005	SW6020A	03/06/14 16:18	PER	7440-47-3	
Cobalt	Not detected	mg/L	0.005	SW6020A	03/06/14 16:18	PER	7440-48-4	
Copper	0.006	mg/L	0.005	SW6020A	03/06/14 16:18	PER	7440-50-8	
Iron	13.0	mg/L	0.02	SW6020A	03/07/14 12:31	PER	7439-89-6	
Lead	Not detected	mg/L	0.003	SW6020A	03/06/14 16:18	PER	7439-92-1	
Manganese	0.133	mg/L	0.005	SW6020A	03/06/14 16:18	PER	7439-96-5	
Mercury	Not detected	mg/L	0.0001	SW7471B	03/04/14 16:53	CCM	7439-97-6	
Nickel	0.015	mg/L	0.005	SW6020A	03/06/14 16:18	PER	7440-02-0	
Selenium	Not detected	mg/L	0.005	SW6020A	03/06/14 16:18	PER	7782-49-2	
Silver	Not detected	mg/L	0.0005	SW6020A	03/06/14 16:18	PER	7440-22-4	
Vanadium	Not detected	mg/L	0.004	SW6020A	03/06/14 16:18	PER	7440-62-2	
Zinc	0.018	mg/L	0.005	SW6020A	03/06/14 16:18	PER	7440-66-6	

Analytical Laboratory Report

Lab Sample ID: S60177.03
Sample Tag: P 3453-SP-5
Collected Date/Time: 03/03/2014 09:15
Matrix: Liquid
COC Reference: 76466

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
1	125ml Plastic	HNO3	Yes	1.2	IR
3	40ml Glass	HCL	Yes	1.2	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	03/04/14 11:35	CCM		
Metal Digestion	Completed			SW3015A	03/06/14 12:00	PER		
pH check for VOCs	<2	STD Units		N/A	03/04/14 13:00	WAT		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	03/06/14 16:20	PER	7440-36-0	
Arsenic	0.007	mg/L	0.002	SW6020A	03/06/14 16:20	PER	7440-38-2	
Barium	0.048	mg/L	0.005	SW6020A	03/06/14 16:20	PER	7440-39-3	
Boron	0.26	mg/L	0.04	SW6020A	03/06/14 16:20	PER	7440-42-8	
Cadmium	Not detected	mg/L	0.0005	SW6020A	03/06/14 16:20	PER	7440-43-9	
Chromium	0.048	mg/L	0.005	SW6020A	03/06/14 16:20	PER	7440-47-3	
Cobalt	Not detected	mg/L	0.005	SW6020A	03/06/14 16:20	PER	7440-48-4	
Copper	0.016	mg/L	0.005	SW6020A	03/06/14 16:20	PER	7440-50-8	
Iron	15.4	mg/L	0.02	SW6020A	03/07/14 12:32	PER	7439-89-6	
Lead	Not detected	mg/L	0.003	SW6020A	03/06/14 16:20	PER	7439-92-1	
Manganese	0.102	mg/L	0.005	SW6020A	03/06/14 16:20	PER	7439-96-5	
Mercury	Not detected	mg/L	0.0001	SW7471B	03/04/14 16:49	CCM	7439-97-6	
Nickel	0.072	mg/L	0.005	SW6020A	03/06/14 16:20	PER	7440-02-0	
Selenium	Not detected	mg/L	0.005	SW6020A	03/06/14 16:20	PER	7782-49-2	
Silver	Not detected	mg/L	0.0005	SW6020A	03/06/14 16:20	PER	7440-22-4	
Vanadium	Not detected	mg/L	0.004	SW6020A	03/06/14 16:20	PER	7440-62-2	
Zinc	0.011	mg/L	0.005	SW6020A	03/06/14 16:20	PER	7440-66-6	
Organics - Volatiles								
1,4-Dioxane	Not detected	ug/L	1	SW8260B - SIM	03/04/14 14:16	WAT	123-91-1	
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	76-13-1	
Acetone	15	ug/L	10	SW8260C	03/04/14 14:28	WAT	67-64-1	
Carbon disulfide	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	75-15-0	
Methyl Acetate	Not detected	ug/L	10	SW8260C	03/04/14 14:28	WAT	79-20-9	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	1634-04-4	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	03/04/14 14:28	WAT	78-93-3	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	75-71-8	
Chloromethane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	74-87-3	
Vinyl chloride	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	75-01-4	
Bromomethane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	74-83-9	
Chloroethane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	75-00-3	
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	75-69-4	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	75-35-4	
Methylene chloride	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	75-09-2	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	156-60-5	

Lab Sample ID: S60177.03 (continued)
Sample Tag: P 3453-SP-5

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	75-34-3	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	156-59-2	
Chloroform	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	67-66-3	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	71-55-6	
Cyclohexane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	110-82-7	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	03/04/14 14:28	WAT	108-10-1	
2-Hexanone	Not detected	ug/L	10	SW8260C	03/04/14 14:28	WAT	591-78-6	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	56-23-5	
Benzene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	71-43-2	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	107-06-2	
Trichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	79-01-6	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	78-87-5	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	75-27-4	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	108-87-2	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	10061-01-5	
Toluene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	108-88-3	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	10061-02-6	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	79-00-5	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	127-18-4	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	124-48-1	
Chlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	108-90-7	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	79-34-5	
Ethylbenzene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	100-41-4	
p,m-Xylene	Not detected	ug/L	2	SW8260C	03/04/14 14:28	WAT		
o-Xylene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	95-47-6	
Styrene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	100-42-5	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	98-82-8	
Bromoform	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	75-25-2	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	541-73-1	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	106-46-7	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	95-50-1	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	120-82-1	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	106-93-4	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	03/04/14 14:28	WAT	96-12-8	

Analytical Laboratory Report

Lab Sample ID: S60177.04
Sample Tag: P 3453-SP-6
Collected Date/Time: 03/03/2014 09:40
Matrix: Liquid
COC Reference: 76466

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
1	125ml Plastic	HNO3	Yes	1.2	IR
3	40ml Glass	HCL	Yes	1.2	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	03/04/14 11:35	CCM		
Metal Digestion	Completed			SW3015A	03/06/14 12:00	PER		
pH check for VOCs	<2	STD Units		N/A	03/04/14 13:00	WAT		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	03/06/14 16:23	PER	7440-36-0	
Arsenic	0.006	mg/L	0.002	SW6020A	03/06/14 16:23	PER	7440-38-2	
Barium	0.034	mg/L	0.005	SW6020A	03/06/14 16:23	PER	7440-39-3	
Boron	0.26	mg/L	0.04	SW6020A	03/06/14 16:23	PER	7440-42-8	
Cadmium	Not detected	mg/L	0.0005	SW6020A	03/06/14 16:23	PER	7440-43-9	
Chromium	0.013	mg/L	0.005	SW6020A	03/06/14 16:23	PER	7440-47-3	
Cobalt	Not detected	mg/L	0.005	SW6020A	03/06/14 16:23	PER	7440-48-4	
Copper	0.009	mg/L	0.005	SW6020A	03/06/14 16:23	PER	7440-50-8	
Iron	12.3	mg/L	0.02	SW6020A	03/07/14 12:34	PER	7439-89-6	
Lead	Not detected	mg/L	0.003	SW6020A	03/06/14 16:23	PER	7439-92-1	
Manganese	0.097	mg/L	0.005	SW6020A	03/06/14 16:23	PER	7439-96-5	
Mercury	Not detected	mg/L	0.0001	SW7471B	03/04/14 16:37	CCM	7439-97-6	
Nickel	0.028	mg/L	0.005	SW6020A	03/06/14 16:23	PER	7440-02-0	
Selenium	Not detected	mg/L	0.005	SW6020A	03/06/14 16:23	PER	7782-49-2	
Silver	Not detected	mg/L	0.0005	SW6020A	03/06/14 16:23	PER	7440-22-4	
Vanadium	Not detected	mg/L	0.004	SW6020A	03/06/14 16:23	PER	7440-62-2	
Zinc	0.008	mg/L	0.005	SW6020A	03/06/14 16:23	PER	7440-66-6	
Organics - Volatiles								
1,4-Dioxane	Not detected	ug/L	1	SW8260B - SIM	03/04/14 14:34	WAT	123-91-1	
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	76-13-1	
Acetone	15	ug/L	10	SW8260C	03/04/14 14:50	WAT	67-64-1	
Carbon disulfide	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	75-15-0	
Methyl Acetate	Not detected	ug/L	10	SW8260C	03/04/14 14:50	WAT	79-20-9	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	1634-04-4	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	03/04/14 14:50	WAT	78-93-3	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	75-71-8	
Chloromethane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	74-87-3	
Vinyl chloride	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	75-01-4	
Bromomethane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	74-83-9	
Chloroethane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	75-00-3	
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	75-69-4	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	75-35-4	
Methylene chloride	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	75-09-2	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	156-60-5	

Lab Sample ID: S60177.04 (continued)
Sample Tag: P 3453-SP-6

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	75-34-3	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	156-59-2	
Chloroform	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	67-66-3	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	71-55-6	
Cyclohexane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	110-82-7	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	03/04/14 14:50	WAT	108-10-1	
2-Hexanone	Not detected	ug/L	10	SW8260C	03/04/14 14:50	WAT	591-78-6	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	56-23-5	
Benzene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	71-43-2	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	107-06-2	
Trichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	79-01-6	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	78-87-5	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	75-27-4	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	108-87-2	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	10061-01-5	
Toluene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	108-88-3	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	10061-02-6	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	79-00-5	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	127-18-4	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	124-48-1	
Chlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	108-90-7	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	79-34-5	
Ethylbenzene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	100-41-4	
p,m-Xylene	Not detected	ug/L	2	SW8260C	03/04/14 14:50	WAT		
o-Xylene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	95-47-6	
Styrene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	100-42-5	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	98-82-8	
Bromoform	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	75-25-2	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	541-73-1	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	106-46-7	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	95-50-1	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	120-82-1	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	106-93-4	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	03/04/14 14:50	WAT	96-12-8	

Analytical Laboratory Report

Lab Sample ID: S60177.05
Sample Tag: P-3453-SP-7
Collected Date/Time: 03/03/2014 10:10
Matrix: Liquid
COC Reference: 76466

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
1	125ml Plastic	HNO3	Yes	1.2	IR
3	40ml Glass	HCL	Yes	1.2	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	03/04/14 11:35	CCM		
Metal Digestion	Completed			SW3015A	03/06/14 12:00	PER		
pH check for VOCs	<2	STD Units		N/A	03/04/14 13:00	WAT		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	03/06/14 16:25	PER	7440-36-0	
Arsenic	0.006	mg/L	0.002	SW6020A	03/06/14 16:25	PER	7440-38-2	
Barium	0.032	mg/L	0.005	SW6020A	03/06/14 16:25	PER	7440-39-3	
Boron	0.27	mg/L	0.04	SW6020A	03/06/14 16:25	PER	7440-42-8	
Cadmium	Not detected	mg/L	0.0005	SW6020A	03/06/14 16:25	PER	7440-43-9	
Chromium	Not detected	mg/L	0.005	SW6020A	03/06/14 16:25	PER	7440-47-3	
Cobalt	Not detected	mg/L	0.005	SW6020A	03/06/14 16:25	PER	7440-48-4	
Copper	0.007	mg/L	0.005	SW6020A	03/06/14 16:25	PER	7440-50-8	
Iron	13.1	mg/L	0.02	SW6020A	03/07/14 12:35	PER	7439-89-6	
Lead	Not detected	mg/L	0.003	SW6020A	03/06/14 16:25	PER	7439-92-1	
Manganese	0.097	mg/L	0.005	SW6020A	03/06/14 16:25	PER	7439-96-5	
Mercury	Not detected	mg/L	0.0001	SW7471B	03/04/14 16:39	CCM	7439-97-6	
Nickel	0.019	mg/L	0.005	SW6020A	03/06/14 16:25	PER	7440-02-0	
Selenium	Not detected	mg/L	0.005	SW6020A	03/06/14 16:25	PER	7782-49-2	
Silver	Not detected	mg/L	0.0005	SW6020A	03/06/14 16:25	PER	7440-22-4	
Vanadium	Not detected	mg/L	0.004	SW6020A	03/06/14 16:25	PER	7440-62-2	
Zinc	0.008	mg/L	0.005	SW6020A	03/06/14 16:25	PER	7440-66-6	
Organics - Volatiles								
1,4-Dioxane	Not detected	ug/L	1	SW8260B - SIM	03/04/14 14:53	WAT	123-91-1	
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	76-13-1	
Acetone	15	ug/L	10	SW8260C	03/04/14 15:11	WAT	67-64-1	
Carbon disulfide	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	75-15-0	
Methyl Acetate	Not detected	ug/L	10	SW8260C	03/04/14 15:11	WAT	79-20-9	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	1634-04-4	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	03/04/14 15:11	WAT	78-93-3	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	75-71-8	
Chloromethane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	74-87-3	
Vinyl chloride	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	75-01-4	
Bromomethane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	74-83-9	
Chloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	75-00-3	
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	75-69-4	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	75-35-4	
Methylene chloride	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	75-09-2	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	156-60-5	

Lab Sample ID: S60177.05 (continued)
Sample Tag: P-3453-SP-7

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	75-34-3	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	156-59-2	
Chloroform	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	67-66-3	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	71-55-6	
Cyclohexane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	110-82-7	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	03/04/14 15:11	WAT	108-10-1	
2-Hexanone	Not detected	ug/L	10	SW8260C	03/04/14 15:11	WAT	591-78-6	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	56-23-5	
Benzene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	71-43-2	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	107-06-2	
Trichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	79-01-6	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	78-87-5	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	75-27-4	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	108-87-2	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	10061-01-5	
Toluene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	108-88-3	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	10061-02-6	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	79-00-5	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	127-18-4	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	124-48-1	
Chlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	108-90-7	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	79-34-5	
Ethylbenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	100-41-4	
p,m-Xylene	Not detected	ug/L	2	SW8260C	03/04/14 15:11	WAT		
o-Xylene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	95-47-6	
Styrene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	100-42-5	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	98-82-8	
Bromoform	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	75-25-2	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	541-73-1	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	106-46-7	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	95-50-1	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	120-82-1	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	106-93-4	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	03/04/14 15:11	WAT	96-12-8	

Analytical Laboratory Report

Lab Sample ID: S60177.06
Sample Tag: P-3453-SP-8
Collected Date/Time: 03/03/2014 10:30
Matrix: Liquid
COC Reference: 76466

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	1.2	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Extraction / Prep.								
pH check for VOCs	<2	STD Units		N/A	03/04/14 13:00	WAT		
Organics - Volatiles								
1,4-Dioxane	Not detected	ug/L	1	SW8260B - SIM	03/04/14 15:11	WAT	123-91-1	
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	76-13-1	
Acetone	15	ug/L	10	SW8260C	03/04/14 15:33	WAT	67-64-1	
Carbon disulfide	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	75-15-0	
Methyl Acetate	Not detected	ug/L	10	SW8260C	03/04/14 15:33	WAT	79-20-9	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	1634-04-4	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	03/04/14 15:33	WAT	78-93-3	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	75-71-8	
Chloromethane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	74-87-3	
Vinyl chloride	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	75-01-4	
Bromomethane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	74-83-9	
Chloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	75-00-3	
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	75-69-4	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	75-35-4	
Methylene chloride	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	75-09-2	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	156-60-5	
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	75-34-3	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	156-59-2	
Chloroform	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	67-66-3	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	71-55-6	
Cyclohexane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	110-82-7	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	03/04/14 15:33	WAT	108-10-1	
2-Hexanone	Not detected	ug/L	10	SW8260C	03/04/14 15:33	WAT	591-78-6	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	56-23-5	
Benzene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	71-43-2	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	107-06-2	
Trichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	79-01-6	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	78-87-5	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	75-27-4	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	108-87-2	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	10061-01-5	
Toluene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	108-88-3	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	10061-02-6	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	79-00-5	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	127-18-4	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	124-48-1	
Chlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	108-90-7	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	79-34-5	

Lab Sample ID: S60177.06 (continued)
Sample Tag: P-3453-SP-8

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
Ethylbenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	100-41-4	
p,m-Xylene	Not detected	ug/L	2	SW8260C	03/04/14 15:33	WAT		
o-Xylene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	95-47-6	
Styrene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	100-42-5	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	98-82-8	
Bromoform	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	75-25-2	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	541-73-1	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	106-46-7	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	95-50-1	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	120-82-1	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	106-93-4	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	03/04/14 15:33	WAT	96-12-8	

Analytical Laboratory Report

Lab Sample ID: S60177.07
Sample Tag: P-3453-SP-15
Collected Date/Time: 03/03/2014 11:15
Matrix: Liquid
COC Reference: 76466

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
1	125ml Plastic	HNO3	Yes	1.2	IR
3	40ml Glass	HCL	Yes	1.2	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	03/04/14 11:35	CCM		
Metal Digestion	Completed			SW3015A	03/06/14 12:00	PER		
pH check for VOCs	<2	STD Units		N/A	03/04/14 13:00	WAT		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	03/06/14 16:27	PER	7440-36-0	
Arsenic	0.007	mg/L	0.002	SW6020A	03/06/14 16:27	PER	7440-38-2	
Barium	0.033	mg/L	0.005	SW6020A	03/06/14 16:27	PER	7440-39-3	
Boron	0.28	mg/L	0.04	SW6020A	03/06/14 16:27	PER	7440-42-8	
Cadmium	Not detected	mg/L	0.0005	SW6020A	03/06/14 16:27	PER	7440-43-9	
Chromium	0.010	mg/L	0.005	SW6020A	03/06/14 16:27	PER	7440-47-3	
Cobalt	Not detected	mg/L	0.005	SW6020A	03/06/14 16:27	PER	7440-48-4	
Copper	0.007	mg/L	0.005	SW6020A	03/06/14 16:27	PER	7440-50-8	
Iron	13.5	mg/L	0.02	SW6020A	03/07/14 12:36	PER	7439-89-6	
Lead	Not detected	mg/L	0.003	SW6020A	03/06/14 16:27	PER	7439-92-1	
Manganese	0.097	mg/L	0.005	SW6020A	03/06/14 16:27	PER	7439-96-5	
Mercury	Not detected	mg/L	0.0001	SW7471B	03/04/14 16:41	CCM	7439-97-6	
Nickel	0.023	mg/L	0.005	SW6020A	03/06/14 16:27	PER	7440-02-0	
Selenium	Not detected	mg/L	0.005	SW6020A	03/06/14 16:27	PER	7782-49-2	
Silver	Not detected	mg/L	0.0005	SW6020A	03/06/14 16:27	PER	7440-22-4	
Vanadium	Not detected	mg/L	0.004	SW6020A	03/06/14 16:27	PER	7440-62-2	
Zinc	0.008	mg/L	0.005	SW6020A	03/06/14 16:27	PER	7440-66-6	
Organics - Volatiles								
1,4-Dioxane	Not detected	ug/L	1	SW8260B - SIM	03/04/14 15:29	WAT	123-91-1	
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	76-13-1	
Acetone	15	ug/L	10	SW8260C	03/04/14 15:55	WAT	67-64-1	
Carbon disulfide	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	75-15-0	
Methyl Acetate	Not detected	ug/L	10	SW8260C	03/04/14 15:55	WAT	79-20-9	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	1634-04-4	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	03/04/14 15:55	WAT	78-93-3	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	75-71-8	
Chloromethane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	74-87-3	
Vinyl chloride	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	75-01-4	
Bromomethane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	74-83-9	
Chloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	75-00-3	
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	75-69-4	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	75-35-4	
Methylene chloride	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	75-09-2	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	156-60-5	

Lab Sample ID: S60177.07 (continued)
Sample Tag: P-3453-SP-15

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	75-34-3	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	156-59-2	
Chloroform	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	67-66-3	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	71-55-6	
Cyclohexane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	110-82-7	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	03/04/14 15:55	WAT	108-10-1	
2-Hexanone	Not detected	ug/L	10	SW8260C	03/04/14 15:55	WAT	591-78-6	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	56-23-5	
Benzene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	71-43-2	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	107-06-2	
Trichloroethene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	79-01-6	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	78-87-5	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	75-27-4	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	108-87-2	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	10061-01-5	
Toluene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	108-88-3	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	10061-02-6	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	79-00-5	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	127-18-4	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	124-48-1	
Chlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	108-90-7	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	79-34-5	
Ethylbenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	100-41-4	
p,m-Xylene	Not detected	ug/L	2	SW8260C	03/04/14 15:55	WAT		
o-Xylene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	95-47-6	
Styrene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	100-42-5	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	98-82-8	
Bromoform	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	75-25-2	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	541-73-1	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	106-46-7	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	95-50-1	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	120-82-1	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	106-93-4	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	03/04/14 15:55	WAT	96-12-8	

Analytical Laboratory Report

Lab Sample ID: S60177.08
Sample Tag: P-3453-SP-16
Collected Date/Time: 03/03/2014 11:40
Matrix: Liquid
COC Reference: 76466

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
1	125ml Plastic	HNO3	Yes	1.2	IR
3	40ml Glass	HCL	Yes	1.2	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	03/04/14 11:35	CCM		
Metal Digestion	Completed			SW3015A	03/06/14 12:00	PER		
pH check for VOCs	<2	STD Units		N/A	03/04/14 13:00	WAT		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	03/06/14 16:31	PER	7440-36-0	
Arsenic	0.006	mg/L	0.002	SW6020A	03/06/14 16:31	PER	7440-38-2	
Barium	0.221	mg/L	0.005	SW6020A	03/06/14 16:31	PER	7440-39-3	
Boron	0.16	mg/L	0.04	SW6020A	03/06/14 16:31	PER	7440-42-8	
Cadmium	Not detected	mg/L	0.0005	SW6020A	03/06/14 16:31	PER	7440-43-9	
Chromium	0.009	mg/L	0.005	SW6020A	03/06/14 16:31	PER	7440-47-3	
Cobalt	Not detected	mg/L	0.005	SW6020A	03/06/14 16:31	PER	7440-48-4	
Copper	0.007	mg/L	0.005	SW6020A	03/06/14 16:31	PER	7440-50-8	
Iron	7.57	mg/L	0.02	SW6020A	03/07/14 12:37	PER	7439-89-6	
Lead	Not detected	mg/L	0.003	SW6020A	03/06/14 16:31	PER	7439-92-1	
Manganese	0.101	mg/L	0.005	SW6020A	03/06/14 16:31	PER	7439-96-5	
Mercury	Not detected	mg/L	0.0001	SW7471B	03/04/14 16:43	CCM	7439-97-6	
Nickel	0.018	mg/L	0.005	SW6020A	03/06/14 16:31	PER	7440-02-0	
Selenium	Not detected	mg/L	0.005	SW6020A	03/06/14 16:31	PER	7782-49-2	
Silver	Not detected	mg/L	0.0005	SW6020A	03/06/14 16:31	PER	7440-22-4	
Vanadium	Not detected	mg/L	0.004	SW6020A	03/06/14 16:31	PER	7440-62-2	
Zinc	0.014	mg/L	0.005	SW6020A	03/06/14 16:31	PER	7440-66-6	
Organics - Volatiles								
1,4-Dioxane	Not detected	ug/L	1	SW8260B - SIM	03/04/14 15:47	WAT	123-91-1	
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	76-13-1	
Acetone	15	ug/L	10	SW8260C	03/05/14 17:52	WAT	67-64-1	
Carbon disulfide	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	75-15-0	
Methyl Acetate	Not detected	ug/L	10	SW8260C	03/05/14 17:52	WAT	79-20-9	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	1634-04-4	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	03/05/14 17:52	WAT	78-93-3	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	75-71-8	
Chloromethane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	74-87-3	
Vinyl chloride	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	75-01-4	
Bromomethane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	74-83-9	
Chloroethane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	75-00-3	
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	75-69-4	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	75-35-4	
Methylene chloride	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	75-09-2	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	156-60-5	

Lab Sample ID: S60177.08 (continued)
Sample Tag: P-3453-SP-16

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	75-34-3	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	156-59-2	
Chloroform	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	67-66-3	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	71-55-6	
Cyclohexane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	110-82-7	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	03/05/14 17:52	WAT	108-10-1	
2-Hexanone	Not detected	ug/L	10	SW8260C	03/05/14 17:52	WAT	591-78-6	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	56-23-5	
Benzene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	71-43-2	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	107-06-2	
Trichloroethene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	79-01-6	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	78-87-5	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	75-27-4	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	108-87-2	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	10061-01-5	
Toluene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	108-88-3	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	10061-02-6	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	79-00-5	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	127-18-4	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	124-48-1	
Chlorobenzene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	108-90-7	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	79-34-5	
Ethylbenzene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	100-41-4	
p,m-Xylene	Not detected	ug/L	2	SW8260C	03/05/14 17:52	WAT		
o-Xylene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	95-47-6	
Styrene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	100-42-5	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	98-82-8	
Bromoform	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	75-25-2	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	541-73-1	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	106-46-7	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	95-50-1	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	120-82-1	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	106-93-4	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	03/05/14 17:52	WAT	96-12-8	

Analytical Laboratory Report

Lab Sample ID: S60177.09
Sample Tag: P-3453-SP-17
Collected Date/Time: 03/03/2014 12:05
Matrix: Liquid
COC Reference: 76466

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
1	125ml Plastic	HNO3	Yes	1.2	IR
3	40ml Glass	HCL	Yes	1.2	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Extraction / Prep.								
Mercury Digestion	Completed			SW7471B	03/04/14 11:35	CCM		
Metal Digestion	Completed			SW3015A	03/06/14 12:00	PER		
pH check for VOCs	<2	STD Units		N/A	03/04/14 13:00	WAT		
Metals								
Antimony	Not detected	mg/L	0.005	SW6020A	03/06/14 16:33	PER	7440-36-0	
Arsenic	0.005	mg/L	0.002	SW6020A	03/06/14 16:33	PER	7440-38-2	
Barium	0.232	mg/L	0.005	SW6020A	03/06/14 16:33	PER	7440-39-3	
Boron	0.16	mg/L	0.04	SW6020A	03/06/14 16:33	PER	7440-42-8	
Cadmium	Not detected	mg/L	0.0005	SW6020A	03/06/14 16:33	PER	7440-43-9	
Chromium	0.013	mg/L	0.005	SW6020A	03/06/14 16:33	PER	7440-47-3	
Cobalt	Not detected	mg/L	0.005	SW6020A	03/06/14 16:33	PER	7440-48-4	
Copper	0.006	mg/L	0.005	SW6020A	03/06/14 16:33	PER	7440-50-8	
Iron	8.23	mg/L	0.02	SW6020A	03/07/14 12:39	PER	7439-89-6	
Lead	Not detected	mg/L	0.003	SW6020A	03/06/14 16:33	PER	7439-92-1	
Manganese	0.103	mg/L	0.005	SW6020A	03/06/14 16:33	PER	7439-96-5	
Mercury	Not detected	mg/L	0.0001	SW7471B	03/04/14 16:45	CCM	7439-97-6	
Nickel	0.016	mg/L	0.005	SW6020A	03/06/14 16:33	PER	7440-02-0	
Selenium	Not detected	mg/L	0.005	SW6020A	03/06/14 16:33	PER	7782-49-2	
Silver	Not detected	mg/L	0.0005	SW6020A	03/06/14 16:33	PER	7440-22-4	
Vanadium	Not detected	mg/L	0.004	SW6020A	03/06/14 16:33	PER	7440-62-2	
Zinc	0.017	mg/L	0.005	SW6020A	03/06/14 16:33	PER	7440-66-6	
Organics - Volatiles								
1,4-Dioxane	Not detected	ug/L	1	SW8260B - SIM	03/04/14 16:06	WAT	123-91-1	
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	76-13-1	
Acetone	16	ug/L	10	SW8260C	03/05/14 18:14	WAT	67-64-1	
Carbon disulfide	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	75-15-0	
Methyl Acetate	Not detected	ug/L	10	SW8260C	03/05/14 18:14	WAT	79-20-9	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	1634-04-4	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	03/05/14 18:14	WAT	78-93-3	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	75-71-8	
Chloromethane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	74-87-3	
Vinyl chloride	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	75-01-4	
Bromomethane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	74-83-9	
Chloroethane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	75-00-3	
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	75-69-4	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	75-35-4	
Methylene chloride	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	75-09-2	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	156-60-5	

Lab Sample ID: S60177.09 (continued)
Sample Tag: P-3453-SP-17

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	75-34-3	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	156-59-2	
Chloroform	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	67-66-3	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	71-55-6	
Cyclohexane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	110-82-7	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	03/05/14 18:14	WAT	108-10-1	
2-Hexanone	Not detected	ug/L	10	SW8260C	03/05/14 18:14	WAT	591-78-6	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	56-23-5	
Benzene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	71-43-2	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	107-06-2	
Trichloroethene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	79-01-6	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	78-87-5	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	75-27-4	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	108-87-2	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	10061-01-5	
Toluene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	108-88-3	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	10061-02-6	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	79-00-5	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	127-18-4	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	124-48-1	
Chlorobenzene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	108-90-7	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	79-34-5	
Ethylbenzene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	100-41-4	
p,m-Xylene	Not detected	ug/L	2	SW8260C	03/05/14 18:14	WAT		
o-Xylene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	95-47-6	
Styrene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	100-42-5	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	98-82-8	
Bromoform	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	75-25-2	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	541-73-1	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	106-46-7	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	95-50-1	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	120-82-1	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	106-93-4	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	03/05/14 18:14	WAT	96-12-8	

Analytical Laboratory Report

Lab Sample ID: S60177.10
Sample Tag: P-3453-SP-18
Collected Date/Time: 03/03/2014 12:40
Matrix: Liquid
COC Reference: 76466

Sample Containers

#	Type	Preservative(s)	Refrigerated?	Arrival Temp. (C)	Thermometer #
3	40ml Glass	HCL	Yes	1.2	IR

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Extraction / Prep.								
pH check for VOCs	<2	STD Units		N/A	03/04/14 13:40	WAT		
Organics - Volatiles								
1,4-Dioxane	Not detected	ug/L	1	SW8260B - SIM	03/04/14 16:24	WAT	123-91-1	
TCL Volatile Organics 8260								
1,1,2-Trichloro-1,2,2-trifluoroethane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	76-13-1	
Acetone	15	ug/L	10	SW8260C	03/05/14 18:36	WAT	67-64-1	
Carbon disulfide	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	75-15-0	
Methyl Acetate	Not detected	ug/L	10	SW8260C	03/05/14 18:36	WAT	79-20-9	
tert-Methyl butyl ether (MTBE)	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	1634-04-4	
2-Butanone (MEK)	Not detected	ug/L	10	SW8260C	03/05/14 18:36	WAT	78-93-3	
Dichlorodifluoromethane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	75-71-8	
Chloromethane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	74-87-3	
Vinyl chloride	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	75-01-4	
Bromomethane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	74-83-9	
Chloroethane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	75-00-3	
Trichlorofluoromethane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	75-69-4	
1,1-Dichloroethene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	75-35-4	
Methylene chloride	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	75-09-2	
trans-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	156-60-5	
1,1-Dichloroethane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	75-34-3	
cis-1,2-Dichloroethene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	156-59-2	
Chloroform	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	67-66-3	
1,1,1-Trichloroethane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	71-55-6	
Cyclohexane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	110-82-7	
4-Methyl-2-pentanone (MIBK)	Not detected	ug/L	10	SW8260C	03/05/14 18:36	WAT	108-10-1	
2-Hexanone	Not detected	ug/L	10	SW8260C	03/05/14 18:36	WAT	591-78-6	
Carbon tetrachloride	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	56-23-5	
Benzene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	71-43-2	
1,2-Dichloroethane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	107-06-2	
Trichloroethene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	79-01-6	
1,2-Dichloropropane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	78-87-5	
Bromodichloromethane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	75-27-4	
Methyl cyclohexane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	108-87-2	
cis-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	10061-01-5	
Toluene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	108-88-3	
trans-1,3-Dichloropropene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	10061-02-6	
1,1,2-Trichloroethane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	79-00-5	
Tetrachloroethene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	127-18-4	
Dibromochloromethane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	124-48-1	
Chlorobenzene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	108-90-7	
1,1,2,2-Tetrachloroethane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	79-34-5	

Lab Sample ID: S60177.10 (continued)
Sample Tag: P-3453-SP-18

Analysis	Results	Units	RL	Method	Run Date/Time	Analyst	CAS #	Flags
Organics - Volatiles (continued)								
TCL Volatile Organics 8260 (continued)								
Ethylbenzene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	100-41-4	
p,m-Xylene	Not detected	ug/L	2	SW8260C	03/05/14 18:36	WAT		
o-Xylene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	95-47-6	
Styrene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	100-42-5	
Isopropylbenzene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	98-82-8	
Bromoform	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	75-25-2	
1,3-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	541-73-1	
1,4-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	106-46-7	
1,2-Dichlorobenzene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	95-50-1	
1,2,4-Trichlorobenzene	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	120-82-1	
1,2-Dibromoethane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	106-93-4	
1,2-Dibromo-3-chloropropane	Not detected	ug/L	1	SW8260C	03/05/14 18:36	WAT	96-12-8	

Merit Laboratories, Inc.

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C.O.C. PAGE # 1 OF 1

76466

CHAIN OF CUSTODY RECORD

REPORT TO

CONTACT NAME: Randy Christensen
COMPANY: Arcadis
ADDRESS: 10 559 Citation Drive Suite 100
CITY: Brighton STATE: MI ZIP CODE: 48116
PHONE NO.: 810-225-1940 FAX NO.: 810 229-8837 P.O. NO.: B006480.0014.00501
E-MAIL ADDRESS: Randy.Christensen@arcadis.com QUOTE NO.:

INVOICE TO

CONTACT NAME: Dan Gustafson ☐ SAME
COMPANY: ULTURA
ADDRESS: 2516 Verne Roberts Circle Suite H102
CITY: Antioch, CA STATE: CA ZIP CODE: 94509
PHONE NO.: 925-754-1191 E-MAIL ADDRESS: dgustafson@ultrawater.com

PROJECT NO./NAME: B006480.0014.00501/Racon PLT 3
SAMPLER(S) - PLEASE PRINT/SIGN NAME: Tim Hofferth

TURNAROUND TIME REQUIRED ☐ 1 DAY ☐ 2 DAYS ☐ 3 DAYS ☐ STANDARD ☐ OTHER

DELIVERABLES REQUIRED ☐ STD ☐ LEVEL II ☐ LEVEL III ☐ LEVEL IV ☐ EDD ☐ OTHER

MATRIX CODE: GW=GROUNDWATER WW=WASTEWATER S=SOIL L=LIQUID SD=SOLID SL=SLUDGE DW=DRINKING WATER O=OIL WP=WIPE A=AIR W=WASTE

ANALYSIS (ATTACH LIST IF MORE SPACE IS REQUIRED)

Certifications: ☐ OHIO VAP ☐ Drinking Water ☐ DoD ☐ NPDES
Project Locations: ☐ Detroit ☐ New York ☐ Other
Special Instructions

MERIT LAB NO. (FOR LAB USE ONLY)	YEAR DATE	YEAR TIME	SAMPLE TAG IDENTIFICATION-DESCRIPTION	MATRIX	# OF BOTTLES	# Containers & Preservatives: NONE	HCl	HNO_3	H_2SO_4	NaOH	MeOH	OTHER	8260 VOC	8260 14 Acetone SIM	Metals	Special Instructions
60177.01	3-3-14	9:15	~~SP-0~~ P-3453-SP-0					X							X	*1,4D detection 1 ug/L
.02	"	12:40	~~SP-10~~ P3453-SP-10					X							X	°Metals list plus Iron
.03	"	9:15	~~SP~~ P3453-SP-5		4		X	X					X	X	X	
.04	"	9:40	P3453-SP-6		4		X	X					X	X	X	
.05	"	10:10	P-3453-SP-7		4		X	X					X	X	X	
.06	"	10:30	P-3453-SP-8		3		X						X	X		
.07	3-3-14	11:15	P-3453-SP-15		4		X	X					X	X	X	
.08	"	11:40	P-3453-SP-16		4		X	X					X	X	X	
.09	"	12:05	P-3453-SP-17		4		X	X					X	X	X	
.10	"	12:40	P-3453-SP-18		3		X						X	X		

RELINQUISHED BY: SIGNATURE/ORGANIZATION [signature] ☒ Sampler DATE 3/3/14 TIME 1500
RECEIVED BY: SIGNATURE/ORGANIZATION DATE TIME
RELINQUISHED BY: SIGNATURE/ORGANIZATION DATE TIME
RECEIVED BY: SIGNATURE/ORGANIZATION DATE TIME

RELINQUISHED BY: SIGNATURE/ORGANIZATION UPS DATE 3/4/14 TIME 935
RECEIVED BY: SIGNATURE/ORGANIZATION Kevin George DATE 3/4/14 TIME 935

SEAL NO. SEAL INTACT YES ☐ NO ☐ INITIALS
SEAL NO. SEAL INTACT YES ☐ NO ☐ INITIALS

NOTES: TEMP. ON ARRIVAL 1.2

PLEASE NOTE: SIGNING ACKNOWLEDGES ADHERENCE TO MERIT'S SAMPLE ACCEPTANCE POLICY ON REVERSE SIDE

Rev. 5.18.12

ARCADIS

Appendix C

LNAPL Conceptual Site Model
Decision Tree

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MEMO

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From:
Jonathon Smith (ARCADIS)

Date:
June 26, 2013

ARCADIS Project No.:
B0064479.2013

Subject:
LNAPL Remedial Decision Tree Analysis: LNAPL Areas 5-2 and 17, RACER Trust, Plants 2 and 3, Lansing, Michigan

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Introduction

Corrective measures for addressing light non-aqueous phase liquid (LNAPL) areas (Plant 2, Area 5-2 and Plant 3, Area 17) have been evaluated following the LNAPL Remedial Decision Tree, provided in this Appendix. The LNAPL Remedial Decision Tree was developed to provide a consistent framework for identifying LNAPL remedial drivers and determining an appropriate remedial strategy based on a sound LNAPL conceptual site model (LCSM). The decision tree identifies risks driven by the chemical composition of the LNAPL (referred to as composition concerns) and/or issues associated with the presence of LNAPL that could move to a location where it could cause an unacceptable discharge (referred to as saturation concerns). If either composition or saturation concerns (or both) are identified, the decision tree provides a systematic approach for contemplation of applicable LNAPL management alternatives that can be employed to mitigate LNAPL concerns and meet remedial objectives in the context of site-specific LNAPL conditions.

The Resource Conservation and Recovery Act Facility Investigation (RFI) findings were used to navigate through the LNAPL Remedial Decision Tree, remedial drivers were identified and a tenable LNAPL management strategy for each LNAPL Area was reached. A detailed summary of the analysis and path through the Decision Tree for each LNAPL Area is provided in Attachment 1.

Attachment 1
LNAPL Remedial Decision Tree
Plant 2: Area 5-2

LNAPL Compositional Concerns (potential exposure/risk issues):

LNAPL Saturation Concerns (mobility and migration issues)

Risk: Are unacceptable dissolved phase, vapor phase or direct contact exposures associated with the LNAPL under any use scenarios?

Yes (1)

Do feasible options exist to mitigate unacceptable risk through compositional change?

Yes (2)

Can institutional/engineering controls provide effective risk mitigation?

Yes (3)

Cost-Benefit Is there potential benefit to partial treatment/removal that outweighs costs?

Yes (4)

Implement treatment/removal action

No

No

No

No Further Action

Migration: Is LNAPL migrating or potentially migrating (i.e., mobile along perimeter)?

No (5)

Yes

Do feasible options exist to mitigate migration through LNAPL recovery or mass control?

Yes

Implement LNAPL Recovery Remedy

Mobility: Is LNAPL potentially mobile within stable LNAPL perimeter?

No

Yes (6)

Recoverability: Is LNAPL readily recoverable?

No (7)

Yes

Cost-Benefit Will potential benefit of LNAPL recovery outweigh costs?

Yes

No

Are controls required?

No

Yes (8)

Implement Controls

Implement Long-Term Stewardship/ Monitoring Plan (**as required**)

No Further Action

(#) NOTES: See Page 2

Attachment 1 Notes

Plant 2: Area 5-2

Background:
LNAPL in Area 5-2 is present within the shallow fill and interbedded zone, and is thought to consist primarily of cutting oil. Elevated concentrations of polychlorinated biphenyls (PCBs) and chlorinated volatile organic compounds (1,1,1-trichloroethane [TCA];1,1-dichloroethane [DCA]; chloroethane; tetrachloroethene [PCE]; and 1,1-dichloroethene [DCE]) have been detected in LNAPL samples collected from Area 5-2. The LNAPL likely acts as a long-term source of volatile organic compounds (VOCs) to groundwater, and may also be associated with 1,4-dioxane in groundwater in the perched zone extending across Plant 2 onto Plant 6. 1,4-dioxane was used as a stabilizer and corrosion inhibitor in chlorinated solvents (USEPA 2006), particularly 1,1-TCA. 1,4-dioxane is miscible in water and has an octanol-water partition coefficient of approximately 0.27 (USEPA 2006), indicating that a significant fraction of the 1,4-dioxane mass may have partitioned out of the LNAPL and into to the aqueous phase. Once dissolved, it is relatively unaffected by sorptive mechanisms, however, it can diffuse into static pore water (water that resides in the fraction of pore space that does not contribute to advective transport) where it can act as a long-term source of impacts through back-diffusion into migratory pore water. Thus, while the majority of 1,4-dioxane mass may be present in the aqueous phase in Area 5-2, there may still be significant concentrations in the LNAPL and in static pore water, and the LNAPL source area may act as an ongoing source of 1,4-dioxane impacts to groundwater in downgradient areas. A more comprehensive overview of the LNAPL conceptual site model for Area 5-2, including information on the significance of the VOCs detected in the LNAPL and the relationship between VOCs in LNAPL and groundwater quality at Plant 2 can be found in the *RFI Phase 1 Activities Summary Report* (ARCADIS 2012) and the *RFI Phase 2 Activities Summary Report* (ARCADIS 2013).

1) YES - the following potential risk/exposure concerns are acknowledged for LNAPL in Area 5-2:
   - Groundwater Concerns: Constituents associated with LNAPL have been detected in groundwater at concentrations exceeding relevant generic groundwater cleanup criteria (VOCs exceed residential drinking water and vapor intrusion criteria; 1,4-dioxane exceeds residential drinking water criteria; SVOCs and PCBs exceed residential drinking water and groundwater contact criteria). Additionally, there are aesthetic concerns associated with groundwater use from any areas of the Site where LNAPL is present. Groundwater quality results to date indicate that constituents associated with the LNAPL in Area 5-2 have not migrated off site, and an initial evaluation of groundwater sampling data collected over the past 2 to 3 years indicate that VOCs and 1,4-dioxane plumes are stable in the perched groundwater at the site (ARCADIS 2014a). Long term groundwater monitoring will be completed to continue evaluating the stability of the perched 1,4-dioxane and spatially limited VOC impacts (ARCADIS 2014b). A contingency remedy will be considered if groundwater use restrictions cannot be executed or the plume stability evaluation shows that the groundwater plume(s) is not stable and is migrating off site above applicable MDEQ cleanup criteria.
   - Volatilization Concerns: VOCs have been detected in soil at concentrations exceeding volatilization to indoor air inhalation criteria. Additionally, it is recognized that anaerobic biodegradation of hydrocarbons will generate methane. While there are currently no structures in the area, it is likely that the Site will be redeveloped in the future, and presence of VOCs and the potential for methane generation could result in indoor air quality concerns for future structures.
   - Direct Contact Concerns: LNAPL impacts in Area 5-2 have been identified at shallow depths in several locations (within the upper 4 ft of soil), and concentrations of PCBs in LNAPL and soil in some areas of Area 5-2 exceed TSCA limits. Under current site conditions, much of the ground surface where direct contact concerns are present is covered with concrete and/or asphalt. However, workers could be exposed to surface soils in areas not currently covered, or in covered areas in future use scenarios if cover were to be removed and left uncovered. Additionally, short-term exposures are possible for future construction or utility workers.

2) YES – a general discussion regarding feasibility of various compositional change remediation approaches considered for Area 5-2 is provided below:
   - Multi-phase extraction was considered as a potential corrective measure for Area 5-2. MPE was not proposed as a corrective measure for Area 5-2 on the basis that there is limited potential for LNAPL recoverability in Area 5-2 (see note 6, below), and anticipated implementation challenges associated with limited soil permeability and geologic heterogeneity.
   - A highly variable suite of constituents of concern (COCs) are present in LNAPL in Area 5-2, including chlorinated VOCs, 1,4-dioxane, SVOCs, and PCBs. Not all COCs in the LNAPL are volatile or biodegradable, rendering remedial technologies which rely primarily on vapor-phase partitioning or enhanced biodegradation, such as soil vapor extraction (SVE), ineffective for addressing all primary target COCs.
   - In situ chemical oxidation (ISCO) was not evaluated for area 5-2 on the basis that the desired chemical reactions occur within the aqueous phase only, and thus would be rate-limited by dissolution of contaminants from the non-aqueous to aqueous phase. ISCO is also infeasible from a cost perspective, given the relatively large quantities of reagent that would be required to address the mass of LNAPL in the subsurface.

3) YES – based on the current understanding of site conditions, institutional controls can provide effective risk mitigation on-site. The COCs in the LNAPL at Area 5-2 likely act as a long-term source of LNAPL constituents to groundwater in areas downgradient of Area 5-2. However, the data collected to date suggest that these constituents have not migrated off-site at concentrations exceeding applicable RBSLs, and thus can be controlled onsite. Additional groundwater monitoring and statistical trend analysis is currently underway to assess the long-term stability of the dissolved-phase plume(s) and to determine the potential for future off-site migration of COCs at concentrations exceeding applicable RBSLs. A contingency remedy will be considered if groundwater use restrictions cannot be executed or the plume stability evaluation shows that the groundwater plume(s) is not stable and is migrating off site above RBSLs.

4) YES - a targeted excavation within Area 5-2 is being completed as an interim corrective measure to remove a former concrete vault where concentrations of PCBs in LNAPL and soil exceed TSCA limits. There is some uncertainty regarding the potential benefit of additional partial treatment or excavation in the LNAPL source area beyond the planned removal of PCBs, particularly with respect to the 1,4-dioxane plume in perched groundwater. While the chlorinated solvent TCA, which is found in Area 5-2, was likely the historical source of the 1,4-dioxane in groundwater, the overall mass of 1,4-dioxane remaining in the source area is not known. 1,4-dioxane was not detected in soil or LNAPL from Area 5-2 due to elevated laboratory detection limits, and based on its chemical properties, it is likely that a significant fraction of the 1,4-dioxane mass may have partitioned out of the LNAPL and into the aqueous phase (see notes in background section, above). Based on this information, it is possible that the bulk of the 1,4-dioxane mass no longer resides in the source area, and additional partial treatment or mass removal in the source area may have little impact on the longevity of the 1,4-dioxane concentrations in groundwater located downgradient of Area 5-2. Given that all impacts associated with the LNAPL (including 1,4-dioxane) appear to be contained on-site and stable (not migrating), risks associated with these impacts can be effectively mitigated through institutional controls. Based on the present understanding of site conditions, additional remediation or excavation is not necessary and does not constitute an appropriate use of financial and natural resources. However, long term groundwater monitoring will be completed to continue evaluating the long-term stability of the perched 1,4-dioxane and spatially limited VOC impacts (ARCADIS 2014b). A contingency remedy will be considered if groundwater use restrictions cannot be executed or the plume stability evaluation shows that the groundwater plume(s) is not stable and is migrating off site above applicable MDEQ cleanup criteria.

5) NO - a comprehensive LNAPL mobility evaluation was completed in Area 5-2 in 2013 (ARCADIS 2013). The evaluation indicated that LNAPL is stable and not migrating, based on the following lines of evidence:
   - Pore velocity potentials were calculated based on API methodology at four soil core locations where field saturation exceeded residual saturation. All calculated LNAPL velocity potentials were less than 1.0×10^{-6} cm/s (the velocity criterion suggested by ASTM [2006]), indicating that LNAPL is functionally immobile in Area 5-2.
   - LNAPL pore-entry pressure analysis indicated that LNAPL thicknesses observed at the perimeter of the LNAPL body in Area 5-2 are below the threshold values required for LNAPL to migrate into soils not previously affected by LNAPL.
   - Operations at the Site were halted in 2006 and thus all LNAPL releases to the subsurface occurred at a minimum, seven years ago. LNAPL bodies typically stabilize 2 to 5 years after the release has stopped (ITRC 2012).

Fluid level gauging data collected through February 2014 indicate LNAPL accumulation in some of the monitoring wells in Area 5-2 (PMW-01, LMW-12-08, and LMW-12-03D). The observed LNAPL accumulation likely reflects gradual equilibration between LNAPL in the formation and the wells, rather than evidence of LNAPL migration. Long term fluid level gauging will be completed to continue evaluating LNAPL stability (ARCADIS 2014b).

6) YES - a comprehensive LNAPL mobility evaluation was completed in Area 5-2. The evaluation demonstrated that mobile LNAPL is present, based on the following lines of evidence:
   - LNAPL accumulates in monitoring wells.
   - Laboratory petrophysical testing of undisturbed soil cores indicated that field LNAPL saturations exceeded residual.

7) NO - LNAPL recoverability was evaluated in Area 5-2 through field LNAPL transmissivity testing (ARCADIS 2013). The Michigan Department of Environmental Quality (MDEQ) has indicated that an LNAPL transmissivity of 0.5 ft^2/day may be established as a standard threshold value for recovery to the maximum extent practicable (Swiger 2013), permitting the use of LNAPL transmissivity as a quantitative recoverability metric in the State of Michigan in the absence of risk-based LNAPL concerns. The LNAPL transmissivity values measured at Area 5-2 ranged from 0.005 to 0.01 ft^2/day, and are well below this criterion. These data indicate that LNAPL is minimally recoverable at Area 5-2, and LNAPL recovery efforts (through hydraulically-based remediation methods) will not result in a beneficial reduction in overall LNAPL mass. Transmissivity testing could not be completed in 11 of the 13 wells in Area 5-2 due to insufficient LNAPL accumulation (<0.2 foot) during the LNAPL transmissivity testing event in 2013 (ARCADIS 2013). Fluid level gauging data collected since the LNAPL transmissivity testing activities completed in 2013 indicate LNAPL accumulation sufficient to facilitate LNAPL transmissivity testing in a few additional wells in Area 5-2. From a qualitative perspective, the slow rate of LNAPL accumulation observed in these wells suggests that LNAPL transmissivity is very low. However, long term fluid level gauging will be completed to evaluate equilibrium conditions in these wells and additional LNAPL transmissivity testing may be completed to re-evaluate LNAPL recoverability.

   Given that LNAPL body at Area 5-2 appears stable, the risks associated with the LNAPL will not change appreciably as a result of active recovery efforts. While no formal assessment of NSZD rates has been completed for Area 5-2, based on recent literature publications (Lundegard and Johnson [2006], Sihota et al [2011]) and ARCADIS' experience, magnitudes of petroleum hydrocarbon-based LNAPL losses through NSZD typically fall within the range of hundreds to thousands of gallons per acre per year. Based on the limited LNAPL transmissivity values measured to date in Area 5-2, active LNAPL recovery is unlikely to yield significant additional mass by comparison to ongoing mass reduction through NSZD.

8) YES - the following controls are proposed for all LNAPL Area 5-2 to limit potential for future exposure:
   - Land Use Restrictions:
     - Land use at the entire Site would be limited to industrial and/or commercial uses.
     - All site soils media and/or debris will be managed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
     - Construction of new structures will not be permitted unless construction incorporates engineering controls designed to eliminate the potential for subsurface vapor phase hazardous substances to migrate into the new structure at concentrations greater than applicable criteria, or unless prior to construction of any structure, an evaluation of the potential for any hazardous substances to volatilize into indoor air assures the protection of persons who may be present in the buildings and is in compliance with all relevant federal, state, and local laws.
     - Intrusive excavation activities will be conducted following a site-specific health and safety plan prepared by qualified professionals and intrusive activities are conducted by appropriately trained personnel.
   - Groundwater Use Restrictions: Groundwater use restrictions will be recorded on the deeds prohibiting the construction and use of wells or other devices on the Site to extract groundwater for consumption, irrigation, or any other purpose, except as provided below:
     - Wells and other devices constructed as part of a response activity for the purpose of evaluating groundwater quality or to remediate subsurface contamination associated with a release of hazardous substances into the environment are permitted provided the construction of the wells or devices complies with all applicable local, state, and federal laws and regulations and does not cause or result in a new release, exacerbation of existing contamination, or any other violation of local, state, or federal laws or regulations.
     - Short-term dewatering for construction purposes is permitted provided the dewatering, including management and disposal of the groundwater, is conducted in accordance with all applicable local, state, and federal laws and regulations and does not cause or result in a new release, exacerbation of existing contamination, or any other violation of local, state, and federal environmental laws and regulations.
   - Monitored Plume Stability: A groundwater monitoring program that provides data to verify dissolved phase plume stability and preserves the current conditions of the existing surface cover to minimize infiltration and maximize the potential for the groundwater plume to remain stable will be implemented.
   - Caps: Capping was incorporated into the proposed corrective measures for Area 5-2 to reduce the potential for direct contact risks associated with the LNAPL.

References:

ARCADIS. 2012. Resource Conservation and Recovery Act Facility Investigation (RFI) Phase 1 Activities Summary Report. RACER Trust, Lansing, Michigan Plants 2, 3 & 6 Industrial Land. January 30.
ARCADIS. 2013a. Resource Conservation and Recovery Act Facility Investigation (RFI) Phase 2 Activities Summary Report. Michigan Plants 2, 3 & 6 Industrial Land. April.
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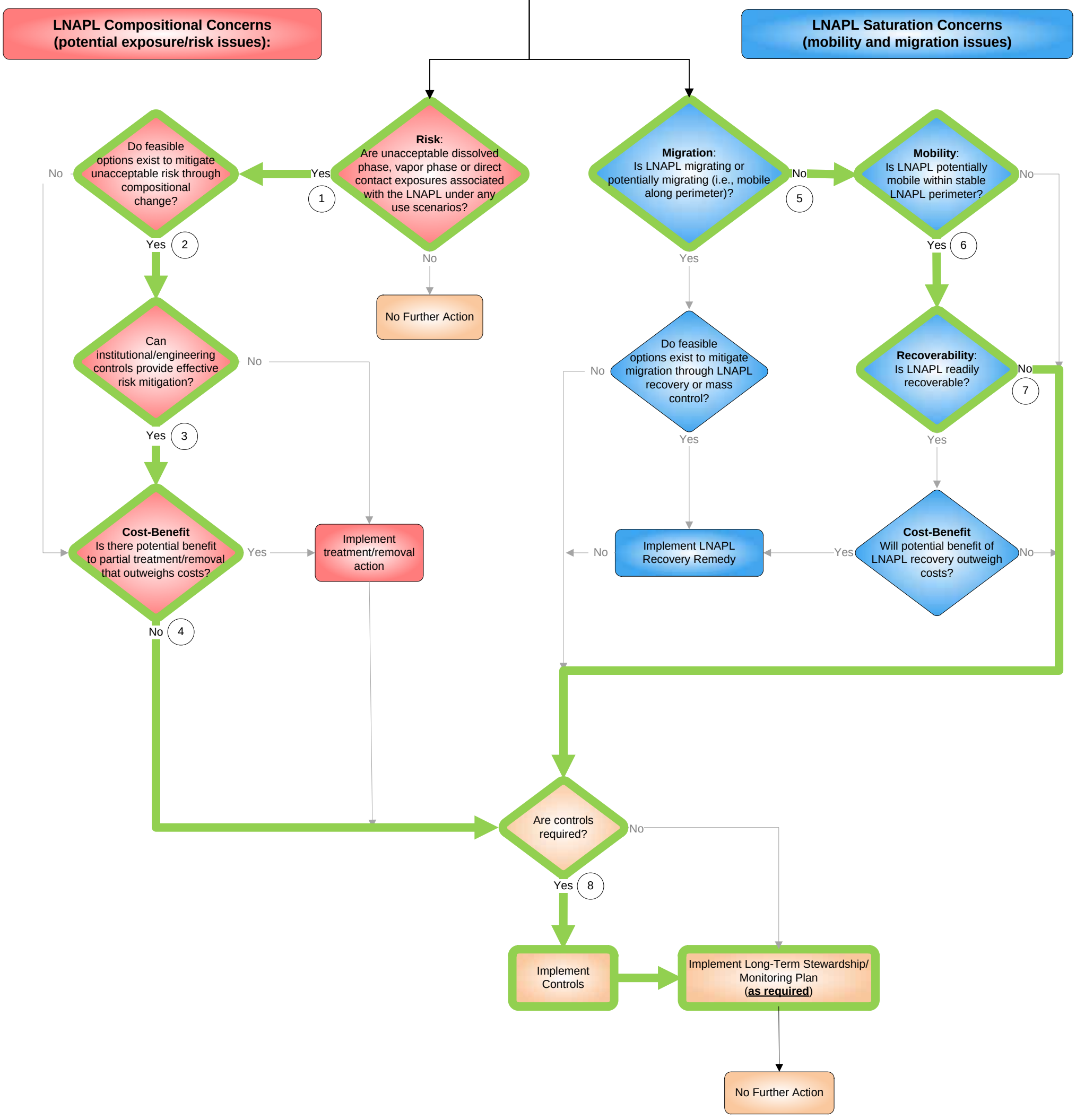
Swiger, N., 2013. Nonaqueous Phase Liquids (NAPL) Management. Presentation at the American Institute of Professional Geologists (AIPG), Michigan Section, March 2013 Meeting.
United States Environmental Protection Agency (USEPA). 2006. Treatment Technologies for 1,4-Dioxane: Fundamentals and Field Applications. Office of Solid Waste and Emergency Response. December 2006. Document number: EPA 542-R-06-009.

Attachment 1
LNAPL Remedial Decision Tree
Plant 3: Area 17



(#) NOTES: See Page 2

Attachment 1 Notes

Plant 3: Area 17

Background:
LNAPL associated with a former underground storage tank is present within the shallow fill material in the north central portion of Plant 3 (Area 17). The LNAPL consists of gasoline with associated soil and groundwater impacts consisting primarily of benzene, toluene, ethylbenzene, and xylenes. A more comprehensive overview of the LNAPL conceptual site model for Area 17 can be found in the *RFI Phase 1 Activities Summary Report* (ARCADIS 2012) and the *RFI Phase 2 Activities Summary Report* (ARCADIS 2013).

1) YES - the following potential risk/exposure concerns are acknowledged for LNAPL in Area 17:
   - Groundwater Concerns: Constituents associated with LNAPL have been detected in groundwater at concentrations exceeding relevant generic groundwater cleanup criteria (VOCs exceed residential drinking water and vapor intrusion criteria; SVOCs exceed residential drinking water criteria). Additionally, there are aesthetic concerns associated with groundwater use from any areas of the Site where LNAPL is present. Groundwater quality results to date indicate that VOCs and SVOCs associated with the LNAPL in Area 17 have not migrated off site, and an initial evaluation of groundwater sampling data collected over the past 2 to 3 years indicate that VOC and SVOC plumes are stable in the perched groundwater at the site (ARCADIS 2014a). Long term groundwater monitoring will be completed to continue evaluating the stability of the dissolved phase impacts (ARCADIS 2014b). A contingency remedy will be considered if groundwater use restrictions cannot be executed or the plume stability evaluation shows that the groundwater plume(s) is not stable and is migrating off site above applicable MDEQ cleanup criteria.
   - Volatilization Concerns: VOCs have been detected in soil at concentrations exceeding volatilization to indoor air inhalation criteria. Additionally, it is recognized that anaerobic biodegradation of hydrocarbons will generate methane. While there are currently no structures in the area, it is likely that the Site will be redeveloped in the future, and presence of VOCs and the potential for methane generation could result in indoor air quality concerns for future structures.
   - Direct Contact Concerns: LNAPL impacts in Area 17 have been identified at shallow depths in several locations (within the upper 4 ft of soil), presenting a direct contact concern for Site workers and/or construction or utility workers.

2) YES - a general discussion regarding feasibility of various compositional change remediation strategies for Area 17 is provided below:
   - The bulk of the COCs in LNAPL in Area 17 are volatile and/or biodegradable, and thus remedial technologies which rely on vapor-phase partitioning or enhanced biodegradation were evaluated. Soil vapor extraction (SVE) and Multi-phase extraction (MPE) were both considered as potential corrective measures for Area 17. Neither SVE nor MPE was selected as a corrective measure for Area 17 on the basis that there is limited potential for LNAPL recoverability in Area 17 (see note 6, below), and anticipated implementation challenges associated with limited soil permeability and geologic heterogeneity.
   - In situ chemical oxidation (ISCO) was not evaluated for area 17 on the basis that the desired chemical reactions occur within the aqueous phase only, and thus would be rate-limited by dissolution of contaminants from the non-aqueous to aqueous phase. ISCO is also infeasible from a cost perspective, given the relatively large quantities of reagent that would be required to address the mass of LNAPL in the subsurface.

3) YES - based on the current understanding of site conditions, institutional controls can provide effective risk mitigation on-site. Based on data collected to date, constituents associated with LNAPL at Area 17 are defined onsite, and do not pose a risk to groundwater in areas downgradient of Area 17, or to the underlying deep overburden and bedrock aquifers. Long term groundwater monitoring will be completed to continue evaluating the stability of the dissolved phase impacts (ARCADIS 2014b). A contingency remedy will be considered if groundwater use restrictions cannot be executed or the plume stability evaluation shows that the groundwater plume(s) is not stable and is migrating off site above applicable MDEQ cleanup criteria.

4) NO – Data collected to date indicate that impacts in Area 17 are contained on-site and do not pose a risk to areas located hydraulically downgradient of Area 17, or to the underlying deep overburden and bedrock aquifers. Based on the present understanding of site conditions, risk can be effectively mitigated through institutional controls. However, long term groundwater monitoring will be completed to continue evaluating the stability of the dissolved phase impacts (ARCADIS 2014b). As a result, a contingency remedy will be considered if groundwater use restrictions cannot be executed or the plume stability evaluation shows that the groundwater plume(s) is not stable and is migrating off site above applicable MDEQ cleanup criteria.

5) NO – a comprehensive LNAPL mobility evaluation was completed for Area 17 (ARCADIS 2013). The evaluation demonstrated that LNAPL is stable and not migrating. This finding is supported by the following lines of evidence:
   - Pore velocity potentials were calculated based on API methodology at four soil core locations where field saturation exceeded residual saturation. All calculated LNAPL velocity potentials were less than 1.0×10^{-6} cm/s (the velocity criterion suggested by ASTM [2006]), indicating that LNAPL is functionally immobile in Area 17.
   - LNAPL pore-entry pressure analysis indicated that LNAPL thicknesses observed at the perimeter of the LNAPL body in Area 17 are below the threshold values required for LNAPL to migrate into soils not previously affected by LNAPL.
   - Operations at the Site were halted in 2006 and thus all LNAPL releases to the subsurface occurred at a minimum, seven years ago. LNAPL bodies typically stabilize 2 to 5 years after the release has stopped (ITRC 2012).

   Fluid level gauging data collected through February 2014 indicate LNAPL accumulation in one of the monitoring wells in Area 17 (LMW-12-10). The observed LNAPL accumulation likely reflects gradual equilibration between LNAPL in the formation and the wells, rather than evidence of LNAPL migration. Long term fluid level gauging will be completed to continue evaluating LNAPL stability (ARCADIS 2014b).

6) YES - a comprehensive LNAPL mobility evaluation was completed in Area 17. The evaluation demonstrated that mobile LNAPL is present, based on the following lines of evidence:
   - LNAPL accumulates in monitoring wells.
   - Laboratory petrophysical testing of undisturbed soil cores indicated that field LNAPL saturations exceeded residual saturation.

7) NO - LNAPL recoverability was evaluated in Area 17 through field LNAPL transmissivity testing. The Michigan Department of Environmental Quality (MDEQ) has indicated that an LNAPL transmissivity of 0.5 ft^2/day may be established as a standard threshold value for recovery to the maximum extent practicable (Swiger 2013), permitting the use of LNAPL transmissivity as a quantitative recoverability metric in the State of Michigan in the absence of risk-based LNAPL concerns. The LNAPL transmissivity measured at Area 17 (0.01 ft^2/d at UNK-14) is well below this criterion, indicating that LNAPL is minimally recoverable at Area 17, and LNAPL recovery efforts (through hydraulically-based remediation methods) will not result in a beneficial reduction in overall LNAPL mass. Transmissivity testing could not be completed in wells other than UNK-14 in Area 17 due to insufficient LNAPL accumulation (<0.2 foot) during the LNAPL transmissivity testing event in 2013 (ARCADIS 2013). Fluid level gauging data collected since the LNAPL transmissivity testing activities completed in 2013 indicate LNAPL accumulation sufficient to facilitate LNAPL transmissivity testing in one additional well in Area 17 (LMW-12-10). From a qualitative perspective, the slow rate of LNAPL accumulation observed in this well suggests that LNAPL transmissivity is very low. However, long term fluid level gauging will be completed to evaluate equilibrium conditions in these wells and additional LNAPL transmissivity testing may be completed to re-evaluate LNAPL recoverability.

Given that LNAPL body at Area 17 appears stable, the risks associated with the LNAPL will not change appreciably as a result of active recovery efforts. While no formal assessment of NSZD rates has been completed for Area 17, based on recent literature publications (Lundegard and Johnson [2006], Sihota et al [2011]) and ARCADIS' experience, magnitudes of petroleum hydrocarbon-based LNAPL losses through NSZD typically fall within the range of hundreds to thousands of gallons per acre per year. Based on the limited LNAPL transmissivity values measured in Area 17 to date, active LNAPL recovery is unlikely to yield significant additional mass by comparison to ongoing mass reduction through NSZD.

8) YES - the following controls are proposed for all LNAPL Area 17 to limit potential for future exposure:
   - Land Use Restrictions:
     - Land use at the entire Site would be limited to industrial and/or commercial uses.
     - All site soils media and/or debris will be managed in accordance with applicable requirements of RCRA and all other relevant state and federal laws.
     - Construction of new structures will not be permitted unless construction incorporates engineering controls designed to eliminate the potential for subsurface vapor phase hazardous substances to migrate into the new structure at concentrations greater than applicable criteria, or unless prior to construction of any structure, an evaluation of the potential for any hazardous substances to volatilize into indoor air assures the protection of persons who may be present in the buildings and is in compliance with all relevant federal, state, and local laws.
     - Intrusive excavation activities will be conducted following a site-specific health and safety plan prepared by qualified professionals and intrusive activities are conducted by appropriately trained personnel.
   - Groundwater Use Restrictions: Groundwater use restrictions will be recorded on the deeds prohibiting the construction and use of wells or other devices on the Site to extract groundwater for consumption, irrigation, or any other purpose, except as provided below:
     - Wells and other devices constructed as part of a response activity for the purpose of evaluating groundwater quality or to remediate subsurface contamination associated with a release of hazardous substances into the environment are permitted provided the construction of the wells or devices complies with all applicable local, state, and federal laws and regulations and does not cause or result in a new release, exacerbation of existing contamination, or any other violation of local, state, or federal laws or regulations.
     - Short-term dewatering for construction purposes is permitted provided the dewatering, including management and disposal of the groundwater, is conducted in accordance with all applicable local, state, and federal laws and regulations and does not cause or result in a new release, exacerbation of existing contamination, or any other violation of local, state, and federal environmental laws and regulations.
   - Monitored Plume Stability: A groundwater monitoring program that provides data to verify dissolved phase plume stability and preserves the current conditions of the existing surface cover to minimize infiltration and maximize the potential for the groundwater plume to remain stable will be implemented.
   - Caps: Capping was incorporated into the proposed corrective measures for Area 17 to reduce the potential for direct contact risks associated with the LNAPL.

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ARCADIS. 2012. Resource Conservation and Recovery Act Facility Investigation (RFI) Phase 1 Activities Summary Report. RACER Trust, Lansing, Michigan Plants 2, 3 & 6 Industrial Land. January 30.

ARCADIS. 2013. Resource Conservation and Recovery Act Facility Investigation (RFI) Phase 2 Activities Summary Report. Michigan Plants 2, 3 & 6 Industrial Land. April.

ARCADIS, 2014a. Preliminary Geochemistry and Plume Stability Assessment. April.

ARCADIS, 2014b. Revised Interim Monitoring Work Plan. May

ASTM International. 2006. Standard Guide for Development of Conceptual Site Models and Remediation Strategies for Light Nonaqueous-Phase Liquids Released to the Subsurface. Document: E 2531-06.

ITRC. 2012. LNAPL Training Part 1: An Improved Understanding of LNAPL Behavior in the Subsurface. Washington, D.C.: Interstate Technology & Regulatory Council, LNAPLs Team. www.itrcweb.org.

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Appendix D

Interim Corrective Measures Work Plan

Environmental & Engineering Services

INTERIM RESPONSE WORK PLAN

2801 West Saginaw Street | Lansing, Michigan
PM Project Number 01-4172-3

Prepared for:

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f: 877-884-6775
t: 616-285-8857

Lansing
3340 Ranger Road
Lansing, MI 48906
f: 877-884-6775
t: 517-321-3331

May 2012

Mr. Dave Favero
Deputy Cleanup Manager - Michigan
The RACER Trust
2930 Ecorse Road
Ypsilanti, Michigan 48198

Re: DRAFT Interim Response Work Plan for Concrete Vault Removal and Test Pit Investigation for the Former General Motors Lansing Plant 2 Located at 2801 West Saginaw Street, Lansing, Michigan
MID No. 980 700 827
PM Environmental, Inc. Project No. 01-4172-3

Dear Mr. Favero:

Enclosed is one (1) CD of the above-referenced document. This Interim Response Work Plan is specific to address the subsurface concrete structures and potential PCB impacted media regulated under the federal Toxic Substance Control Act (TSCA) in Area 5-2 at the RACER Trust Lansing Plant 2 property.

If you have any questions regarding the information in this report, please contact us at (517) 321-3331.

Sincerely,
PM ENVIRONMENTAL, INC.

Casey Armstrong
Manager – Remediation Services

J. Adam Patton, CHMM
Manager of Site Investigation Services

PM ENVIRONMENTAL
ISO 9001 REGISTERED

Detroit
4080 W. 11 Mile Rd
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May 2013

Mr. Peter Quackenbush
Department of Environmental Quality
Constitution Hall, Atrium North
525 West Allegan Street
P.O. Box 30241
Lansing, Michigan 48909

Re: DRAFT Interim Response Work Plan for Concrete Vault Removal and Test Pit Investigation for the Former General Motors Lansing Plant 2 Located at 2801 West Saginaw Street, Lansing, Michigan
MID No. 980 700 827
PM Environmental, Inc. Project No. 01-4172-3

Dear Mr. Quackenbush:

Enclosed is one (1) CD of the above-referenced document. This Interim Response Work Plan is specific to address the subsurface concrete structures and potential PCB impacted media regulated under the federal Toxic Substance Control Act (TSCA) in Area 5-2 at the RACER Trust Lansing Plant 2 property.

If you have any questions regarding the information in this report, please contact us at (517) 321-3331.

Sincerely,
PM ENVIRONMENTAL, INC.

Casey Armstrong
Manager – Remediation Services

J. Adam Patton, CHMM
Manager of Site Investigation Services

Cc: Peter Ramanauskas, USEPA Region 5
Jean Greensley, USEPA Region 5

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SECTION 1.0 INTRODUCTION

This Interim Response Work Plan (Work Plan) was prepared on behalf of The RACER Trust (RACER), 2930 Ecorse Road, Ypsilanti, Michigan for the Lansing Plant 2 property located at 2801 West Saginaw Street, Lansing, Ingham County, Michigan (Figure 1), in general accordance with Title 40 Code of Federal Regulations, Chapter I, Subchapter R-Toxic Substance Control Act, Part 761 (40 CFR 761). Polychlorinated biphenyls (PCBs) were detected at the subject property in light non-aqueous phase liquid (LNAPL) at levels above relevant federal Toxic Substance Control Act (TSCA) Subpart-D concentrations during site investigations conducted by ARCADIS and PM Environmental, Inc. (PM) in 2011 and 2012. The date of the release and the concentration of the original spill are unknown.

This Interim Response Work Plan addresses Area 5-2 on the Lansing Plant 2 property and presents an excavation plan to remove an underground concrete structure and to restore and maintain the paved surface cover as an exposure barrier to existing impacted soil and groundwater. This Work Plan was prepared specifically to address impact at the subject property in Area 5-2 (Figure 2).

Section 1.1 Previous Reports

PM reviewed the following reports pertaining to previous environmental investigations during the preparation of this Work Plan:

- Current Conditions Report for GM Lansing Plants 2,3, and 6, August 1 2008, ARCADIS;
- Resource Conservation and Recovery Act (RCRA) Facility Investigation (RFI) Phase I Activities Summary Report, January 30, 2012 ARCADIS;
- Concrete Vault Wastewater Analytical Results, February 6, 2012, ARCADIS;
- RFI Phase 2 Activities Summary Report, April 2013.

Copies of the previous reports are included within Appendix A.

Section 1.2 Site Background and Investigations

On June, 1 2009, General Motors Corporation (GMC) filed for Chapter 11 Protection under U.S bankruptcy code. On July 10, 2009, GMC was renamed Motors Liquidation Company (MLC) and on the same day, some of the operating assets of GMC were sold to a newly formed company "General Motors Company". General Motors Company subsequently changed its name to General Motors LLC (GM LLC) on October 16, 2009. Assets not sold to GM LLC remained the property of MLC, in its capacity as debtor-in-possession in the bankruptcy case. On March 31, 2011, the environmental remediation of the subject property was transferred from MLC to the RACER. Ownership of this property was transferred to RACER Properties LLC, a wholly owned subsidiary of RACER.

Former General Motors Lansing Plant 2 (Plant 2) is located at 2801 West Saginaw Street in Lansing, Michigan and occupies approximately 63 acres of land. The subject property is located in the Township Four North (T. 4N), Range Two West (R. 2W), Sections 7, 17 and 18, Lansing, Ingham County, Michigan. Review of municipal records documents that the subject property is currently zoned 302 - Industrial. Refer to Figure 1 for a Property Vicinity Map and Figure 2 for a Generalized Diagram of the Subject Property and Surrounding Area.

Plant 2 was constructed in the early 1900's and operations included various automobile manufacturing processes. Decommissioning of the plant begin in 2007. For additional detail regarding previous site operations, refer to the Current Conditions Report (CCR, ARCADIS 2008, Appendix A).

The subject property buildings have been demolished; the subject property is unoccupied and secured with fencing and locked gates. Concrete slabs and asphalt parking lots remain in place. Further demolition activities are planned at the subject property to fill in the remaining pits and basements and remove miscellaneous concrete and scrap steel from the ground surface.

The RFI Phase I site investigation activities were complete between July 19, 2011 and December 1, 2011 to investigate a total of 25 Areas of Interest (AOI's) at Plant 2, which included the advancement of 39 soil borings by ARCADIS. A total of 87 soil samples and three perched groundwater samples were collected for laboratory analysis for volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), PCBs, and metals (antimony, arsenic, barium, beryllium, boron, cadmium, chromium, cobalt, copper, manganese, lead, mercury, nickel, selenium, silver, thallium, vanadium, and zinc), or a combination thereof. Site-wide analytical results from samples collected during the RFI Phase I activities are summarized in the RFI Phase I Activities Summary Report within Appendix A.

Light Non-aqueous Phase Liquid (LNAPL) was observed in a perched saturation unit at a depth of approximately 6.5 feet below ground surface (bgs) at soil boring P2-SB-37 (Figure 4) during site investigations completed in 2011. A sample of the LNAPL was collected on October 18, 2011. Various concentrations of VOCs and PCBs (52,000 µg/L) were detected in the LNAPL sample. Therefore, the LNAPL associated with P2-SB-37 was handled as a TSCA regulated substance when removed. ARCADIS' review of the chromatogram completed on the LNAPL suggests that the LNAPL is a mixture of light lubrication oil with a small amount of diesel fuel. A permanent monitoring well (MW-37) was installed at this location and a baildown recovery test was completed to assess potential recoverability of the LNAPL.

The baildown test indicated that the LNAPL exhibited a transmissivity of approximately 0.0003 feet squared per day (ft^2/day). Published transmissivity values representing lower limits for practicable LNAPL recoverability range from 0.015 ft^2/day (Beckett and Lundegard) to a range of 0.1 to 0.8 ft^2/day (ITRC 2009). The LNAPL transmissivity value calculated at well P2-SB-37/MW-37 was lower than the lower end of this recoverability threshold, suggesting that recovery of the LNAPL with in-situ techniques is not practical.

Subsequent to the completion of the RFI Phase I site investigation activities, the RFI Phase II work plan was developed and completed for further investigation of site wide AOIs. A total of 24 additional soil borings and vertical aquifer profile borings (VAP) were advanced within a 200-foot perimeter of P2-SB-37/MW-37 (Figures 3A, 3B, and 4). Additionally, the extent of LNAPL within soils at Area 5-2 was determined using laser-induced fluorescence (LIF) and installation of permanent monitoring wells. LIF allows for high-resolution assessment of LNAPL impacts based upon fluorescent properties of PNA compounds. Approximately 58 LIF soil borings were advanced in the suspected LNAPL plume at Plant 2. The horizontal extent of LNAPL based upon the LIF response is depicted on Figures 3A, 3B, and 4.

PM completed a site investigation in Area 5-2 in October 2012 which consisted of advancing 16 soil borings (P2-GP-1 through P2-GP-16) to characterize soil in Area 5-2 surrounding the subsurface

concrete structures (Figure 3B). Additionally, three permanent monitoring wells (P2-GP-1/PMW-1, P2-GP-2/PMW-2, and P2-GP-11/PMW-3) were installed on the perimeter of the concrete structures (Figure 4).

In November 2012, ARCADIS installed nine wells Plant 2 (LMW-12-01 through LMW-12-08, and LMW-12-03D) to facilitate LNAPL transmissivity testing. The new wells were installed in areas where previous LIF screening results indicated the highest relative fluorescence responses, where fluorescence intensity is roughly proportionate to LNAPL saturation. In February 2013, only 2 of the 13 wells contained sufficient LNAPL thickness accumulations (>0.2 foot) to facilitate LNAPL transmissivity testing (LMW-12-03D with 8.10 feet, and PMW-01 with 0.64 foot).

Manual LNAPL skimming tests were initiated in wells LMW-12-03D and PMW-01 on February 6, 2013. The manual LNAPL skimming test completed at well LMW-12-03D was analyzed in accordance with ASTM guidance, yielding a transmissivity value of approximately 0.005 square feet per day (ft^2/day). The test completed at PMW-1 could not be analyzed using conventional manual skimming test analysis. Instead, fluid level data collected during the initial recharge monitoring step of the test was analyzed using the Cooper and Jacob (1946)/Jacob and Lohman (1952) baildown test analysis method provided in the API LNAPL Transmissivity Workbook (API 2012), which yielded an estimated LNAPL transmissivity of 0.01 ft^2/day.

The ITRC suggests LNAPL transmissivity range of 0.1 to 0.8 ft²/day as a lower-bound threshold for practicable LNAPL recovery using hydraulic methods (ITRC 2009). Measured LNAPL transmissivity at wells LMW-12-03D and PMW-1 are at least an order of magnitude lower than this range, indicating that LNAPL is minimally recoverable at these wells. While LNAPL transmissivity could not be directly measured at 11 of the 13 wells located in Plant 2, the lack of LNAPL accumulation suggests that LNAPL transmissivity is very low and likely less than LNAPL transmissivity in wells that contained sufficient LNAPL to permit transmissivity testing.

During completion of previous site investigations at Area 5-2, a concrete vault was discovered approximately 20-feet south of P2-SB-37/MW-37 (Figures 3A, 3B and 4). The concrete vault measures approximately 25-feet long (east to west), 4-feet wide, and 4-feet deep. Additionally, two concrete trenches are located directly north of the vault and are partially filled with soil and stone. A 10-inch diameter hole was cored through the top of the vault to inspect the contents. The concrete slab and associated concrete lid covering the vault area were determined to be 10.0 inches thick. As of August 1, 2012, 1.27 feet of liquid was measured in the concrete vault which exhibits a visual petroleum sheen. Analytical results of the samples collected from the concrete vault (Appendix A), indicate this liquid will be disposed of as characteristically non-hazardous, non-TSCA regulated waste water.

Section 1.3 Soil Analytical Results

The soil PCB analytical results from the 40 sample locations in the area of P2-SB-37/MW-37 are summarized in Tables 1A and 1B and Figures 3A and 3B. The concentrations of PCBs (1,100-10,000 µg/Kg) at P2-SB-24, SB-A5.2-NR128, SB-A5.2-NZ128, VAP-A5.2-NV119, P2-GP-2, P2-GP-3, P2-GP-4, and P2-GP-15 are above the TSCA, 40 CFR 761(d)(4), direct contact criterion for high occupancy use without a cap (1,000 µg/Kg), but at or below the high occupancy use with a cap and deed restriction criterion (10,000 µg/Kg). The concentrations of PCBs (22,000-39,000 µg/Kg) at SB-A5.2-NW124 and VAP-A5.2-NV119 are above the TSCA, 40 CFR 761(d)(4), direct contact criterion for high occupancy use with a cap and deed restriction criterion (10,000 µg/Kg).

With respect to PCB soil impact the horizontal extent of impact is delineated to below the laboratory method detection levels (MDLs) and/or TSCA direct contact criterion for high occupancy use without a cap to the west (SB-A5.2-NL114, SB-A5.2-NO106, SB-A5.2-NT111, SB-A5.2-NU107 and SB-A5.2-OC107), south (SB-A5.2-OB120 and VAP-A5.2-OE129), east (SB-A5.2-NZ138, SB-A5.2-NZ144, and SB-A5.2-OA138), and north (SB-A5.2-NG127 and SB-A5.2-NJ145). The vertical extents of PCB impact is delineated to below MDLs at each sample location surrounding P2-SB-37/MW-37 (Tables 1A and 1B and Figures 3A and 3B).

Section 1.4 Groundwater Analytical Results

The groundwater analytical results from four sample locations (VAP-A5.2-NV119, VAP-A5.2-OE129, VAP-A5.2-NK132, and VAP-A5.2-NU137) that were collected on the perimeter of P2-SB/MW-37 are summarized in Table 2 and Figure 4. Concentrations of PCBs (30-800 µg/L) in groundwater at VAP-A5.2-NV119 exceed the MDEQ Part 201 Nonresidential Drinking Water (DW), Groundwater Surface Water Interface (GSI), Groundwater Volatilization to Indoor Air Inhalation (GVII), and/or Groundwater Contact (GC) Generic Cleanup Criteria.

With respect to PCB groundwater impact, the horizontal extent of impact is delineated to below the laboratory MDLs and/or the most restrictive MDEQ Part 201 Tier 1 cleanup criteria to the south (VAP-A5.2-OE129), east (VAP-A5.2-NK137), and north (VAP-A5.2-NK132). The vertical extents of PCB impact is delineated to below MDLs at each sample location surrounding P2-SB-37/MW-37 (Table 2 and Figure 4). On a site-wide basis, PCB groundwater impact is defined to the west beyond Area 5-2 (Appendix A).

Section 1.5 Geology and Hydrogeology

A review of the 7.5 Minute, Lansing South Quadrangle, Map (Figure 1) prepared by the United States Geological Survey (USGS), dated 1965, photorevised 1973, indicates that the subject property is approximately 860 feet relative to the National Geodetic Vertical Datum (NGVD). The immediate subject property area appears to be relatively flat.

The Quaternary Geologic Map of Michigan (Farrand and Bell 1982a, 1982b) indicates the unconsolidated glacial geology at the subject property consists of “fine-textured glacial till”. Bedrock beneath the subject property is composed of the Pennsylvanian Grand River and Saginaw geologic formations. Together, the Grand River and Saginaw Formations form a major and productive drinking water aquifer. Locally, the bedrock surface is encountered at the depth of approximately 60 feet below ground surface (bgs) beneath the east adjoining property and a depth of 110 feet bgs beneath the north adjoining property, suggesting the bedrock surface in the area has significant topography.

In general, the shallow lithology at the subject property consists of 5 to 10 feet of sandy fill imported to the site during original construction activities, underlain by clay and clay/sand/silt mixtures that are heavily interbedded with thin silt, sand and occasional gravel seams to depth of 30.0 feet bgs.

Groundwater beneath Plant 2 is encountered within multiple hydrostratigraphic units at varying depths across the subject property. The groundwater at the subject property has been divided in four aquifers: deep bedrock, deep overburden, middle overburden (approximately 30.0 to 40.0 feet bgs), and perched (approximately 5.0 to 15.0 feet bgs) groundwater units. The perched groundwater units are generally located where fill material overlies low permeability clays. Often the perched groundwater is located immediately below the ground surface. The perched unit

appears to be local, discontinuous, and potentially seasonal in nature. As such, the perched groundwater does not appear representative of an aquifer.

The primary water supply in the Lansing area is the Grand River-Saginaw aquifer, which is the principle source of municipal, industrial, and domestic drinking water in the Lansing area. The Grand River-Saginaw aquifer consists chiefly of sandstone as well as interbedded shale and siltstone. Because the sandstone of the Grand River Formation was formed within erosional valleys of the Saginaw Formation, the two formations are hydraulically connected and comprise one aquifer.

SECTION 2.0 INTERIM RESPONSE WORK PLAN ACTIVITIES

This Work Plan outlines activities intended excavate and dispose of the subsurface concrete structures located in Area 5-2. Subsequent to the completion of the interim work plan, a TSCA-compliant PCB remediation work plan will be prepared which will include land-use restrictions and requirements for maintaining surface pavement as a cap to prevent direct contact with residual impacted soils. Sections 2.1 through 2.4 below detail the interim response activities proposed.

Section 2.1 Concrete Vault Excavation/Test Pit Investigation

An excavation/test pit of the subsurface concrete structures is proposed in the area of P2-SB-37/MW-37 and P2-GP-2/PMW-2. Prior to excavating the concrete vault, waste characterization sampling of the liquid within the vault will be completed to determine appropriate disposal methods. Approximately 1,200-gallons of liquid will be removed from the vault, transported and properly disposed at a licensed disposal facility. Any PCB impacted material in excess of 50 ppm will be containerized separately (i.e., in sealed roll-off boxes, drums, or other suitable containers) and transported for proper disposal at The Environmental Quality Company's (EQ's) Wayne Disposal facility in Belleville, Michigan.

The concrete vault/test pit excavation area has potential to encounter soils/liquids containing concentrations of PCBs greater than 50 ppm, based upon its proximity to the LNAPL monitoring wells P2-SB-37/MW-37 and P2-GP-2/PMW-2. The concrete vault measures approximately 25-feet long (east to west), 4-feet wide, and 4-feet deep. Addiitonally, two concrete trenches are located directly north of the vault and are partially filled with soil and stone. The proposed excavation to remove the vault and trenches is estimated to be 50 feet long (east to west) by 90 feet wide (north to south) and up to 10 feet deep (Figure 5). An estimated total of 200 cubic yards of concrete (slab, vault, and trenches) and up to 1,700 cubic yards of soil will be generated for proper offsite disposal.

Concrete and soil sampling will be performed for waste characterization purposes to determine appropriate disposal methods. In accordance with 40 CFR 761, Subpart-O, up to 50 verification samples will be collected from the concrete vault/test pit for laboratory analysis of PCBs. The exact number of samples will be determined based upon the final dimensions of the test pit excavation.

The excavation area will be backfilled with Class III fill sand compacted in place with onsite equipment, and topped to within 6.0 inches of final grade with course sub-base material (i.e., crushed stone, gravel, crushed limestone, or equivalent material) in preparation of final cap. The final cap will consist of 6.0 inches of reinforced concrete in accordance with 40 CFR 761(a)(3).

Following the completion of the subsurface investigation, which documents the extent of the PCB

impact at levels above the TSCA direct contact criterion for low occupancy use with a cap, a Summary Report will be completed. The Summary Report will detail the investigation and include analytical tables, soil boring logs/well construction diagrams, excavation profiles, disposal documentation, and soil boring and groundwater sampling location maps.

Subsequent to the completion of the above tasks, a Risk-Based PCB Remediation Work Plan will be completed which will include restricting land use for purposes consistent with a Nonresidential Land- Use as defined in the December 2010 amendments to Michigan Part 201 and in a manner consistent with a low occupancy area as defined under TSCA.

Section 2.2 Project Staff

The following is a list of staff that will be involved with this project. This list can also be found in the site-specific Health and Safety Plan (HASP).

- Project Managers: Casey Armstrong, J. Adam Patton, CHMM, and Peter S. Bosanic, P.E.
- Site Safety Officer: Steve Stelter
- Project Staff: Alex Villhauer, Bruce Lemmon, Clifford Walls and Kelly Lennon

Section 2.3 Schedule

The project activities will be scheduled following the approval of this Work Plan and will generally adhere to the following schedule:

- Vault excavation activities will be complete in up to 15 business days.
- Laboratory analysis will be complete in up to 10 business days.
- The final investigation report will be complete within 45 business days following receipt of the laboratory report.

Section 2.4 Health and Safety Plan

A site-specific HASP was developed for this project by PM. All field personnel will be required to review, sign and date the HASP before beginning any site activities within each project phase. A copy of the HASP is available upon request.

SECTION 3.0 CERTIFICATION

In accordance with 40 CFR 761.61(a)(3)(i)(E), PM on behalf of RACER conducting this work plan, certify that all sampling plans, sample collection procedures, sample preparation procedures, extraction procedures, and instrument/chemical analysis procedures used by PM to assess or characterize the PCB contamination at the subject property will be maintained on file at the PM office located at 3340 Ranger Road, Lansing, Ingham County, Michigan, and will be made available for inspection by the MDEQ and/or the USEPA.

Work Plan Prepared By:

Casey Armstrong
Manager – Remediation Services

Work Plan Reviewed By:

J. Adam Patton, CHMM
Manager of Site Investigation Services

Tables

PM ENVIRONMENTAL Environmental & Engineering Services

TABLE 1A
SUMMARY OF SOIL ANALYTICAL RESULTS - PCBS
FORMER GENERAL MOTORS LANSING PLANT 2; AREA OF INTEREST OF 5.2
PM ENVIRONMENTAL PROJECT NUMBER 01-4172-3

Polychlorinated Biphenyls (PCBs) (ug/kg)			Aroclor-1016 (PCB-1016)	Aroclor-1221 (PCB-1221)	Aroclor-1232 (PCB-1232)	Aroclor-1242 (PCB-1242)	Aroclor-1248 (PCB-1248)	Aroclor-1254 (PCB-1254)	Aroclor-1260 (PCB-1260)	Total PCBs
Location ID:	**Date Collected:**	**Depth (ft):**								
P2-SB-29	Not Analyzed	NA	NA	NA	NA	NA	NA	NA	NA	NA
P2-SB-14	08/31/11	9 - 10	<3	<3	<3	<3	<3	<3	<3	<3
		14 - 15	<3	<3	<3	<3	<3	<3	<3	<3
SB-A5.2-NG127	05/02/12	2 - 3	<3	<3	<3	<3	<3	<3	<15	ND
		6 - 7	<3	<3	<3	<3	<3	<3	<3	ND
		13 - 14	<3	<3	<3	<3	<3	<3	<3	ND
		19 - 20	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-NJ129	05/23/12	1 - 2	<3	<3	<3	<3	<3	<3	8	8
		8.5 - 9.5	<20 Y	<20 Y	<20 Y	<20 Y	<20 Y	120 Y	<20 Y	120
		12.5 - 13	<3	<3	<3	<3	<3	60	<3	60
		13.5 - 14.5	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-NJ145	05/08/12	1 - 2	<3	<3	<3	<3	<3	<3	<3	ND
		7 - 8	<3	<3	<3	<3	<3	<7	<3	ND
		15 - 16	<3	<3	<3	<3	<3	<3	<3	ND
		21 - 22	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-NL114	05/23/12	1 - 2	<3	<3	<3	<3	<3	<3	<3	ND
		8.5 - 9.5	<3	<3	<3	<3	<3	<3	<3	ND
		14.5 - 15.5	<3	<3	<3	<3	<3	<3	<3	ND
		16.5 - 17.5	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-NL121	05/02/12	1 - 2	<3	<3	<3	<3	<3	<10	<3	ND
		5 - 6	<3	<3	<3	<3	<3	<3	<3	ND
		10 - 11	<3	<3	<3	<3	<3	<3	<3	ND
		15 - 16	<3	<3	<3	<3	<3	<3	<3	ND
		20 - 21	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-NV133	04/30/12	1 - 2	<3	<3	<3	<3	<3	<3	<3	ND
		4 - 5	<3	<3	<3	40 Q	<3	<3	<3	40
		6 - 7	<10 X	<10 X	<10 X	<10 X	<10 X	10 X	<10 X	10
		9 - 10	<3	<3	<3	<3	<3	<3	<3	ND
		12 - 13	<3	<3	<3	<3	<3	<3	<3	ND
		18 - 19	<5 X	<5 X	<5 X	<5 X	<5 X	<5 X	<5 X	ND
		23 - 24	<3	<3	<3	<3	<3	<3	<3	ND
		28 - 29	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-NW124	05/01/12	1 - 2	<3	<3	<3	<3	<3	<3	<20	ND
		4 - 5	<3,000 Y	<3,000 Y	<3,000 Y	**22,000 Y**	<3,000 Y	<3,000 Y	<3,000 Y	**22,000**
		7 - 8	<8 Y	<8 Y	<8 Y	<8 Y	<8 Y	<8 Y	<8 Y	100
		11 - 12	<3	<3	<3	<20	<3	<3	<3	ND
		16 - 17	<3	<3	<3	<3	<3	<3	<3	ND
		22 - 23	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-NR128	05/01/12	1 - 2	<130 Y	<130 Y	<130 Y	**2,400**	<130 Y	<130 Y	<130 Y	**2,400**
		3 - 4	<50 Y	<50 Y	<50 Y	500	<50 Y	<50 Y	<50 Y	500
		8 - 9	<8 Y	<8 Y	<8 Y	100	<8 Y	<8 Y	<8 Y	100
		13 - 14	<3	<3	<3	<3	<3	<3	<3	ND
		17 - 18	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-NZ128	05/01/12	1 - 2	<3	<3	<3	<3	<3	<3	<3	ND
		4 - 5	<300 Y	<300 Y	<300 Y	**2,800 Q**	<300 Y	<300 Y	<300 Y	**2,800**
		6.5 - 7.5	<50 Y	<50 Y	<50 Y	600 YQ	<50 Y	<50 Y	<50 Y	600
		11 - 12	<3	<3	<3	<3	<3	<3	<3	ND
		16 - 17	<3	<3	<3	<3	<3	<3	<3	ND
		20 - 21	<3	<3	<3	<3	<3	<3	<3	ND
		25 - 26	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-NZ138	05/01/12	1 - 2	<5 X	<5 X	<5 X	<5 X	<5 X	10 X	<5 X	10
SB-A5.2-NZ144	05/04/12	1 - 2	<5 X	<5 X	<5 X	<5 X	<5 X	<5 X	<5 X	ND
		6 - 7	<3	<3	<3	<3	<3	<3	<3	ND
		12 - 13	<3	<3	<3	<3	<3	<3	<3	ND
		18 - 19	<3	<3	<3	<3	<3	<3	<3	ND
		24 - 25	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-OA138	05/10/12	1 - 2	<8 Y	<8 Y	<8 Y	<8 Y	<8 Y	100 Y	<8 Y	100
		7 - 8	<3	<3	<3	<3	<3	<3	<3	ND
		11 - 12	<3	<3	<3	<3	<3	<3	<3	ND
		17 - 18	<3	<3	<3	<3	<3	<3	<3	ND
		23 - 24	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-OB120	05/22/12	1.5 - 2.5	<3	<3	<3	<3	<3	<3	<3	ND
		7.5 - 8.5	<3	<3	<3	<3	<3	<3	<3	ND
		23 - 24	<3	<3	<3	<3	<3	6	<3	6
		26 - 27	<20 Y	<20 Y	<20 Y	<20 Y	<20 Y	160 Y	<20 Y	160
SB-A5.2-NU132	04/30/12	1 - 2	<3	<3	<3	<3	<3	<3	<3	ND
		2 - 3	<30 Y	<30 Y	<30 Y	300 YQ	<30 Y	<30 Y	<30 Y	300
VAP-A5.2-NV119	05/03/12	1 - 2	<30 Y	<30 Y	<30 Y	<30 Y	<30 Y	600	<30 Y	600
		6 - 7	<3,000 Y	<3,000 Y	<3,000 Y	**39,000**	<3,000 Y	<3,000 Y	<3,000 Y	**39,000**
		8 - 9	<300 Y	<300 Y	<300 Y	**5,400**	<300 Y	<300 Y	<300 Y	**5,400**
		14 - 15	<3	<3	<3	<5	<3	<3	<3	ND
		18 - 19	<250 Y	<250 Y	<250 Y	**4,500**	<250 Y	<250 Y	<250 Y	**4,500**
		24 - 25	<3	<3	<3	<20	<3	<3	<3	ND
		28 - 29	<3	<3	<3	<6	<3	<3	<3	ND
		33 - 34	<3	<3	<3	<3	<3	<3	<3	ND
VAP-A5.2-OE129	05/01/12	7 - 8	<3	<3	<3	<3	<3	<3	<3	ND
		12 - 13	<8 Y	<8 Y	<8 Y	<8 Y	<8 Y	100	<8 Y	100
		17 - 18	<3	<3	<3	<3	<3	<3	<3	ND
		22 - 23	<3	<3	<3	<3	<3	<3	<3	ND
VAP-A5.2-NU137	04/30/12	0 - 2	<10 Y	<10 Y	<10 Y	<10 Y	<10 Y	100	<10 Y	100
		5 - 6	<5 X	<5 X	<5 X	<5 X	<5 X	<5 X	<5 X	ND
		10 - 11	<3	<3	<3	<3	<3	<3	<3	ND
		15 - 16	<3	<3	<3	<3	<3	<3	<3	ND
		20 - 21	<3	<3	<3	<3	<3	<3	<3	ND
VAP-A5.2-NK132	05/15/12	1 - 2	<3	<3	<3	<3	<3	<3	<3	ND
		8 - 9	<100 Y	<100 Y	<100 Y	400	<100 Y	<100 Y	<100 Y	400
		14 - 15	<3	<3	<3	<3	<3	<3	<3	ND
		27 - 28	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-NT111	05/03/12	1 - 2	<3	<3	<3	<3	<3	<3	<3	ND
		4 - 5	<3	<3	<3	<3	<3	<3	<3	ND
		7 - 8	<3	<3	<3	<3	<3	<3	<3	ND
		12 - 13	<3	<3	<3	<3	<3	<3	<3	ND
		17 - 18	<3	<3	<3	<3	<3	<3	<3	ND
		19 - 20	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-NO106	05/03/12	1 - 2	<3	<3	<3	<3	<3	<3	<3	ND
		6 - 7	<3	<3	<3	<3	<3	<3	<3	ND
		10 - 11	<3	<3	<3	<3	<3	<3	<3	ND
		13 - 14	<3	<3	<3	<3	<3	<3	<3	ND
		20 - 21	<3	<3	<3	<3	<3	<3	<3	ND
		24 - 25	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-NO116	05/02/12	1 - 2	<3	<3	<3	<3	<3	<3	<3	ND
		2 - 3	<3	<3	<3	<3	<3	<3	<40	ND
		7 - 8	<3	<3	<3	<3	<3	<3	<3	ND
		12 - 13	<3	<3	<3	<3	<3	<3	<3	ND
		17 - 18	<3	<3	<3	<3	<3	<3	<3	ND
		22 - 23	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-NU107	05/22/12	1.5 - 2.5	<3	<3	<3	<3	<3	<3	<3	ND
		8 - 9	<3	<3	<3	<3	<3	10	<3	10
		12 - 13	<6 X	<6 X	<6 X	<6 X	<6 X	<6 X	<6 X	ND
		15.5 - 16.5	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-OC107	05/22/12	1.9 - 2.9	<3	<3	<3	<3	<3	10	<3	10
		5.5 - 6.5	<3	<3	<3	<3	<3	<3	<3	ND
		8 - 9	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-OC107A	05/22/12	8 - 9	<3	<3	<3	<3	<3	3	<3	3
		16 - 17	<3	<3	<3	<3	<3	<3	<3	ND
SB-A5.2-NK111	05/03/12	1 - 2	<3	<3	<3	<3	<3	<3	<3	ND
		7.5 - 8.5	<3	<3	<3	<3	<3	<30	<3	ND
		12 - 13	<3	<3	<3	<3	<3	<3	<3	ND
		15 - 16	<3	<3	<3	<3	<3	<3	<3	ND
		20 - 21	<3	<3	<3	<3	<3	<3	<3	ND
		23 - 24	<3	<3	<3	<3	<3	<3	<3	ND
		25 - 26	<3	<3	<3	<3	<3	<3	<3	ND

Operational Memorandum No. 1: Part 201 Cleanup Criteria and Part 213 Risk-based Screening Levels (RBSLs),
Attachment 1: Soil Tables 2 and 3 Residential and Nonresidential Part 201 Generic Cleanup Criteria and Screening Levels; Part 213 Tier 1 RBSLs, March 25, 2011

Residential (µg/Kg)									
Statewide Default Background Levels	NA	NA	NA	NA	NA	NA	NA	NA	
Drinking Water Protection (Res DWP)	NLL	NLL	NLL	NLL	NLL	NLL	NLL	NLL	
Groundwater Surface Water Interface Protection (GSIP)	NLL	NLL	NLL	NLL	NLL	NLL	NLL	NLL	
GSIP Human Drinking Water	NA	NA	NA	NA	NA	NA	NA	NA	
Groundwater Contact Protection (GCP)	NLL	NLL	NLL	NLL	NLL	NLL	NLL	NLL	
Soil Volatilization to Indoor Air Inhalation (Res SVII)	3.0E+06	3.0E+06	3.0E+06	3.0E+06	3.0E+06	3.0E+06	3.0E+06	3.0E+06	
Ambient Air Infinite Source Volatile Soil Inhalation (Res VSI)	240,000	240,000	240,000	240,000	240,000	240,000	240,000	240,000	
Ambient Air Finite VSI for 5 Meter Source Thickness	7.9E+06	7.9E+06	7.9E+06	7.9E+06	7.9E+06	7.9E+06	7.9E+06	7.9E+06	
Ambient Air Finite VSI for 2 Meter Source Thickness	7.9E+06	7.9E+06	7.9E+06	7.9E+06	7.9E+06	7.9E+06	7.9E+06	7.9E+06	
Ambient Air Particulate Soil Inhalation (Res PSI)	5.2E+06	5.2E+06	5.2E+06	5.2E+06	5.2E+06	5.2E+06	5.2E+06	5.2E+06	
Direct Contact (Res DC)	1,000 {T}	1,000 {T}	1,000 {T}	1,000 {T}	1,000 {T}	1,000 {T}	1,000 {T}	1,000 {T}	
Nonresidential (µg/Kg)									
Drinking Water Protection (Nonres DWP)	NLL	NLL	NLL	NLL	NLL	NLL	NLL	NLL	
Soil Volatilization to Indoor Air Inhalation (Nonres SVII)	1.6E+07	1.6E+07	1.6E+07	1.6E+07	1.6E+07	1.6E+07	1.6E+07	1.6E+07	
Ambient Air Infinite Source Volatile Soil Inhalation (Nonres VSI)	810,000	810,000	810,000	810,000	810,000	810,000	810,000	810,000	
Ambient Air Finite VSI for 5 Meter Source Thickness	2.8E+07	2.8E+07	2.8E+07	2.8E+07	2.8E+07	2.8E+07	2.8E+07	2.8E+07	
Ambient Air Finite VSI for 2 Meter Source Thickness	2.8E+07	2.8E+07	2.8E+07	2.8E+07	2.8E+07	2.8E+07	2.8E+07	2.8E+07	
Ambient Air Particulate Soil Inhalation (Nonres PSI)	6.5E+06	6.5E+06	6.5E+06	6.5E+06	6.5E+06	6.5E+06	6.5E+06	6.5E+06	
Direct Contact (Nonres DC)	10,000 {T}	10,000 {T}	10,000 {T}	10,000 {T}	10,000 {T}	10,000 {T}	10,000 {T}	10,000 {T}	

{T} Refer to the Toxic Substance Control Act (TSCA), 40 CFR 761, Subparts D and G, as amended, to determine the applicability of TSCA cleanup standards. Alternatives to compliance with the standards listed below are possible under Subpart D. New Releases may be subject to the standards identified in Subpart G. Use Part 201 soil direct contact criteria in the table below where TSCA standards are not applicable.

LAND USE CATEGORY	TSCA, Subpart D	Part 201
Residential	1,000 µg/Kg, or 10,000 µg/Kg if capped	4,000 µg/Kg
Nonresidential		16,000 µg/Kg

Criteria Exceeded
BOLD Value Exceeds Applicable Criteria
bgs Below Grade Surface (feet)
1 Maximum of analyzed or calculated total lead value.

X Elevated reporting limit due to matrix interference
Y Elevated reporting limit due to high target concentraion

TABLE 2
SUMMARY OF GROUNDWATER ANALYTICAL RESULTS - PCBS
FORMER GENERAL MOTORS LANSING PLANT 2; AREA OF INTEREST 5-2
PM ENVIRONMENTAL PROJECT NUMBER 01-4172-3

Polychlorinated Biphenyls (PCBs) **(ug/L)**			Aroclor-1016 (PCB-1016)	Aroclor-1221 (PCB-1221)	Aroclor-1232 (PCB-1232)	Aroclor-1242 (PCB-1242)	Aroclor-1248 (PCB-1248)	Aroclor-1254 (PCB-1254)	Aroclor-1260 (PCB-1260)	Total PCBs
Location ID:	**Date Collected:**	**Depth (ft):**								
P2-SB-37/MW-37 (LNAPL)	10/18/11	5.0-10.0	ND Y	**52,000**	ND Y	ND Y	ND Y	ND Y	ND Y	**52,000**
P2-PMW-2 (LNAPL	10/19/12	2.6-7.6	ND Y	ND Y	ND Y	**133,000**	ND Y	ND Y	ND Y	**133,000**
VAP-A5.2-NK132	05/15/12	10.0-11.0	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	ND
		21.0-22.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	ND
		30.0-32.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	ND
VAP-A5.2-NU137	05/01/12	16.0-18.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	ND
		24.0-26.0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	ND
VAP-A5.2-NV119	05/02/12	8.0-9.0	<100 Y	<100 Y	<100 Y	**800 Y**	<100 Y	<100 Y	<100 Y	**800**
		20.0-22.0	<5 Y	<5 Y	<5 Y	**30 Y**	<5 Y	<5 Y	<5 Y	**30**
VAP-A5.2-OE129	05/02/12	18.5-19.5	<0.05	<0.05	<0.05	<0.05	<0.05	0.05	<0.05	0.05
Operational Memorandum No. 1: Part 201 Cleanup Criteria and Part 213 Risk-based Screening Levels (RBSLs), Attachment 1: Soil Tables 2 and 3 Residential and Nonresidential Part 201 Generic Cleanup Criteria and Screening Levels; Part 213 Tier 1 RBSLs, March 25, 2011										
Residential & Nonresidential (µg/L)										
Residential Drinking Water (Res DW)			0.5 {A}	0.5 {A}	0.5 {A}	0.5 {A}	0.5 {A}	0.5 {A}	0.5 {A}	0.5 {A}
Residential Health Based Drinking Water Values			NL	NL	NL	NL	NL	NL	NL	NL
Nonresidential Drinking Water (Nonres DW)			0.5 {A}	0.5 {A}	0.5 {A}	0.5 {A}	0.5 {A}	0.5 {A}	0.5 {A}	0.5 {A}
Nonresidential Health Based Drinking Water Values			NL	NL	NL	NL	NL	NL	NL	NL
Groundwater Surface Water Interface (GSI)			0.2 {M}; 2.6E-5	0.2 {M}; 2.6E-5	0.2 {M}; 2.6E-5	0.2 {M}; 2.6E-5	0.2 {M}; 2.6E-5	0.2 {M}; 2.6E-5	0.2 {M}; 2.6E-5	0.2 {M}; 2.6E-5
GSI Final Acute Values (FAV) [1]			ID	ID	ID	ID	ID	ID	ID	ID
GSI Human Drinking Water			NA	NA	NA	NA	NA	NA	NA	NA
Residential Groundwater Volatilization to Indoor Air Inhalation (Res GVII) [2]			45 {S}	45 {S}	45 {S}	45 {S}	45 {S}	45 {S}	45 {S}	45 {S}
Nonresidential Groundwater Volatilization to Indoor Air Inhalation (Nonres GVII) [2]			45 {S}	45 {S}	45 {S}	45 {S}	45 {S}	45 {S}	45 {S}	45 {S}
Groundwater Contact (GC)			3.3 {AA}	3.3 {AA}	3.3 {AA}	3.3 {AA}	3.3 {AA}	3.3 {AA}	3.3 {AA}	3.3 {AA}

aa

Criteria/RBSL Exceeded

BOLD Value Exceeds Applicable Criteria

bgs Below Grade Surface (feet)

ND Not detected at levels above the laboratory Method Detection Limit (MDL) or Minimum Quantitative Level (MQL)

[1] Rule 323.1057 of Part 4 Water Quality Standards

[2] Tier 1 GVII Criteria based on 3 meter (or greater) groundwater depth

[3] (Program Redesign 2009 Draft) Screening Levels based on depth to groundwater less than 3 meters and not in contact with building foundation

Y Elevated reporting limit due to high target concentration

NL Not Listed

TABLE 1B
SUMMARY OF SOIL ANALYTICAL RESULTS
POLYCHLORINATED BIPHENYLS (PCBs) VOLATILE ORGANIC COMPOUNDS (VOCs)
FORMER LANSING PLANT 2, 2801 WEST SAGINAW STREET, LANSING, MICHIGAN
PME PROJECT # 01-4172-3

Polychlorinated Biphenyls (PCBs) & Volatile Organic Compounds (VOCs)			Polychlorinated Biphenyls	Chloroethane	1,1-Dichloroethane	Ethylbenzene	Toluene	1,1,1-Trichloroethane	Trichloroethylene	Xylenes	1,2,4-Trichlorobenzene	Other VOCs
Chemical Abstract Service Number (CAS#)			1336363	75003	75343	100414	108883	71556	79016	1330207	120821	Various
Sample ID	**Sample Date**	**Sample Depth (bgs)**	**PCBs**	**VOCs**								
P2-GP-1	10/11/2012	7.0-7.5	140	780	90	<70	80	<70	<70	<170	<70	ND
P2-GP-2	10/11/2012	1.0-2.0	**5,300**	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-2	10/11/2012	7.0-7.5	550	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-3	10/11/2012	4.0-5.0	**1,100**	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-4	10/11/2012	4.0-5.0	**2,600**	260	90	<60	490	<60	80	200	90	ND
A-1 (Duplicate)			**3,200**	330	250	<60	570	100	90	200	110	ND
P2-GP-4	10/11/2012	8.0-9.0	180	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-5	10/11/2012	4.0-5.0	17	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-5	10/11/2012	8.0-9.0	<6	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-6	10/11/2012	4.0-5.0	160	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-7	10/11/2012	5.0-6.0	240	1,170	<60	<60	<60	<60	<60	<160	<60	ND
P2-GP-8	10/11/2012	5.0-6.0	51	<600	4,100	**12,200**	<600	<600	<600	**65,500**	<600	ND
P2-GP-9	10/11/2012	4.0-5.0	37	NA	NA	NA	NA	NA	NA	NA	NA	ND
A-3 (Duplicate)			27	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-10	10/12/2012	2.0-3.0	<3	<60	<60	<60	<60	<60	<60	<160	<60	ND
P2-GP-11	10/12/2012	3.0-4.0	170	<60	170	<60	<60	60	<60	<160	<60	ND
P2-GP-12	10/19/2012	2.0-3.0	3	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-12	10/19/2012	5.0-6.0	<3	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-13	10/19/2012	2.0-3.0	6	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-13	10/19/2012	6.0-7.0	200	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-14	10/19/2012	1.0-2.0	<3	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-14	10/19/2012	6.0-7.0	16	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-15	10/19/2012	1.0-2.0	800	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-15	10/19/2012	4.0-5.0	**4,700**	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-15	10/19/2012	10.0-11.0	200	NA	NA	NA	NA	NA	NA	NA	NA	ND
P2-GP-16	10/19/2012	1.0-2.0	<3	NA	NA	NA	NA	NA	NA	NA	NA	ND
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Residential (µg/Kg)												
Statewide Default Background Levels			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Drinking Water Protection (Res DWP)			NLL	8,600	18,000	1,500	16,000	4,000	100	5,600	4,200	Various
Groundwater Surface Water Interface Protection (GSIP)			NLL	22,000 {X}	15,000	360	5,400	1,800	4,000 {X}	820	5,900 {X}	Various
GSIP Human Drinking Water			NA	NA	NA	NA	NA	NA	580	NA	NA	Various
Groundwater Contact Protection (GCP)			NLL	9.5E+5 {C}	8.9E+5 {C}	1.4E+5 {C}	2.5E+5 {C}	4.6E+5 {C}	4.4E+5	1.5E+5 {C}	1.10E+06	Various
Soil Volatilization to Indoor Air Inhalation (Res SVII)			3.0E+06	9.5E+5 {C}	230,000	87,000	2.5E+5 {C}	250,000	7,100	1.5E+5 {C}	1.1E+6 {C}	Various
Ambient Air Infinite Source Volatile Soil Inhalation (Res VSI)			240,000	3.00E+07	2.10E+06	720,000	2.80E+06	3.80E+06	78,000	4.60E+07	2.80E+07	Various
Ambient Air Finite VSI for 5 Meter Source Thickness			7.9E+06	1.20E+08	5.90E+06	1.00E+06	5.10E+06	1.20E+07	1.70E+05	6.10E+07	2.80E+07	Various
Ambient Air Finite VSI for 2 Meter Source Thickness			7.9E+06	2.80E+08	1.40E+07	2.20E+06	1.20E+07	2.80E+07	3.90E+05	1.30E+08	2.80E+07	Various
Ambient Air Particulate Soil Inhalation (Res PSI)			5.2E+06	6.70E+11	3.30E+10	1.00E+10	2.70E+10	6.70E+10	1.80E+09	2.90E+11	2.50E+10	Various
Direct Contact (Res DC)			1,000 {T}	9.5E+5 {C}	8.9E+5 {C}	1.4E+5 {C}	2.5E+5 {C}	4.6E+5 {C}	5.0E+5 {C,DD}	1.5E+5 {C}	9.9E+5 {DD}	Various
Nonresidential (µg/Kg)												
Drinking Water Protection (Nonres DWP)			NLL	34,000	50,000	1,500	16,000	4,000	100	5,600	4,200	Various
Soil Volatilization to Indoor Air Inhalation (Nonres SVII)			1.6E+07	9.5E+5 {C}	430,000	1.4E+5 {C}	2.5E+5 {C}	460,000	37,000	1.5E+5 {C}	1.1E+6 {C}	Various
Ambient Air Infinite Source Volatile Soil Inhalation (Nonres VSI)			810,000	3.60E+07	2.50E+06	2.40E+06	3.30E+06	4.50E+06	260,000	5.40E+07	3.40E+07	Various
Ambient Air Finite VSI for 5 Meter Source Thickness			2.8E+07	1.20E+08	6.00E+06	3.10E+06	3.60E+07	1.50E+07	440,000	6.50E+07	3.40E+07	Various
Ambient Air Finite VSI for 2 Meter Source Thickness			2.8E+07	2.80E+08	1.40E+07	6.50E+06	3.60E+07	3.10E+07	1.10E+06	1.30E+08	3.40E+07	Various
Ambient Air Particulate Soil Inhalation (Nonres PSI)			6.5E+06	2.90E+11	1.50E+10	1.30E+10	1.20E+10	2.90E+10	2.30E+09	1.30E+11	1.10E+10	Various
Direct Contact (Nonres DC)			10,000 {T}	9.5E+5 {C}	8.9E+5 {C}	1.4E+5 {C}	2.5E+5 {C}	4.6E+5 {C}	5.0E+5 {C,DD}	1.5E+5 {C}	1.1E+6 {C,DD}	Various
Screening Levels (µg/Kg)												
Soil Saturation Concentration Screening Levels (Csat)			NA	950,000	890,000	140,000	250,000	460,000	500,000	150,000	1.10E+06	Various

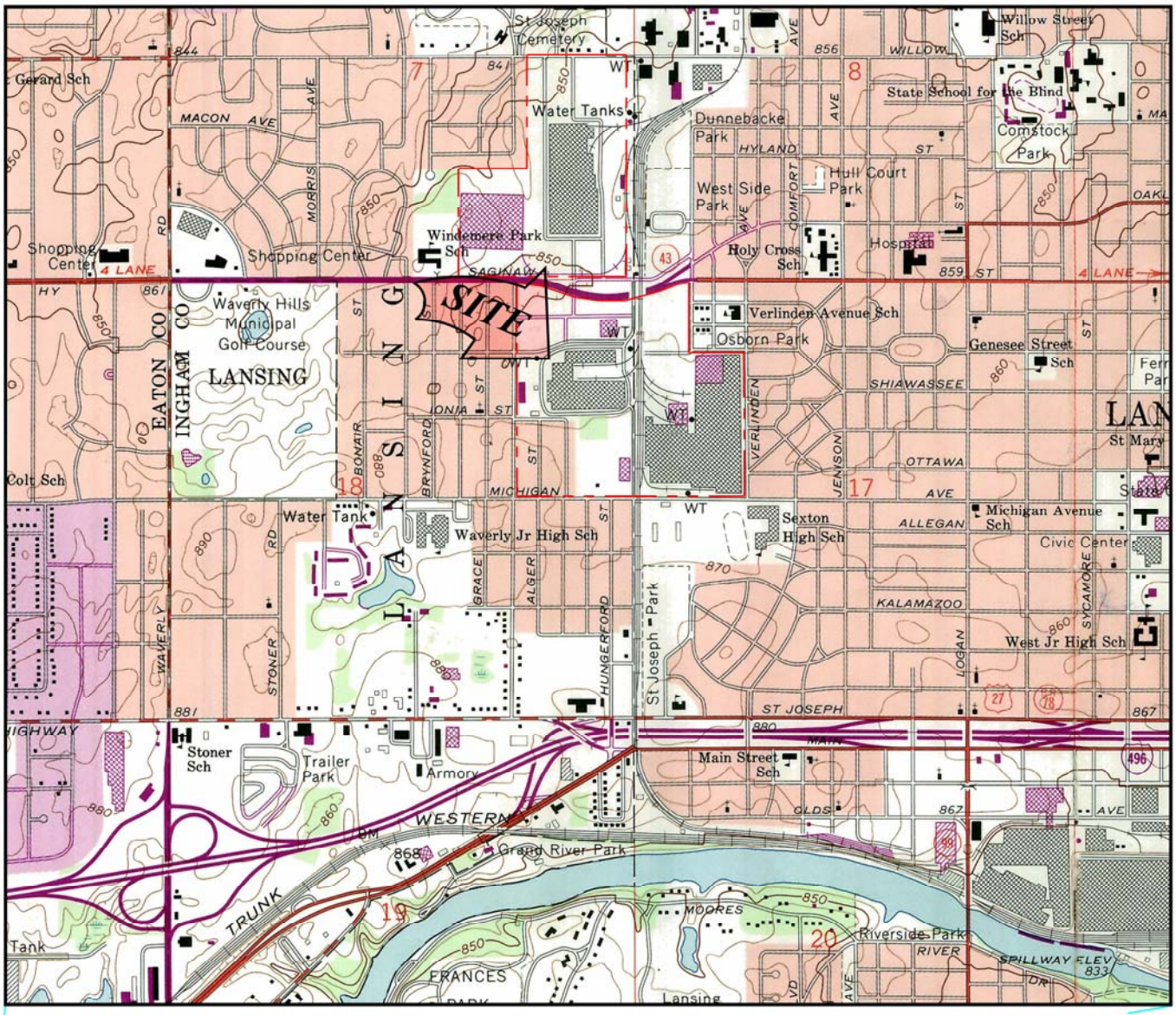
{T} Refer to the Toxic Substance Control Act (TSCA), 40 CFR 761, Subparts D and G, as amended, to determine the applicability of TSCA cleanup standards. Alternatives to compliance with the standards listed below are possible under Subpart D. New Releases may be subject to the standards identified in Subpart G. Use Part 201 soil direct contact criteria in the table below where TSCA standards are not applicable.

LAND USE CATEGORY	TSCA, Subpart D	Part 201
Residential	1,000 µg/Kg, or 10,000 µg/Kg if capped	4,000 µg/Kg
Nonresidential		16,000 µg/Kg

Criteria Exceeded
BOLD Value Exceeds Applicable Criteria
bgs Below Grade Surface (feet)
1 Maximum of analyzed or calculated total lead value.

Figures

PM ENVIRONMENTAL Environmental & Engineering Services



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7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

T:4 N., R:2 W., Sec. 7, 17, & 18

INGHAM COUNTY

MICHIGAN QUADRANGLE LOCATION

SCALE 1:24,000

1 MILE 1/2 MILE 0 1 MILE

FIGURE 1

PROPERTY VICINITY MAP

USGS, 7.5 MINUTE SERIES

LANSING SOUTH, MI QUADRANGLE, 1965. PHOTO REVISED 1973.

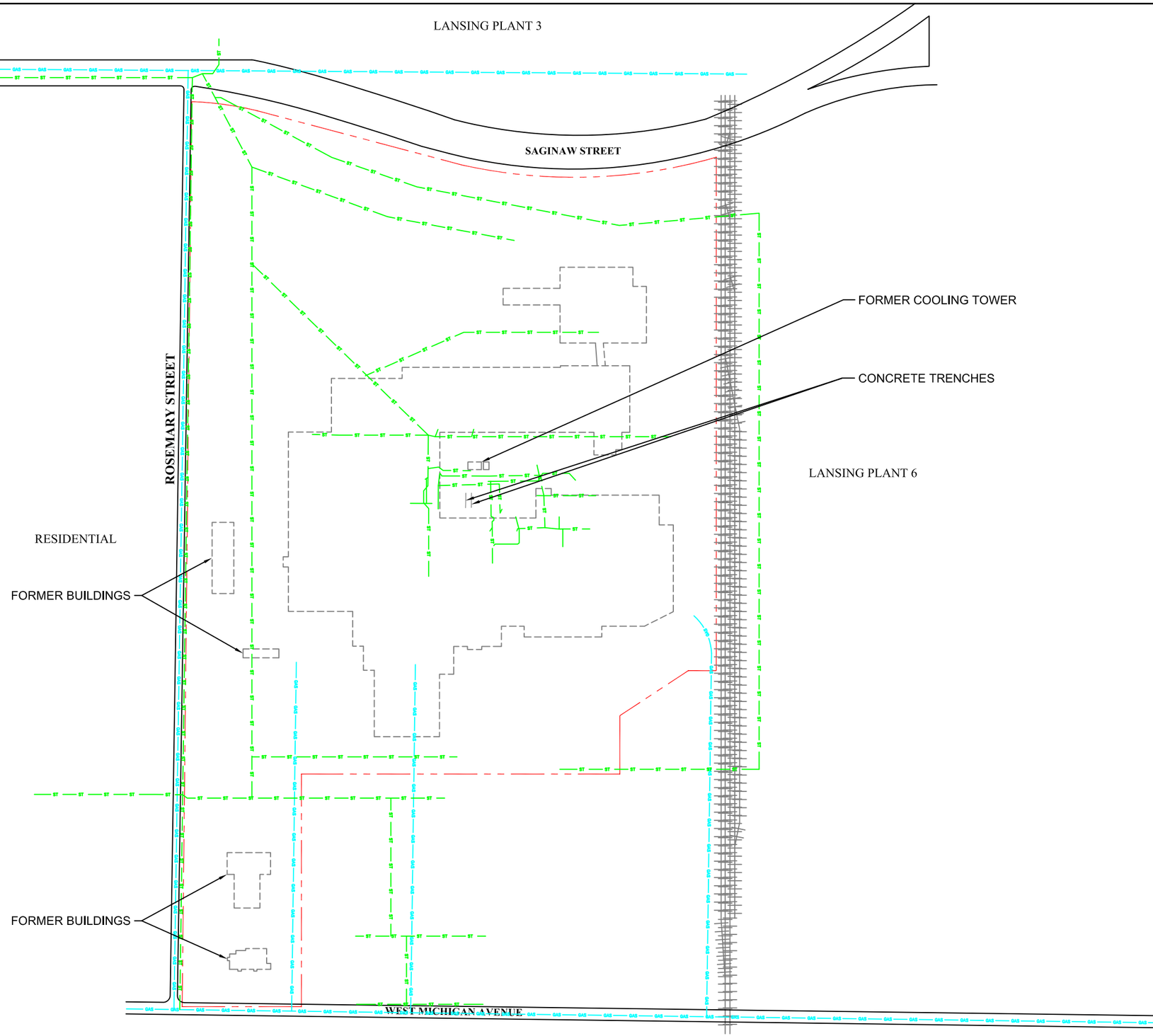
PM ENVIRONMENTAL | Environmental & Engineering Services

PROJ:
FORMER LANSING PLANT 2
2801 WEST SAGINAW STREET
LANSING, MI

THIS IS NOT A LEGAL SURVEY

VERIFY SCALE
0 2,000'
IF NOT 1" ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DRN BY: TS
DATE: 7/27/2012
CHKD BY: CA
SCALE: 1" = 2,000'
FILE NAME: 01-4172-0F01R00



LEGEND:

- SUBJECT PROPERTY
- FORMER/HISTORICAL SITE FEATURES
- GAS — GAS
- ST — STORM SEWER

PM ENVIRONMENTAL | Environmental & Engineering Services

FIGURE 2

GENERALIZED DIAGRAM OF THE SUBJECT PROPERTY AND ADJOINING PROPERTIES

PROJ:

FORMER LANSING PLANT 2
2801 WEST SAGINAW STREET
LANSING, MI

THIS IS NOT A LEGAL SURVEY	DRN BY: TS	DATE: 7/27/2012
VERIFY SCALE 0 [redacted] 300' IF NOT 1" ON THIS SHEET, ADJUST SCALES ACCORDINGLY.	CHKD BY: CA	SCALE: 1" = 300'
	FILE NAME: 01-4172-0F00R00	

SB-A5.2-NG127	
5/2/2012	
PCBs	
2-3'	<MDL
6-7'	<MDL
13-14'	<MDL
19-20'	<MDL

SB-A5.2-NL121	
5/2/2012	
PCBs	
1-2'	<MDL
5-6'	<MDL
10-11'	<MDL
15-16'	<MDL
20-21'	<MDL

SB-A5.2-NJ129	
5/23/2012	
PCBs	
1-2'	8
8.5-9.5'	120
12.5-13'	60
13.5-14.5'	<MDL

SB-A5.2-NK111	
5/3/2012	
PCBs	
1-2'	<MDL
7.5-8.5'	<MDL
12-13'	<MDL
15-16'	<MDL
20-21'	<MDL
23-24'	<MDL
25-26'	<MDL

SB-24	
10/1/2011	
PCBs	
5.5-6.5'	10,000

SB-A5.2-NL114	
5/23/2012	
PCBs	
1-2'	<MDL
8.5-9.5'	<MDL
14.5-15.5'	<MDL
16.5-17.5'	<MDL

SB-A5.2-NO116	
5/3/2012	
PCBs	
1-2'	<MDL
2-3'	<MDL
7-8'	<MDL
12-13'	<MDL
17-18'	<MDL
22-23'	<MDL

SB-A5.2-NO106	
5/3/2012	
PCBs	
1-2'	<MDL
6-7'	<MDL
10-11'	<MDL
13-14'	<MDL
20-21'	<MDL
24-25'	<MDL

SB-A5.2-NO107	
5/3/2012	
PCBs	
1.5-2.5'	<MDL
8-9'	10
12-13'	<MDL
15.5-16.5'	<MDL

P2-SB-14	
8/31/2011	
PCBs	
9 - 10'	<MDL
14 - 15'	<MDL

VAP-A5.2-NV119	
5/3/2012	
PCBs	
1-2'	600
6-7'	39,000
8-9'	5,400
14-15'	<MDL
18-19'	4,500
24-25'	<MDL
28-29'	<MDL
33-34'	<MDL

SB-A5.2-NW124	
5/1/2012	
PCBs	
1-2'	<MDL
4-5'	22,000
7-8'	100
11-12'	<MDL
16-17'	<MDL
22-23'	<MDL

SB-A5.2-0C107	
5/22/2012	
PCBs	
1.9-2.9'	10
5.5-6.5'	<MDL
8-9'	<MDL

SB-A5.2-0C107A	
5/22/2012	
PCBs	
8-9'	<MDL
16-17'	<MDL

SB-A5.2-0B120	
5/22/2012	
PCBs	
1.5-2.5'	<MDL
7.5-8.5'	<MDL
23-24'	6
26-27'	160

SB-A5.2-NZ128	
5/1/2012	
PCBs	
1-2'	<MDL
4-5'	2,800
6.5-7.5'	600
11-12'	<MDL
16-17'	<MDL
20-21'	<MDL
25-26'	<MDL

VAP-A5.2-0E129	
5/1/2012	
PCBs	
7-8'	<MDL
12-13'	100
17-18'	<MDL
22-23'	<MDL

VAP-A5.2-NK132	
5/15/2012	
PCBs	
1-2'	<MDL
8-9'	400
14-15'	<MDL
27-28'	<MDL

SB-A5.2-NJ145	
5/8/2012	
PCBs	
1-2'	<MDL
7-8'	<MDL
15-16'	<MDL
21-22'	<MDL

SB-A5.2-NT111	
5/3/2012	
PCBs	
1-2'	<MDL
4-5'	<MDL
7-8'	<MDL
12-13'	<MDL
17-18'	<MDL
19-20'	<MDL

SB-A5.2-NR128	
5/1/2012	
PCBs	
1-2'	2,400
3-4'	500
8-9'	100
13-14'	<MDL
17-18'	<MDL

SB-A5.2-NU132	
5/1/2012	
PCBs	
1-2'	<MDL
2-3'	300

VAP-A5.2-NU137	
4/30/2012	
PCBs	
0-2'	100
5-6'	<MDL
10-11'	<MDL
15-16'	<MDL
20-21'	<MDL

SB-A5.2-NV133	
4/30/2012	
PCBs	
1-2'	<MDL
4-5'	40
6-7'	10
9-10'	<MDL
12-13'	<MDL
18-19'	<MDL
23-24'	<MDL
28-29'	<MDL

SB-A5.2-0A138	
5/10/2012	
PCBs	
1-2'	100
7-8'	<MDL
11-12'	<MDL
17-18'	<MDL
23-24'	<MDL

SB-A5.2-NZ138	
5/1/2012	
PCBs	
1-2'	10

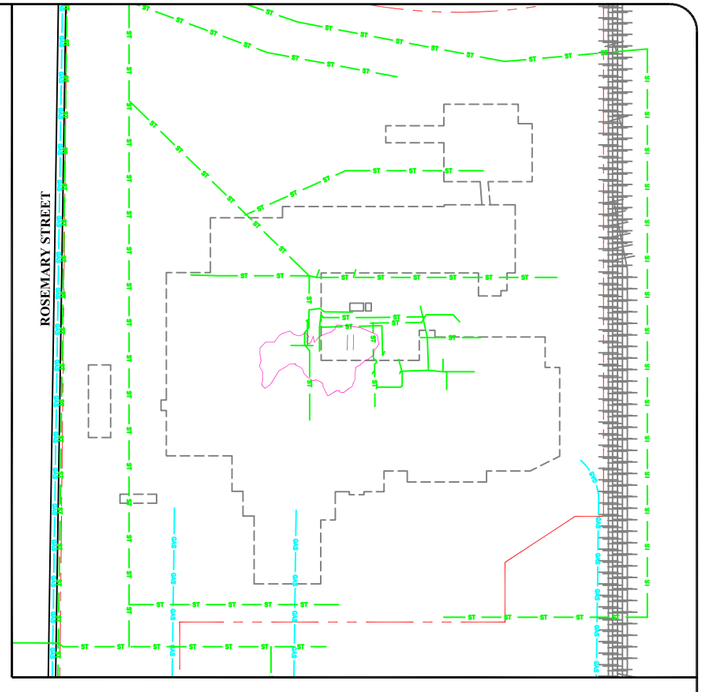
SB-A5.2-NZ144	
5/4/2012	
PCBs	
1-2'	<MDL
6-7'	<MDL
12-13'	<MDL
18-19'	<MDL
24-25'	<MDL

FORMER COOLING TOWER

CONCRETE TRENCHES

CONCRETE VAULT LOCATION
(25'x4'x4' DEEP)

SB-A5.2-NG127 SB-A5.2-NK111 SB-A5.2-NJ129 VAP-A5.2-NK132 SB-A5.2-NJ145 SB-A5.2-NL114 SB-A5.2-NL121 SB-24 SB-A5.2-NO116 SB-A5.2-NO106 P2-SB-14 SB-A5.2-NO107 SB-A5.2-NT111 P2-SB-29 P2-GP-9 SB-A5.2-NR128 P2-GP-2/PMW-2 P2-GP-15 P2-GP-1/PMW-1 P2-GP-14 P2-GP-3 SB-A5.2-NU132 P2-SB-37/MW-37 VAP-A5.2-NV119 SB-A5.2-NW124 P2-GP-4 P2-GP-5 SB-A5.2-NV133 VAP-A5.2-NU137 P2-GP-7 P2-GP-8 P2-GP-16 P2-GP-12 P2-GP-10 P2-GP-6 P2-GP-13 P2-GP-11/PMW-3 SB-A5.2-NZ128 SB-A5.2-NZ138 SB-A5.2-0A138 SB-A5.2-NZ144 SB-A5.2-0C107 SB-A5.2-0C107A SB-A5.2-0B120 VAP-A5.2-0E129



LEGEND:

- SUBJECT PROPERTY
- FORMER/HISTORICAL SITE FEATURES
- GAS
- ST — STORM SEWER
- ESTIMATED EXTENT OF LNAPL BASED UPON LIF RESPONSE
- SOIL BORING
- VAP BORING
- PCBs — POLYCHLORINATED BIPHENYLS
- MDL — METHOD DETECTION LIMIT
- UNITs — ug/Kg (UNLESS NOTED)
- VALUE EXCEEDS APPLICABLE CRITERIA

NOTES: REFER TO TABLES FOR SPECIFIC COMPOUNDS ANALYZED

PM ENVIRONMENTAL | Environmental & Engineering Services

FIGURE 3A

SOIL BORING LOCATION MAP WITH SOIL PCB ANALYTICAL RESULTS
(MAY, 2012)

PROJ:
FORMER LANSING PLANT 2
2801 WEST SAGINAW STREET
LANSING, MI

THIS IS NOT A LEGAL SURVEY

VERIFY SCALE
0 60'
IF NOT 1" ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DRN BY: TS | DATE: 7/27/2012
CHKD BY: CA | SCALE: 1" = 60'
FILE NAME: 01-4172-0F00R00

P2-GP-3	
10/11/2012	
4.0 – 5.0	
PCBs	1,100
VOCs	<MDL

P2-GP-9	
10/11/2012	
4.0 – 5.0	
PCBs	37
VOCs	<MDL

A-3	
10/11/2012	
4.0 – 5.0	
PCBs	27
VOCs	<MDL

P2-GP-1	
10/11/2012	
7.0 – 7.5'	
PCBs	140
CHLOROETHANE	780
1,1-DCA	90
T	80
OTHER VOCs	<MDL

P2-GP-2	
10/11/2012	
1.0 – 2.0	
PCBs	5,300
VOCs	<MDL

P2-GP-2	
10/11/2012	
7.0 – 7.5	
PCBs	550
VOCs	<MDL

P2-GP-15		
10/19/2012	10/19/2012	10/19/2012
1.0 – 2.0	4.0 – 5.0	2.0 – 3.0
PCBs 800	PCBs 4,700	PCBs 200
VOCs <MDL	VOCs <MDL	VOCs <MDL

P2-GP-14	
10/19/2012	10/19/2012
1.0 – 2.0	6.0 – 7.0
PCBs <MDL	PCBs 16
VOCs <MDL	VOCs <MDL

P2-GP-5	
10/11/2012	10/11/2012
4.0 – 5.0	8.0 – 9.0
PCBs 17	VOCs <MDL
VOCs <MDL	

P2-GP-12
10/19/2012
2.0 – 3.0
PCBs 3
VOCs <MDL

P2-GP-7
10/11/2012
5.0 – 6.0
PCBs 240
CHLOROETHANE 1,170
OTHER VOCs <MDL

P2-GP-4		
10/11/2012	10/11/2012	10/11/2012
4.0 – 5.0	4.0 – 5.0	8.0 – 9.0
PCBs 2,600	PCBs 3,200	PCBs 180
CHLOROETHANE 260	CHLOROETHANE 330	VOCs <MDL
1,1-DCA 90	1,1-DCA 250	
T 490	T 570	
TCE 80	1,1,1-TCA 100	
X 200	TCE 90	
1,2,4-TMB 90	X 200	
OTHER VOCs <MDL	1,2,4-TMB 110	
	OTHER VOCs <MDL	

P2-GP-10
10/12/2012
2.0 – 3.0
PCBs <MDL
VOCs <MDL

P2-GP-16
10/19/2012
1.0 – 2.0
PCBs <MDL
VOCs <MDL

P2-GP-13	
10/19/2012	10/19/2012
2.0 – 3.0	6.0 – 7.0
PCBs 6	PCBs 200
VOCs <MDL	VOCs <MDL

P2-GP-11
10/12/2012
3.0 – 4.0
PCBs 170
1,1-DCA 170
1,1,1-TCA 60
OTHER VOCs <MDL

P2-GP-6
10/11/2012
4.0 – 5.0
PCBs <MDL
OTHER VOCs <MDL

P2-GP-8
10/11/2012
5.0 – 6.0
PCBs 51
1,1-DCA 4,100
E 12,200
X 65,500
OTHER VOCs <MDL

FORMER COOLING TOWER

CONCRETE TRENCHES

CONCRETE VAULT LOCATION (25'x4'x4' DEEP)

ESTIMATED EXTENT OF LNAPL

ROSEMARY STREET

SB-A5.2-NG127 SB-A5.2-NJ145 SB-A5.2-NK111 SB-A5.2-NJ129 VAP-A5.2-NK132 SB-A5.2-NL114 SB-A5.2-NL121 SB-24 SB-A5.2-ND106 P2-SB-14 SB-A5.2-ND116 P2-GP-9 SB-A5.2-NR128 P2-GP-2/PMW-2 P2-GP-15 P2-GP-1/PMW-1 P2-GP-14 SB-A5.2-NT111 P2-SB-29 P2-GP-3 SB-A5.2-NU107 SB-A5.2-NU132 VAP-A5.2-NV119 P2-SB-37/MW-37 P2-GP-5 SB-A5.2-NV133 VAP-A5.2-NU137 SB-A5.2-NW124 P2-GP-4 P2-GP-7 P2-GP-8 P2-GP-12 P2-GP-10 P2-GP-16 P2-GP-6 P2-GP-13 P2-GP-11/PMW-3 SB-A5.2-NZ128 SB-A5.2-NZ138 SB-A5.2-NZ144 SB-A5.2-0A138 SB-A5.2-0C107 SB-A5.2-0C107A SB-A5.2-0B120 VAP-A5.2-0E129

LEGEND:

- SUBJECT PROPERTY
- FORMER/HISTORICAL SITE FEATURES
- GAS — GAS
- ST — STORM SEWER
- ESTIMATED EXTENT OF LNAPL BASED UPON LIF RESPONSE
- SOIL BORING
- VAP BORING
- PCBs — POLYCHLORINATED BIPHENYLS
- MDL — METHOD DETECTION LIMIT
- UNITs — ug/L (UNLESS NOTED)
- VALUE EXCEEDS APPLICABLE CRITERIA

NOTES: REFER TO TABLES FOR SPECIFIC COMPOUNDS ANALYZED

N

PM ENVIRONMENTAL | Environmental & Engineering Services

FIGURE 3B

SOIL BORING LOCATION MAP WITH SOIL PCB ANALYTICAL RESULTS (OCTOBER, 2012)

PROJ:

FORMER LANSING PLANT 2
2801 WEST SAGINAW STREET
LANSING, MI

THIS IS NOT A LEGAL SURVEY

VERIFY SCALE 0 60'

IF NOT 1" ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DRN BY: TS/MM | DATE: 11/21/2012

CHKD BY: CA | SCALE: 1" = 60'

FILE NAME: 01-4172-0F00R00

VAP–A5.2–NK132	
5/15/2012	
PCBs	
10–11'	<MDL
21–22'	<MDL
30–32'	<MDL

P2–PMW–2 LNAPL	
10/19/2012	
SCREEN 2.6 – 7.6'	
PCBs	133,000
VOCs	<MDL

FORMER COOLING TOWER

CONCRETE TRENCHES

ROSEMARY STREET

VAP–A5.2–NK137	
5/1/2012	
PCBs	
16–18'	<MDL
24–26'	<MDL

ESTIMATED EXTENT OF LNAPL

MW–37 (LNAPL)	
10/18/2011	
PCBs	
5–10'	52,000

VAP–A5.2–NV119	
5/2/2012	
PCBs	
8–9'	800
20–22'	30

SB-A5.2-NG127
SB-A5.2-NJ145
SB-A5.2-NK111
SB-A5.2-NJ129
VAP-A5.2-NK132
SB-A5.2-NL114
SB-A5.2-NL121
SB-24
SB-A5.2-ND106
P2-SB-14
SB-A5.2-ND116
P2-GP-9
SB-A5.2-NR128
P2-GP-2/PMW-2
P2-GP-15
P2-GP-1/PMW-1
P2-GP-14
SB-A5.2-NT111
P2-SB-29
P2-GP-3
SB-A5.2-NU132
SB-A5.2-NU107
P2-SB-37/MW-37
VAP-A5.2-NU137
P2-GP-5
SB-A5.2-NV133
VAP-A5.2-NV119
SB-A5.2-NW124
P2-GP-4
P2-GP-7
P2-GP-8
P2-GP-12
P2-GP-16
P2-GP-10
P2-GP-6
P2-GP-13
P2-GP-11/PMW-3
SB-A5.2-NZ128
SB-A5.2-NZ138
SB-A5.2-NZ144
SB-A5.2-0A138
SB-A5.2-0C107
SB-A5.2-0C107A
SB-A5.2-0B120
VAP-A5.2-0E129

CONCRETE VAULT LOCATION (25'x4'x4' DEEP)

VAP–A5.2–0E129	
5/2/2012	
PCBs	
18.5–19.5'	0.05

LEGEND:

- SUBJECT PROPERTY
- FORMER/HISTORICAL SITE FEATURES
- GAS
- ST — STORM SEWER
- ESTIMATED EXTENT OF LNAPL BASED UPON LIF RESPONSE
- SOIL BORING
- VAP BORING
- PCBs — POLYCHLORINATED BIPHENYLS
- MDL — METHOD DETECTION LIMIT
- UNITs — ug/L (UNLESS NOTED)
- VALUE EXCEEDS APPLICABLE CRITERIA

NOTES: REFER TO TABLES FOR SPECIFIC COMPOUNDS ANALYZED

N

PM ENVIRONMENTAL | Environmental & Engineering Services

FIGURE 4

SOIL BORING LOCATION MAP WITH GROUNDWATER PCB ANALYTICAL RESULTS

PROJ:

FORMER LANSING PLANT 2
2801 WEST SAGINAW STREET
LANSING, MI

THIS IS NOT A LEGAL SURVEY

VERIFY SCALE
0 60'
IF NOT 1" ON THIS SHEET, ADJUST SCALES ACCORDINGLY.

DRN BY: TS/MM
DATE: 11/21/2012
CHKD BY: CA
SCALE: 1" = 60'
FILE NAME: 01–4172–0F00R00

FORMER COOLING TOWER

ESTIMATED EXTENT OF LNAPL

CONCRETE TRENCHES

SB-A5.2-NG127

SB-A5.2-NJ129

VAP-A5.2-NK132

SB-A5.2-NL121

SB-24

SB-A5.2-NO116

P2-GP-9

SB-A5.2-NR128

P2-GP-2/PMW-2

P2-GP-15

P2-GP-1/PMW-1

P2-GP-14

P2-SB-29

P2-GP-3

SB-A5.2-NU132

VAP-A5.2-NU137

P2-SB-37/MW-37

P2-GP-5

SB-A5.2-NV133

VAP-A5.2-NV119

SB-A5.2-NW124

P2-GP-4

P2-GP-7

P2-GP-8

P2-GP-12

P2-GP-16

P2-GP-10

P2-GP-6

P2-GP-13

P2-GP-11/PMW-3

SB-A5.2-NZ128

SB-A5.2-NZ138

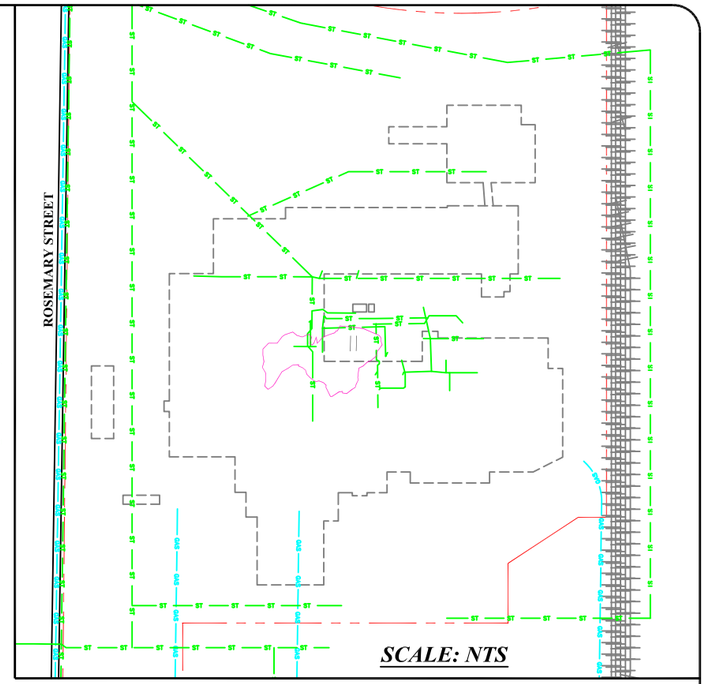
SB-A5.2-0A138

SB-A5.2-0B120

VAP-A5.2-0E129

CONCRETE VAULT LOCATION
(25'x4'x4' DEEP)

PROPOSED CONCRETE
VAULT TEST PIT EXCAVATION
(50'x90'x10' DEEP)



LEGEND:

- SUBJECT PROPERTY
- FORMER/HISTORICAL SITE FEATURES
- GAS
- STORM SEWER
- ESTIMATED EXTENT OF LNAPL BASED UPON LIF RESPONSE
- SOIL BORING
- VAP BORING

PM ENVIRONMENTAL | Environmental & Engineering Services

FIGURE 5

PROPOSED CONCRETE VAULT EXCAVATION

PROJ:

FORMER LANSING PLANT 2
2801 WEST SAGINAW STREET
LANSING, MI

THIS IS NOT A LEGAL SURVEY	DRN. BY: TS/MW/DF	DATE: 11/8/2012
VERIFY SCALE 0 30' IF NOT 1" ON THIS SHEET, ADJUST SCALES ACCORDINGLY.	CHKD BY: CA	SCALE: 1" = 30'
	FILE NAME: 01-4172-0F00R00	

Appendix A

PM ENVIRONMENTAL Environmental & Engineering Services

ARCADIS

Appendix E

Corrective Measures Alternative Cost Estimate Backup

Appendix E
Lower 1,4-D Pump-and-Treat Cost Details

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Table 1
Summary of Costs (+/- 30%) for Two Pump and Treat Systems

Cost Item	Scenario #1 Toe of Plume	Scenario #2 Recovery Along Spine	Scenario #3 Recovery and Injection Along Spine
Pump and Treat System Capital Cost	$1,009,000	$2,304,000	$2,600,000
Pump and Treat System Startup Cost	$83,000	$107,000	$106,000
Annual O&M Annual Costs	$322,000	$574,000	$500,000
Annual Groundwater Monitoring	$72,000	$72,000	$72,000

Notes:
O&M = operation and maintenance

Table 2
Cost Estimate (+/- 30%) - Groundwater Recovery and Treatment System - Scenario 2 - Recovery at Toe of Plume

Items	Unit Price	No. of Units	Cost
Cost Overview			
See attached document			
Groundwater Pump and Treat System Capital Cost	Unit Price	Units	Cost
Design			
Treatability studies (AOP bench test)	10,000 LS	1	10,000
Site surveying	3,000 LS	1	3,000
Utility location services	3,000 LS	1	3,000
Design and Bid Packages (Recovery System)	3,000 LS	1	3,000
Design and Bid Packages (Treatment System)	25,000 LS	1	25,000
Permitting/Access Agreements			
Remedial Action Plan	20,000 LS	1	20,000
Permitting - sanitary sewer discharge permitting	4,000 LS	1	4,000
Access agreements - jack-and-bore across Oakland Rd	8,000 LS	0	0
Recovery/Injection System			
Recovery wells			
Well installation 4" - 85 feet deep	6,000 each	2	12,000
Cuttings disposal	500 /well	2	1,000
Well vaults	1,500 LS	2	3,000
Geologist oversight	1,200 LS	2	2,400
Recovery pumps - electrical submersible	2,000 each	2	4,000
In-well pressure transducers	600 each	2	1,200
Recovery wellhead piping, valving, and flow meter	1,000 each	2	2,000
Recovery piping from wells to treatment system			
2-inch recovery pipe (pipe only)	10 /LF	300	3,000
pipe trenching	30 /LF	300	9,000
trench cover replacement	2 /SF	600	1,200
Access vaults and hydraulic control valves (air release, isolation)	2,000 LS	1	2,000
Treated water discharge piping to sewer			
3-inch recovery pipe (pipe and trench)	10 /LF	300	3,000
pipe trenching	30 /LF	300	9,000
Jack-and-bore (road crossing)	145 each	0	0
Electrical wiring and conduit	20 /LF	300	6,000
Power drops	8,000 LS	1	8,000
Electrical pump j-boxes and terminations	600 each	2	1,200
		Recovery System Subtotal	68,000
		taxes (7%) (on select items)	630
		shipping (10%) (on select items)	900
		mark-up (5%)	3,400
		Recovery System Total	72,930
Water Process Equipment			
Equalization tank (1,500 gallon)	3,000 LS	1	3,000
pH adjust system (NaOH 50 g tank and metering pump)	4,000 LS	1	4,000
Air compressor (with refrigerated air dryer)	6,000 LS	1	6,000
Aeration diffusers mounted in EQ tank	2,000 LS	1	2,000
Transfer pump	2,500 LS	2	5,000
Multi-media Filters (3 vessels, 1.5 foot diameter)	12,000 LS	1	12,000
Layne-Ox Filters (3 vessels, 2.0 foot diameter)	22,000 LS	1	22,000
Advanced oxidation system (HiPOx, with EQ tank)	140,000 LS	1	140,000
Pump tank (1,200 gallon)	3,500 LS	1	3,500
Transfer pump	2,500 LS	2	5,000
Clean backwash tank (2,000 gallon)	3,000 LS	1	3,000
Solids settling tank (6,000 gallon)	12,000 LS	1	12,000
Backwash pump	3,000 LS	1	3,000
Decant pump	1,500 LS	1	1,500
Instrumentation	10,000 LS	1	10,000
Control panel	20,000 LS	1	20,000
Motor control center/ VFD Panel	10,000 LS	1	10,000
Distribution panel	8,000 LS	1	8,000
PLC and data communications	5,000 LS	1	5,000
Data collection software and hardware	4,000 LS	1	4,000
Controls integrator	12,000 LS	1	12,000
Dial-out/internet communications package	4,000 LS	1	4,000
		Process Equipment Subtotal	295,000
		taxes (7%)	20,650
		shipping (10%)	29,500
		mark-up (5%)	17,258
		Equipment Total	362,408
Plant Subcontractors (Building)			
Design	13,000 LS	1	13,000
Permitting - local building/plumbing/electrical/mechanical	8,000 LS	1	8,000
Building and foundation (20 x 50)	90 square feet	1,000	90,000
Parking area and fencing	8,000 LS	1	8,000
Landscaping and finishing	5,000 LS	1	5,000
		Building Subcontractor Subtotal	124,000
		Project management (10%)	12,400
		Building Subcontractor Subtotal	136,400
Plant Subcontractors (Mechanical)			
Permitting - local plumbing/mechanical	4,000 LS	1	4,000
Mobilization	4,000 LS	1	4,000
General plant assembly	10,000 LS	1	10,000
Equipment receiving and laydown	10,000 LS	1	10,000
Plant piping assembly - labor	30,000 LS	1	30,000
Plant piping assembly - parts (includes tax and mark-up)	30,000 LS	1	30,000
Miscellaneous support	3,000 LS	1	3,000
		Mechanical Subcontractor Subtotal	91,000
		Subcontractor project management (5%)	4,550
		mark-up (5%)	4,778
		Mechanical Subcontractor Subtotal	100,328

Appendix E
Lower 1,4-D Pump-and-Treat Cost Details

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant Subcontractors (Electrical)					
Permitting - local electrical	4,000	LS	1		4,000
Panel receiving and installation	5,000	LS	1		5,000
Conduit and wiring - materials	30,000	LS	1		30,000
Conduit and wiring - installation	30,000	LS	1		30,000
Panel terminations	8,000	LS	1		8,000
Conduit racks	8,000	LS	1		8,000
Lightning/surge protection	8,000	LS	1		8,000
				Electrical Subcontractor Subtotal	93,000
				Subcontractor project management (5%)	4,650
				mark-up (5%)	4,883
				Mechanical Subcontractor Subtotal	102,533
PLC Programming	25,000	each	1		25,000
Office and lab set-up	4,000	each	1		4,000
Health & Safety equipment	4,000	each	1		4,000
Misc construction costs (expenses)	3,000	each	1		3,000
				Subtotal for Groundwater System Capital Cost	878,598
Reporting - As-built drawings					12,000
On-Site Construction Management, Engineering, and Startup (5%)					43,900
Project Management (3%)					26,400
				Subtotal	960,898
				Contingency (5%)	48,045
Total Groundwater Pump and Treat Capital Cost					**1,009,000**
Groundwater Pump and Treat System Startup Cost (assume 2 weeks)					
Senior principal engineer oversight	180	$/hour	8		1,440
Senior engineer oversight	127	$/hour	30		3,810
Engineer management	98	$/hour	80		7,840
Lead operator	79	$/hour	90		7,110
Junior operator	68	$/hour	90		6,120
Subcontractor support (mechanical)	5,000	LS	1		5,000
Subcontractor support (electrical)	4,000	LS	1		4,000
Subcontractor support (controls)	5,000	LS	1		5,000
ARCADIS general expenses	3,000	LS	1		3,000
				Subtotal	43,320
O&M Manual with operating procedures					28,000
Updated H&S Plan					8,000
Project Management (10%)					4,000
Total Groundwater Pump and Treat Startup Costs					**83,000**
Groundwater Pump and Treat Operations Cost					
Annual O&M Costs					
Operations Labor					
Senior principal engineer oversight (2 hours per month)	180	$/hour	24		4,320
Senior engineer oversight (6 hours per month)	127	$/hour	72		9,140
Engineer management (6 hours per week)	98	$/hour	312		30,580
Operator (20 hours per week)	79	$/hour	1,040		82,160
Junior operator (0 hours per week)	79	$/hour	0		0
Subcontractor support	500	month	12		6,000
General expenses	400	month	12		4,800
Utilities - plant electric (25 HP, $0.12/kw-hr) excludes AOP	800	$/HP/year	25		20,000
AOP operations cost (electric, hydrogen peroxide)	8,000	LS	1		8,000
Sodium hydroxide	3.50	gallon	3,120		10,920
Granular activated carbon (500 pound changeout every four months)	1,500	$/lb	0		0
Discharge to City POTW (20 gpm, 95% uptime)	3.50	/1,000 gal	10,000		35,000
POTW discharge monitoring	500	/ samples	12		6,000
Utilities - water	6	/1,000 gal	40		240
Well cleaning rehabilitation (2 wells/year)	5,000	LS	1		2,500
Internet and communication fees	150	month	12		1,800
Plant process monitoring	300	/ samples	75		22,500
Misc site maintenance	2,000	LS	1		2,000
Equipment repairs/replacement (2% of equipment capital cost)	5,900	LS	1		5,900
Sludge disposal (3% solids, semi-annual clean-out of solids holding tank)	2	$/gallon	6,000		12,000
Lab and field instrumentation maintenance	300	month	12		3,600
Health and safety equipment	200	month	12		2,400
				Subtotal	269,860
Reporting					25,000
Contingency (5%)					13,493
Project Management (10%)					13,500
Total Groundwater Pump and Treat O&M Annual Costs					**322,000**
Annual Groundwater Monitoring During Operations					
Groundwater Monitoring					
Off-Site Groundwater Monitoring (semi-annual)					
Analytical (30 wells, 2 events, 2 QA/QC per event)	275	well	60		16,500
Sampling expenses (30 wells, 2 events)	85	well	60		5,100
Hydraulic monitoring (50 wells, 2 events)	20	well	100		2,000
Travel expenses	3,000	LS	2		6,000
Labor (2 men, 32 hours each man, per event)	70	$/hour	128		9,000
				Subtotal	38,600
Reporting and Data Management					20,000
Contingency (5%)					1,930
Technical Support (20%)					7,720
Project Management (10%)					3,860
Total Annual Groundwater Monitoring During Operations					**72,000**

Groundwater Pump and Treat System Capital Cost	$1,009,000
Groundwater Pump and Treat System Startup Cost (assume 2 weeks)	$83,000
Total Groundwater Pump and Treat O&M Annual Costs	$322,000
Annual Groundwater Monitoring During Operations	$72,000

Appendix E
Lower 1,4-D Pump-and-Treat Cost Details

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Table 3
Cost Estimate (+/- 30%) - Groundwater Recovery and Treatment System - Scenario 2 - Recovery Along Plume Spine

Items	Unit Price	No. of Units	Cost
Cost Overview			
See attached document			

Groundwater Pump and Treat System Capital Cost	Unit Price	Units	Cost
Design			
Treatability studies (AOP bench test)	10,000 LS	1	10,000
Site surveying	12,000 LS	1	12,000
Utility location services	5,000 LS	1	5,000
Design and Bid Packages (Recovery System)	70,000 LS	1	70,000
Design and Bid Packages (Treatment System)	70,000 LS	1	70,000
Permitting/Access Agreements			
Remedial Action Plan	25,000 LS	1	25,000
Permitting - sanitary sewer discharge permitting	3,000 LS	1	3,000
Access agreements - jack-and-bore across Oakland Rd	8,000 LS	1	8,000
Recovery/Injection System			
Recovery wells			
Well installation 4" - 85 feet deep	6,000 each	6	36,000
Cuttings disposal	500 /well	6	3,000
Well vaults	1,300 LS	6	7,800
Geologist oversight	1,200 LS	6	7,200
Recovery pumps - electrical submersible	2,000 each	6	12,000
In-well pressure transducers	600 each	6	3,600
Recovery wellhead piping, valving, and flow meter	1,000 each	6	6,000
Recovery piping from wells to treatment system			
2 or 3-inch recovery pipe (pipe only)	14 /LF	3,100	43,400
pipe trenching	30 /LF	3,100	93,000
trench cover replacement	2 /SF	6,200	12,400
Access vaults and hydraulic control valves (air release, isolation)	2,000 LS	8	16,000
Treated water discharge piping to sewer			
6-inch recovery pipe (pipe and trench)	20 /LF	300	6,000
pipe trenching	30 /LF	300	9,000
Jack-and-bore (road crossing)	145 each	200	29,000
Electrical wiring and conduit	35 /LF	3,100	108,500
Power drops	8,000 LS	3	24,000
Electrical pump j-boxes and terminations	600 each	6	3,600
		Recovery System Subtotal	420,500
		taxes (7%) (on select items)	1,806
		shipping (10%) (on select items)	2,580
		mark-up (5%)	21,025
		Recovery System Total	445,911
Water Process Equipment			
Equalization tank (5,000 gallon)	18,000 LS	1	18,000
pH adjust system (NaOH 100 g tank and metering pump)	6,000 LS	1	6,000
Air compressor (with refrigerated air dryer)	8,000 LS	1	8,000
Aeration diffusers mounted in EQ tank	4,000 LS	1	4,000
Transfer pump	3,500 LS	2	7,000
Multi-media Filters (3 vessels, 2.5 foot diameter)	20,000 LS	1	20,000
Layne-Ox Filters (3 vessels, 3.0 foot diameter)	37,000 LS	1	37,000
Advanced oxidation system (HiPOx, with EQ tank)	375,000 LS	1	375,000
Pump tank (1,200 gallon)	4,000 LS	1	4,000
Transfer pump	3,500 LS	2	7,000
Clean backwash tank (4,000 gallon)	8,000 LS	1	8,000
Solids settling tank (10,000 gallon)	30,000 LS	1	30,000
Backwash pump	3,500 LS	1	3,500
Decant pump	1,500 LS	1	1,500
Instrumentation	15,000 LS	1	15,000
Control panel	25,000 LS	1	25,000
Motor control center/ VFD Panel	20,000 LS	1	20,000
Distribution panel	10,000 LS	1	10,000
PLC and data communications	5,000 LS	1	5,000
Data collection software and hardware	4,000 LS	1	4,000
Controls integrator	30,000 LS	1	30,000
Dial-out/internet communications package	4,000 LS	1	4,000
		Process Equipment Subtotal	642,000
		taxes (7%)	44,940
		shipping (10%)	64,200
		mark-up (5%)	37,557
		Equipment Total	788,697
Plant Subcontractors (Building)			
Design	18,000 LS	1	18,000
Permitting - local building/plumbing/electrical/mechanical	8,000 LS	1	8,000
Building and foundation (30 x 60)	90 square feet	1,800	162,000
Parking area and fencing	8,000 LS	1	8,000
Landscaping and finishing	5,000 LS	1	5,000
		Building Subcontractor Subtotal	201,000
		Project management (10%)	20,100
		Building Subcontractor Subtotal	221,100
Plant Subcontractors (Mechanical)			
Permitting - local plumbing/mechanical	4,000 LS	1	4,000
Mobilization	4,000 LS	1	4,000
General plant assembly	30,000 LS	1	30,000
Equipment receiving and laydown	15,000 LS	1	15,000
Plant piping assembly - labor	45,000 LS	1	45,000
Plant piping assembly - parts (includes tax and mark-up)	45,000 LS	1	45,000
Miscellaneous support	5,000 LS	1	5,000
		Mechanical Subcontractor Subtotal	148,000
		Subcontractor project management (5%)	7,400
		mark-up (5%)	7,770
		Mechanical Subcontractor Subtotal	163,170

Appendix E
Lower 1,4-D Pump-and-Treat Cost Details

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant Subcontractors (Electrical)					
Permitting - local electrical	3,000	LS	1		3,000
Panel receiving and installation	5,000	LS	1		5,000
Conduit and wiring - materials	45,000	LS	1		45,000
Conduit and wiring - installation	45,000	LS	1		45,000
Panel terminations	8,000	LS	1		8,000
Conduit racks	12,000	LS	1		12,000
Lightning/surge protection	10,000	LS	1		10,000
				Electrical Subcontractor Subtotal	128,000
				Subcontractor project management (5%)	6,400
				mark-up (5%)	6,720
				Mechanical Subcontractor Subtotal	141,120
PLC Programming	25,000	each	1		25,000
Office and lab set-up	8,000	each	1		8,000
Health & Safety equipment	8,000	each	1		8,000
Misc construction costs (expenses)	5,000	each	1		5,000
				Subtotal for Groundwater System Capital Cost	2,008,998
Reporting - As-built drawings					25,000
On-Site Construction Management, Engineering, and Start-up (5%)					100,400
Project Management (3%)					60,300
				Subtotal	2,194,698
				Contingency (5%)	109,735
Total Groundwater Pump and Treat Capital Cost					**2,304,000**
Groundwater Pump and Treat System Startup Cost (assume 3 weeks)					
Senior principal engineer oversight	180	$/hour	10		1,800
Senior engineer oversight	127	$/hour	50		6,350
Engineer management	98	$/hour	150		14,700
Lead operator	79	$/hour	150		11,850
Junior operator	68	$/hour	150		10,200
Subcontractor support (mechanical)	7,000	LS	1		7,000
Subcontractor support (electrical)	4,000	LS	1		4,000
Subcontractor support (controls)	7,000	LS	1		7,000
ARCADIS general expenses	5,000	LS	1		5,000
				Subtotal	67,900
O&M Manual with operating procedures					25,000
Updated H&S Plan					9,000
Project Management (10%)					5,100
Total Groundwater Pump and Treat Startup Costs					**107,000**
Groundwater Pump and Treat Operations Cost					
Annual O&M Costs					
Operations Labor					
Senior principal engineer oversight (2 hours per month)	180	$/hour	20		3,600
Senior engineer oversight (6 hours per month)	127	$/hour	72		9,140
Engineer management (6 hours per week)	98	$/hour	312		30,580
Operator (40 hours per week)	79	$/hour	2,080		164,320
Junior operator (8 hours per week)	79	$/hour	416		32,860
Subcontractor support	400	month	12		4,800
General expenses	400	month	12		4,800
Utilities - plant electric (40 HP, $0.12/kw-hr) excludes AOP	800	$/HP/year	40		32,000
AOP operations cost (electric, hydrogen peroxide)	20,000	LS	1		20,000
Sodium hydroxide	3.50	gallon	3,120		10,920
Granular activated carbon (500 pound changeout every four months)	1,500	$/lb	0		0
Discharge to City POTW (60 gpm, 95% uptime)	3.50	/1,000 gal	30,000		105,000
POTW discharge monitoring	500	/ samples	12		6,000
Utilities - water	6	/1,000 gal	40		240
Well cleaning rehabilitation (2 wells/year)	4,000	LS	2		8,000
Internet and communication fees	150	month	12		1,800
Plant process monitoring	300	/ samples	75		22,500
Misc site maintenance	3,000	LS	1		3,000
Equipment repairs/replacement (2% of equipment capital cost)	12,840	LS	1		12,840
Sludge disposal (3% solids, quarterly clean-out of solids holding tank)	1.75	$/gallon	12,000		21,000
Lab and field instrumentation maintenance	300	month	12		3,600
Health and safety equipment	200	month	12		2,400
				Subtotal	499,400
Reporting					25,000
Contingency (5%)					24,970
Project Management (10%)					25,000
Total Groundwater Pump and Treat O&M Annual Costs					**574,000**
Annual Groundwater Monitoring During Operations					
Groundwater Monitoring					
Off-Site Groundwater Monitoring (semi-annual)					
Analytical (30 wells, 2 events, 2 QA/QC per event)	275	well	60		16,500
Sampling expenses (30 wells, 2 events)	85	well	60		5,100
Hydraulic monitoring (50 wells, 2 events)	20	well	100		2,000
Travel expenses	3,000	LS	2		6,000
Labor (2 men, 32 hours each man, per event)	70	$/hour	128		9,000
				Subtotal	38,600
Reporting and Data Management					20,000
Contingency (5%)					1,930
Technical Support (20%)					7,720
Project Management (10%)					3,860
Total Annual Groundwater Monitoring During Operations					**72,000**

Groundwater Pump and Treat System Capital Cost	$2,304,000
Groundwater Pump and Treat System Startup Cost (assume 3 weeks)	$107,000
Total Groundwater Pump and Treat O&M Annual Costs	$574,000
Annual Groundwater Monitoring During Operations	$72,000

Appendix E
Lower 1,4-D Pump-and-Treat Cost Details

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Table 4
Cost Estimate (+/- 30%) - Groundwater Recovery and Treatment System - Scenario 3 - Recovery and Injection Along Plume Spine

Items	Unit Price	No. of Units	Cost
Cost Overview			
See attached document			

Groundwater Pump and Treat System Capital Cost	Unit Price	Units	Cost
Design			
Treatability studies (AOP bench test)	12,000 LS	1	12,000
Site surveying	12,000 LS	1	12,000
Utility location services	4,000 LS	1	4,000
Design and Bid Packages (Recovery/Injection System)	75,000 LS	1	75,000
Design and Bid Packages (Treatment System)	70,000 LS	1	70,000
Permitting/Access Agreements			
Remedial Action Plan	30,000 LS	1	30,000
Permitting - sanitary sewer discharge permitting	4,000 LS	0	0
Access agreements - jack-and-bore across Oakland Rd	8,000 LS	1	8,000
Recovery/Injection System			
Recovery wells			
Well installation 4" - 85 feet deep	5,000 each	6	30,000
Cuttings disposal	500 /well	6	3,000
Well vaults	1,300 LS	6	7,800
Geologist oversight	1,200 LS	6	7,200
Injection wells			
Well installation 4" - 85 feet deep	5,000 each	9	45,000
Cuttings disposal	500 /well	9	4,500
Well vaults	1,300 LS	9	11,700
Geologist oversight	1,200 LS	9	10,800
Recovery pumps - electrical submersible	2,000 each	6	12,000
In-well pressure transducers	600 each	15	9,000
Recovery/Injection wellhead piping, valving, and flow meter	850 each	15	12,800
Recovery/Injection piping from wells to treatment system			
2 or 3-inch recovery pipe (pipe only)	14 /LF	3,100	43,400
2 or 3-inch injection pipe (pipe only)	13 /LF	3,700	48,100
pipe trenching	30 /LF	4,600	138,000
trench cover replacement	2 /SF	8,750	17,500
Access vaults and hydraulic control valves (air release, isolation)	1,750 LS	10	17,500
Treated water discharge piping to sewer			
1.5-inch recovery pipe (pipe and trench)	10 /LF	0	0
pipe trenching	30 /LF	0	0
Jack-and-bore (road crossing)	130 each	200	26,000
Electrical wiring and conduit	35 /LF	4,600	161,000
Power drops	7,000 LS	3	21,000
Electrical pump j-boxes and terminations	600 each	15	9,000
		Recovery System Subtotal	635,300
		taxes (7%) (on select items)	2,282
		shipping (10%) (on select items)	3,260
		mark-up (5%)	31,765
		Recovery System Total	672,607
Water Process Equipment			
Equalization tank (5,000 gallon)	18,000 LS	1	18,000
pH adjust system (NaOH 100 g tank and metering pump)	6,000 LS	1	6,000
Air compressor (with refrigerated air dryer)	8,000 LS	1	8,000
Aeration diffusers mounted in EQ tank	4,000 LS	1	4,000
Transfer pump	3,500 LS	2	7,000
Multi-media Filters (3 vessels, 2.5 foot diameter)	20,000 LS	1	20,000
Layne-Ox Filters (3 vessels, 3.0 foot diameter)	37,000 LS	1	37,000
Advanced oxidation system (HiPOx, with EQ tank)	375,000 LS	1	375,000
Pump tank (1,200 gallon)	4,000 LS	1	4,000
Transfer pump (injection pump)	8,000 LS	2	16,000
Bag filters (6-bag housing)	15,000 LS	2	30,000
Clean backwash tank (4,000 gallon)	8,000 LS	1	8,000
Solids settling tank (10,000 gallon)	30,000 LS	1	30,000
Backwash pump	3,500 LS	1	3,500
Decant pump	1,500 LS	1	1,500
Instrumentation	15,000 LS	1	15,000
Control panel	24,000 LS	1	24,000
Motor control center/ VFD Panel	20,000 LS	1	20,000
Distribution panel	8,000 LS	1	8,000
PLC and data communications	5,000 LS	1	5,000
Data collection software and hardware	4,000 LS	1	4,000
Controls integrator	30,000 LS	1	30,000
Dial-out/internet communications package	4,000 LS	1	4,000
		Process Equipment Subtotal	678,000
		taxes (7%)	47,460
		shipping (10%)	67,800
		mark-up (5%)	39,663
		Equipment Total	832,923
Plant Subcontractors (Building)			
Design	18,000 LS	1	18,000
Permitting - local building/plumbing/electrical/mechanical	8,000 LS	1	8,000
Building and foundation (30 x 60)	90 square feet	1,800	162,000
Parking area and fencing	8,000 LS	1	8,000
Landscaping and finishing	5,000 LS	1	5,000
		Building Subcontractor Subtotal	201,000
		Project management (10%)	20,100
		Building Subcontractor Subtotal	221,100
Plant Subcontractors (Mechanical)			
Permitting - local plumbing/mechanical	3,000 LS	1	3,000
Mobilization	4,000 LS	1	4,000
General plant assembly	25,000 LS	1	25,000
Equipment receiving and laydown	10,000 LS	1	10,000
Plant piping assembly - labor	45,000 LS	1	45,000
Plant piping assembly - parts (includes tax and mark-up)	45,000 LS	1	45,000
Miscellaneous support	4,000 LS	1	4,000
		Mechanical Subcontractor Subtotal	136,000
		Subcontractor project management (5%)	6,800
		mark-up (5%)	7,140
		Mechanical Subcontractor Subtotal	149,940

Appendix E
Lower 1,4-D Pump-and-Treat Cost Details

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant Subcontractors (Electrical)				
Permitting - local electrical	3,000 LS	1		3,000
Panel receiving and installation	5,000 LS	1		5,000
Conduit and wiring - materials	45,000 LS	1		45,000
Conduit and wiring - installation	45,000 LS	1		45,000
Panel terminations	8,000 LS	1		8,000
Conduit racks	9,000 LS	1		9,000
Lightning/surge protection	8,000 LS	1		8,000
			Electrical Subcontractor Subtotal	123,000
			Subcontractor project management (5%)	6,150
			mark-up (5%)	6,458
			Mechanical Subcontractor Subtotal	135,608
PLC Programming	25,000 each	1		25,000
Office and lab set-up	8,000 each	1		8,000
Health & Safety equipment	8,000 each	1		8,000
Misc construction costs (expenses)	5,000 each	1		5,000
			Subtotal for Groundwater System Capital Cost	2,269,178
Reporting - As-built drawings				25,000
On-Site Construction Management, Engineering, and Start-up (5%)				113,500
Project Management (3%)				68,100
			Subtotal	2,475,778
			Contingency (5%)	123,789
Total Groundwater Pump and Treat Capital Cost				**2,600,000**
Groundwater Pump and Treat System Start-up Cost (assume 3 weeks)				
Senior principal engineer oversigh	180 $/hour	10		1,800
Senior engineer oversight	127 $/hour	50		6,350
Engineer management	98 $/hour	135		13,230
Lead operator	79 $/hour	135		10,670
Junior operator	68 $/hour	135		9,180
Subcontractor support (mechanical)	8,000 LS	1		8,000
Subcontractor support (electrical)	5,000 LS	1		5,000
Subcontractor support (controls)	8,000 LS	1		8,000
ARCADIS general expenses	5,000 LS	1		5,000
			Subtotal	67,230
O&M Manual with operating procedures				25,000
Updated H&S Plan				9,000
Project Management (10%)				5,100
Total Groundwater Pump and Treat Startup Costs				**106,000**
Groundwater Pump and Treat Operations Cost				
Annual O&M Costs				
Operations Labor				
Senior principal engineer oversight (2 hours per month	180 $/hour	24		4,320
Senior engineer oversight (6 hours per month)	127 $/hour	72		9,140
Engineer management (6 hours per week)	98 $/hour	312		30,580
Operator (40 hours per week)	79 $/hour	2,080		164,320
Junior operator (8 hours per week)	79 $/hour	416		32,860
Subcontractor support	400 month	12		4,800
General expenses	400 month	12		4,800
Utilities - plant electric (80 HP, $0.12/kw-hr) excludes AOP	775 $/HP/year	80		62,000
AOP operations cost (electric, hydrogen peroxide)	20,000 LS	1		20,000
Sodium hydroxide	3.50 gallon	3,120		10,920
Bag filters (12/week)	7.50 $/filter bag	624		4,680
Granular activated carbon (500 pound changeout every four months)	1,500 $/lb	0		0
Discharge to City POTW (14 gpm, 90% uptime)	4.00 /1,000 gal	0		0
POTW discharge monitoring	500 / samples	0		0
Well cleaning rehabilitation (4 wells/year)	4,000 LS	4		16,000
Utilities - water	6 /1,000 gal	40		240
Internet and communication fees	150 month	12		1,800
Plant process monitoring	300 / samples	75		22,500
Misc site maintenance	3,000 LS	1		3,000
Equipment repairs/replacement (2% of equipment capital cost)	13,560 LS	1		13,560
Sludge disposal (3% solids, quarterly clean-out of solids holding tank)	1.75 $/gallon	12,000		21,000
Lab and field instrumentation maintenance	275 month	12		3,300
Health and safety equipment	175 month	12		2,100
			Subtotal	431,920
Reporting				25,000
Contingency (5%)				21,596
Project Management (10%)				21,600
Total Groundwater Pump and Treat O&M Annual Costs				**500,000**
Annual Groundwater Monitoring During Operations				
Groundwater Monitoring				
Off-Site Groundwater Monitoring (semi-annual)				
Analytical (30 wells, 2 events, 2 QA/QC per event)	275 well	60		16,500
Sampling expenses (30 wells, 2 events)	85 well	60		5,100
Hydraulic monitoring (50 wells, 2 events)	20 well	100		2,000
Travel expenses	3,000 LS	2		6,000
Labor (2 men, 32 hours each man, per event)	70 $/hour	128		9,000
			Subtotal	38,600
Reporting and Data Management				20,000
Contingency (5%)				1,930
Technical Support (20%)				7,720
Project Management (10%)				3,860
Total Annual Groundwater Monitoring During Operations				**72,000**

Groundwater Pump and Treat System Capital Cost	$2,600,000
Groundwater Pump and Treat System Start-up Cost (assume 3 weeks)	$106,000
Groundwater Pump and Treat Operations Cost	$500,000
Annual Groundwater Monitoring During Operations	$72,000

Appendix E
Perched Pump and Treat Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Table 1
Summary of Costs (+/- 30% - 50%) for Pump-and-Treat System

Cost Item	10 gpm
Pump and Treat System Capital Cost	$3,324,000
Pump and Treat System Startup Cost	$50,000
Annual O&M Annual Costs	$517,000
Annual Groundwater Monitoring	$96,000

Pump and Treat System Cost Assumptions:

1. Cost estimates based on 10-gallong per minute (gpm) total flow rate.
2. For the purposes of this cost estimate, it assumed that there will be one treatment system to treat water/fluids from all areas, and the treatment system will be located within the Plant 2 area.
3. NOTE: this is a complex groundwater system with multiple types of contaminants, and treatability testing will be required to finalize the process design.
4. The expected influent concentrations and required final water quality is summarized in Table 1.
5. The number of recovery well, flow rates, and well depths are summarized in Table 2.
6. Assume flow contribution – Plant 2 = 25%, Plant 6 = 80%.
7. No treatment of air emissions is required if total discharge is less than 1,000 pounds per month and less than 20 pounds per month of carcinogens. At 10 gpm – 25.5 pounds per month total volatile organic compound (VOC); if xylene is not considered a carcinogen, then no air treatment is required.
8. Discharge of treated water will be to local sanitary sewer at $5 per 1,000 gallons.
9. Treatment process:
   a. Equalization, aeration, and pH adjustment (Iron oxidation)
   b. Filtration (multi-media filters with backwashing capability) (iron removal and first stage suspended solids and polychlorinated biphenyl [PCB] removal)
   c. Filtration (bag or cartridge filters) (PCB removal)
   d. Airstripping (VOC removal)
   e. Advanced oxidation (HiPOX system) (1,4-dioxane removal)
   f. Ion exchange (with on-site regeneration) (chromium and other metals removal)
   g. Granular-activated carbon (final polishing)

Appendix E
Perched Pump and Treat Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Table 2
Cost Estimate (+/- 30%) - Groundwater Recovery and Treatment System - 10 gpm

Items	Unit Price	No. of Units	Cost
Cost Overview			
See attached document			
Groundwater Pump and Treat System Capital Cost	Unit Price	Units	Cost
Design			
Treatability studies	40,000 LS	1	40,000
Site surveying	30,000 LS	1	30,000
Design and Bid Packages (Recovery System)	100,000 LS	1	100,000
Design and Bid Packages (Treatment System)	100,000 LS	1	100,000
Permitting/Access Agreements			
Permitting - sanitary sewer discharge permitting	8,000 LS	1	8,000
Access agreements	20,000 LS	1	20,000
Recovery System			
Recovery wells			
Well installation 4" - 30 feet deep	2,100 each	8	16,800
Cuttings disposal	250 /well	8	2,000
Well vaults	1,500 LS	8	12,000
Recovery pumps - electrical submersible	2,500 each	0	0
Recovery pumps - pneumatic	3,800 each	8	30,400
Recovery pump controllers	1,000 each	8	8,000
Recovery wellhead piping and valving	1,000 each	8	8,000
Recovery piping from wells to treatment system (2)			
1-inch recovery pipe (pipe and trench)	40 /LF	10,200	408,000
2-inch recovery pipe (pipe and trench)	40 /LF	1,500	60,000
Compressed air piping for peumatic recovery wells			
1-inch recovery pipe (pipe only)	7 /LF	11,500	80,500
1.5-inch recovery pipe (pipe only)	9 /LF	0	0
Recovery trenches (3 trenches, 610 feet,160 feet, and 140 feet)	120 /LF	0	0
Electrical substations	8,000 LS	3	24,000
Electrical wiring and conduit	30 /LF	8,000	240,000
		Recovery System Subtotal	889,700
		taxes (7%) (on select items)	4,088
		shipping (10%) (on select items)	5,840
		mark-up (5%) (on select items)	44,485
		Recovery System Total	944,113
Water Process Equipment			
Influent equalization tanks	5,000 LS	1	5,000
Aeration blower	1,500 LS	2	3,000
pH adjust system	5,000 LS	1	5,000
Transfer pump	2,500 LS	2	5,000
Multi-media filters	18,000 LS	1	18,000
Cartridge filter system	3,000 LS	1	3,000
Clean backwash tank	3,000 LS	1	3,000
Backwash pump	2,500 LS	1	2,500
Polymer metering pump	2,000 LS	1	2,000
Static mixer	1,000 LS	1	1,000
Flocculator tank	6,000 LS	1	6,000
Flocculator mixer	1,500 LS	1	1,500
Solids transfer pump	1,200 LS	1	1,200
Filter press	20,000 LS	0	0
Filter press stand	10,000 LS	0	0
Filter press feed pump	2,000 LS	0	0
Pre-coat tank	1,000 LS	0	0
Pre-coat pump	1,500 LS	0	0
Air stripper	20,000 LS	1	20,000
Transfer pump	2,500 LS	2	5,000
Vapor-phase granular activated carbon	3,000 LS	3	9,000
Advanced oxidation system (HiPOx)	200,000 LS	1	200,000
Transfer pump	2,500 LS	2	5,000
Ion exchange system	250,000 LS	1	250,000
Granular activated carbon	3,000 LS	3	9,000
Air compressor	5,000 LS	1	5,000
Refrigerated air dryer	1,000 LS	1	1,000
Containment area pump	1,500 LS	2	3,000
Instrumentation	30,000 LS	1	30,000
Control panel	30,000 LS	1	30,000
Distribution panel	20,000 LS	2	40,000
VFD panel	15,000 LS	1	15,000
PLC and data communications	5,000 LS	1	5,000
Data collection software and hardware	5,000 LS	1	5,000
Dial-out/internet communications package	5,000 LS	1	5,000
		Process Equipment Subtotal	693,200
		taxes (7%)	48,524
		shipping (10%)	69,320
		mark-up (5%)	40,552
		Equipment Total	851,596
Plant Subcontractors (Building)			
Design	30,000 LS	1	30,000
Permitting - local building/plumbing	10,000 LS	1	10,000
Building and foundation	80 square feet	3,200	256,000
Parking area and fencing	15,000 LS	1	15,000
Landscaping and finishing	15,000 LS	1	15,000
		Building Subcontractor Subtotal	326,000
		Project management (10%)	32,600
		Building Subcontractor Subtotal	358,600
Plant Subcontractors (Mechanical)			
Permitting - local building/plumbing	5,000 LS	1	5,000
Mobilization	5,000 LS	1	5,000
Utilities clearing	2,000 LS	1	2,000
General plant assembly	10,000 LS	1	10,000
Equipment receiving and laydown	10,000 LS	1	10,000
Plant piping assembly - labor	60,000 LS	1	80,000
Plant piping assembly - parts (includes tax and mark-up)	60,000 LS	1	80,000
Miscellaneous support	20,000 LS	1	20,000
		Mechanical Subcontractor Subtotal	212,000
		Subcontractor project management (5%)	10,600
		mark-up (5%)	11,130
		Mechanical Subcontractor Subtotal	233,730

Appendix E
Perched Pump and Treat Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Plant Subcontractors (Electrical)				
Permitting - local electrical	5,000 LS	1		5,000
Panel receiving and installation	5,000 LS	1		5,000
Conduit and wiring - materials	40,000 LS	1		40,000
Conduit and wiring - installation	40,000 LS	1		40,000
Panel terminations	9,000 LS	1		9,000
Conduit racks	10,000 LS	1		10,000
Lightning/surge protection	20,000 LS	1		20,000
			Electrical Subcontractor Subtotal	129,000
			Subcontractor project management (5%)	6,450
			mark-up (5%)	6,773
			Mechanical Subcontractor Subtotal	142,223
PLC Programming	50,000 each	1		50,000
Office and lab set-up	10,000 each	1		10,000
Health & Safety equipment	10,000 each	1		10,000
Misc construction costs (expenses)	5,000 each	1		5,000
			Subtotal for Groundwater System Capital Cost	2,903,262
Reporting - As-built drawings				30,000
On-Site Construction Management, Engineering, and Start-up (5%)				145,200
Project Management (3%)				87,100
			Subtotal	3,165,562
			Contingency (5%)	158,278
Total Groundwater Pump and Treat Capital Cost				**3,324,000**
Groundwater Pump and Treat System Startup Cost (assume 2 weeks)				
Senior principal engineer oversight	180 $/hour	8		1,400
Senior engineer oversight	127 $/hour	40		5,100
Engineer management	98 $/hour	100		9,800
Lead operator	79 $/hour	100		7,900
Junior operator	68 $/hour	100		6,800
Subcontractor support (mechanical)	3,000 LS	1		3,000
Subcontractor support (electrical)	3,000 LS	1		3,000
Subcontractor support (controls)	6,000 LS	1		6,000
ARCADIS general expenses	5,000 LS	1		5,000
			Subtotal	48,000
Project Management (10%)				2,400
Total Groundwater Pump and Treat Startup Costs				**50,000**
Groundwater Pump and Treat Operations Cost				
Annual O&M Costs				
Operations Labor				
Senior principal engineer oversight (1 hours per week)	180 $/hour	52		9,400
Senior engineer oversight (2 hours per week)	127 $/hour	104		13,200
Engineer management (6 hours per week)	98 $/hour	312		30,600
Lead operator (30 hours per week)	79 $/hour	1,560		123,200
Junior operator (10 hours per week)	68 $/hour	520		35,400
Subcontractor support	500 month	12		6,000
General expenses	1,000 month	12		12,000
Utilities - plant electric (60 HP, $0.12/kw-hr)	1,000 $/HP/year	20		20,000
Sodium hydroxide	4 gallon	500		2,000
Discharge to City POTW (100 gpm, 90% uptime)	4.00 /1,000 gal	4,730		18,900
POTW discharge monitoring	1,000 / samples	12		12,000
Utilities - water	6 /1,000 gal	40		200
Internet and communication fees	150 month	9		1,400
Plant process monitoring	300 / samples	100		30,000
Misc site maintenance	5,000 LS	1		5,000
Equipment repairs/replacement (0.5% of equipment capital cost)	3,466 LS	1		3,500
AOP operations cost	6,000 LS	1		6,000
Ion exchange operations cost	80,000 LS	1		80,000
Sludge disposal	200 ton	30		6,000
Lab and field instrumentation maintenance	300 month	12		3,600
Health and safety equipment	500 month	12		6,000
			Subtotal	424,400
Reporting				50,000
Contingency (5%)				21,220
Project Management (10%)				21,200
Total Groundwater Pump and Treat O&M Annual Costs				**517,000**
Annual Groundwater Monitoring During Operations				
Groundwater Monitoring				
Off-Site Groundwater Monitoring (semi-annual)				
Analytical (40 wells, 2 events)	300 well	80		24,000
Sampling expenses (40 wells, 2 events)	100 well	80		8,000
Hydraulic monitoring (90 wells, 2 events)	20 well	180		3,600
Travel expenses	3,000 LS	1		3,000
Labor	70 $/hour	144		10,100
			Subtotal	48,700
Reporting and Data Management				30,000
Contingency (5%)				2,435
Technical Support (20%)				9,740
Project Management (10%)				4,870
Total Annual Groundwater Monitoring During Operations				**96,000**

Groundwater Pump and Treat System Capital Cost	$3,324,000
Groundwater Pump and Treat System Startup Cost (assume 2 weeks)	$50,000
Total Groundwater Pump and Treat O&M Annual Costs	$517,000
Annual Groundwater Monitoring During Operations	$96,000

Appendix E
Perched Pump and Treat Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Table 3
Expected Influent Concentrations and Discharge Criteria

Location ID: Screen Interval (ft): Date Collected:	Units	Residential Drinking Water Criteria	Maximum Detect Plant 2	Maximum Detect Plant 6	Arithmetic Average Plant 2	Arithmetic Average Plant 6	Expected Influent Concentration (Flow-weighted Average)
Volatile Organics					20%	80%	
Chlorobenzene		100(A)	0.8	210	0.800	210	168.2
1,4-Dioxane	µg/L	85	2500	68	269	22.9	72.1
Tetrachloroethene	µg/L	5(A)	361	12	105	4.03	24.2
Vinyl chloride	µg/L	2(A)	4.2	13	3.10	4.22	4.0
Benzene	µg/L	5(A)	840	134	82.2	22.0	34.0
Ethylbenzene	µg/L	74(E)	1320	33000	316	2440	2,015.2
Toluene	µg/L	790(E)	2940	820	180	110	124.0
o-Xylene	µg/L	280(E)	350	24000	56.0	1880	1,515.2
m&p-Xylene	µg/L	280(E)	1530	124000	679	10000	8,135.8
Xylene (total)	µg/L	280(E)	1880	148000	405	9780	7,905.0
Semivolatile Organics							
Chrysene	µg/L	1.6(S)	80		80.0		16.0
Semivolatile Organics-Filtered							
PCBs							
Aroclor-1242 (PCB-1242)	µg/L	0.5(A)	800		800		160.0
Total PCBs	µg/L	0.5(A)	800		800		160.0
PCBs-Filtered							
Total PCBs (dissolved)	µg/L	0.5(A)	30		11.4		2.3
Aroclor-1242 (PCB-1242)	µg/L	0.5(A)	30		17.0		3.4
Inorganics							
Antimony	mg/L	0.006(A)		0.077		0.0168	0.013
Arsenic	mg/L	0.01(A)	0.0327	0.109	0.00880	0.0167	0.015
Chromium VI (hexavalent)	mg/L	0.1(A)					0.000
Chromium	mg/L	0.1(A)	0.058	0.033	0.0380	0.0166	0.021
Lead	mg/L	0.004(L)	0.018	1.49	0.00870	0.0475	0.040
Manganese	mg/L	0.05(E)	2.14	1.36	0.314	0.332	0.328
Vanadium	mg/L	0.0045	0.008	0.068	0.00560	0.0111	0.010
Inorganics-Filtered							
Arsenic (dissolved)	mg/L	0.01(A)	0.22	0.09	0.0168	0.0137	0.014
Chromium VI (hexavalent) (dissolved)	mg/L	0.1(A)					0.000
Chromium Total	mg/L	0.1(A)	0.066		0.0415		0.008
Lead (dissolved)	mg/L	0.004(L)	0.063	0.024	0.0184	0.00686	0.009
Manganese (dissolved)	mg/L	0.05(E)	2.67	4.23	0.433	0.431	0.431
Selenium (dissolved)	mg/L	0.05(A)	0.008	0.003	0.00425	0.00260	0.003
Vanadium (dissolved)	mg/L	0.0045	0.08	0.046	0.0151	0.0117	0.012

Notes:

Highlighted cells = The cleanup criteria for 1,4-dioxane may decrease to 8.5µg/L in the future and treatment will be included.

(A) = criterion is the state of Michigan drinking water standard established pursuant to Section 5 of 1976 PA 399, MCL 325.1005.

(E) = criterion is the aesthetic drinking water value.

(L) = generic residential drinking water criterion.

(S) = criterion defaults to the hazardous substance specific water solubility limit.

ft = feet

mg/L = milligrams per liter

PCB = polychlorinated biphenyl

µg/L = micrograms per liter

Appendix E
Perched Pump and Treat Cost Detail

RCRA Corrective Action Corrective Measures Study
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Table 4
Recovery Well and Trench Summary

Area	Target Depth (ft)	Low-Flow Cost Estimate			
		# wells	Flow Rate	Flow Rate per Well	Pump Type
Plant 2	10-30	2	2.5	1.3	Pneumatic
Plant 6	10-30	6	7.5	1.3	Pneumatic
	Totals:	**8.0**	**10.0**		

Notes:
ft = feet

Appendix E
Restrictive Covenant Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Restrictive Covenant Cost Assumptions:

- All site-wide restrictions will be in one Restrictive Covenant (RC) per Plant
- Area-specific restrictions will be completed per Area
- Each Plant and each Area needing a restriction will be surveyed
- Survey includes actual survey and legal description
- 3 Plants need Site-wide restrictions
- 16 Areas need additional restrictions
  - 16 Areas requiring a Cap either for Direct Contact or Particulate Soil Inhalation Criteria exceedances
  - 16 Areas require a Health and Safety Plan due to Direct Contact Criteria exceedances
- 12 Areas do not require additional restrictions
- Cost estimates are engineering estimates, +/- 30 to 50 percent

Restrictive Covenant Coordination and Completion	Unit Cost	Unit	Qty	Markup	Total Cost	Notes
ARCADIS Labor						
Principal Engineer/Scientist	$143	hr	47	0%	$6,726	
Sr Engineer/Sci II	$131	hr		0%	$0	
Sr Engineer/Sci I	$124	hr	94	0%	$11,658	
Sr Project Engineer/Scientist II	$108	hr	235	0%	$25,408	
Sr Project Engineer/Scientist I	$98	hr	141	0%	$13,750	
Project Engineer/Scientist	$89	hr		0%	$0	
Engineer/Scientist	$73	hr	80	0%	$5,851	Oversight of 4 hours per survey
Senior Drafter	$69	hr	120	0%	$8,268	Figures for coordination and for RCs
ARCADIS Expenses						
Meals	$50	day	10	0%	$500	
Truck	$115	day	10	0%	$1,150	
Hotel	$120	day	8	0%	$960	
Mileage	$0.45	mi	600	0%	$270	
PPE	$25	day	10	0%	$250	
Survey Subcontractor						
Survey with legal description	$1,500	each	19	15%	$32,775	

RC Subtotal		**$108,000**
PM	**10%**	**$11,000**
RC TOTAL		**$119,000**
GW Use Total:		**$25,000**
Land Use Total:		**$94,000**

Restrictive Covenant Total:	**$119,000**

Appendix E
Monitored Plume Stability Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
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Monitored Plume Stability Cost Assumptions:

- Interm GW Monitoring Cost from "Attachment 5 - 2013 and Future Years Cost Re-allocation2013 EA Budget Amendment No. 2"May 2013
- Assume RACER will own the property for 30 years (timeframe for Slab Maintenance)
- Assume Slab Maintenance will occur once every 5 years (starting in year 5)
- Cost estimates are engineering estimates, +/- 30 to 50 percent

Groundwater Monitoring				
Items	**Unit**	**Qty**	**Cost**	**Extension**
1. Plant 2				
Year 1 (Interim Groundwater Sampling)	annual cost	1	$156,600	$156,600
Years 2-5 (Semi-Annual Sampling)	annual cost	4	$41,100	$164,400
Years 6-10 (Annual Sampling)	annual cost	5	$25,200	$126,000
Years 11-30 (Sampling Every 2 Years)	annual cost	10	$24,900	$249,000
2. Plant 3				
Year 1 (Interim Groundwater Sampling)	annual cost	1	$244,900	$244,900
Years 2-5 (Semi-Annual Sampling)	annual cost	4	$68,900	$275,600
Years 6-10 (Annual Sampling)	annual cost	5	$38,300	$191,500
Years 11-30 (Sampling Every 2 Years)	annual cost	10	$38,000	$380,000
3. Plant 6				
Year 1 (Interim Groundwater Sampling)	annual cost	1	$226,100	$226,100
Years 2-5 (Semi-Annual Sampling)	annual cost	4	$61,500	$246,000
Years 6-10 (Annual Sampling)	annual cost	5	$35,800	$179,000
Years 11-30 (Sampling Every 2 Years)	annual cost	10	$34,400	$344,000
			Groundwater Monitoring Plant 2 Subtotal	**$696,000**
			Groundwater Monitoring Plant 3 Subtotal	**$1,092,000**
			Groundwater Monitoring Plant 6 Subtotal	**$996,000**
			Groundwater Monitoring Total	**$2,784,000**

Existing Surface (e.g. building slabs, asphalt, concrete) Maintenance and Inspections				
See "Area Estimate Plants 2 3 6 Surface Maintenance_revised 3052014 for quantitiy details (environmental cost fro				
Items	**Unit**	**Qty**	**Cost**	**Extension**
1. Initial Clearing				
Plant 2 Concrete	acre	17.1	$2,200	$37,641
Plant 2 Asphalt	acre	1.4	$9,700	$13,851
Plant 3 Concrete	acre	7.5	$2,200	$16,505
Plant 3 Asphalt	acre	0.5	$9,700	$4,498
Fill Low Areas	LS	1	$100,000	$100,000
ARCADIS Labor/Expenses	LS	1	$34,499	$34,499
2. Annual Maintenance				
Plant 2	annual cost	30	$17,000	$510,000
Plant 3	annual cost	30	$8,500	$255,000
ARCADIS Labor/Expenses	annual cost	30	$5,100	$153,000
3. Periodic Maintenance (years 5, 10, 15, 20, 25, and 30)				
Plant 2	annual cost	6	$10,000	$60,000
Plant 3	annual cost	6	$5,000	$30,000
ARCADIS Labor/Expenses	annual cost	6	$3,000	$18,000
			Maintenance and Inspections Plant 2 Subtotal	**$775,000**
			Maintenance and Inspections Plant 3 Subtotal	**$443,000**
			Maintenance and Inspections Plant 6 Subtotal	**$0**
			Maintenance Total	**$1,218,000**

Appendix E
Monitored Plume Stability Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Well Abandonment				
Items	**Unit**	**Qty**	**Cost**	**Extension**
Well Abandonment				
Plant 2	LS	1	$26,000	$26,000
Plant 3	LS	1	$55,000	$55,000
Plant 6	LS	1	$41,000	$41,000
		Maintenance and Inspections Total		**$122,000**

Groundwater Monitoring Monitoring Total	**$2,784,000**
Maintenance and Inspections Total	**$1,218,000**
Well Abandomnet Total	**$122,000**
Monitored Plume Stability Total (30 yrs)	**$4,124,000**

Appendix E
Plant 2 Cap and Excavation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

CONCEPTUAL CORRECTIVE MEASURES EXCAVATION AND CAPPING COSTS RACER TRUST LANSING PLANT 2		Plant 2															
		Area 2						Area 5-1		Area 5-2							
		Soil Cap Area: 800 ft2		DC/PSIC Excavation Area: 800 ft^2		SVIIC Excavation Area: 7,700 ft^2		DC/PSIC Excavation Area: 4,900 ft^2		Concrete Cap Area: 20,000 ft^2		DC/PSIC Excavate Area 5-2: 135,000 ft^2		Excavate Entire LNAPL Plume Area: 50,000 ft^2		Targeted Excavation LNAPL Area: 9,400 ft^2	
				Excavation Depth: 2 ft and 10 ft		Excavation Depth: 20 ft and 25 ft		Excavation Depth: 5 ft				Excavation Depth: 5 ft (10 x 10 ft2 area to 27 ft)		Excavation Average Depth: 15 ft		Excavation Depths: 6 ft to 13 ft	
								Cap Area: NA								Cap Area: NA	
DIRECT LABOR	**Unit Billing Rate**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**
PROJECT MANAGEMENT - WORKPLAN PREPARATION																	
Principal	$145	1	$145	2	$290	2	$290	1	$145	2	$290	2	$290	2	$290	1	$145
Program Manager/Principal	$145	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Senior Project Engineer/Senior Professional II	$105	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Manager of Site Investigation/Senior Professional I	$95	4	$380	8	$760	117	$11,115	16	$1,520	20	$1,900	200	$19,000	100	$9,500	60	$5,700
Project Manager/Project Professional II	$80	20	$1,600	80	$6,400	468	$37,440	100	$8,000	100	$8,000	800	$64,000	600	$48,000	200	$16,000
Project Geologist/Project Professional II	$80	0	$0	40	$3,200	234	$18,720	50	$4,000	20	$1,600	400	$32,000	300	$24,000	100	$8,000
OVERSIGHT OF CORRECTIVE MEASURES																	
Senior Field II	$65	8	$520	36	$2,340	156	$10,140	78	$5,070	144	$9,360	1832	$119,080	2356	$153,140	252	$16,380
Field Scientist	$55	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Operator	$60	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
DATA PROCESSING																	
CAD II	$65	2	$130	4	$260	8	$520	6	$390	12	$780	50	$3,250	70	$4,550	20	$1,300
CAD I	$55	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Administrative I	$35	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
SUB-TOTAL LABOR			$2,775		$13,250		$78,225		$19,125		$21,930		$237,620		$239,480		$47,525
SUPPLIES AND EQUIPMENT	**Unit Billing Rate**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**
Mileage	$0.5	50	$25	50	$25	350	$175	350	$175	900	$450	8,000	$4,000	11,200	$5,600	1,050	$525
Support Vehicle	$75	1	$75	1	$75	7	$525	7	$525	18	$1,350	160	$12,000	224	$16,800	21	$1,575
GPR Unit - Utility Locate	$400	0	$0	2	$800	6	$2,400	2	$800	0	$0	46	$18,400	47	$18,800	7	$2,800
Concrete Core Machine	$125	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Interface Probe (per day)	$75	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Generator (per day)	$75	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Peristaltic Low-flow Sample Equipment (per day)	$65	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Submersible Low-flow Sample Equipment (per day)	$90	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Poly-tubing (per foot)	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Flex-tubing (per foot)	$2	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
55-Gallon Steel Dum	$44	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
PID (per day)	$75	1	$75	1	$75	7	$525	7	$525	18	$1,350	160	$12,000	224	$16,800	21	$1,575
Groundwater Metals Filters	$17	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Sample Prep Supplies	$10	0	$0	20	$200	60	$600	40	$400	0	$0	150	$1,500	250	$2,500	60	$600
Personal Protective Equipment	$15	1	$15	1	$15	7	$105	7	$105	18	$270	160	$2,400	224	$3,360	21	$315
Decontamination Equipment	$50	1	$50	2	$100	13	$650	3	$150	18	$900	46	$2,300	47	$2,350	7	$350
Drilling Supplies	$150	0	$0	2	$300	6	$900	2	$300	0	$0	46	$6,900	47	$7,050	7	$1,050
Geoprobe (Equipment Only)	$800	0	$0	2	$1,600	6	$4,800	2	$1,600	0	$0	46	$36,800	47	$37,600	7	$5,600
SUB-TOTAL SUPPLIES AND EQUIPMENT			$240		$3,190		$10,680		$4,580		$4,320		$96,300		$110,860		$14,390
CORRECTIVE MEASURES	**Unit Billing Rate**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**
Saw-cut concrete up to 10-inches thick (per linear foot)	$6	0	$0	360	$2,160	500	$3,000	400	$2,400	0	$0	1,580	$9,480	900	$5,400	750	$4,500
Saw-cut concrete up to 20-inches thick (per linear foot)	$12	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Concrete Breaker and Operator (per 10-hour day)	$4,400	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Excavator and Operator (per 10-hour day)	$2,900	1	$2,900	0	$0	7	$20,300	1	$2,900	0	$0	0	$0	0	$0	0	$0
Vacuum/Tanker Truck Mobilization (per day)	$1,500	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Groundwater Disposal (per gallon) NON-HAZ	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Excavate/Transport/Disposal Non-Harzardous Soil (per trucked yard)	$30	0	$0	178	$5,340	6,204	$186,111	908	$27,240	0	$0	27,200	$816,000	27,800	$834,000	3,700	$111,000
Excavate/Transport/Disposal Concrete (per trucked cubic yard)	$15	0	$0	30	$450	185	$2,778	182	$2,730	0	$0	5,000	$75,000	1,900	$28,500	175	$2,625
TSCA Regulated Contaminated Liquid Disposal (per drum)	$1,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
TSCA Regulated Contaminated Liquid Transportion (up to 10 drums Lansing to WDI)	$1,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
TSCA Regulated Contaminated Soil Transportaion and Disposal (per ton)	$200	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
TSCA Regulated Contaminated Debris Transportation and Disposal (per ton)	$300	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Backfill material (per trucked cubic yard)	$10	33	$330	130	$1,300	6,204	$62,037	1,167	$11,670	0	$0	32,000	$320,000	23,500	$235,000	4,000	$40,000
Wire-mesh Reinforced Concrete Resurface (per square foot; 6-inches thick)	$9	0	$0	0	$0	0	$0	4,900	$44,100	20,000	$180,000	50,000	$450,000	50,000	$450,000	9,400	$84,600
Wire-mesh Reinforced Concrete Resurface (per square foot; 8-inches thick)	$10	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Asphalt Resurface (per square foot; 6-inches thick)	$8	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
SUB-TOTAL CORRECTIVE MEASURES			$3,230		$9,250		$274,226		$91,040		$180,000		$1,670,480		$1,552,900		$242,725
SUB-TOTAL		$6,300		$25,700		$363,200		$114,800		$206,300		$2,004,400		$1,903,300		$304,700	
CONTINGENCY	30%	$1,900		$7,800		$109,000		$34,500		$61,900		$601,400		$571,000		$91,400	
TOTAL BUDGETARY COST CAP		$9,000								$269,000							
TOTAL BUDGETARY COST EXCAVATION				$34,000		$473,000		$150,000				$2,606,000		$2,475,000		$397,000	

ASSUMPTIONS:

Costs assume excavated material is not classified as a Listed or Hazardous Waste.
Costs associated with performance bonding not included.
Costs assume approximately 1000-cubic yards of material excavated, transported, and disposed per day.
Costs assume approximately 2,000-square feet of concrete cap installed per day.
All work will be completed under Level D or Level C PPE.
Costs assume no shoring will be required and any materials removed for excavation benching and sloping will not require offsite transport and disposal.
Costs assume benching and sloping activities are incidental to the project and are not subject to unit rates.
Conceptual costs assume the existing concrete slab over each proposed excavation area at Plant 2 will be saw cut prior to implementing corrective measures activities.
Excavation area and depths provided by ARCADIS. Conceptual costs assume the total depth of excavation beneath the bottom of existing concrete slabs.
Soil and Concrete Disposal: Assumes all soil and concrete is classified as characteristically non-hazardous waste.
Groundwater Disposal: Assumes all groundwater is classified as characteristically non-hazardous waste.
Plant 2 Corrective Measures Project Totals does not include cost for excavation dewatering/groundwater disposal.

Appendix E
Plant 2 Cap and Excavation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

CONCEPTUAL CORRECTIVE MEASURES EXCAVATION AND CAPPING COSTS RACER TRUST LANSING PLANT 2		Plant 2							
		Area 5-3				Area 5-5			
		Concrete Cap Area: 800 ft2		DC/PSIC Excavation Area: 3,300 ft^2 Excavation Depth: 2 ft		Soil Cap Area: 2,200 ft^2		DC/PSIC Excavation Area: 2,200 ft^2 Excavation Depth: 3 ft	
DIRECT LABOR	**Unit Billing Rate**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**
PROJECT MANAGEMENT - WORKPLAN PREPARATION									
Principal	$145	1	$145	1	$145	1	$145	1	$145
Program Manager/Principal	$145	0	$0	0	$0	0	$0	0	$0
Senior Project Engineer/Senior Professional II	$105	0	$0	0	$0	0	$0	0	$0
Manager of Site Investigation/Senior Professional I	$95	4	$380	8	$760	4	$380	8	$760
Project Manager/Project Professional II	$80	20	$1,600	60	$4,800	20	$1,600	60	$4,800
Project Geologist/Project Professional II	$80	0	$0	30	$2,400	4	$320	30	$2,400
OVERSIGHT OF CORRECTIVE MEASURES									
Senior Field II	$65	8	$520	48	$3,120	16	$1,040	48	$3,120
Field Scientist	$55	0	$0	0	$0	0	$0	0	$0
Operator	$60	0	$0	0	$0	0	$0	0	$0
DATA PROCESSING									
CAD II	$65	2	$130	4	$260	4	$260	4	$260
CAD I	$55	0	$0	0	$0	0	$0	0	$0
Administrative I	$35	0	$0	0	$0	0	$0	0	$0
SUB-TOTAL LABOR			$2,775		$11,485		$3,745		$11,485
SUPPLIES AND EQUIPMENT	**Unit Billing Rate**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**
Mileage	$0.5	50	$25	150	$75	100	$50	150	$75
Support Vehicle	$75	1	$75	3	$225	2	$150	3	$225
GPR Unit - Utility Locate	$400	0	$0	0	$0	0	$0	0	$0
Concrete Core Machine	$125	0	$0	2	$250	0	$0	2	$250
Interface Probe (per day)	$75	0	$0	0	$0	0	$0	0	$0
Generator (per day)	$75	0	$0	0	$0	0	$0	0	$0
Peristaltic Low-flow Sample Equipment (per day)	$65	0	$0	0	$0	0	$0	0	$0
Submersible Low-flow Sample Equipment (per day)	$90	0	$0	0	$0	0	$0	0	$0
Poly-tubing (per foot)	$0	0	$0	0	$0	0	$0	0	$0
Flex-tubing (per foot)	$2	0	$0	0	$0	0	$0	0	$0
55-Gallon Steel Dum	$44	0	$0	0	$0	0	$0	0	$0
PID (per day)	$75	1	$75	3	$225	2	$150	3	$225
Groundwater Metals Filters	$17	0	$0	0	$0	0	$0	0	$0
Sample Prep Supplies	$10	0	$0	20	$200	0	$0	20	$200
Personal Protective Equipment	$15	1	$15	3	$45	2	$30	3	$45
Decontamination Equipment	$50	1	$50	2	$100	2	$100	2	$100
Drilling Supplies	$150	0	$0	2	$300	0	$0	2	$300
Geoprobe (Equipment Only)	$800	0	$0	2	$1,600	0	$0	2	$1,600
SUB-TOTAL SUPPLIES AND EQUIPMENT			$240		$3,020		$480		$3,020
CORRECTIVE MEASURES	**Unit Billing Rate**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**
Saw-cut concrete up to 10-inches thick (per linear foot)	$6	0	$0	540	$3,240	0	$0	190	$1,140
Saw-cut concrete up to 20-inches thick (per linear foot)	$12	0	$0	0	$0	0	$0	0	$0
Concrete Breaker and Operator (per 10-hour day)	$4,400	0	$0	0	$0	0	$0	0	$0
Excavator and Operator (per 10-hour day)	$2,900	0	$0	0	$0	2	$5,800	0	$0
Vacuum/Tanker Truck Mobilization (per day)	$1,500	0	$0	0	$0	0	$0	0	$0
Groundwater Disposal (per gallon) NON-HAZ	$0	0	$0	0	$0	0	$0	0	$0
Excavate/Transport/Disposal Non-Harzardous Soil (per trucked yard)	$30	0	$0	250	$7,500	0	$0	244	$7,320
Excavate/Transport/Disposal Concrete (per trucked cubic yard)	$15	0	$0	125	$1,875	0	$0	81	$1,215
TSCA Regulated Contaminated Liquid Disposal (per drum)	$1,000	0	$0	0	$0	0	$0	0	$0
TSCA Regulated Contaminated Liquid Transportion (up to 10 drums Lansing to WDI)	$1,000	0	$0	0	$0	0	$0	0	$0
TSCA Regulated Contaminated Soil Transportaion and Disposal (per ton)	$200	0	$0	0	$0	0	$0	0	$0
TSCA Regulated Contaminated Debris Transportation and Disposal (per ton)	$300	0	$0	0	$0	0	$0	0	$0
Backfill material (per trucked cubic yard)	$10	0	$0	400	$4,000	88	$880	314	$3,140
Wire-mesh Reinforced Concrete Resurface (per square foot; 6-inches thick)	$9	800	$7,200	3,300	$29,700	0	$0	0	$0
Wire-mesh Reinforced Concrete Resurface (per square foot; 8-inches thick)	$10	0	$0	0	$0	0	$0	0	$0
Asphalt Resurface (per square foot; 6-inches thick)	$8	0	$0	0	$0	0	$0	0	$0
SUB-TOTAL CORRECTIVE MEASURES			$7,200		$46,315		$6,680		$12,815
SUB-TOTAL		$10,300		$60,900		$11,000		$27,400	
CONTINGENCY	30%	$3,100		$18,300		$3,300		$8,200	
TOTAL BUDGETARY COST CAP		$11,000				$11,000			
TOTAL BUDGETARY COST EXCAVATION				$61,000				$28,000	

ASSUMPTIONS:
Costs assume excavated material is not classified as a Listed or Hazardous Waste.
Costs associated with performance bonding not included.
Costs assume approximately 1000-cubic yards of material excavated, transported, and disposed per day.
Costs assume approximately 2,000-square feet of concrete cap installed per day.
All work will be completed under Level D or Level C PPE.
Costs assume no shoring will be required and any materials removed for excavation benching and sloping will not require offsite transport and disposal.
Costs assume benching and sloping activities are incidental to the project and are not subject to unit rates.
Conceptual costs assume the existing concrete slab over each proposed excavation area at Plant 2 will be saw cut prior to implementing corrective measures activities.
Excavation area and depths provided by ARCADIS. Conceptual costs assume the total depth of excavation beneath the bottom of existing concrete slabs.
Soil and Concrete Disposal: Assumes all soil and concrete is classified as characteristically non-hazardous waste.
Groundwater Disposal: Assumes all groundwater is classified as characteristically non-hazardous waste.
Plant 2 Corrective Measures Project Totals does not include cost for excavation dewatering/groundwater disposal.

Appendix E
Plant 3 Cap and Excavation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

CONCEPTUAL CORRECTIVE MEASURES EXCAVATION AND CAPPING COSTS RACER TRUST LANSING PLANT 3		Plant 3																			
		Area 11		Area 16		Area 17						Area 18				Area 19		Area 20		Area 21	
		SVIIC Excavation Area: 2,400 ft²		DC/PSIC Excavation Area: 3,500 ft²		Concrete Cap Area: 3,800 ft²		Excavate Entire LNAPL Plume Area: 3,800 ft²		Targeted Excavation LNAPL Area: 3,800 ft²		Soil Cap Area: 8,300 ft²		DC/PSIC Excavation Area: 8,300 ft²		DC/PSIC Excavation Area: 3,400 ft²		DC/PSIC Excavation Area: 4,700 ft²		DC/PSIC Excavation Area: 1,000 ft²	
		Excavation Depth: 15 ft		Excavation Depth: 9 ft				Excavation Depth: North Plume 10 ft; South Plume 22 ft		Excavation Depth: 5 ft				Excavation Depth: 2 ft		Excavation Depth: 10 ft		Excavation Depth: 18 ft		Excavation Depth: 5 ft	
DIRECT LABOR	**Unit Billing Rate**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**
PROJECT MANAGEMENT - WORKPLAN PREPARATION																					
Principal	$145	2	$290	2	$290	1	$145	2	$290	1	$145	2	$290	2	$290	1	$145	2	$290	1	$145
Program Manager/Principal	$145	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Senior Project Engineer/Senior Professional II	$105	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Manager of Site Investigation/Senior Professional I	$95	18	$1,710	8	$760	4	$380	36	$3,420	20	$1,900	8	$760	8	$760	10	$950	28	$2,660	8	$760
Project Manager/Project Professional II	$80	72	$5,760	80	$6,400	40	$3,200	200	$16,000	100	$8,000	40	$3,200	80	$6,400	80	$6,400	160	$12,800	80	$6,400
Project Geologist/Project Professional II	$80	36	$2,880	40	$3,200	4	$320	100	$8,000	50	$4,000	20	$1,600	40	$3,200	40	$3,200	80	$6,400	40	$3,200
OVERSIGHT OF CORRECTIVE MEASURES																					
Senior Field II	$65	24	$1,560	80	$5,200	24	$1,560	268	$17,420	88	$5,720	40	$2,600	64	$4,160	64	$4,160	208	$13,520	40	$2,600
Field Scientist	$55	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Operator	$60	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
DATA PROCESSING																					
CAD II	$65	44	$2,860	6	$390	4	$260	32	$2,080	10	$650	8	$520	8	$520	10	$650	24	$1,560	4	$260
CAD I	$55	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Administrative I	$35	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
SUB-TOTAL LABOR			$15,060		$16,240		$5,865		$47,210		$20,415		$8,970		$15,330		$15,505		$37,230		$13,365
SUPPLIES AND EQUIPMENT	**Unit Billing Rate**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**
Mileage	$0.5	100	$50	350	$175	150	$75	1,150	$575	400	$200	200	$100	250	$125	400	$200	850	$425	100	$50
Support Vehicle	$75	2	$150	7	$525	3	$225	23	$1,725	8	$600	4	$300	5	$375	8	$600	17	$1,275	2	$150
GPR Unit - Utility Locate	$400	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Concrete Core Machine	$125	3	$375	2	$250	0	$0	7	$875	2	$250	0	$0	2	$250	3	$375	6	$750	2	$250
Interface Probe (per day)	$75	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Generator (per day)	$75	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Peristaltic Low-flow Sample Equipment (per day)	$65	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Submersible Low-flow Sample Equipment (per day)	$90	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Poly-tubing (per foot)	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Flex-tubing (per foot)	$2	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
55-Gallon Steel Dum	$44	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
PID (per day)	$75	2	$150	7	$525	3	$225	23	$1,725	8	$600	4	$300	5	$375	8	$600	17	$1,275	2	$150
Groundwater Metals Filters	$17	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Sample Prep Supplies	$10	40	$400	40	$400	0	$0	100	$1,000	50	$500	0	$0	20	$200	40	$400	60	$600	20	$200
Personal Protective Equipment	$15	2	$30	7	$105	3	$45	23	$345	8	$120	4	$60	5	$75	8	$120	17	$255	2	$30
Decontamination Equipment	$50	5	$250	2	$100	3	$150	7	$350	8	$400	4	$200	2	$100	3	$150	6	$300	2	$100
Drilling Supplies	$150	3	$450	2	$300	0	$0	7	$1,050	0	$0	0	$0	2	$300	3	$450	6	$900	2	$300
Geoprobe (Equipment Only)	$800	3	$2,400	2	$1,600	0	$0	7	$5,600	2	$1,600	0	$0	2	$1,600	3	$2,400	6	$4,800	2	$1,600
SUB-TOTAL SUPPLIES AND EQUIPMENT			$4,255		$3,980		$720		$13,245		$4,270		$960		$3,400		$5,295		$10,580		$2,830
CORRECTIVE MEASURES	**Unit Billing Rate**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**
Saw-cut concrete up to 10-inches thick (per linear foot)	$6	200	$1,200	240	$1,440	0	$0	480	$2,880	480	$2,880	0	$0	370	$2,220	240	$1,440	280	$1,680	140	$840
Saw-cut concrete up to 20-inches thick (per linear foot)	$12	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Concrete Breaker and Operator (per 10-hour day)	$4,400	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Excavator and Operator (per 10-hour day)	$2,900	2	$5,800	0	$0	0	$0	0	$0	0	$0	4	$11,600	0	$0	0	$0	0	$0	0	$0
Vacuum/Tanker Truck Mobilization (per day)	$1,500	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Groundwater Disposal (per gallon) NON-HAZ	$0.45	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Excavate/Transport/Disposal Non-Hazardous Soil (per trucked yard)	$30	1,333	$40,000	1,167	$35,010	0	$0	4,100	$123,000	704	$21,120	0	$0	615	$18,450	1,260	$37,800	3,134	$94,020	185	$5,550
Excavate/Transport/Disposal Concrete (per trucked cubic yard)	$15	89	$1,333	0	$0	0	$0	280	$4,200	280	$4,200	0	$0	308	$4,620	126	$1,890	175	$2,625	37	$555
TSCA Regulated Contaminated Liquid Disposal (per drum)	$1,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
TSCA Regulated Contaminated Liquid Transportation (up to 10 drums Lansing to WDI)	$1,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
TSCA Regulated Contaminated Soil Transportation and Disposal (per ton)	$200	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
TSCA Regulated Contaminated Debris Transportation and Disposal (per ton)	$300	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Backfill material (per trucked cubic yard)	$10	1,333	$13,333	1,387	$13,870	0	$0	4,710	$47,100	950	$9,500	350	$3,500	1,350	$13,500	1,484	$14,840	3,541	$35,410	238	$2,380
Wire-mesh Reinforced Concrete Resurface (per square foot; 6-inches thick)	$9	2,400	$21,600	0	$0	3,800	$34,200	7,400	$66,600	7,400	$66,600	0	$0	0	$0	3,400	$30,600	2,800	$25,200	0	$0
Wire-mesh Reinforced Concrete Resurface (per square foot; 8-inches thick)	$10	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Asphalt Resurface (per square foot; 6-inches thick)	$8	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
SUB-TOTAL CORRECTIVE MEASURES			$83,267		$50,320		$34,200		$243,780		$104,300		$15,100		$38,790		$86,570		$158,935		$9,325
SUB-TOTAL		$102,600		$70,600		$40,800		$304,300		$129,000		$25,100		$57,600		$107,400		$206,800		$25,520	
CONTINGENCY	30%	$30,800		$21,200		$12,300		$91,300		$38,700		$7,600		$17,300		$32,300		$62,100		$7,700	
TOTAL BUDGETARY COST CAP						$54,000						$33,000									
TOTAL BUDGETARY COST EXCAVATION		$134,000		$92,000				$396,000		$168,000				$75,000		$140,000		$269,000		$26,000	

ASSUMPTIONS:

Costs assume excavated material is not classified as a Listed or Hazardous Waste.
Costs associated with performance bonding not included.
Costs assume approximately 1000-cubic yards of material excavated, transported, and disposed per day.
Costs assume approximately 2,000-square feet of concrete cap installed per day.
All work will be completed under Level D or Level C PPE
Costs assume no shoring will be required and any materials removed for excavation benching and sloping will not require offsite transport and disposal.
Costs assume benching and sloping activities are incidental to the project and are not subject to unit rates.
Conceptual costs assume the existing concrete slab over each proposed excavation area at Plant 3 (with the exception of Area 16) will be saw cut prior to implementing corrective measures activities.
Excavation area and depths provided by ARCADIS. Conceptual costs assume the total depth of excavation beneath the bottom of existing concrete slabs.
Soil and Concrete Disposal: Assumes all soil and concrete is classified as characteristically non-hazardous waste.
Groundwater Disposal: Assumes all groundwater is classified as characteristically non-hazardous waste.
Plant 3 Corrective Measures Project Totals does not include cost for excavation dewatering/groundwater disposal.

Appendix E
Plant 6 Cap and Excavation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

CONCEPTUAL CORRECTIVE MEASURES EXCAVATION AND CAPPING COSTS RACER TRUST LANSING PLANT 6		Plant 6																			
		Area 5-6				Area 5-7		Area 5-8		Area 7								Area 9			
		Soil Cap Area: 20,000 ft²		Excavation Area: 20,000 ft²		SVIIC Excavation Area: 1,650 ft²		DC/PSIC Excavation Area: 2,200 ft²		Soil Cap Area: 400 ft² (West Area)		Soil Cap Area: 2,300 ft² (East Area)		DC/PSIC Excavation Excavation Area: 2,700 ft²		SVIIC Excavation Area: 1,650 ft²		DC/PSIC Excavation Excavation Area: 1,400 ft²		SVIIC Excavation Area: 1,400 ft²	
				Excavation Depth: 7 ft		Excavation Depth: 12 ft		Excavation Depth: 3 ft						Excavation Depth: 2 ft and 10 ft		Excavation Depth: 12 ft		Excavation Depth: 12 ft		Excavation Depth: 12 ft	
DIRECT LABOR	**Unit Billing Rate**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**
PROJECT MANAGEMENT - WORKPLAN PREPARATION																					
Principal	$145	1	$145	3	$435	2	$290	1	$145	1	$145	1	$145	2	$290	2	$290	2	$290	2	$290
Program Manager/Principal	$145	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Senior Project Engineer/Senior Professional II	$105	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Manager of Site Investigation/Senior Professional I	$95	20	$1,900	48	$4,560	27	$2,565	8	$760	4	$380	8	$760	63	$5,985	54	$5,130	54	$5,130	54	$5,130
Project Manager/Project Professional II	$80	60	$4,800	248	$19,840	108	$8,640	60	$4,800	20	$1,600	30	$2,400	252	$20,160	216	$17,280	216	$17,280	216	$17,280
Project Geologist/Project Professional II	$80	20	$1,600	124	$9,920	54	$4,320	30	$2,400	10	$800	15	$1,200	126	$10,080	108	$8,640	108	$8,640	108	$8,640
OVERSIGHT OF CORRECTIVE MEASURES																					
Senior Field II	$65	80	$5,200	356	$23,140	36	$2,340	48	$3,120	8	$520	8	$520	84	$5,460	72	$4,680	72	$4,680	72	$4,680
Field Scientist	$55	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Operator	$60	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
DATA PROCESSING																					
CAD II	$65	16	$1,040	40	$2,600	8	$520	4	$260	4	$260	8	$520	4	$260	8	$520	8	$520	8	$520
CAD I	$55	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Administrative I	$35	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
SUB-TOTAL LABOR			$14,685		$60,495		$18,675		$11,485		$3,705		$5,545		$42,235		$36,540		$36,540		$36,540
SUPPLIES AND EQUIPMENT	**Unit Billing Rate**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**
Mileage	$0.5	500	$250	1,550	$775	50	$25	150	$75	50	$25	50	$25	250	$125	200	$100	200	$100	200	$100
Support Vehicle	$75	10	$750	31	$2,325	1	$75	3	$225	1	$75	1	$75	5	$375	4	$300	4	$300	4	$300
GPR Unit - Utility Locate	$400	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Concrete Core Machine	$125	0	$0	9	$1,125	2	$250	2	$250	0	$0	0	$0	2	$250	2	$250	2	$250	2	$250
Interface Probe (per day)	$75	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Generator (per day)	$75	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Peristaltic Low-flow Sample Equipment (per day)	$65	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Submersible Low-flow Sample Equipment (per day)	$90	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Poly-tubing (per foot)	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Flex-tubing (per foot)	$2	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
55-Gallon Steel Dum	$44	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
PID (per day)	$75	10	$750	31	$2,325	1	$75	3	$225	1	$75	1	$75	1	$75	1	$75	1	$75	1	$75
Groundwater Metals Filters	$17	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Sample Prep Supplies	$10	10	$100	160	$1,600	73	$733	20	$200	0	$0	0	$0	88	$881	73	$733	62	$622	62	$622
Personal Protective Equipment	$15	10	$150	31	$465	1	$15	3	$45	1	$15	1	$15	1	$15	1	$15	1	$15	1	$15
Decontamination Equipment	$50	31	$1,550	9	$450	3	$150	2	$100	1	$50	1	$50	3	$150	3	$150	3	$150	3	$150
Drilling Supplies	$150	0	$0	9	$1,350	2	$300	2	$300	0	$0	0	$0	2	$300	2	$300	2	$300	2	$300
Geoprobe (Equipment Only)	$800	0	$0	9	$7,200	2	$1,600	2	$1,600	0	$0	0	$0	2	$1,600	2	$1,600	2	$1,600	2	$1,600
SUB-TOTAL SUPPLIES AND EQUIPMENT			$3,550		$17,615		$3,223		$3,020		$240		$240		$3,771		$3,523		$3,412		$3,412
CORRECTIVE MEASURES	**Unit Billing Rate**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**	**Units**	**Cost**
Saw-cut concrete up to 10-inches thick (per linear foot)	$6	0	$0	570	$3,420	160	$960	190	$1,140	0	$0	0	$0	160	$960	160	$960	260	$1,560	260	$1,560
Saw-cut concrete up to 20-inches thick (per linear foot)	$12	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Utility Management (36 inch sewer, Area 9 only)	$5,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	3	$15,000	3	$15,000
Concrete Breaker and Operator (per 10-hour day)	$4,400	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	4	$17,600	3	$13,200	0	$0	0	$0
Excavator and Operator (per 10-hour day)	$2,900	10	$29,000	0	$0	1	$2,900	0	$0	1	$2,900	1	$2,900	1	$2,900	1	$2,900	1	$2,900	1	$2,900
Vacuum/Tanker Truck Mobilization (per day)	$1,500	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Groundwater Disposal (per gallon) Non-Hazardous	$0.45	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Excavate/Transport/Disposal Non-Hazardous Soil (per trucked cubic yard)	$30	0	$0	5,185	$155,550	733	$22,000	250	$7,500	0	$0	0	$0	881	$26,444	733	$22,000	622	$18,667	622	$18,667
Excavate/Transport/Disposal Concrete (per trucked cubic yard)	$15	0	$0	741	$11,115	61	$917	81	$1,215	0	$0	0	$0	0	$1	61	$917	156	$2,340	156	$2,340
TSCA Regulated Contaminated Liquid Disposal (per drum)	$1,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
TSCA Regulated Contaminated Liquid Transportation (up to 10 drums Lansing to WDI)	$1,000	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
TSCA Regulated Contaminated Soil Transportation and Disposal (per ton)	$200	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
TSCA Regulated Contaminated Debris Transportation and Disposal (per ton)	$300	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Backfill material (per trucked cubic yard)	$10	790	$7,900	7,150	$71,500	733	$7,333	268	$2,680	20	$200	90	$900	881	$8,815	733	$7,333	1,832	$18,320	1,832	$18,320
Wire-mesh Reinforced Concrete Resurface (per square foot; 6-inches thick)	$9	0	$0	0	$0	0	$0	2,200	$19,800	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Wire-mesh Reinforced Concrete Resurface (per square foot; 8-inches thick)	$10	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
Asphalt Resurface (per square foot; 6-inches thick)	$8	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0	0	$0
SUB-TOTAL CORRECTIVE MEASURES			$36,900		$241,585		$34,110		$32,335		$3,100		$3,800		$56,720		$47,310		$58,787		$58,787
SUB-TOTAL		$55,200		$319,700		$56,100		$46,900		$7,100		$9,600		$102,800		$87,400		$98,800		$98,800	
CONTINGENCY	30%	$16,600		$96,000		$16,900		$14,100		$2,200		$2,900		$30,900		$26,300		$29,700		$29,700	
TOTAL BUDGETARY COST CAP		$72,000								$10,000		$13,000									
TOTAL BUDGETARY COST EXCAVATION				$416,000		$73,000		$61,000						$134,000		$114,000		$129,000		$129,000	

ASSUMPTIONS:
Costs assume excavated material is not classified as a Listed or Hazardous Waste.
Costs associated with performance bonding not included.
Costs assume approximately 1000-cubic yards of material excavated, transported, and disposed per day.
Costs assume approximately 2,000-square feet of concrete cap installed per day.
All work will be completed under Level D or Level C PPE.
Costs assume no shoring will be required (with the exception of Area 9) and any materials removed for excavation benching and sloping will not require offsite transport and disposal.
Costs assume benching and sloping activities are incidental to the project and are not subject to unit rates.
Conceptual costs assume the existing concrete slab over each proposed excavation area at Plant 6 will be saw cut prior to implementing corrective measures activities.
Excavation area and depths provided by ARCADIS. Conceptual costs assume the total depth of excavation beneath the bottom of existing concrete slabs.
Soil and Concrete Disposal: Assumes all soil and concrete is classified as characteristically non-hazardous waste.
Groundwater Disposal: Assumes all groundwater is classified as characteristically non-hazardous waste.
Plant 6 Corrective Measures Project Totals does not include cost for excavation dewatering/groundwater disposal.

Appendix E
Area 9 In-Situ Chemical Oxidation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

ISCO Cost Assumptions:

- Investigation to refine vertical and horizontal treatment area will be conducted, cost for investigation is not included as a separate line item as it is assumed it will be covered by the cost savings from reducing the treatment area.
- Base cost assumes pilot test of 2 injection wells and full-scale injection of 12 wells
- Injection Wells installed to a depth of 10 feet with 5 foot treatment interval (5-10 ft)
- Injection Wells installed for full coverage, assuming a 10 foot ROI
- Assumes 2 injections to reduce Xylene concentrations below FESL, not to MCLs
- Assume pilot test wells will be utilized in full-scale system operation
- Sonic drilling for all wells
- Assumes no subgrade utilities in the injection area and directly downgradient of the injection area
- Cost estimates are engineering estimates, +/- 30 to 50 percent

ISCO Pilot Test Work Plan, Injection Permitting, and update Health and Safety Plan					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	25	$143	$3,578	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	50	$124	$6,201	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	100	$98	$9,752	
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	50	$73	$3,657	
		Labor Markup	**0%**	**$0**	
		Project Management	**10%**	**$2,319**	
		Permitting, Work Plan Subtotal		**$26,000**	

Appendix E
Area 9 In-Situ Chemical Oxidation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Baseline Monitoring

1 Labor and expenses include baseline monitoring of 8 wells (6 new Dose Response and Down Gradient Wells)
Assumes sampling rate of 6 wells/day
2 Subs
Laboratory cost for:
8 wells
1 QA/QC

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR		$143	$0	
Sr Engineer/Sci II	HR	4	$131	$526	
Sr Engineer/Sci I	HR	4	$124	$496	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	8	$98	$780	
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	24	$73	$1,755	
2. ARCADIS Expenses					
Field vehicle	DAY	2	$115	$230	
Mileage	MI	120	$0.45	$54	
Meals	DAY	2	$50	$100	
Hotel	DAY	1	$120	$120	
PPE	DAY	2	$25	$50	
Peristaltic Pump	DAY	2	$35	$70	
Water Level Meter	DAY	2	$37	$74	
Turbidity Meter	DAY	2	$20	$40	
Tubing	LS	2	$50	$100	
3. Subcontractor					
Lab- VOCs 8260	EACH	9	$75	$675	
Lab- Metals and Na, Al, Mn 6010	EACH	9	$150	$1,350	
Lab- Mercury 245.1	EACH	9	$25	$225	
Lab- Sulfate SM 4500 SO4-D	EACH	9	$15	$135	
Lab- TDS SM 2540C	EACH	9	$20	$180	
Lab- Fe 200.7	EACH	9	$10	$90	
Lab- Alkalinity 310.1	EACH	9	$20	$180	
Lab- TOC 9060	EACH	9	$20	$180	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$126**	
		Markup on Subs	**15%**	**$452**	
		Project Management	**10%**	**$356**	
		Baseline Monitoring Subtotal		**$8,400**	

Appendix E
Area 9 In-Situ Chemical Oxidation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Injection Test Well Drilling

1 Labor and expenses include oversight of injection well installation and development. Geologist to oversee drilling and development.
2 Drilling

Treatment depth	10	ft	
Treatment thickness	5	ft	
Mobile porosity	0.1		
Injection well ROI	10	ft	
Injection well volume per well	1175	gal	
Number of Is	2	wells	
IW Well Depth	10	ft	
Number of Shallow MWs	2	wells	Installed at expected ROI (10ft)
Shallow MW Well Depth	10	ft	
Number of Deep MWs	4	wells	2 Installed at expected ROI (10ft), 2 installed downgradient
Deep MW Well Depth	20	ft	
Drilling rate	50	ft/day	

Injection wells are 2" diameter with 5' SS screens
Monitoring wells are 2" diameter with 5' PVC screens
3 Other
PID rental for drilling (not needed for well development)
Survey new injection and monitoring wells

Hours per well for setup/decon/move	1	hr
Hours per well for development	1.5	hr

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	7	$143	$1,002	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	11	$124	$1,364	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	21	$98	$2,048	Coordination, Contracting, Field Support
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	41	$73	$2,999	Field 12 hrs/day, 1 day utility located and KO Meeting
2. ARCADIS Expenses					
Field vehicle	DAY	4	$115	$460	
Mileage	MI	240	$0.45	$108	
Meals	DAY	4	$50	$200	
Hotel	DAY	3	$120	$360	
PPE	DAY	4	$25	$100	
PID	DAY	4	$75	$300	
3. Subcontractor Drilling					
Mob/Demob	ls	1	$1,200	$1,200	
4" x 6" Sonic Drilling with Continuous Sampling	ft	120	$32	$3,840	
7" x 8" Sonic Drilling with Continuous Sampling	ft	0	$45	$0	
Sonic Bedrock Drilling	ft	0	$60	$0	
2" PVC Well Installation (Labor and Materials)	ft	110	$16	$1,760	
2" x 5' SS Screen (Labor and Materials)	each	2	$350	$700	
Development	hr	12	$175	$2,100	
Well Completions	each	8	$300	$2,400	
Drums	each	5	$60	$300	
Move, Setup, Decon, IDW Handling (sonic)	hr	8	$325	$2,600	
Stand-By	hr		$400	$0	
4. Other					
IDW - Disposal Soil	drum	5	$100	$500	
IDW - Disposal Water	drum	3	$100	$300	
IDW - Transportation	trip	1	$200	$200	Assume 20 drums per trip
Survey new wells	LS	1	$500	$500	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$229**	
		Markup on Subs	**15%**	**$2,460**	
		Project Management	**10%**	**$741**	
		Injection Test Well Drilling Subtotal		**$29,000**	

Appendix E
Area 9 In-Situ Chemical Oxidation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Injection Test

1 Labor and expenses includes personnel to perform the injection.
2 Materials

Number of Injection Wells	2		Sodium Persulfate Concentration	50	g/L
Estimated Mobile Porosity	0.1		Sodium Persulfate Mass	980	lbs
Radius of influence	10	ft	Ferrous Sulfate Heptahydrate Concentrati	1.3	g/L
Screen length	5	ft	Ferrous Sulfate Heptahydrate Mass	25	lbs
Injection Volume per well	1175	gal	Citric Acid Concentration	0.86	g/L
Total Injection Volume	2350	gal	Citric Acid Mass	17	lbs
Estimated flow rate	3	gpm			
Wells Injected Simultaneously	2	wells			
Daily injection time	10	hrs/day			
Total injection time for one injection	1	days			

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	5	$143	$716	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	10	$124	$1,240	Field Support
Sr Project Engineer/Scientist II	HR		$108	$0	Field Support
Sr Project Engineer/Scientist I	HR	14	$98	$1,365	Coordination, field support
Project Engineer/Scientist	HR	28	$89	$2,493	Field Injection, setup/tare down
Engineer/Scientist	HR		$73	$0	
2a. ARCADIS Expenses					
Field vehicle	DAY	3	$115	$345	
Mileage	MI	180	$0.45	$81	
Meals	DAY	3	$50	$150	
Hotel	DAY	2	$120	$240	
Level D PPE	DAY	3	$25	$75	
2c. Materials					
Sodium Persulfate	LB	980	$1.41	$1,382	
Citric Acid	BAG	1	$113.00	$113	
Ferrous Sulfate	LB	50	$4.55	$228	
Chemical freight and tax	LS	1	$345	$345	
City Permitting, hydrant tap, flow meter	DAY	3	$100	$280	
Utilities - water	GAL	2,350	$0.03	$70	
Meters: cond, WL, pump	DAY	3	$500	$1,400	
Transducers	EACH	6	$1,000	$6,000	
Field Sodium Permanganate testing kits	EACH	2	$100	$200	
Replacement part/misc supplies	LS	1	$1,000	$1,000	
3. Subcontractor					
Water Tank/Truck	LS	2	$2,000	$4,000	
Injection Trailer	DAY	2	$4,000	$8,000	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$1,786**	
		Markup on Subs	**15%**	**$1,800**	
		Project Management	**10%**	**$581.41**	
		Injection Test Subtotal		**$34,000**	

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Area 9 In-Situ Chemical Oxidation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Post-Injection Monitoring						
1 Labor and expenses for post-injection monitoring.						
Number of wells sampled	8	wells				
Assumes sampling rate of	8	wells/day				
Number of sampling events	8					
Items		**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor						
Principal Engineer/Scientist		HR	16	$143	$2,290	
Sr Engineer/Sci II		HR		$131	$0	
Sr Engineer/Sci I		HR	16	$124	$1,984	
Sr Project Engineer/Scientist II		HR		$108	$0	
Sr Project Engineer/Scientist I		HR	48	$98	$4,681	Coordination/data analysis
Project Engineer/Scientist		HR		$89	$0	
Engineer/Scientist		HR	96	$73	$7,021	Field Sampling
2. ARCADIS Expenses						
Field vehicle		DAY	8	$115	$920	
Mileage		MI	960	$0.45	$432	
Meals		DAY	8	$50	$400	
Hotel		DAY	0	$120	$0	
Level D PPE		DAY	8	$25	$200	
Field Sodium Permanganate testing kits		EACH	8	$100	$800	
Sampling equipment		LS	8	$250	$2,000	
3. Laboratory						
Lab- VOCs 8260		EACH	8	$75	$600	
			Labor Markup	**0%**	**$0**	
			Markup on ARCADIS Expenses	**15%**	**$713**	
			Markup on Subs	**15%**	**$90**	
			Project Management	**10%**	**$1,598**	
			Post-Injection Monitoring Subtotal		**$24,000**	

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Area 9 In-Situ Chemical Oxidation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Full-Scale ISCO Design					
1 Labor to design system					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	60	$174	$10,440	
Sr Engineer/Sci II	HR		$145	$0	
Sr Engineer/Sci I	HR	120	$135	$16,200	
Sr Project Engineer/Scientist II	HR		$115	$0	
Sr Project Engineer/Scientist I	HR	150	$98	$14,700	
Project Engineer/Scientist	HR		$85	$0	
Engineer/Scientist	HR	75	$68	$5,100	
		Labor Markup	**0%**	**$0**	
		Project Management	**10%**	**$4,644**	
		Full-Scale ISCO Design Subtotal		**$51,100**	

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Area 9 In-Situ Chemical Oxidation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Full-Scale Well Drilling

1 Labor and expenses include oversight of injection well installation and development. Geologist to oversee drilling and development.
2 Drilling

Treatment depth	10	ft
Treatment thickness	5	ft
Mobile porosity	0.1	
Injection well ROI	10	ft
Injection well volume per well	1175	gal
Injection Area:	4200	ft^2
Number of Is	12	wells
IW Well Depth	10	ft
Number of Shallow MWs	0	wells
Shallow MW Well Depth	15	ft
Number of Deep MWs	0	wells
Deep MW Well Depth	25	ft
Drilling rate	50	ft/day

Injection wells are 2" diameter with 5' SS screens
Monitoring wells are 2" diameter with 5' PVC screens
3 Other
PID rental for drilling (not needed for well development)
Survey new injection and monitoring wells

Hours per well for setup/decon/move	1	hr
Hours per well for development	1.5	hr

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	7	$143	$1,002	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	11	$124	$1,364	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	21	$98	$2,048	Coordination, Contracting, Field Support
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	41	$73	$2,999	Field 12 hrs/day, 1 day utility located and KO Meeting
2. ARCADIS Expenses					
Field vehicle	DAY	4	$115	$460	
Mileage	MI	240	$0.45	$108	
Meals	DAY	4	$50	$200	
Hotel	DAY	3	$120	$360	
PPE	DAY	4	$25	$100	
PID	DAY	4	$75	$300	
3. Subcontractor Drilling					
Mob/Demob	ls	1	$1,200	$1,200	
4" x 6" Sonic Drilling with Continuous Sampling	ft	120	$32	$3,840	
7" x 8" Sonic Drilling with Continuous Sampling	ft	0	$45	$0	
Sonic Bedrock Drilling	ft	0	$60	$0	
2" PVC Well Installation (Labor and Materials)	ft	60	$16	$960	
2" x 5' SS Screen (Labor and Materials)	each	12	$350	$4,200	
Development	hr	18	$175	$3,150	
Well Completions	each	12	$300	$3,600	
Drums	each	5	$60	$300	
Move, Setup, Decon, IDW Handling (sonic)	hr	12	$325	$3,900	
Stand-By	hr		$400	$0	
4. Other					
IDW - Disposal Soil	drum	5	$100	$500	
IDW - Disposal Water	drum	3	$100	$300	
IDW - Transportation	trip	1	$200	$200	Assume 20 drums per trip
Survey new wells	LS	1	$500	$500	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$229**	
		Markup on Subs	**15%**	**$3,398**	
		Project Management	**10%**	**$741.26**	
		Full-Scale Well Drilling Subtotal		**$36,000**	

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Area 9 In-Situ Chemical Oxidation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Full-Scale Chemical Injection

1 Labor and expenses includes personnel to perform the injection, two engineers full time
2 Materials

Number of Wells	14	wells	Sodium Persulfate Concentration	50	g/L
Treatment Thickness	5	ft	Sodium Persulfate Mass	7,093	lbs
Injection Well ROI	10	ft	Ferrous Sulfate Heptahydrate Concentratio	1.3	g/L
Estimated Mobile Porosity	0.1		Ferrous Sulfate Heptahydrate Mass	177	lbs
Injection Volume	1175	gal	Citric Acid Concentration	0.86	g/L
Estimated flow rate	3	gpm	Citric Acid Mass	121	lbs
Total Injection volume	17,000	gal			
Daily injection time	10	hrs per day			
Number of injected simultaneously	6	wells			
Total injection time for one injection	2	days			
Set up/Tare Down	1	days			

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	8	$143	$1,145	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	19	$124	$2,356	Field Support
Sr Project Engineer/Scientist II	HR		$108	$0	Field Support
Sr Project Engineer/Scientist I	HR	26	$98	$2,536	Coordination, field support
Project Engineer/Scientist	HR	52	$89	$4,630	Field Injection, setup/tare down
Engineer/Scientist	HR		$73	$0	
2a. ARCADIS Expenses					
Field vehicle	DAY	5	$115	$575	
Mileage	MI	300	$0.45	$135	
Meals	DAY	5	$50	$250	
Hotel	DAY	4	$120	$480	
Level D PPE	DAY	5	$25	$125	
2c. Materials					
Sodium Persulfate	LB	7,093	$1.41	$10,001	
Citric Acid	BAG	3	$113.00	$339	
Ferrous Sulfate	LB	200	$4.55	$910	
Deuterium oxide	L		$222	$0	
Chemical freight and tax	LS	1	$2,250	$2,250	
Deuterium oxide lab analysis	EACH		$30	$0	
City Permitting, hydrant tap, flow meter	DAY	5	$100	$520	
Utilities - water	GAL	17,000	$0.03	$510	
Meters: cond, WL, pump	DAY	5	$500	$2,600	
Transducers	EACH	6	$1,000	$6,000	
Field Sodium Permanganate testing kits	EACH	2	$100	$200	
Replacement part/misc supplies	LS	1	$1,000	$1,000	
3. Subcontractor					
Water Tank/Truck	LS	3	$2,000	$6,000	
Injection Trailer	DAY	3	$4,000	$12,000	

Labor Markup	**0%**	**$0**
Markup on ARCADIS Expenses	**15%**	**$3,884**
Markup on Subs	**15%**	**$2,700**
Project Management	**10%**	**$1,067**
Chemical Injection #1 (% of Injection Wells)	**100%**	**$63,000**
Chemical Injection #2 (% of Injection Wells)	**100%**	**$63,000**
Chemical Injection #3 (% of Injection Wells)		**$0**
Chemical Injection #4 (% of Injection Wells)		**$0**
Injection Subtotal		**$126,000**

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Area 9 In-Situ Chemical Oxidation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Post-Injection Monitoring						
1 Labor and expenses for post-injection monitoring.						
Number of wells sampled	8	wells				
Number of oxidant events	8	events				
Number of VOC/Metals sampling events	1	events				
Assumes sampling rate of	8	wells/day for oxidant				
Assumes sampling rate of	8	wells/day for VOCs				
Items		**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor						
Principal Engineer/Scientist		HR		$143	$0	
Sr Engineer/Sci II		HR	2	$131	$263	
Sr Engineer/Sci I		HR	10	$124	$1,240	
Sr Project Engineer/Scientist II		HR	20	$108	$2,162	
Sr Project Engineer/Scientist I		HR	30	$98	$2,926	
Project Engineer/Scientist		HR		$89	$0	
Engineer/Scientist		HR	108	$73	$7,899	
2. ARCADIS Expenses						
Field vehicle		DAY	9	$115	$1,035	
Mileage		MI	1080	$0.45	$486	
Meals		DAY	9	$50	$450	
Hotel		DAY	8	$120	$960	
Level D PPE		DAY	9	$25	$225	
Sampling equipment		LS	9	$250	$2,250	
3. Laboratory						
Lab- VOCs 8260		EACH	8	$75	$600	
Lab- Metals 6010		EACH	8	$120	$960	
Field analysis - Permanganate		EACH	64	$10	$640	
			Labor Markup	**0%**	**$0**	
			Markup on ARCADIS Expenses	**15%**	**$811**	
			Markup on Subs	**15%**	**$330**	
			Project Management	**10%**	**$1,449**	
			Post-Injection Monitoring Subtotal Per Injection		**$24,700**	
			Number of Injections		**2**	
			Post-Injection Monitoring Subtotal		**$49,400**	

Pilot/Design: **$173,000**

Full-Scale Well Installation/Injection/Post-Injection Monitoring: **$212,000**

ISCO Total: $390,000

Appendix E
Area 11 In-Situ Chemical Oxidation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

ISCO Cost Assumptions:

- Base cost assumes pilot test of 2 injection wells and full-scale injection of 12 wells
- Injection Wells installed to a depth of 80 feet with 10 foot treatment interval (70-80 ft)
- 33 Injection Wells
- Assume pilot test wells will be utilized in full-scale system operation
- Sonic drilling for all wells
- Cost estimates are engineering estimates, +/- 30 to 50 percent

ISCO Pilot Test Work Plan, Injection Permitting, and update Health and Safety Plan

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	30	$143	$4,293	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	60	$124	$7,441	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	120	$98	$11,702	
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	60	$73	$4,388	
		Labor Markup	**0%**	**$0**	
		Project Management	**10%**	**$2,783**	
		Permitting, Work Plan Subtotal		**$31,000**	

Baseline Monitoring

1 Labor and expenses include baseline monitoring of 8 wells (2 new Dose Response, 2 new Down Gradient Wells and 4 existing MWs)
Assumes sampling rate of 4 wells/day
2 Subs
Laboratory cost for:
8 wells
1 QA/QC

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR		$143	$0	
Sr Engineer/Sci II	HR	4	$131	$526	
Sr Engineer/Sci I	HR	4	$124	$496	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	8	$98	$780	
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	24	$73	$1,755	
2. ARCADIS Expenses					
Field vehicle	DAY	2	$115	$230	
Mileage	MI	120	$0.45	$54	
Meals	DAY	2	$50	$100	
Hotel	DAY	1	$120	$120	
PPE	DAY	2	$25	$50	
Peristaltic Pump	DAY	2	$35	$70	
Water Level Meter	DAY	2	$37	$74	
Turbidity Meter	DAY	2	$20	$40	
Tubing	LS	2	$50	$100	
3. Subcontractor					
Lab- VOCs 8260	EACH	9	$125	$1,125	
Lab- Metals and Na, Al, Mn 6010	EACH	9	$150	$1,350	
Lab- Mercury 245.1	EACH	9	$25	$225	
Lab- Sulfate SM 4500 SO4-D	EACH	9	$15	$135	
Lab- TDS SM 2540C	EACH	9	$20	$180	
Lab- Fe 200.7	EACH	9	$10	$90	
Lab- Alkalinity 310.1	EACH	9	$20	$180	
Lab- TOC 9060	EACH	9	$20	$180	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$126**	
		Markup on Subs	**15%**	**$520**	
		Project Management	**10%**	**$356**	
		Baseline Monitoring Subtotal		**$8,900**	

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Area 11 In-Situ Chemical Oxidation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Injection Test Well Drilling

1 Labor and expenses include oversight of injection well installation and development. Geologist to oversee drilling and development.

2 Drilling

Treatment depth	80	ft	
Treatment thickness	10	ft	
Mobile porosity	0.1		
Injection well ROI	12.5	ft	
Injection well volume per well	3672	gal	
Number of IWs	2	wells	
IW Well Depth	80	ft	
Number of DRWs	2	wells	Installed at expected ROI (10ft)
Shallow MW Well Depth	80	ft	
Number of Downgradient MWs	2	wells	
Downgradient Well Depth	80	ft	
Drilling rate	80	ft/day	

Injection wells are 2" diameter with 10' SS screens
Monitoring wells are 2" diameter with 10' PVC screens

3 Other

PID rental for drilling (not needed for well development)
Survey new injection and monitoring wells

Hours per well for setup/decon/move	1	hr
Hours per well for development	1.5	hr

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	13	$143	$1,860	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	21	$124	$2,604	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	42	$98	$4,096	Coordination, Contracting,
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	84	$73	$6,144	Field 12 hrs/day, 1 day utility
2. ARCADIS Expenses					
Field vehicle	DAY	7	$115	$805	
Mileage	MI	420	$0.45	$189	
Meals	DAY	7	$50	$350	
Hotel	DAY	6	$120	$720	
PPE	DAY	7	$25	$175	
PID	DAY	7	$75	$525	
3. Subcontractor Drilling					
Mob/Demob	ls	1	$1,200	$1,200	
4" x 6" Sonic Drilling with Continuous Sampling	ft	480	$32	$15,360	
7" x 8" Sonic Drilling with Continuous Sampling	ft		$45	$0	
Sonic Bedrock Drilling	ft	0	$60	$0	
2" PVC Well Installation (Labor and Materials)	ft	460	$16	$7,360	
2" x 10' SS Screen (Labor and Materials)	each	2	$450	$900	
Development	hr	9	$175	$1,575	
Well Completions	each	6	$300	$1,800	
Drums	each	17	$60	$1,020	
Move, Setup, Decon, IDW Handling (sonic)	hr	6	$325	$1,950	
Stand-By	hr		$400	$0	
4. Other					
IDW - Disposal Soil	drum	17	$100	$1,700	
IDW - Disposal Water	drum	3	$100	$300	
IDW - Transportation	trip	1	$200	$200	Assume 20 drums per trip
Survey new wells	LS	1	$500	$500	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$414.60**	
		Markup on Subs	**15%**	**$5,080**	
		Project Management	**10%**	**$1,470**	
		Injection Test Well Drilling Subtotal		**$59,000**	

Appendix E
Area 11 In-Situ Chemical Oxidation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Injection Test

1 Labor and expenses includes personnel to perform the injection.
2 Materials

Number of Injection Wells	2		Sodium Persulfate Concentration	50	g/L
Estimated Mobile Porosity	0.1		Sodium Persulfate Mass	3,064	lbs
Radius of influence	12.5	ft	NaOH	40.0	g/L
Screen length	10	ft	NaOH Mass	2,451	lbs
Injection Volume per well	3672	gal	Mass of 25% NaOH	9,804	lbs
Total Injection Volume	7343	gal	Density	10.66	lbs/gal
Estimated flow rate	0.5	gpm			
Wells Injected Simultaneously	2	wells			
Daily injection time	8	hrs/day			
Total injection time for one injection	16	days			

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	32	$143	$4,579	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	73	$124	$9,053	Field Support
Sr Project Engineer/Scientist II	HR		$108	$0	Field Support
Sr Project Engineer/Scientist I	HR	104	$98	$10,142	Coordination, field support
Project Engineer/Scientist	HR	208	$89	$18,520	Field Injection, setup/tare
Engineer/Scientist	HR		$73	$0	
2a. ARCADIS Expenses					
Field vehicle	DAY	18	$115	$2,070	
Mileage	MI	1080	$0.45	$486	
Meals	DAY	18	$50	$900	
Hotel	DAY	17	$120	$2,040	
Level D PPE	DAY	18	$25	$450	
2c. Materials					
Sodium Persulfate	LB	3,064	$1.41	$4,320	
25% NaOH	LB	9,850	$0.25	$2,463	
Chemical freight and tax	LS	1	$1,356	$1,356	
City Permitting, hydrant tap, flow meter	DAY	21	$100	$2,080	
Utilities - water	GAL	7,343	$0.03	$220	
Meters: cond, WL, pump	DAY	21	$500	$10,400	
Transducers	EACH	4	$1,000	$4,000	
Field Sodium Persulfate testing kits	EACH	100	$10	$1,000	
Replacement part/misc supplies	LS	1	$1,000	$1,000	
3. Subcontractor					
Water Tank/Truck	LS	2	$2,000	$4,000	
Subcontractor Mob	LS	1	$7,500	$7,500	
Injection Sub	DAY	17	$4,500	$76,500	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$4,918**	
		Markup on Subs	**15%**	**$13,200**	
		Project Management	**10%**	**$4,229.51**	
		Injection Test Subtotal		**$186,000**	

Appendix E
Area 11 In-Situ Chemical Oxidation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Post-Injection Monitoring

1 Labor and expenses for post-injection monitoring.
Number of wells sampled 8 wells
Assumes sampling rate of 4 wells/day
Number of sampling events 8 oxidant
Number of sampling events 3 VOCs

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	16	$143	$2,290	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	16	$124	$1,984	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	96	$98	$9,362	Coordination/data analysis
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	192	$73	$14,043	Field Sampling
2. ARCADIS Expenses					
Field vehicle	DAY	16	$115	$1,840	
Mileage	MI	1920	$0.45	$864	
Meals	DAY	16	$50	$800	
Hotel	DAY	0	$120	$0	
Level D PPE	DAY	16	$25	$400	
Field Sodium Persulfate testing kits	EACH	64	$10	$640	
Sampling equipment	LS	8	$250	$2,000	
3. Laboratory					
Lab- VOCs 8260	EACH	24	$125	$3,000	
			Labor Markup	**0%**	**$0**
			Markup on ARCADIS Expenses	**15%**	**$982**
			Markup on Subs	**15%**	**$450**
			Project Management	**10%**	**$2,768**
			Post-Injection Monitoring Subtotal		**$42,000**

Full-Scale ISCO Design

1 Labor to design system

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	60	$174	$10,440	
Sr Engineer/Sci II	HR		$145	$0	
Sr Engineer/Sci I	HR	120	$135	$16,200	
Sr Project Engineer/Scientist II	HR		$115	$0	
Sr Project Engineer/Scientist I	HR	150	$98	$14,700	
Project Engineer/Scientist	HR		$85	$0	
Engineer/Scientist	HR	75	$68	$5,100	
			Labor Markup	**0%**	**$0**
			Project Management	**10%**	**$4,644**
			Full-Scale ISCO Design Subtotal		**$51,100**

Appendix E
Area 11 In-Situ Chemical Oxidation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Full-Scale Well Drilling

1 Labor and expenses include oversight of injection well installation and development. Geologist to oversee drilling and development.
2 Drilling

Treatment depth	80	ft
Treatment thickness	10	ft
Mobile porosity	0.1	
Injection well ROI	12.5	ft
Injection well volume per well	3672	gal
Number of IWs	31	wells
IW Well Depth	80	ft
Number of Shallow MWs	0	wells
Shallow MW Well Depth	0	ft
Number of Deep MWs	0	wells
Deep MW Well Depth	0	ft
Drilling rate	80	ft/day

Injection wells are 2" diameter with 10' SS screens
3 Other
PID rental for drilling (not needed for well development)
Survey new injection and monitoring wells

Hours per well for setup/decon/move	1	hr
Hours per well for development	1.5	hr

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	58	$143	$8,300	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	96	$124	$11,906	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	192	$98	$18,724	Coordination, Contracting,
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	384	$73	$28,086	Field 12 hrs/day, 1 day utility
2. ARCADIS Expenses					
Field vehicle	DAY	32	$115	$3,680	
Mileage	MI	1920	$0.45	$864	
Meals	DAY	32	$50	$1,600	
Hotel	DAY	31	$120	$3,720	
PPE	DAY	32	$25	$800	
PID	DAY	32	$75	$2,400	
3. Subcontractor Drilling					
Mob/Demob	ls	1	$1,200	$1,200	
4" x 6" Sonic Drilling with Continuous Sampling	ft	2480	$32	$79,360	
7" x 8" Sonic Drilling with Continuous Sampling	ft	0	$45	$0	
Sonic Bedrock Drilling	ft	0	$60	$0	
2" PVC Well Installation (Labor and Materials)	ft	2170	$16	$34,720	
2" x 5' SS Screen (Labor and Materials)	each	31	$350	$10,850	
Development	hr	46.5	$175	$8,138	
Well Completions	each	31	$300	$9,300	
Drums	each	87	$60	$5,220	
Move, Setup, Decon, IDW Handling (sonic)	hr	31	$325	$10,075	
Stand-By	hr		$400	$0	
4. Other					
IDW - Disposal Soil	drum	87	$100	$8,700	
IDW - Disposal Water	drum	3	$100	$300	
IDW - Transportation	trip	5	$200	$1,000	Assume 20 drums per trip
Survey new wells	LS	1	$500	$500	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$1,960**	
		Markup on Subs	**15%**	**$25,404**	
		Project Management	**10%**	**$6,701.53**	
		Full-Scale Well Drilling Subtotal		**$284,000**	

Appendix E
Area 11 In-Situ Chemical Oxidation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Full-Scale Chemical Injection

1 Labor and expenses includes personnel to perform the injection, two engineers full time
2 Materials

Number of Wells	33	wells	Sodium Persulfate Concentration	50	g/L
Treatment Thickness	10	ft	Sodium Persulfate Mass	50,901	lbs
Injection Well ROI	12.5	ft	NaOH	40.0	g/L
Estimated Mobile Porosity	0.1		NaOH Mass	40,720	lbs
Injection Volume	3672	gal	Mass of 25% NaOH	162,882	lbs
Estimated flow rate	0.5	gpm	Density	10.66	lbs/gal
Total Injection volume	122,000	gal			
Daily injection time	8	hrs per day			
Number of injected simultaneously	12	wells			
Total injection time for one injection	43	days			
Set up/Tare Down	1	days			

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	82	$143	$11,734	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	191	$124	$23,688	Field Support
Sr Project Engineer/Scientist II	HR		$108	$0	Field Support
Sr Project Engineer/Scientist I	HR	272	$98	$26,525	Coordination, field support
Project Engineer/Scientist	HR	544	$89	$48,438	Field Injection, setup/tare
Engineer/Scientist	HR		$73	$0	
2a. ARCADIS Expenses					
Field vehicle	DAY	46	$115	$5,290	
Mileage	MI	2760	$0.45	$1,242	
Meals	DAY	46	$50	$2,300	
Hotel	DAY	45	$120	$5,400	
Level D PPE	DAY	46	$25	$1,150	
2c. Materials					
Sodium Persulfate	LB	50,901	$1.41	$71,770	
25% NaOH	LB	162,882	$0.25	$40,720	
Chemical freight and tax	LS	1	$22,498	$22,498	
City Permitting, hydrant tap, flow meter	DAY	54	$100	$5,440	
Utilities - water	GAL	122,000	$0.03	$3,660	
Meters: cond, WL, pump	DAY	54	$500	$27,200	
Transducers	EACH	4	$1,000	$4,000	
Field Sodium Persulfate testing kits	EACH	100	$10	$1,000	
Replacement part/misc supplies	LS	1	$2,500	$2,500	
3. Subcontractor					
Water Tank/Truck	LS	44	$2,000	$88,000	
Subcontractor Mobilization	LS	1	$7,500	$7,500	
Injection Trailer	DAY	44	$4,000	$176,000	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$29,126**	
		Markup on Subs	**15%**	**$40,725**	
		Project Management	**10%**	**$11,039**	
		Chemical Injection #1 (% of Injection Wells)	**100%**	**$657,000**	

Appendix E
Area 11 In-Situ Chemical Oxidation Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Post-Injection Monitoring

1 Labor and expenses for post-injection monitoring.

Number of wells sampled	10	wells
Number of oxidant events	8	events
Number of VOC/Metals sampling events	1	events
Assumes sampling rate of	10	wells/day for oxidant
Assumes sampling rate of	4	wells/day for VOCs

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR		$143	$0	
Sr Engineer/Sci II	HR	2	$131	$263	
Sr Engineer/Sci I	HR	10	$124	$1,240	
Sr Project Engineer/Scientist II	HR	20	$108	$2,162	
Sr Project Engineer/Scientist I	HR	30	$98	$2,926	
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	126	$73	$9,216	
2. ARCADIS Expenses					
Field vehicle	DAY	10.5	$115	$1,208	
Mileage	MI	1260	$0.45	$567	
Meals	DAY	10.5	$50	$525	
Hotel	DAY	9.5	$120	$1,140	
Level D PPE	DAY	10.5	$25	$263	
Sampling equipment	LS	10.5	$250	$2,625	
3. Laboratory					
Lab- VOCs 8260	EACH	10	$75	$750	
Lab- Metals 6010	EACH	10	$120	$1,200	
Field analysis - Persulfate	EACH	80	$10	$800	
			Labor Markup	**0%**	**$0**
			Markup on ARCADIS Expenses	**15%**	**$949**
			Markup on Subs	**15%**	**$413**
			Project Management	**10%**	**$1,581**
			Post-Injection Monitoring Subtotal Per Injection		**$27,900**

Pilot/Design:	**$378,000**	
Full-Scale Well Installation:	**$284,000**	
Full-Scale ISCO Injection:	**$657,000**	**per event**
Post-Injection Monitoring:	**$27,900**	**per event**

ISCO Total for 1 Full-Scale Injection: $1,350,000

ISCO Total for 3 Full-Scale Injections: $2,720,000

Appendix E
Area 5-2 LNAPL Skimming Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Area 5-2 LNAPL Skimming Cost Assumptions:

- Investigation to refine vertical and horizontal treatment area will be conducted, cost for investigation is not included as a separate line item as it is assumed it will be covered by the cost savings from reducing the treatment area.
- Base cost assumes pilot test of 2 LNAPL recovery wells, 6 monitoring wells, and full-scale installation of 160 wells
- Recovery Wells installed to a max depth of 24 feet with 10 foot treatment interval
- Assume average well depth of 18 feet with 10 foot treatment interval (14-24 or 2-12 depending on location within LNAPL plume)
- Recover Wells installed for full coverage with 10 ft ROI
- Assume skimmers will be installed in half the recovery wells and rotated around once LNAPL is no longer recoverable on a well by well basis
- Assumes 30 yrs of operation to reduce source mass concentrations and extract recoverable LNAPL. Not expected to reach MCLs.
- Assume pilot test wells will be utilized in full-scale system operation
- Sonic drilling for all wells
- Cost estimates are engineering estimates, +/- 30 to 50 percent

Pilot Test Work Plan and update Health and Safety Plan					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	20	$143	$2,862	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	40	$124	$4,961	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	80	$98	$7,802	
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	40	$73	$2,925.60	
	Labor Markup		**0%**	**$0**	
	Project Management		**10%**	**$1,855**	
	Work Plan Subtotal			**$21,000**	

Appendix E
Area 5-2 LNAPL Skimming Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Pilot Test Well Drilling

1 Labor and expenses include oversight of injection well installation and development. Geologist to oversee drilling and development.
2 Drilling

Treatment depth	18	ft	One well to 24 ft, One well to 12 ft
Treatment thickness	10	ft	
Recovery Well ROI	10	ft	
Number of RWs:	2	wells	
RW Well Depth	18	ft	
Number of MWs:	6	wells	Installed at radial distances from RW
MW Well Depth	18	ft	
Drilling rate	50	ft/day	

recovery wells are 4" diameter with 10' SS screens
Monitoring wells are 2" diameter with 10' SS screens
3 Other
PID rental for drilling (not needed for well development)
Survey new injection and monitoring wells

Hours per well for setup/decon/move	1	hr
Hours per well for development	1.5	hr

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	8	$143	$1,145	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	12	$124	$1,488	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	24	$98	$2,340	Coordination, Contracting, Field Support
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	47	$73	$3,438	Field 12 hrs/day, 1 day utility located and KO Meeting
2. ARCADIS Expenses					
Field vehicle	DAY	4	$115	$460	
Mileage	MI	240	$0.45	$108	
Meals	DAY	4	$50	$200	
Hotel	DAY	3	$120	$360	
PPE	DAY	4	$25	$100	
PID	DAY	4	$75	$300	
3. Subcontractor Drilling					
Mob/Demob	ls	1	$1,200	$1,200	
4" x 6" Sonic Drilling with Continuous Sampling	ft	108	$32	$3,456	
7" x 8" Sonic Drilling with Continuous Sampling	ft	36	$45	$1,620	
Sonic Bedrock Drilling	ft	0	$60	$0	
2" PVC Well Installation (Labor and Materials)	ft	48	$16	$768	
2" x 10' SS Screen (Labor and Materials)	each	6	$700	$4,200	
4" PVC Well Installation (Labor and Materials)	ft	16	$24	$384	
4" x 10' SS Screen (Labor and Materials)	each	2	$1,300	$2,600	
Development	hr	12	$175	$2,100	
Well Completions	each	8	$300	$2,400	
Drums	each	6	$60	$360	
Move, Setup, Decon, IDW Handling (sonic)	hr	8	$325	$2,600	
Stand-By	hr		$400	$0	
4. Other					
IDW - Disposal Soil	drum	6	$100	$600	
IDW - Disposal Water	drum	2	$100	$200	
IDW - Transportation	trip	1	$200	$200	Assume 20 drums per trip
Survey new wells	LS	1	$500	$500	

Labor Markup	**0%**	**$0**
Markup on ARCADIS Expenses	**15%**	**$184**
Markup on Subs	**15%**	**$3,478**
Project Management	**10%**	**$841**
Pilot Test Well Drilling Subtotal		**$38,000**

Appendix E
Area 5-2 LNAPL Skimming Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Pilot Test					
1 Labor and expenses includes personnel to perform installation of recovery system, and 12 months of O&M					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	22	$143	$3,148	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	54	$124	$6,697	Field Support
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	108	$98	$10,532	Coordination, field support, data analysis
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	216	$73	$15,798	2 days installation, 12 monthly O&M events, 4 troubleshooting events
2a. ARCADIS Expenses					
Field vehicle	DAY	18	$115	$2,070	
Mileage	MI	1080	$0.45	$486	
Meals	DAY	18	$50	$900	
Hotel	DAY	4	$120	$480	
Level D PPE	DAY	18	$25	$450	
PID	DAY	18	$75	$1,350	
IP	DAY	18	$37	$666	
3. Subcontractor					
LNAPL Skimmers	LS	2	$10,000	$20,000	5K for Spill Buster, 3K for Solar Panels, 2K for Skimmer Housing
Subcontractor Skimmer Installation	LS	1	$8,000	$8,000	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$658**	
		Markup on Subs	**15%**	**$4,200**	
		Project Management	**10%**	**$3,618**	
		Pilot Test Subtotal		**$80,000**	

Appendix E
Area 5-2 LNAPL Skimming Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Full-Scale Design					
1 Labor to design system					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	60	$174	$10,440	
Sr Engineer/Sci II	HR		$145	$0	
Sr Engineer/Sci I	HR	120	$135	$16,200	
Sr Project Engineer/Scientist II	HR		$115	$0	
Sr Project Engineer/Scientist I	HR	240	$98	$23,520	
Project Engineer/Scientist	HR		$85	$0	
Engineer/Scientist	HR	120	$68	$8,160	
		Labor Markup	**0%**	**$0**	
		Project Management	**10%**	**$5,832**	
		Full-Scale Design Subtotal		**$64,200**	

Appendix E
Area 5-2 LNAPL Skimming Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Full-Scale Well Drilling

1 Labor and expenses include oversight of injection well installation and development. Geologist to oversee drilling and development. well.
2 Assume one third of the waste would be TSCA Regulated
3 Drilling

Treatment depth	18	ft	
Treatment thickness	10	ft	
Recovery Well ROI	10	ft	
Recovery Well Area	50,000	ft^2	
Number of RWs:	158	wells	
RW Well Depth	18	ft	
Number of MWs:	0	wells	Installed at radial distances from RW
MW Well Depth	18	ft	
Drilling rate	50	ft/day	

recovery wells are 4" diameter with 10' SS screens
Monitoring wells are 2" diameter with 10' SS screens

4 Other
PID rental for drilling (not needed for well development)
Survey new injection and monitoring wells

Hours per well for setup/decon/move	1	hr	
Hours per well for development	1.5	hr	

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	105	$143	$15,026	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	174	$124	$21,579	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	348	$98	$33,937	Coordination, Contracting, Field Support
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	695	$73	$50,832	Field 12 hrs/day, 1 day utility located and KO Meeting
2. ARCADIS Expenses					
Field vehicle	DAY	58	$115	$6,670	
Mileage	MI	3480	$0.45	$1,566	
Meals	DAY	58	$50	$2,900	
Hotel	DAY	57	$120	$6,840	
PPE	DAY	58	$25	$1,450	
PID	DAY	58	$75	$4,350	
3. Subcontractor Drilling					
Mob/Demob	ls	1	$1,200	$1,200	
4" x 6" Sonic Drilling with Continuous Sampling	ft	0	$32	$0	
7" x 8" Sonic Drilling with Continuous Sampling	ft	2844	$45	$127,980	
Sonic Bedrock Drilling	ft	0	$60	$0	
2" PVC Well Installation (Labor and Materials)	ft	0	$16	$0	
2" x 10' SS Screen (Labor and Materials)	each	0	$700	$0	
4" PVC Well Installation (Labor and Materials)	ft	1264	$24	$30,336	
4" x 10' SS Screen (Labor and Materials)	each	158	$1,300	$205,400	
Development	hr	237	$175	$41,475	
Well Completions	each	158	$300	$47,400	
Drums	each	176	$60	$10,560	
Move, Setup, Decon, IDW Handling (sonic)	hr	158	$325	$51,350	
Stand-By	hr		$400	$0	
4. Other					
IDW - Disposal Soil	drum	116	$100	$11,616	
IDW - Disposal Water	drum	23	$100	$2,310	
IDW - Transportation	trip	7	$200	$1,400	Assume 20 drums per trip
IDW - TSCA Disposal Soil	Drum	58	$200	$11,616	
IDW - TSCA Disposal Water	Drum	6	$1,000	$5,940	TSCA Regulated Contaminated Liquid Disposal (per drum)
IDW - TSCA Transportation	Trip	7	$200	$1,400	Assume 10 drums per trip, TSCA Regulated Contaminated Liquid Transportation (up to 10 drums Lansing to MDI)
Survey new wells	LS	1	$500	$500	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$2,914**	
		Markup on Subs	**15%**	**$82,572**	
		Project Management	**10%**	**$12,137**	
		Full-Scale Well Drilling Subtotal		**$794,000**	

Appendix E
Area 5-2 LNAPL Skimming Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Skimmer Installation					
1 Labor and expenses includes personnel to perform installation of recovery system					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	54	$143	$7,727	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	135	$124	$16,743	Field Support
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	270	$98	$26,330	Coordination, field support, data analysis
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	540	$73	$39,496	Assume installation of 2 Skimmers per day, plus 5 days setup/tare down/misc
2a. ARCADIS Expenses					
Field vehicle	DAY	45	$115	$5,175	
Mileage	MI	2700	$0.45	$1,215	
Meals	DAY	45	$50	$2,250	
Hotel	DAY	4	$120	$480	
Level D PPE	DAY	45	$25	$1,125	
PID	DAY	45	$75	$3,375	
IP	DAY	45	$0	$0	
3. Subcontractor					
LNAPL Skimmers	LS	79	$10,000	$790,000	5K for Spill Buster, 3K for Solar Panels, 2K for Skimmer Housing
Subcontractor Skimmer Installation	LS	1	$316,000	$316,000	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$1,537**	
		Markup on Subs	**15%**	**$165,900**	
		Project Management	**10%**	**$9,030**	
		Skimmer Installation Subtotal		**$1,387,000**	

Appendix E
Area 5-2 LNAPL Skimming Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Annual O&M					
1 Labor and expenses includes personnel to perform annual O&M					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	20	$143	$2,862	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	48	$124	$5,953	Field Support
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	96	$98	$9,362	Coordination, field support, data analysis
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	192	$73	$14,043	Monthly O&M for 12 months, 4 troubleshooting visits
2a. ARCADIS Expenses					
Field vehicle	DAY	16	$115	$1,840	
Mileage	MI	960	$0.45	$432	
Meals	DAY	16	$50	$800	
Hotel	DAY	4	$120	$480	
Level D PPE	DAY	16	$25	$400	
PID	DAY	16	$75	$1,200	
IP	DAY	16	$37	$592	
Misc. Repairs	LS	1	$15,000	$15,000	
3. Subcontractor					
TSCA Regulated LNAPL Disposal	Drum	19	$1,000	$19,000	Assume 0.12 gallon per well per day for 30% of the skimmers based on ASTM E2856, TSCA Regulated Contaminated Liquid Disposal (per drum)
TSCA Regulated LNAPL Transportation	Trip	1	$200	$200	Assume 10 drums per trip, TSCA Regulated Contaminated Liquid Transportation (up to 10 drums Lansing to MDI)

Labor Markup	**0%**	**$0**
Markup on ARCADIS Expenses	**15%**	**$862**
Markup on Subs	**15%**	**$2,880**
Project Management	**10%**	**$3,222**
Annual O&M		**$80,000**
Years of Operation		**30**
O&M Subtotal		**$2,400,000**

Pilot/Design: $204,000
Full-Scale Well Installation/System installation: $2,181,000
Life Cycle O&M: $2,400,000

Area 5-2 LNAPL Skimmer Total: $4,790,000

Appendix E
Area 17 LNAPL Skimming Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Area 17 LNAPL Skimming Cost Assumptions:

- Investigation to refine vertical and horizontal treatment area will be conducted, cost for investigation is not included as a separate line item as it is assumed it will be covered by the cost savings from reducing the treatment area.
- Base cost assumes pilot test of 2 LNAPL recovery wells, 6 monitoring wells, and full-scale installation of 49 wells
- Recovery Wells installed to a max depth of 22 feet with 10 foot treatment interval (12-22 ft)
- Recover Wells installed for full coverage with 10 ft ROI
- Assume skimmers will be installed in half the recovery wells and rotated around once LNAPL is no longer recoverable on a well by well basis
- Assumes 30 yrs of operation to reduce source mass concentrations and extract recoverable LNAPL. Not expected to reach MCLs.
- Assume pilot test wells will be utilized in full-scale system operation
- Sonic drilling for all wells
- Cost estimates are engineering estimates, +/- 30 to 50 percent

Pilot Test Work Plan and update Health and Safety Plan					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	20	$143	$2,862	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	40	$124	$4,961	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	80	$98	$7,802	
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	40	$73	$2,925.60	
		Labor Markup	**0%**	**$0**	
		Project Management	**10%**	**$1,855**	
		Work Plan Subtotal		**$21,000**	

Appendix E
Area 17 LNAPL Skimming Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Pilot Test Well Drilling

1 Labor and expenses include oversight of injection well installation and development. Geologist to oversee drilling and development.
2 Drilling

Treatment depth	22	ft	
Treatment thickness	10	ft	
Recovery Well ROI	10	ft	
Number of RWs:	2	wells	
RW Well Depth	22	ft	
Number of MWs:	6	wells	Installed at radial distances from RW
MW Well Depth	22	ft	
Drilling rate	50	ft/day	

recovery wells are 4" diameter with 10' SS screens
Monitoring wells are 2" diameter with 10' SS screens
3 Other
PID rental for drilling (not needed for well development)
Survey new injection and monitoring wells

Hours per well for setup/decon/move	1	hr
Hours per well for development	1.5	hr

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	9	$143	$1,288	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	14	$124	$1,736	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	28	$98	$2,731	Coordination, Contracting, Field Support
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	55	$73	$4,023	Field 12 hrs/day, 1 day utility located and KO Meeting
2. ARCADIS Expenses					
Field vehicle	DAY	5	$115	$575	
Mileage	MI	300	$0.45	$135	
Meals	DAY	5	$50	$250	
Hotel	DAY	4	$120	$480	
PPE	DAY	5	$25	$125	
PID	DAY	5	$75	$375	
3. Subcontractor Drilling					
Mob/Demob	ls	1	$1,200	$1,200	
4" x 6" Sonic Drilling with Continuous Sampling	ft	132	$32	$4,224	
7" x 8" Sonic Drilling with Continuous Sampling	ft	44	$45	$1,980	
Sonic Bedrock Drilling	ft	0	$60	$0	
2" PVC Well Installation (Labor and Materials)	ft	72	$16	$1,152	
2" x 10' SS Screen (Labor and Materials)	each	6	$700	$4,200	
4" PVC Well Installation (Labor and Materials)	ft	24	$24	$576	
4" x 10' SS Screen (Labor and Materials)	each	2	$1,300	$2,600	
Development	hr	12	$175	$2,100	
Well Completions	each	8	$300	$2,400	
Drums	each	8	$60	$480	
Move, Setup, Decon, IDW Handling (sonic)	hr	8	$325	$2,600	
Stand-By	hr		$400	$0	
4. Other					
IDW - Disposal Soil	drum	8	$100	$800	
IDW - Disposal Water	drum	3	$100	$300	
IDW - Transportation	trip	1	$200	$200	Assume 20 drums per trip
Survey new wells	LS	1	$500	$500	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$235**	
		Markup on Subs	**15%**	**$3,797**	
		Project Management	**10%**	**$978**	
		Pilot Test Well Drilling Subtotal		**$43,000**	

Appendix E
Area 17 LNAPL Skimming Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Pilot Test					
1 Labor and expenses includes personnel to perform installation of recovery system, and 12 months of O&M					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	22	$143	$3,148	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	54	$124	$6,697	Field Support
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	108	$98	$10,532	Coordination, field support, data analysis
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	216	$73	$15,798	2 days installation, 12 monthly O&M events, 4 troubleshooting events
2a. ARCADIS Expenses					
Field vehicle	DAY	18	$115	$2,070	
Mileage	MI	1080	$0.45	$486	
Meals	DAY	18	$50	$900	
Hotel	DAY	4	$120	$480	
Level D PPE	DAY	18	$25	$450	
PID	DAY	18	$75	$1,350	
IP	DAY	18	$37	$666	
3. Subcontractor					
LNAPL Skimmers	LS	2	$10,000	$20,000	5K for Spill Buster, 3K for Solar Panels, 2K for Skimmer Housing
Subcontractor Skimmer Installation	LS	1	$8,000	$8,000	
			Labor Markup	**0%**	**$0**
			Markup on ARCADIS Expenses	**15%**	**$658**
			Markup on Subs	**15%**	**$4,200**
			Project Management	**10%**	**$3,618**
			Pilot Test Subtotal		**$80,000**

Appendix E
Area 17 LNAPL Skimming Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Full-Scale Design					
1 Labor to design system					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	45	$174	$7,830	
Sr Engineer/Sci II	HR		$145	$0	
Sr Engineer/Sci I	HR	90	$135	$12,150	
Sr Project Engineer/Scientist II	HR		$115	$0	
Sr Project Engineer/Scientist I	HR	180	$98	$17,640	
Project Engineer/Scientist	HR		$85	$0	
Engineer/Scientist	HR	90	$68	$6,120	
		Labor Markup	**0%**	**$0**	
		Project Management	**10%**	**$4,374**	
		Full-Scale Design Subtotal		**$48,200**	

Appendix E
Area 17 LNAPL Skimming Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Full-Scale Well Drilling

1 Labor and expenses include oversight of injection well installation and development. Geologist to oversee drilling and development. well.
2 Drilling

Treatment depth	22	ft	
Treatment thickness	10	ft	
Recovery Well ROI	10	ft	
Recovery Well Area	3,800	ft^2	
Number of RWs:	11	wells	
RW Well Depth	22	ft	
Number of MWs:	0	wells	Installed at radial distances from RW
MW Well Depth	22	ft	
Drilling rate	50	ft/day	

recovery wells are 4" diameter with 10' SS screens
Monitoring wells are 2" diameter with 10' SS screens
3 Other
PID rental for drilling (not needed for well development)
Survey new injection and monitoring wells

Hours per well for setup/decon/move	1	hr
Hours per well for development	1.5	hr

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	11	$143	$1,574	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	18	$124	$2,232	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	36	$98	$3,511	Coordination, Contracting, Field Support
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	71	$73	$5,193	Field 12 hrs/day, 1 day utility located and KO Meeting
2. ARCADIS Expenses					
Field vehicle	DAY	6	$115	$690	
Mileage	MI	360	$0.45	$162	
Meals	DAY	6	$50	$300	
Hotel	DAY	5	$120	$600	
PPE	DAY	6	$25	$150	
PID	DAY	6	$75	$450	
3. Subcontractor Drilling					
Mob/Demob	ls	1	$1,200	$1,200	
4" x 6" Sonic Drilling with Continuous Sampling	ft	0	$32	$0	
7" x 8" Sonic Drilling with Continuous Sampling	ft	242	$45	$10,890	
Sonic Bedrock Drilling	ft	0	$60	$0	
2" PVC Well Installation (Labor and Materials)	ft	0	$16	$0	
2" x 10' SS Screen (Labor and Materials)	each	0	$700	$0	
4" PVC Well Installation (Labor and Materials)	ft	132	$24	$3,168	
4" x 10' SS Screen (Labor and Materials)	each	11	$1,300	$14,300	
Development	hr	16.5	$175	$2,888	
Well Completions	each	11	$300	$3,300	
Drums	each	15	$60	$900	
Move, Setup, Decon, IDW Handling (sonic)	hr	11	$325	$3,575	
Stand-By	hr		$400	$0	
4. Other					
IDW - Disposal Soil	drum	15	$100	$1,500	
IDW - Disposal Water	drum	5	$100	$500	
IDW - Transportation	trip	1	$200	$200	Assume 20 drums per trip
Survey new wells	LS	1	$500	$500	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$285**	
		Markup on Subs	**15%**	**$6,438**	
		Project Management	**10%**	**$1,251**	
		Full-Scale Well Drilling Subtotal		**$66,000**	

Appendix E
Area 17 LNAPL Skimming Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Skimmer Installation					
1 Labor and expenses includes personnel to perform installation of recovery system					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	10	$143	$1,431	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	24	$124	$2,976	Field Support
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	48	$98	$4,681	Coordination, field support, data analysis
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	96	$73	$7,021	Assume installation of 2 Skimmers per day, plus 5 days setup/ tare down /misc
2a. ARCADIS Expenses					
Field vehicle	DAY	8	$115	$920	
Mileage	MI	480	$0.45	$216	
Meals	DAY	8	$50	$400	
Hotel	DAY	4	$120	$480	
Level D PPE	DAY	8	$25	$200	
PID	DAY	8	$75	$600	
IP	DAY	8	$0	$0	
3. Subcontractor					
LNAPL Skimmers	LS	6	$10,000	$60,000	5K for Spill Buster, 3K for Solar Panels, 2K for Skimmer Housing
Subcontractor Skimmer Installation	LS	1	$24,000	$24,000	
			Labor Markup	**0%**	**$0**
			Markup on ARCADIS Expenses	**15%**	**$332**
			Markup on Subs	**15%**	**$12,600**
			Project Management	**10%**	**$1,611**
			Skimmer Installation Subtotal		**$118,000**

Appendix E
Area 17 LNAPL Skimming Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Annual O&M					
1 Labor and expenses includes personnel to perform annual O&M					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	29	$143	$4,150	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	72	$124	$8,929	Field Support
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	144	$98	$14,043	Coordination, field support, data analysis
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	288	$73	$21,064	Monthly O&M for 12 months, 4 troubleshooting visits, 16 hrs per skimmer for mob to other wells
2a. ARCADIS Expenses					
Field vehicle	DAY	24	$115	$2,760	
Mileage	MI	1440	$0.45	$648	
Meals	DAY	24	$50	$1,200	
Hotel	DAY	4	$120	$480	
Level D PPE	DAY	24	$25	$600	
PID	DAY	24	$75	$1,800	
IP	DAY	24	$37	$888	
Misc. Repairs	LS	1	$5,000	$5,000	
3. Subcontractor				$0	
Non-TSCA Regulated LNAPL Disposal	Gal	26	$1	$26	Assume 0.04 gallon per well per day from 30% of the skimmers based on ASTM E2556
Non-TSCA Regulated LNAPL Transportation	Trip	1	$200	$200	Assume 20 drums per trip or 1 trip per year
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$853**	
		Markup on Subs	**15%**		
		Project Management	**10%**	**$4,819**	
		Annual O&M		**$68,000**	
		Years of Operation		**30**	
		O&M Subtotal		**$2,040,000**	

Pilot/Design:	**$200,000**
Full-Scale Well Installation/System installation:	**$190,000**
Life Cycle O&M:	**$2,040,000**

Area 17 LNAPL Skimmer Total:	**$2,430,000**

Appendix E
Area 17 SVE Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Area 17 SVE Cost Assumptions:

- Investigation to refine vertical and horizontal treatment area will be conducted, cost for investigation is not included as a separate line item as it is assumed it will be covered by the cost savings from reducing the treatment area.
- Base cost assumes pilot test of 2 SVE wells and full-scale SVE of 6 wells
- SVE Wells installed to a depth of 22 feet with 10 foot treatment interval (12-22 ft)
- SVE Wells installed assuming a 20 foot ROI
- Assume pilot test wells will be utilized in full-scale system operation
- Sonic drilling for all wells
- Cost estimates are engineering estimates, +/- 30 to 50 percent

Pilot Test Work Plan and update Health and Safety Plan					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	30	$143	$4,293	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	60	$124	$7,441	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	120	$98	$11,702	
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	60	$73	$4,388	
	Labor Markup		**0%**	**$0**	
	Project Management		**10%**	**$2,783**	
	Work Plan Subtotal			**$31,000**	

Appendix E
Area 17 SVE Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Pilot Test Well Drilling

1 Labor and expenses include oversight of injection well installation and development. Geologist to oversee drilling and development.
2 Drilling
Treatment depth 22 ft
Treatment thickness 10 ft
SVE Well ROI 20 ft
Number of SVE Wells: 2 wells
SVE Well Depth 22 ft
VMPs: 6 wells
VMP Depth 22 ft
Drilling rate 50 ft/day
SVE wells are 2" diameter with 10' SS screens
VMPs are 2" diameter with PVC screens
3 Other
PID rental for drilling (not needed for well development)
Survey new injection and monitoring wells
Hours per well for setup/decon/move 1 hr
Hours per well for development 1.5 hr

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	9	$143	$1,288	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	14	$124	$1,736	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	28	$98	$2,731	Coordination, Contracting, Field Support
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	55	$73	$4,023	Field 12 hrs/day, 1 day utility located and KO Meeting
2. ARCADIS Expenses					
Field vehicle	DAY	5	$115	$575	
Mileage	MI	300	$0.45	$135	
Meals	DAY	5	$50	$250	
Hotel	DAY	4	$120	$480	
PPE	DAY	5	$25	$125	
PID	DAY	5	$75	$375	
3. Subcontractor Drilling					
Mob/Demob	ls	1	$1,200	$1,200	
4" x 6" Sonic Drilling with Continuous Sampling	ft	176	$32	$5,632	
7" x 8" Sonic Drilling with Continuous Sampling	ft	0	$45	$0	
Sonic Bedrock Drilling	ft	0	$60	$0	
2" PVC Well Installation (Labor and Materials)	ft	156	$16	$2,496	
2" x 5' SS Screen (Labor and Materials)	each	0	$350	$0	
2" x 10' SS Screen (Labor and Materials)	each	2	$700	$1,400	
Development	hr	0	$175	$0	
Well Completions	each	8	$300	$2,400	
Drums	each	7	$60	$420	
Move, Setup, Decon, IDW Handling (sonic)	hr	8	$325	$2,600	
Stand-By	hr		$400	$0	
4. Other					
IDW - Disposal Soil	drum	7	$100	$700	
IDW - Disposal Water	drum	3	$100	$300	
IDW - Transportation	trip	1	$200	$200	Assume 20 drums per trip
Survey new wells	LS	1	$500	$500	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$235**	
		Markup on Subs	**15%**	**$2,677**	
		Project Management	**10%**	**$978**	
		Pilot Test Well Drilling Subtotal		**$34,000**	

Appendix E
Area 17 SVE Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Pilot Test					
1 Labor and expenses includes personnel to perform the SVE pilot test					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	11	$143	$1,574	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	26	$124	$3,225	Field Support
Sr Project Engineer/Scientist II	HR		$108	$0	Field Support
Sr Project Engineer/Scientist I	HR	36	$98	$3,511	Coordination, field support
Project Engineer/Scientist	HR	72	$89	$6,411	Field - 2 People
Engineer/Scientist	HR		$73	$0	
2a. ARCADIS Expenses					
Field vehicle	DAY	6	$115	$690	
Mileage	MI	360	$0.45	$162	
Meals	DAY	6	$50	$300	
Hotel	DAY	4	$120	$480	
Level D PPE	DAY	6	$25	$150	
PID rental	DAY	3	$75	$225	
Dreager Chip Reader	DAY	3	$60	$180	
Dreager Chips	EACH	4	$200	$800	
WL Meter	DAY	3	$37	$111	
Gauges, meters, Magnehelic	LS	1	$1,000	$1,000	
Generator Rental	WK	1	$600	$600	
Generator Delivery	LS	1	$100	$100	
Diesel for generator	GAL	60	$4	$240	30 hrs, 2 gal/hr, @ 4.00/gal
Subcontractor - Lab					
Lab - VOC Vapor samples	EACH	15	$125	$1,875	
Subcontractor					
Mobilization and same day set up	LS	1	$1,150	$1,150	
System Rental first day	DAY	1	$1,600	$1,600	
System Rental after first day	DAY	2	$150	$300	
Technician	DAY	3	$1,050	$3,150	
Demob/Remob (weekend)	EACH		$800	$0	
Vapor Carbon Drums (180lb drums)	LS	2	$650	$1,300	
Vapor Carbon Drums (180lb drums) Credit	LS	2	$500	$1,000	
Demobilization	LS	1	1,150	1,150	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$1,037**	
		Markup on Subs	**15%**	**$1,729**	
		Project Management	**10%**	**$1,472**	
		SVE Pilot Test Subtotal		**$36,000**	

Appendix E
Area 17 SVE Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Full-Scale SVE Design					
1 Labor to design system					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	60	$174	$10,440	
Sr Engineer/Sci II	HR		$145	$0	
Sr Engineer/Sci I	HR	120	$135	$16,200	
Sr Project Engineer/Scientist II	HR		$115	$0	
Sr Project Engineer/Scientist I	HR	240	$98	$23,520	
Project Engineer/Scientist	HR		$85	$0	
Engineer/Scientist	HR	120	$68	$8,160	
		Labor Markup	**0%**	**$0**	
		Project Management	**10%**	**$5,832**	
		Full-Scale SVE Design Subtotal		**$64,200**	

Appendix E
Area 17 SVE Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Full-Scale Well Drilling

1 Labor and expenses include oversight of injection well installation and development. Geologist to oversee drilling and development.
2 Drilling

Treatment depth	22	ft
Treatment thickness	10	ft
Injection well ROI	20	ft
Treatment Area:	3800	ft^2
Number of SVE Wells:	4	wells
SVE Well Depth	22	ft
VMPs	0	wells
VMP Well Depth	15	ft
Drilling rate	50	ft/day

Injection wells are 2" diameter with 5' SS screens
Monitoring wells are 2" diameter with 5' PVC screens
3 Other
PID rental for drilling (not needed for well development)
Survey new injection and monitoring wells

Hours per well for setup/decon/move	1	hr
Hours per well for development	1.5	hr

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	6	$143	$859	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	9	$124	$1,116	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	17	$98	$1,658	Coordination, Contracting, Field Support
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	34	$73	$2,487	Field 12 hrs/day, 1 day utility located and KO Meeting
2. ARCADIS Expenses					
Field vehicle	DAY	3	$115	$345	
Mileage	MI	180	$0.45	$81	
Meals	DAY	3	$50	$150	
Hotel	DAY	2	$120	$240	
PPE	DAY	3	$25	$75	
PID	DAY	3	$75	$225	
3. Subcontractor Drilling					
Mob/Demob	ls	1	$1,200	$1,200	
4" x 6" Sonic Drilling with Continuous Sampling	ft	88	$32	$2,816	
7" x 8" Sonic Drilling with Continuous Sampling	ft	0	$45	$0	
Sonic Bedrock Drilling	ft	0	$60	$0	
2" PVC Well Installation (Labor and Materials)	ft	48	$16	$768	
2" x 5' SS Screen (Labor and Materials)	each	0	$350	$0	
2" x 10' SS Screen (Labor and Materials)	each	4	$700	$2,800	
Development	hr	0	$175	$0	
Well Completions	each	4	$300	$1,200	
Drums	each	4	$60	$240	
Move, Setup, Decon, IDW Handling (sonic)	hr	4	$325	$1,300	
Stand-By	hr		$400	$0	
4. Other					
IDW - Disposal Soil	drum	4	$100	$400	
IDW - Disposal Water	drum	3	$100	$300	
IDW - Transportation	trip	1	$200	$200	Assume 20 drums per trip
Survey new wells	LS	1	$500	$500	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$134**	
		Markup on Subs	**15%**	**$1,759**	
		Project Management	**10%**	**$611.94**	
		Full-Scale Well Drilling Subtotal		**$22,000**	

Appendix E
Area 17 SVE Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Full-Scale System Installation					
1 Labor and expenses includes personnel to oversee system installation					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	21	$143	$3,005	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	84	$124	$10,418	Field Support
Sr Project Engineer/Scientist II	HR		$108	$0	Field Support
Sr Project Engineer/Scientist I	HR	210	$98	$20,479	Coordination, field support, start up
Project Engineer/Scientist	HR	300	$89	$26,712	Oversight 5 days electrical, 10 days subgrade, 5 days system, 5 days start up
Engineer/Scientist	HR		$73	$0	
2a. ARCADIS Expenses					
Field vehicle	DAY	30	$115	$3,450	
Mileage	MI	1800	$0.45	$810	
Meals	DAY	30	$50	$1,500	
Hotel	DAY	24	$120	$2,880	
Level D PPE	DAY	30	$25	$750	
PID rental	DAY	25	$75	$1,875	
Underground					
Mob/Demobilization	LS	1	$5,000	$5,000	
Trenching	LF	300	$10	$3,000	estimate for contractor labor and materials
SVE piping	LF	780	$5	$3,900	estimate for contractor labor and materials
Backfill/Compaction	LF	300	$25	$7,500	estimate for contractor labor and materials
Surface Restoration	LF	300	$5	$1,500	estimate for contractor labor and materials
SVE Well Connections	EACH	6	$250	$1,500	estimate for contractor labor and materials
KO Leg Vault	LS	1	$6,000	$6,000	estimate for contractor labor and materials
IDW- Disposal	TON	227	$21	$4,647	
IDW - Transportation	TRIP	4	$200	$800	Assume 68 tons per trip (40 cy)
Other Subs/Materials/Equipment					
Electrician	LS	1	$15,000	$15,000	
Electrical Drop	LS	2	$20,000	$40,000	
Equipment Trailer Mob/Unload	LS	1	$5,000	$5,000	
Carbon First Fill	LB	2000	$3	$6,000	2 1000 lb Vessels
System Construction	LS	1	$60,000	$60,000	Conex container and equipment (e.g., blowers, compressor)
Survey	LS	1	$1,500	$1,500	survey piping
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$1,690**	
		Markup on Subs	**15%**	**$24,202**	
		Project Management	**10%**	**$6,061**	
		Full-Scale Installation Subtotal		**$265,179**	

Appendix E
Area 17 SVE Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Annual O&M					
1 Labor and expenses for annual O&M					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	24	$143	$3,434	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	48	$124	$5,953	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	96	$98	$9,362	
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	192	$73	$14,043	Monthly O&M plus 4 troubleshooting visits
2. ARCADIS Expenses					
Field vehicle	DAY	16	$115	$1,840	
Mileage	MI	1920	$0.45	$864	
Meals	DAY	16	$50	$800	
Hotel	DAY	15	$120	$1,800	
Level D PPE	DAY	16	$25	$400	
PID rental	DAY	16	$75	$1,200	
Subs/Materials/Equipment					
Carbon Fill/Disposal	LB	4000	$3	$12,000	2 1000 lb Vessels changed out twice per year
Utilities - Electric	MO	12	$417	$5,002	
VOC - Air	EACH	36	$125	$4,500	Monthly Influent, Midfluent, Effluent
Misc. supplies	LS	1	$2,000	$2,000	
			Labor Markup	**0%**	**$0**
			Markup on ARCADIS Expenses	**15%**	**$1,036**
			Markup on Subs	**15%**	**$3,525.29**
			Project Management	**10%**	**$3,279.22**
			Annual O&M		**$71,100**
			Years of O&M		**15**
			O&M Subtotal		**$1,070,000**

Pilot/Design: $166,000
Full-Scale Well Installation/System Installation: $288,000
O&M: $1,070,000

SVE 17 Total: $1,530,000

Appendix E
Area 5-2 MPE Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Area 5-2 MPE Cost Assumptions:

- Area 5-2 MPE Cost Estimate Based on 10 gpm P&T Cost Estimate due to presence of 1,4-Dioxane in groundwater (See P&T Cost estimate for additional MPE assumptions)
- Investigation to refine vertical and horizontal treatment area will be conducted, cost for investigation is not included as a separate line item as it is assumed it will be covered by the cost savings from reducing the treatment area.
- Base cost assumes pilot test of 2 MPE wells and full-scale MPE of 56 wells
- MPE Wells installed to a depth of 24 feet with 10 foot treatment interval (14-22 ft)
- MPE Wells installed assuming a 15 foot ROI
- Assume pilot test wells will be utilized in full-scale system operation
- Sonic drilling for all wells
- Cost estimates are engineering estimates, +/- 30 to 50 percent

Items	Unit Price	Units	Cost
Cost Overview			
See attached document			

Appendix E
Area 5-2 MPE Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

MPE System Capital Cost	Unit Price	Units	Cost
Design			
Treatability studies	40,000 LS	1	40,000
Pilot Test Well Drilling	46,000	1	46,000
Pilot Testing	146,000	1	146,000
Site surveying	30,000 LS	1	30,000
Design and Bid Packages (Recovery System)	30,000 LS	1	30,000
Design and Bid Packages (Treatment System)	100,000 LS	1	100,000
Permitting/Access Agreements			
Permitting - sanitary sewer discharge permitting	8,000 LS	1	8,000
Recovery System			
Full-Scale Well Installation	229,000 LS	1	229,000
Full-Scale Subgrade Piping	242,047 LS	1	242,047
		Recovery System Subtotal	471,047
		taxes (7%)	32,973
		mark-up (5%)	25,201
		Recovery System Total	529,221
Water Process Equipment			
Influent equalization tanks	5,000 LS	1	5,000
Aeration blower	1,500 LS	2	3,000
pH adjust system	5,000 LS	1	5,000
Transfer pump	2,500 LS	2	5,000
Multi-media filters	18,000 LS	1	18,000
Cartridge filter system	3,000 LS	1	3,000
Clean backwash tank	3,000 LS	1	3,000
Backwash pump	2,500 LS	1	2,500
Polymer metering pump	2,000 LS	1	2,000
Static mixer	1,000 LS	1	1,000
Flocculator tank	6,000 LS	1	6,000
Flocculator mixer	1,500 LS	1	1,500
Solids transfer pump	1,200 LS	1	1,200
Filter press	20,000 LS	0	0
Filter press stand	10,000 LS	0	0
Filter press feed pump	2,000 LS	0	0
Pre-coat tank	1,000 LS	0	0
Pre-coat pump	1,500 LS	0	0
Air stripper	20,000 LS	1	20,000
Transfer pump	2,500 LS	2	5,000
Vapor-phase granular activated carbon	3,000 LS	3	9,000
Advanced oxidation system (HiPOx)	200,000 LS	1	200,000
Transfer pump	2,500 LS	2	5,000
Ion exchange system	250,000 LS	1	250,000
Granular activated carbon	3,000 LS	3	9,000
Air compressor	5,000 LS	1	5,000
Refrigerated air dryer	1,000 LS	1	1,000
Containment area pump	1,500 LS	2	3,000
Instrumentation	30,000 LS	1	30,000
Control panel	30,000 LS	1	30,000
Distribution panel	20,000 LS	2	40,000
VFD panel	15,000 LS	1	15,000
PLC and data communications	5,000 LS	1	5,000
Data collection software and hardware	5,000 LS	1	5,000
Dial-out/internet communications package	5,000 LS	1	5,000
		Process Equipment Subtotal	693,200
		taxes (7%)	48,524
		shipping (10%)	69,320
		mark-up (5%)	40,552
		Equipment Total	851,596

Appendix E
Area 5-2 MPE Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
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Plant Subcontractors (Building)				
Design	30,000	LS	1	30,000
Permitting - local building/plumbing	10,000	LS	1	10,000
Building and foundation	80	square feet	3,200	256,000
Parking area and fencing	15,000	LS	1	15,000
Landscaping and finishing	15,000	LS	1	15,000
			Building Subcontractor Subtotal	326,000
			Project management (10%)	32,600
			Building Subcontractor Subtotal	358,600
Plant Subcontractors (Mechanical)				
Permitting - local building/plumbing	5,000	LS	1	5,000
Mobilization	5,000	LS	1	5,000
Utilities clearing	2,000	LS	1	2,000
General plant assembly	10,000	LS	1	10,000
Equipment receiving and laydown	10,000	LS	1	10,000
Plant piping assembly - labor	60,000	LS	1	80,000
Plant piping assembly - parts (includes tax and mark-up)	60,000	LS	1	80,000
Miscellaneous support	20,000	LS	1	20,000
			Mechanical Subcontractor Subtotal	212,000
			Subcontractor project management (5%)	10,600
			mark-up (5%)	11,130
			Mechanical Subcontractor Subtotal	233,730
Plant Subcontractors (Electrical)				
Permitting - local electrical	5,000	LS	1	5,000
Panel receiving and installation	5,000	LS	1	5,000
Conduit and wiring - materials	40,000	LS	1	40,000
Conduit and wiring - installation	40,000	LS	1	40,000
Panel terminations	9,000	LS	1	9,000
Conduit racks	10,000	LS	1	10,000
Lightning/surge protection	20,000	LS	1	20,000
			Electrical Subcontractor Subtotal	129,000
			Subcontractor project management (5%)	6,450
			mark-up (5%)	6,773
			Mechanical Subcontractor Subtotal	142,223
PLC Programming	50,000	each	1	50,000
Office and lab set-up	10,000	each	1	10,000
Health & Safety equipment	10,000	each	1	10,000
Misc construction costs (expenses)	5,000	each	1	5,000
			Subtotal for Groundwater System Capital Cost	2,590,370
Reporting - As-built drawings				30,000
On-Site Construction Management, Engineering, and Start-up (5%)				129,500
Project Management (3%)				77,700
			Subtotal	2,827,570
			Contingency (5%)	141,378
Total MPE Capital Cost				**2,969,000**

Appendix E
Area 5-2 MPE Cost Detail

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

MPE System Startup Cost (assume 2 weeks)

Senior principal engineer oversight	180	$/hour	8		1,400
Senior engineer oversight	127	$/hour	40		5,100
Engineer management	98	$/hour	100		9,800
Lead operator	79	$/hour	100		7,900
Junior operator	68	$/hour	100		6,800
Subcontractor support (mechanical)	3,000	LS	1		3,000
Subcontractor support (electrical)	3,000	LS	1		3,000
Subcontractor support (controls)	6,000	LS	1		6,000
ARCADIS general expenses	5,000	LS	1		5,000
				Subtotal	48,000
Project Management (10%)					2,400
Total MPE Startup Costs					**50,000**

MPE Operations Cost

Annual O&M Costs					
Operations Labor					
Senior principal engineer oversight (1 hours per week)	180	$/hour	52		9,400
Senior engineer oversight (2 hours per week)	127	$/hour	104		13,200
Engineer management (6 hours per week)	98	$/hour	312		30,600
Lead operator (30 hours per week)	79	$/hour	1,560		123,200
Junior operator (10 hours per week)	68	$/hour	520		35,400
Subcontractor support	500	month	12		6,000
General expenses	1,000	month	12		12,000
Utilities - plant electric (60 HP, $0.12/kw-hr)	1,000	$/HP/year	20		20,000
Sodium hydroxide	4	gallon	500		2,000
TSCA Regulated LNAPL Disposal (2 gal per well per day for 30% of the wells based on ASTM E2556)	223	drum	1,000		223,000
Discharge to City POTW (1.6 gpm per well)	4.00	/1,000 gal	47,094		188,400
POTW discharge monitoring	1,000	/ samples	12		12,000
Utilities - water	6	/1,000 gal	40		200
Internet and communication fees	150	month	9		1,400
Plant process monitoring	300	/ samples	100		30,000
Misc site maintenance	5,000	LS	1		5,000
Equipment repairs/replacement (0.5% of equipment capital cost)	3,466	LS	1		3,500
AOP operations cost	6,000	LS	1		6,000
Ion exchange operations cost	80,000	LS	1		80,000
Sludge disposal	200	ton	30		6,000
Lab and field instrumentation maintenance	300	month	12		3,600
Health and safety equipment	500	month	12		6,000
				Subtotal	816,900
Reporting					50,000
Contingency (5%)					40,845
Project Management (10%)					40,800
Total MPE O&M Annual Costs					**949,000**

Summary

MPE System Capital Cost	**$2,969,000**
MPE System Startup Cost (assume 2 weeks)	**$50,000**
MPE Capital Cost	**$3,100,000**
Total MPE O&M Annual Costs	**$949,000**
Years of O&M	**15**
MPE Total	**17,400,000**

Appendix E
CMS Report
RACER Plants 2, 3 and 6
Area 17 MPE Cost Detail

Area 17 MPE Cost Assumptions:

- Investigation to refine vertical and horizontal treatment area will be conducted, cost for investigation is not included as a separate line item as it is assumed it will be covered by the cost savings from reducing the treatment area.
- Base cost assumes pilot test of 2 MPE wells and full-scale MPE of 9 wells
- MPE Wells installed to a depth of 22 feet with 10 foot treatment interval (12-22 ft)
- MPE Wells installed assuming a 15 foot ROI
- Assume pilot test wells will be utilized in full-scale system operation
- Sonic drilling for all wells
- Cost estimates are engineering estimates, +/- 30 to 50 percent

Pilot Test Work Plan and update Health and Safety Plan					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	35	$143	$5,009	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	70	$124	$8,681	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	140	$98	$13,653	
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	70	$73	$5,120	
		Labor Markup	**0%**	**$0**	
		Project Management	**10%**	**$3,246**	
		Work Plan Subtotal		**$36,000**	

Appendix E
CMS Report
RACER Plants 2, 3 and 6
Area 17 MPE Cost Detail

Pilot Test Well Drilling

1 Labor and expenses include oversight of injection well installation and development. Geologist to oversee drilling and development.

2 Drilling

Treatment depth	22	ft
Treatment thickness	10	ft
MPE Well ROI	15	ft
Number of MPE Wells:	2	wells
MPE Well Depth	22	ft
Monitoring Wells	8	wells
Monitoring Well Depth	22	ft
Drilling rate	50	ft/day

MPE wells are 4" diameter with 10' SS screens
MWs are 2" diameter with PVC screens

3 Other

PID rental for drilling (not needed for well development)
Survey new injection and monitoring wells

Hours per well for setup/decon/move	1	hr
Hours per well for development	1.5	hr

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	9	$143	$1,288	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	14	$124	$1,736	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	28	$98	$2,731	Coordination, Contracting, Field Support
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	55	$73	$4,023	Field 12 hrs/day, 1 day utility located and KO Meeting
2. ARCADIS Expenses					
Field vehicle	DAY	5	$115	$575	
Mileage	MI	300	$0.45	$135	
Meals	DAY	5	$50	$250	
Hotel	DAY	4	$120	$480	
PPE	DAY	5	$25	$125	
PID	DAY	5	$75	$375	
3. Subcontractor Drilling					
Mob/Demob	ls	1	$1,200	$1,200	
4" x 6" Sonic Drilling with Continuous Sampling	ft	176	$32	$5,632	
7" x 8" Sonic Drilling with Continuous Sampling	ft	44	$45	$1,980	
Sonic Bedrock Drilling	ft	0	$60	$0	
2" PVC Well Installation (Labor and Materials)	ft	176	$16	$2,816	
2" x 5' SS Screen (Labor and Materials)	each	0	$350	$0	
2" x 10' SS Screen (Labor and Materials)	each	0	$700	$0	
4" PVC Well Installation (Labor and Materials)	ft	24	$24	$576	
4" x 10' SS Screen (Labor and Materials)	each	2	$1,300	$2,600	
Development	hr	15	$175	$2,625	
Well Completions	each	10	$300	$3,000	
Drums	each	9	$60	$540	
Move, Setup, Decon, IDW Handling (sonic)	hr	10	$325	$3,250	
Stand-By	hr		$400	$0	
4. Other					
IDW - Disposal Soil	drum	9	$100	$900	
IDW - Disposal Water	drum	3	$100	$300	
IDW - Transportation	trip	1	$200	$200	Assume 20 drums per trip
Survey new wells	LS	1	$500	$500	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$235**	
		Markup on Subs	**15%**	**$3,918**	
		Project Management	**10%**	**$978**	
		Pilot Test Well Drilling Subtotal		**$43,000**	

Appendix E
CMS Report
RACER Plants 2, 3 and 6
Area 17 MPE Cost Detail

Pilot Test					
1 Labor and expenses includes personnel to perform the MPE pilot test					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	40	$143	$5,724	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	93	$124	$11,534	Field Support
Sr Project Engineer/Scientist II	HR		$108	$0	Field Support
Sr Project Engineer/Scientist I	HR	132	$98	$12,873	Coordination, field support
Project Engineer/Scientist	HR	264	$89	$23,507	Field - 2 People 5 days, twice weekly for 3 weeks
Engineer/Scientist	HR		$73	$0	
2a. ARCADIS Expenses					
Field vehicle	DAY	22	$115	$2,530	
Mileage	MI	1320	$0.45	$594	
Meals	DAY	22	$50	$1,100	
Hotel	DAY	8	$120	$960	
Level D PPE	DAY	22	$25	$550	
PID rental	DAY	11	$75	$825	
Dreager Chip Reader	DAY	11	$60	$660	
Dreager Chips	EACH	8	$200	$1,600	
WL Meter	DAY	11	$37	$407	
Gauges, meters, Magnehelic	LS	2	$1,000	$2,000	
Generator Rental	WK	4	$600	$2,400	
Generator Delivery	LS	1	$100	$100	
Diesel for generator	GAL	840	$4	$3,360	24 hrs, 30 days, 2 gal/hr, @ 4.00/gal
Subcontractor - Lab					
Lab - VOC Vapor samples	EACH	20	$125	$2,500	
Lab- VOCs 8260	EACH	20	$75	$1,500	
Lab- Metals and Na, Al, Mn 6010	EACH	20	$150	$3,000	
Lab- TDS SM 2540C	EACH	20	$20	$400	
Lab- Fe 200.7	EACH	20	$10	$200	
Lab- Alkalinity 310.1	EACH	20	$20	$400	
Lab- TOC 9060	EACH	20	$20	$400	
Subcontractor					
Mobilization and same day set up	LS	1	$1,150	$1,150	
System Rental	MO	1	$20,000	$16,000	
Technician	DAY	5	$1,050	$5,250	
Demob/Remob (weekend)	EACH		$800	$0	
Vapor Carbon Drums (180lb drums)	LS	2	$650	$1,300	
Vapor Carbon Drums (180lb drums) Credit	LS	2	$500	$1,000	
Frac Tank	MO	2	$1,000	$2,000	
Non-TSCA Regulated LNAPL Disposal	Gal	20000	$1	$18,000	Assume 1 gallon per month per well
Non-TSCA Regulated LNAPL Transportation	Trip	4	$1,000	$4,000	Assume 6000 gal per trip
Demobilization	LS	1	1,150	1,150	
			Labor Markup	**0%**	**$0**
			Markup on ARCADIS Expenses	**15%**	**$2,938**
			Markup on Subs	**15%**	**$8,738**
			Project Management	**10%**	**$5,364**
			MPE Pilot Test Subtotal		**$147,000**

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CMS Report
RACER Plants 2, 3 and 6
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Full-Scale MPE Design					
1 Labor to design system					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	100	$174	$17,400	
Sr Engineer/Sci II	HR		$145	$0	
Sr Engineer/Sci I	HR	200	$135	$27,000	
Sr Project Engineer/Scientist II	HR		$115	$0	
Sr Project Engineer/Scientist I	HR	400	$98	$39,200	
Project Engineer/Scientist	HR		$85	$0	
Engineer/Scientist	HR	200	$68	$13,600	
			Labor Markup	**0%**	**$0**
			Project Management	**10%**	**$9,720**
			Full-Scale MPE Design Subtotal		**$107,000**

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Full-Scale Well Drilling

1 Labor and expenses include oversight of injection well installation and development. Geologist to oversee drilling and development.

2 Drilling

Treatment depth	22	ft
Treatment thickness	10	ft
Injection well ROI	15	ft
Treatment Area:	3800	ft^2
Number of MPE Wells:	7	wells
MPE Well Depth	22	ft
MWs	0	wells
MW Depth	15	ft
Drilling rate	50	ft/day

MPE wells are 4" diameter with 10' SS screens
Monitoring wells are 2" diameter with 10' PVC screens

3 Other

PID rental for drilling (not needed for well development)
Survey new injection and monitoring wells

Hours per well for setup/decon/move	1	hr
Hours per well for development	1.5	hr

Items	Unit	Qty	Cost	Extension	Assumptions
1. Labor					
Principal Engineer/Scientist	HR	2	$143	$286	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	3	$124	$372	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	6	$98	$585	Coordination, Contracting, Field Support
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	12	$73	$878	Field 12 hrs/day, 1 day utility located and KO Meeting
2. ARCADIS Expenses					
Field vehicle	DAY	1	$115	$115	
Mileage	MI	60	$0.45	$27	
Meals	DAY	1	$50	$50	
Hotel	DAY	0	$120	$0	
PPE	DAY	1	$25	$25	
PID	DAY	1	$75	$75	
3. Subcontractor Drilling					
Mob/Demob	ls	1	$1,200	$1,200	
4" x 6" Sonic Drilling with Continuous Sampling	ft		$32	$0	
7" x 8" Sonic Drilling with Continuous Sampling	ft	154	$45	$6,930	
Sonic Bedrock Drilling	ft	0	$60	$0	
2" PVC Well Installation (Labor and Materials)	ft	0	$16	$0	
2" x 5' SS Screen (Labor and Materials)	each	0	$350	$0	
2" x 10' SS Screen (Labor and Materials)	each	0	$700	$0	
4" PVC Well Installation (Labor and Materials)	ft	84	$24	$2,016	
4" x 10' SS Screen (Labor and Materials)	each	7	$1,300	$9,100	
Development	hr	0	$175	$0	
Well Completions	each	7	$300	$2,100	
Drums	each	10	$60	$600	
Move, Setup, Decon, IDW Handling (sonic)	hr	7	$325	$2,275	
Stand-By	hr		$400	$0	
4. Other					
IDW - Disposal Soil	drum	10	$100	$1,000	
IDW - Disposal Water	drum	3	$100	$300	
IDW - Transportation	trip	1	$200	$200	Assume 20 drums per trip
Survey new wells	LS	1	$500	$500	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$33**	
		Markup on Subs	**15%**	**$3,933**	
		Project Management	**10%**	**$212.11**	
		Full-Scale Well Drilling Subtotal		**$33,000**	

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Full-Scale System Installation					
1 Labor and expenses includes personnel to oversee system installation					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	30	$143	$4,293	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	120	$124	$14,882	Field Support
Sr Project Engineer/Scientist II	HR		$108	$0	Field Support
Sr Project Engineer/Scientist I	HR	300	$98	$29,256	Coordination, field support, start up
Project Engineer/Scientist	HR	360	$89	$32,054	Oversight 5 days electrical, 10 days subgrade, 5 days system, 10 days start up
Engineer/Scientist	HR		$73	$0	
2a. ARCADIS Expenses					
Field vehicle	DAY	35	$115	$4,025	
Mileage	MI	2100	$0.45	$945	
Meals	DAY	35	$50	$1,750	
Hotel	DAY	29	$120	$3,480	
Level D PPE	DAY	35	$25	$875	
PID rental	DAY	30	$75	$2,250	
Underground					
Mob/Demobilization	LS	1	$5,000	$5,000	
Trenching	LF	300	$10	$3,000	estimate for contractor labor and materials
MPE piping	LF	1170	$5	$5,850	estimate for contractor labor and materials
Backfill/Compaction	LF	300	$25	$7,500	estimate for contractor labor and materials
Surface Restoration	LF	300	$5	$1,500	estimate for contractor labor and materials
MPE Well Connections	EACH	9	$500	$4,500	estimate for contractor labor and materials
IDW- Disposal	TON	227	$21	$4,647	
IDW - Transportation	TRIP	4	$200	$800	Assume 68 tons per trip (40 cy)
Other Subs/Materials/Equipment					
Electrician	LS	1	$15,000	$15,000	
Electrical Drop	LS	2	$20,000	$40,000	
Equipment Trailer Mob/Unload	LS	1	$5,000	$5,000	
Carbon First Fill (liquid/vapor)	LB	4000	$3	$12,000	4 1000 lb Vessels
System Construction	LS	1	$120,000	$120,000	Conex container and equipment (blowers, compressor, etc.)
Survey	LS	1	$1,500	$1,500	survey piping
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$1,999**	
		Markup on Subs	**15%**	**$33,945**	
		Project Management	**10%**	**$8,049**	
		Full-Scale Installation Subtotal		**$364,099**	

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Annual O&M					
1 Labor and expenses for annual O&M					
Items	**Unit**	**Qty**	**Cost**	**Extension**	**Assumptions**
1. Labor					
Principal Engineer/Scientist	HR	24	$143	$3,434	
Sr Engineer/Sci II	HR		$131	$0	
Sr Engineer/Sci I	HR	48	$124	$5,953	
Sr Project Engineer/Scientist II	HR		$108	$0	
Sr Project Engineer/Scientist I	HR	96	$98	$9,362	
Project Engineer/Scientist	HR		$89	$0	
Engineer/Scientist	HR	192	$73	$14,043	Monthly O&M plus 4 troubleshooting visits
2. ARCADIS Expenses					
Field vehicle	DAY	16	$115	$1,840	
Mileage	MI	1920	$0.45	$864	
Meals	DAY	16	$50	$800	
Hotel	DAY	15	$120	$1,800	
Level D PPE	DAY	16	$25	$400	
PID rental	DAY	16	$75	$1,200	
Subs/Materials/Equipment					
Carbon Fill/Disposal	LB	16000	$3	$48,000	2 1000 lb Vessels (vapor) changed out twice per year, 2 GAC changed every other month
Utilities - Electric	MO	12	$556	$6,669	
VOC - Air	EACH	36	$125	$4,500	Monthly Influent, Midfluent, Effluent
Non-TSCA Regulated LNAPL Disposal	Gal	4238	$1	$4,238	Assume 4.3 gal per well per day for 30% of the wells based on ASTM E2556
Non-TSCA Regulated LNAPL Transportation	Trip	78	$200	$15,600	Assume 20 drums per trip or 1 trip per year
Water Disposal	1000 Gal	2365.2	$4.00	$9,461	Assume 0.5 gpm per well
Misc. supplies	LS	1	$2,000	$2,000	
		Labor Markup	**0%**	**$0**	
		Markup on ARCADIS Expenses	**15%**	**$1,036**	
		Markup on Subs	**15%**	**$13,570**	
		Project Management	**10%**	**$3,279**	
		Annual O&M		**$149,000**	
		Years of O&M		**15**	
		O&M Subtotal		**$2,235,000**	

Pilot/Design:	**$333,000**
Full-Scale Well Installation/System Installation:	**$398,000**
O&M:	**$2,235,000**
MPE 17 Total:	**$2,970,000**

Appendix E
Cost Detail Acronyms and Abbreviations

RCRA Corrective Action Corrective Measures Study
RACER Plants 2, 3, and 6
Lansing, Michigan

Acronyms and Abbreviations:

Al	aluminum
AOP	advanced oxidation process
cond	conductivity
cy	cubic yards
Demob	demobilize
Fe	iron
FESL	Flammability and Explosivity Screening Level
ft	feet
ft^2	square feet
GAC	granular-activated carbon
g/L	grams per liter
gpm	gallons per minute
GW	groundwater
hr	hour
hrs	hours
IDW	investigation derived waste
IP	interface probe
ISCO	in-situ chemical oxidation
IW	injection well
KO	knock out
kw	kilowatt
Lab	laboratory
lb	pound
lbs	pounds
LNAPL	light non-aqueous phase liquid
ls	lump sum
MCLs	maximum contaminate levels
mi	mile
misc	miscellaneous
Mn	manganese
mob	mobilize
MPE	multi-phase extraction
MW	monitoring well
Na	sodium
NA	not applicable
O&M	operations and maintenance
PID	photoionization detector
PLC	programmable logic controller
PM	project management
POTW	publically owned treatment works
PPE	personal protective equipment
PVC	polyvinyl chloride
Qty	quantity
RC	Restrictive Covenant
Remob	remobilize
ROI	radius of influence
RW	recovery well
Sci	scientist
SM	standard method
Sr	senior
SS	stainless steel
SVE	soil vapor extraction
TDS	total dissolved solids
TSCA	Toxic Substance Control Act
VFD	variable frequency drive
VI	vapor intrusion
VMPs	vapor monitoring points
VOC	volatile organic compounds
WDI	Wayne Disposal, Inc.
WL	water-level meter
yr	year
yrs	years