Memorandum

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| Copies: | Scott Adamek and Ryan Robert, City of Bothell |
| From: | Gabe Cisneros and Danielle Gallaher, Floyd|Snider |
| Date: | March 14, 2025 |
| Project ID: | COB-OnCall 2717 |
| Re: | 2024 Annual Groundwater Monitoring |

## Introduction

This annual groundwater monitoring memorandum presents the results of the 2024 annual groundwater monitoring and sampling events conducted in April and September 2024 at the City of Bothell’s (City’s) Bothell Service Center (BSC) Simon & Son Site (Site) located at 9911 Main Street, formerly identified as 18107 Bothell Way NE in Bothell, Washington (Figure 1). Annual performance monitoring at the Site was conducted in accordance with the Consent Decree (CD) No. 18-2-02852-3 SEA (first and latest amendment entered into King County Superior Court on October 31, 2019). Annual groundwater sampling is conducted to monitor the performance of selected remedy in reducing chlorinated volatile organic compounds (CVOCs) concentrations in groundwater. The sections below include the following:

* A brief summary of the Site background
* Timeline of the selected remedy
* A review of the previous data
* System optimization adjustments
* Field activities performed during monitoring events
* Analytical results
* Evaluation of the results based on system adjustments
* Conclusions and next steps

## Site Background and History

The property containing the source of contamination was previously owned by Bothell Service Center Associates. The Site was once three separate parcels that included the following:

* A former dry cleaning facility, BSC, located in the northwestern portion of the Site
* A former gasoline station and automotive repair facility, Al’s Auto Bothell Wexler (Wexler), in the northeastern portion of the Site
* A former automotive repair, Bothell Former Hertz/AARenco/AA Rentals of Bothell Inc. (Hertz), in the southern portion of the Site

All three former parcels are currently located within one city block (Bothell Lot D) that consists of one parcel (King County Tax Parcel No. 945720-0050) totaling approximately 2.6 acres. The Site has been developed into an approximate 105,000-square foot mixed-use, six-story multi-family apartment building, with occupancy beginning in 2025. The ground floor consists of an open-air parking garage, residential apartments to the north and west, and commercial tenant spaces to the east (along Bothell Way Northeast). The second floor consists of an open-air parking garage and residential apartments, and the third through sixth floors consist of residential apartments.

From the 1990s to present, numerous subsurface investigations and remedial actions have been performed at the Site. Historical investigation results indicated that total petroleum hydrocarbons, metals, and CVOCs were present in soil and groundwater.

### Summarize Cleanup Action Plan Remedial Action Objectives

The 2015 Remedial Investigation/Feasibility Study identified exposure pathways of constituents of concern (COCs) at the Site, and based on the nature and the extent of contamination, the likely greatest potential risk to human receptors is dermal contact of soil and/or groundwater to construction workers during soil-disturbing activities (HWA Geosciences Inc. 2015). The Site COCs were determined to be tetrachloroethylene (PCE), trichloroethylene (TCE), *cis*‑1,2‑dichloroethylene (DCE), and vinyl chloride (VC). However, since the redevelopment of the properties, the most likely exposure risk is inhalation of vapors by commercial workers within the businesses and occupants of the residential dwellings on the ground floor. Additionally, another potential risk is to ecological receptors, which include incidental soil ingestion and dermal contact, as well as ingestion and direct contact with groundwater. Therefore, the remedial action objectives for the selected cleanup addressed these risks, which are currently being mitigated to remove the contaminants to levels that are protective to receptors, and institutional or engineering controls were placed to prevent exposure. The selected Model Toxics Control Act (MTCA) Methods A and B cleanup levels for soil and groundwater at the Site are shown in the tables below.

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| Site Soil Cleanup Levels (CULs) for Unrestricted Land Use | | |
| COC | | MTCA Method A Soil CUL |
| PCE | | 0.05 mg/kg |
| TCE | | 0.03 mg/kg |
| DCE | | 0.00515 mg/kg (protection of groundwater saturated) |
| VC | | 0.0000885 mg/kg (protection of groundwater saturated) |
| Abbreviation: | | |
| mg/kg | Milligrams per kilogram | |

|  |  |  |  |
| --- | --- | --- | --- |
| Site Groundwater CULs | | | |
| COC | | | MTCA Method A and B Groundwater CUL |
| PCE | | | 5 µg/L |
| TCE | | | 5 µg/L |
| DCE | | | 16 µg/L (1) |
| VC | | | 0.2 µg/L |
| Note: | | | |
| 1 | MTCA Method B | | |
| Abbreviation: | | | |
| µg/L | | Micrograms per liter | |

### Remediation Timeline

Several environmental investigations were completed prior to 2016 at the Site. The findings of these investigations include the following:

* A release of an unknown quantity of PCE occurred at the Site between 1989 and 1999 during operation of Simon & Son Fine Drycleaning, and a residual source of PCE remains beneath the northwest corner of the Site.
* The PCE release(s) affected the soil above and below the water table as well as groundwater at the Site.
* PCE as dense non-aqueous phase liquid has been encountered on the Site at depths of approximately 45 to 50 feet below ground surface (bgs).
* Groundwater is affected to a depth of at least 50 feet, where a silty stratum occurs in the source area, and at a depth of 30 to 40 feet downgradient and across much of the Site.
* The groundwater plume of CVOCs (i.e., PCE and its breakdown products) migrated from the source area with east and east-southeasterly flowing groundwater.

Prior to 2016, the following interim actions were taken to address high PCE concentrations at the site:

* Injection of potassium permanganate into the source for in situ chemical oxidation; rebound was observed.
* A soil vapor extraction (SVE) system was installed to address soil vapor contamination.
* More chemical oxidation injections were performed with hydrogen peroxide and in well cells containing chelated iron and sodium persulfate.
* After additional data was collected, bioremediation was found to be a suitable solution and several rounds of EOS Remediation products were injected at the Site, along with bioaugmentation of *dehalococcoides* (DHC), which was found to be successful.

#### Thermal and Soil Vapor Extraction System

To address soil contamination in the source area on the western side of the property, an electric resistance heating in situ remediation technique was constructed. In total, 27 heating well locations were installed primarily in the 5 to 25 foot bgs range, with some locations advancing to 55 feet bgs. This system operated for approximately 6 months in 2018 in conjunction with the SVE system installed as an interim action. The process was successful in reducing soil concentrations on the west side of the property to less than CULs for PCE. Additionally, two small, targeted areas of soil were excavated on the eastern side of the property for removal of PCE source material.

#### Bioremediation and Recirculation Commenced in 2020

Since the completion of the electric resistance heating, a groundwater bioremediation and recirculation system has been operating to address the remaining extent of the CVOC plume. This system consists of 12 extraction wells and 12 injection wells at three different intervals of the saturated zone: shallow, intermediate, and deep. The groundwater recirculation system is an automated, programmable treatment process to extract contaminated groundwater, run the groundwater through activated carbon to remove CVOCs, add an organic carbon remedial substrate, and reinject the groundwater/substrate mixture back into the aquifer. This recirculation provides a continuous supply of remedial substrate to be utilized by the established microbial community responsible for the enhanced reductive dechlorination process. The recirculation loop is also intended to provide a degree of hydraulic control to mitigate downgradient migration of the contaminated groundwater plume.

Initially after startup, a reduction in PCE concentrations in groundwater was observed, with some of the most highly contaminated portions of the plume experiencing a significant decrease in PCE. However, monitoring event results after 2021 indicate a slight rebound near the northwest quadrant of the property, which is attributed to sorbed PCE in saturated soil diffusing back to groundwater more quickly than it is degraded by enhanced reductive dechlorination.

#### New Alexan Multi-Use Building Construction and Vapor Barrier

The development of the Site into the Alexan Main Street Apartments (Alexan Multi-Use) began in 2022 and was substantially completed in 2024. Alexan Multi-Use is a six-story apartment building with residential and commercial spaces. The first level of the building consists of a parking garage on the interior, residential apartments along 98th Avenue and Main Street, and commercial space along Bothell Way NE. During the construction of the foundation and vapor barrier of the building, groundwater bioremediation treatment system operation was paused to bury all treatment system piping between the injection and extraction wells and the treatment system. The bioremediation treatment system shed is now located in the northwest corner of the garage level contained within a fenced-off area consisting of three parking spaces. Figure 2 is a Site map that shows the building footprint, layout, and the monitoring, injection, and extraction wells.

In accordance with the restrictions and requirements outlined in the environmental covenant implemented for the property, and as part of the redevelopment of the Site, Terracon oversaw the installation of a Vapor Intrusion Mitigation System that consists of subgrade vent piping and two vapor membranes rated to mitigate vapor intrusion of CVOCs.

At the request of the Washington State Department of Ecology (Ecology) that was conveyed through the City, Terracon prepared the sampling work plan to perform indoor air and subslab soil gas sampling via existing sampling ports prior to occupancy of the Site building in general accordance with the CD.

Once redevelopment activities were completed inside and outside the building, the groundwater monitoring and injection/extraction well casings and well boxes were brought to grade at the garage level through the foundation, through surrounding sidewalks, and within roadways along 98th Avenue and Main Street.

## Summary of Optimization

Since the transfer of this project to Floyd|Snider at the beginning of March 2024, steps have been taken to understand and optimize the treatment system by reviewing the analytical data and understanding the system operation. The spring sampling event, the first semiannual event of the year, was conducted in April, and all significant operational changes to help optimize the system occurred after the April 2024 sampling event.

### Data Review and Assessment

A review of the existing groundwater sampling data (Tables 1 through 4) between the startup of the bioremediation system and prior to 2024 (Attachment 4) indicate that CVOC concentrations were not declining as quickly as projected. Oxidation–reduction potential (ORP) and dissolved oxygen (DO) readings provide insight on whether anaerobic conditions are present. ORP readings should be negative, and DO must be depleted in an anaerobic bioremediation system. DO readings of <0.5 milligrams per liter (mg/L) generally indicate an anaerobic pathway suitable for anaerobic dechlorination to occur. Data show that ORP and DO readings are within ideal ranges across the Site for anaerobic biodegradation but could be lower in some areas of the Site.

In addition to ORP and DO total organic carbon (TOC) concentrations are an indicator of substrate distribution during performance monitoring. The TOC data indicated that TOC concentrations are generally not within the desired range for anaerobic biodegradation across most of the Site. TOC concentrations between 20 and 50 mg/L are the ideal range for anaerobic biodegradation (USEPA 2023). Data prior to 2024 indicate that one well, MW-6, recorded TOC concentrations between 49 and 60 mg/L, DO concentrations of <0.5 mg/L, and negative ORP, which coincided with a decline in PCE concentrations from 3,800 micrograms per liter (µg/L) to 0.91 µg/L. Therefore, it is likely that additional CarBstrate™, which provides TOC, is required to assist with anaerobic biodegradation across the Site.The method used to implement this was to limit the CarBstrate injections to the areas of the PCE plume with the greatest PCE concentrations located underneath the building. This method involved considering the geometry of the injection and extraction well configuration when deciding which wells to leave on and which ones to shut off to create the largest flux of CarBstrate mixture to areas of the plume with the greatest PCE concentrations. This would help to increase TOC concentrations to be within the ideal range and promote biodegradation.

### System Upgrades and Optimization

The system optimization goal is to obtain negative ORP values in conjunction with low levels of DO and provide a sufficient amount of TOC to promote anaerobic biodegradation. Therefore, a variety of system upgrades, including system modifications and operational changes, have been implemented in 2024. System modifications are components that were added to the treatment system to improve and monitor performance. Operational changes are additional actions or adjustments to the treatment system or supplemental monitoring at Site wells.

System modifications included the following:

* In April 2024:
* Pressure gauges added to each carbon vessel to monitor transfer pump operation and back pressure
* Sample port added after injection pump to monitor water quality parameters of the injected water, as a combined flow of granular activated carbon (GAC)- treated water and CarBstrate mixture
* New, larger y-strainers added to more efficiently remove larger particulates from extracted water flow
* In September 2024:
* Drop hoses added to Holding Tank 2 to limit the addition of DO to the injected water supply
* New transfer pump installed to improve the efficiency of the carbon vessels and achieve desired flow rates

Routine Operation and Maintenance (O&M) Adjustments:

* Regular backflushing will prevent buildup and clogging of the carbon vessels and extend the life of the GAC.
* Carbon changeout, triggered by volatile organic compound (VOC) detections in the effluent sample, occurred in October 2024 after lab results were obtained earlier that month. Conducting carbon changeouts as necessary improved effectiveness of the GAC.
* O&M tracking forms include regular documentation of the following operational items:
* Y-strainer maintenance, cleaning, and condition
* CarBstrate mixing tank maintenance and monitoring
* Investigation-derived waste management
* Carbon vessel pressure monitoring
* Injection and extraction well totalizer logs
* Completed O&M tracking forms are included in Attachment 1.

Operational Changes:

* Focused Injections
* The number of active injection wells was reduced from 13 to 6 to target wells with higher CVOC concentrations, as described previously.
* CarBstrate™ is applied in a more concentrated areas instead of being diluted across the whole Site.
* With more CarBstrate injected into key locations, more electron donors are present to facilitate the breakdown of the chlorinated solvents.
* TOC Monitoring
* Monitoring was conducted to ensure that the focused injections were effective in increasing TOC concentrations to target levels
* MW-4R, MW-7, and MW-12 were sampled on a bimonthly basis in between semiannual monitoring events for TOC (Figure 2).

## Groundwater Monitoring events

### April 2024 Groundwater Monitoring Activities

Semiannual groundwater monitoring was completed at the Site during April 2024. Prior to collecting groundwater samples, synoptic depth-to-water (DTW) measurements were collected from a total of 27 site monitoring wells in April 2024 (all collected within an hour) while the bio-remediation and recirculation system (treatment system) was operating (September 8, 2024) and while it had been off for 3 days (September 11, 2024). There are a total of 33 site monitoring wells that are specified in the CD/CAP and are sampled for analytes specified in the CD/CAP semiannually, but two of these wells (MW-6 and HZ-MW-33R) have angled elbow couplings that do not allow for the DTW meter to pass through. Therefore, they could not be measured. All wells, including injection and extraction wells that are not sampled are shown in Figure 2, and Figures 3 through 5 show the monitoring, injection, and extraction wells for each aquifer zone: shallow, intermediate, and deep, respectively. Groundwater elevations and field parameters for all events are presented in Table 4. All laboratory analytical reports for this groundwater monitoring event are provided in Attachment 2. April 2024 groundwater elevations with the system on and off are presented by water-bearing zone in Figures 6a through 6d, which also show potentiometric groundwater contours and groundwater flow directions. The well HZ-MW-19R is located within the Site area but is not part of the sampling requirements; therefore, its location is included in the site maps, but has no data associated with it for the purposes of this report. Groundwater samples were collected using low-flow sampling techniques in accordance with Floyd|Snider standard guidelines (Attachment 3). A data validation summary was prepared for this event and can be found in Attachment 6, and the Quality Assurance Project Plan (QAPP) is included as Attachment 7.

Groundwater contours were developed for the shallow and intermediate zones. Groundwater contours could not be prepared for the deep zone because there were only measurements for two wells; the third well, MW-29, was inaccessible during the April 2024 sampling event.

**Shallow Zone (System On):** Groundwater elevations collected on April 8, 2024, while the system was operating, show that the shallow zone wells ranged from 39.34 to 34.98 feet North American Vertical Datum of 1988 ([NAVD 88] Figure 6a). Groundwater in the shallow zone appears to be mounded around monitoring and injection wells MW-45R, 2i, MW-27, and 18iR, and groundwater generally flows to the southeast and to the south, with gradients ranging between 0.02 and 0.04 feet per foot.

**Shallow Zone (System Off):** Groundwater elevations were also collected on April 11, 2024, while the system had been off for at least 3 days. Groundwater elevations show that the shallow zone wells ranged from 39.45 to 35.01 feet NAVD 88 (Figure 6c). However, even after 3 days of shutting off the system, groundwater in the shallow zone was still mounded around monitoring and injection wells MW-45R, 2i, MW-27, and 18iR. Groundwater flow was to the southeast and to the south, with gradients ranging between 0.02 and 0.05 feet per foot.

**Intermediate Zone (System On):** The intermediate zone groundwater elevations ranged from 38.28 to 34.12 feet NAVD 88 (Figure 6b). Groundwater in the intermediate zone generally flows to the southeast with a gradient ranging between approximately 0.01 and 0.06 feet per foot, and there appears to be some influence from the system around MW-12.

**Intermediate Zone (System Off):** The intermediate zone groundwater elevations ranged from 38.29 to 34.19 feet NAVD 88 (Figure 6d). Groundwater in the intermediate zone generally flows to the southeast with a gradient of approximately 0.025 feet per foot; however, the system’s influence on the groundwater contours around MW-12 is absent after 3 days of not running the system.

There are no extraction or injection wells in the deep aquifer; therefore, no impact is expected between system operation or nonoperation.

### April 2024 Groundwater Sampling Results

Tables 1 through 4 provide semiannual groundwater analytical results for CVOCs compared with their respective MTCA Method A CULs. Figures 7a through 10c show CVOC groundwater concentrations at each monitoring well location by each aquifer zone.

#### Shallow Aquifer

PCE was detected in 14 out of the 16 shallow aquifer wells sampled, with 9 wells containing concentrations greater than the MTCA Method A CUL of 5 µg/L during the spring sampling event. Shallow wells HZ-MW-31 and S-MW-1 were not located or accessible during the sampling event due to construction activities; therefore, these wells were not sampled during the April 2024 monitoring event. PCE concentrations ranged from less than the practical quantitation limit (PQL) to 1,900 µg/L at MW-40. Figure 7a shows the April 2024 PCE isocontours and concentrations within the shallow aquifer. The area of the greatest concentration beneath the building is centered around MW-7 (having a concentration of 1,600 µg/L).There are separate areas of exceedances around MW-43R and MW-40 on the west side of the Site, outside the building along 98th Avenue NE.

TCE was detected in 13 out of the 16 shallow aquifer wells sampled, with 7 wells containing concentrations greater than the MTCA Method A CUL of 5 µg/L during the spring sampling event. TCE concentrations ranged from less than the PQL to 3,700 µg/L at MW-40. Figure 8a shows TCE isocontours and concentrations within the shallow zone: two separate areas of exceedance beneath the building centered around MW-7 and one in the western portion of the property outside the building.

DCE was detected in 14 out of the 16 shallow aquifer wells sampled, with seven wells containing concentrations greater than the MTCA CUL of 16 µg/L during the spring sampling event. DCE concentrations ranged from less than the PQL to 590 µg/L at MW-4R. Figure 9a shows DCE isocontours and concentrations within the shallow zone. The area with the greatest concentration beneath the building is centered around MW-4R, with a separate plume centered around MW-40 on the west side of the Site outside the building and along 98th Avenue NE.

VC was detected in 11 out of the 16 shallow aquifer wells sampled, and all detections contained concentrations greater than the MTCA Method A CUL of 0.2 µg/L during the spring sampling event. VC concentrations ranged from less than the PQL to 130 µg/L at MW-40. Figure 10a shows VC isocontours and concentrations within the shallow zone. The area with the greatest concentration beneath the building is centered around MW-4R, with a concentration of 13 µg/L. There are two other separate plumes with exceedances centered around HZ-MW-34 beneath the northeastern portion of the Site and centered around MW-40 located the on the west side of the Site outside the building and along 98th Avenue NE.

Generally, April 2024 CVOC concentrations within the shallow zone have remained consistent with previous analytical results; however, PCE and TCE concentrations at MW-40 have increased when compared with the 2023 sampling results.

#### Intermediate Aquifer

PCE was detected in 7 out of the 11 intermediate aquifer wells sampled, with four wells containing concentrations greater than the MTCA Method A CUL of 5 µg/L during the spring sampling event. PCE concentrations ranged from less than the PQL to 1,500 µg/L at HZ-MW-15D. Figure 7b shows the April 2024 PCE isocontours and concentrations within the intermediate aquifer. The area with the greatest concentration beneath the building is centered around HZ‑MW-15D with a concentration of 1,500 µg/L. A separate area of exceedances occurs around MW-20R on the west side of the Site, inside the building near the location of the treatment shed.

TCE was detected in 8 out of the 11 intermediate aquifer wells sampled, with 2 wells containing concentrations greater than the MTCA Method A CUL of 5 µg/L during the spring sampling event. TCE concentrations ranged from less than the PQL to 220 µg/L at HZ-MW-15D. Figure 8b shows TCE isocontours and concentrations within the intermediate zone, with an area of exceedance beneath the building between HZ-MW-15D and MW-20R.

DCE was detected in 10 out of the 11 intermediate aquifer wells sampled, with 4 wells containing concentrations greater than the MTCA CUL of 16 µg/L during the spring sampling event. DCE concentrations ranged from less than the PQL to 260 µg/L at HZ-MW-15D. Figure 9b shows DCE isocontours and concentrations within the intermediate zone. The area with the greatest concentration beneath the building is centered around HZ-MW-15D, with a separate plume centered around HZ-MW-29 on the northeastern portion of the Site inside the building.

VC was detected in 9 out of the 11 intermediate aquifer wells sampled, and all detections contained concentrations greater than the MTCA Method A CUL of 0.2 µg/L during the spring sampling event. VC concentrations ranged from less than the PQL to 72 µg/L at MW-20R. Figure 10b shows VC isocontours and concentrations within the intermediate zone. The area with the greatest concentration beneath the building is centered around MW-20R with a concentration of 72 µg/L, and there is a lobe extending to the east at HZ-MW-29 beneath the northeastern portion of the Site.

Intermediate well MW-44R was not located during the spring sampling event due to construction activities and therefore was not sampled during this semiannual monitoring event. Generally, April 2024 CVOC concentrations within the intermediate zone have remained consistent with previous analytical results; however, CVOC concentrations at MW-12 have decreased when compared with the 2023 sampling results.

#### Deep Aquifer

PCE was detected in both deep aquifer wells that were sampled, with one location containing concentrations greater than the MTCA Method A CUL of 5 µg/L during the spring sampling event. PCE concentrations ranged from less than the PQL to 220 µg/L at MW-39. Figure 7c shows the April 2024 PCE isocontours and concentrations within the deep aquifer. The well with the greatest concentration outside of the building within 98th Avenue is MW-39.

TCE was detected in both deep aquifer wells that were sampled, with one location containing concentrations greater than the MTCA Method A CUL of 5 µg/L during the spring sampling event. TCE concentrations ranged from less than the PQL to 56 µg/L at MW-39. Figure 8c shows TCE isocontours and concentrations within the deep zone; the only exceedance is outside the building within 98th Avenue.

DCE was detected in one out of the two deep aquifer wells that were sampled, MW-34, but the detection did not exceed MTCA CUL of 16 µg/L during the spring sampling event. Figure 9c shows DCE isocontours and concentrations within the deep zone. None of the deep aquifer wells exceed the respective CUL.

VC was detected in one out of the two deep aquifer wells that were sampled, MW-34, which resulted in a concentration greater than the MTCA Method A CUL of 0.2 µg/L during the spring sampling event. VC concentrations ranged from less than the PQL to 0.57 µg/L at MW-34. Figure 10c shows VC isocontours and concentrations within the deep zone. The only well with an exceedance is located beneath the building at MW-34, near the location of the treatment shed.

Deep well MW-29 was not located during the spring sampling event due to construction activities and therefore was not sampled during this semiannual monitoring event. Generally, April 2024 CVOC concentrations within the deep zone have remained consistent with previous analytical results.

### September 2024 Groundwater Monitoring Activities

Semiannual groundwater monitoring was completed at the Site during September 2024. Prior to collecting groundwater samples, synoptic DTW measurements were collected from a total of 31 site monitoring wells only while the treatment system was operating. There are a total of 33 site monitoring wells that are sampled semiannually, but two of these wells, MW-6 and HZ-MW-33R, have angled elbow couplings that do not allow the DTW meter to pass through and therefore cannot be measured.

Groundwater contours were developed for all three zones during the September 2024 sampling event using the synoptic DTW measurements collected while the system was running. However, these measurements were collected 6 months after system optimization adjustments were in place, which included limiting injections and extractions to wells 1iR, 4i, 6iR, 9iR, 11i, 3e, 7e, and 13eR.

Figures 11a through 11c show potentiometric groundwater contours and groundwater flow directions for all three aquifers. Groundwater elevations for all events are presented in Table 4**.** Groundwater samples were collected using low-flow sampling techniques in accordance with Floyd|Snider standard guidelines (Attachment 3). A data validation summary was prepared for this event and can be found in Attachment 6, and the QAPP is included as Attachment 7.

**Shallow Zone (System On):** Groundwater elevations collected on September 23, 2024, while the system was operating, show that the shallow zone wells ranged from 38.80 to 28.30 feet NAVD 88 (Figure 11a). Groundwater generally flows to the southeast from MW-43R to HZ-MW-1 and to the south from MW-40 to HZ-MW-31. The greatest gradient is in the southwestern portion of the Site, with a gradient of approximately 0.04 feet per foot to the south. The gradient for the flow direction to the southeast is approximately 0.02 feet per foot. Groundwater in the shallow zone no longer displays obvious mounding; however, injection wells 1iR, 4i, and 6iR have a slight influence on groundwater contours.

**Intermediate Zone (System On):** The intermediate zone groundwater elevations ranged from 38.14 to 33.34 feet NAVD 88 (Figure 11b). Groundwater in the intermediate zone generally flows to the southeast, with a gradient ranging between approximately 0.008 and 0.03 feet per foot.

**Deep Zone (System On):** The deep zone groundwater elevations ranged from 37.42 to 36.90 feet NAVD 88 (Figure 11c). Groundwater in the deep zone flows to the south-southeast, with a gradient of 0.009 feet per foot.

### September 2024 Groundwater Sampling Results

Tables 1 through 4 provide semiannual groundwater analytical results for CVOCs compared with their respective MTCA Method A CULs. Figures 12a through 15c show CVOC groundwater concentrations at each monitoring well location by each aquifer zone.

#### Shallow Aquifer

PCE was detected in 13 out of the 18 shallow aquifer wells, with 7 wells containing concentrations greater than the MTCA Method A CUL of 5 µg/L during the fall sampling event. PCE concentrations ranged from less than the PQL to 890 µg/L at MW-40. Figure 12a shows the September 2024 PCE isocontours and concentrations within the shallow aquifer. Two areas with the greatest concentration beneath the building are S-MW-5R and HZ-MW-14S with concentrations of 350 µg/L and 170 µg/L, respectively. A separate area of exceedance occurs around MW-40 on the west side of the Site outside the building along 98th Avenue NE.

TCE was detected in 13 out of the 18 shallow aquifer wells, with three wells containing concentrations greater than the MTCA Method A CUL of 5 µg/L during the fall sampling event. TCE concentrations ranged from less than the PQL to 1,600 µg/L at MW-40. Figure 13a shows TCE isocontours and concentrations within the shallow zone, with two separate areas of exceedance beneath the building and one in the western portion of the Site outside the building.

DCE was detected in 16 out of the 18 shallow aquifer wells, with 7 wells containing concentrations greater than the MTCA CUL of 16 µg/L during the fall sampling event. DCE concentrations ranged from less than the PQL to 330 µg/L at MW-40. Figure 14a shows DCE isocontours and concentrations within the shallow zone. The area with the greatest concentration beneath the building is centered around MW-4R. Two areas of exceedances are centered around MW-40 and HS-MW-31 located on the west side and southwest corner of the Site outside the building along 98th Avenue NE.

VC was detected in 12 out of the 18 shallow aquifer wells, and all detections contained concentrations greater than the MTCA Method A CUL of 0.2 µg/L during the fall sampling event. VC concentrations ranged from less than the PQL to 97 µg/L at MW-40. Figure 15a shows VC isocontours and concentrations within the shallow zone. The area with the greatest concentration beneath the building is centered around MW-4R, with a concentration of 42 µg/L. There are four other separate hot spots with exceedances centered around HZ-MW-34 beneath the northeastern portion of the Site, HZ-MW-1 in the center of the building, and centered around MW-40 and HZ‑MW-31 located the on the west side of the Site outside the building along 98th Avenue NE.

Generally, PCE, TCE, and DCE concentrations declined within the area of influence of the system when compared with the April 2024 sampling. However, observed VC concentrations within the area of the bioremediation system’s influence can be attributed to breakdown of PCE to VC. This observation indicates that the system optimization changes that were made are effective in helping with the anaerobic bioremediation and reductive dechlorination process. CVOC concentrations increased in locations (1) near where injection wells had been turned off or (2) were outside the system’s influence. Concentrations at each shallow monitoring well are shown in Table 1.

#### Intermediate Aquifer

PCE was detected in 8 out of the 12 intermediate aquifer wells, with 5 wells containing concentrations greater than the MTCA Method A CUL of 5 µg/L during the fall sampling event. PCE concentrations ranged from less than the PQL to 1,100 µg/L at HZ-MW-15D. Figure 12b shows the September 2024 PCE isocontours and concentrations within the intermediate aquifer. The area with the greatest concentration beneath the building is centered around HZ-MW-15D, with a concentration of 1,100 µg/L, and an area of exceedances around MW-20R on the west side of the Site, which is inside the building near the location of the treatment shed.

TCE was detected in 9 out of the 12 intermediate aquifer wells, with 3 wells containing concentrations greater than the MTCA Method A CUL of 5 µg/L during the fall sampling event. TCE concentrations ranged from less than the PQL to 450 µg/L at HZ-MW-15D. Figure 13b shows TCE isocontours and concentrations within the intermediate zone, with an area of exceedance beneath the building between HZ-MW-15D and MW-20R.

DCE was detected in 10 out of the 12 intermediate aquifer wells, with five wells containing concentrations greater than the MTCA CUL of 16 µg/L during the fall sampling event. DCE concentrations ranged from less than the PQL to 520 µg/L at MW-12. Figure 14b shows DCE isocontours and concentrations within the intermediate zone. The area with the greatest concentration beneath the building is centered around MW-12, with a separate, smaller plume centered around HZ-MW-29 on the northeastern portion of the Site inside the building.

VC was detected in 8 out of the 12 intermediate aquifer wells, with all detections containing concentrations greater than the MTCA Method A CUL of 0.2 µg/L during the fall sampling event. VC concentrations ranged from less than the PQL to 90 µg/L at MW-12. Figure 15b shows VC isocontours and concentrations within the intermediate zone. The area with the greatest concentration beneath the building is centered around MW-20R and MW-12, and there is one other hot spot with exceedances centered around HZ-MW-29 beneath the northeastern portion of the Site.

Generally, CVOC concentrations remained consistent with previous analytical results; however, VC concentrations in MW-12 have increased when compared with the April 2024 results. MW-12 is located near injection well 11i, and the increase in VC concentrations indicate that (1) MW-12 is within the radius of the bioremediation system’s influence and (2) can be attributed to breakdown of PCE to VC. CVOC concentrations at each intermediate monitoring well are shown in Table 2.

#### Deep Aquifer

PCE was detected in two out of the three deep aquifer wells, with one containing a concentration greater than the MTCA Method A CUL of 5 µg/L during the fall sampling event. PCE concentrations ranged from less than the PQL to 200 µg/L at MW-39. Figure 12c shows the September 2024 PCE isocontours and concentrations within the deep aquifer. The well with the greatest concentration outside of the building within 98th Avenue is MW-39.

TCE was detected in two out of the three deep aquifer wells, with one containing a concentration greater than the MTCA Method A CUL of 5 µg/L during the fall sampling event. TCE concentrations ranged from less than the PQL to 53 µg/L at MW-39. Figure 13c shows TCE isocontours and concentrations within the deep zone with the only exceedance outside the building within 98th Avenue.

DCE was detected in one out of the three deep aquifer wells, MW-34, but it did not exceed the MTCA CUL of 16 µg/L during the fall sampling event. Figure 14c shows DCE isocontours and concentrations within the deep zone.

VC was detected in one out of the three deep aquifer wells and contained a concentration greater than the MTCA Method A CUL of 0.2 µg/L during the fall sampling event. In the monitoring well samples, VC concentrations ranged from less than the PQL to 0.37 µg/L at MW-34. Figure 15c shows VC isocontours and concentrations within the deep zone. The only well with an exceedance is under the building at MW-34, near the area where the treatment shed is located.

Generally, CVOC concentrations detected during the September 2024 event have slightly decreased when compared with the previous sampling results. Concentrations at each deep monitoring well are shown in Table 3.

#### Microbial Deoxyribonucleic Acid Analyses

Conducted on an annual basis, microbial deoxyribonucleic acid (DNA) samples are collected from five site wells. In September 2024, DNA samples were collected from MW-6, MW-5R, MW-7, MW-4R, and MW-12 after standard semiannual sample bottle ware had been filled. The results are presented in Attachment 5. The process of collecting these DNA samples consisted of slowing the peristaltic pump flow as much as possible, attaching the provided adaptor from the low-density polyethylene tubing to the provided DNA filter flow through cell, and then allowing approximately 1 liter of water to flow through the filter. The total flow through the filter is recorded in milliliters and included on the sample label. To meet required hold times, the samples were then shipped in a cooler for next-day delivery to Microbial Insights for analysis.

The results show that there is a sustained microbial population that is present in all wells sampled. This indicates that the microbial population is thriving and helping in the reductive dechlorination process; therefore, introducing an additional microbial population is not required at the Site. According to the interpretation section of the Microbial Insights report, a DHC concentration of 1 x 104 cells per milliliter is used as a screening criterion to identify sites where biological reductive dechlorination is predicted to proceed at “generally useful” rates. Some of the analyzed Site wells show concentrations above this level or just below it, indicating that supporting these populations will yield positive results.

## Observations, Conclusions, and Next Steps

In an assessment of all the data collected, the Contaminated Site Clean-Up Information (USEPA 2023) regarding anaerobic bioremediation was used as a reference to evaluate the performance of the bioremediation system. Therefore, in addition to reviewing the CVOC concentrations, the select indictor parameters below were reviewed to determine whether (1) there is remedial progress or success within the source zone mass and (2) any additional optimization adjustments are needed for anaerobic dechlorination to occur. The results for the parameters discussed below are presented in Table 4.

* **Methane, ethane, and ethene:** Elevated levels of methane (>1 mg/L) indicate fermentation is occurring in a highly anaerobic environment and that reducing conditions are appropriate for anaerobic degradation. Elevated levels of ethane and ethene (above background) can be used to infer anaerobic dechlorination. Note that ethane and ethene can be subjected to rapid biodegradation, so their absence in a sample does not necessarily mean that degradation is not occurring. In the hot spot wells of the Site where optimization activities have occurred, the majority of hot spot wells have methane concentrations above 1 mg/L, and some have shown ethene detections within the past year (Table 4).
* **TOC:** TOC concentrations >20 to 50 mg/L are desired in the anaerobic treatment zone. Stable or declining TOC levels (<20 mg/L) in conjunction with elevated levels of VOCs and alternate electron acceptors indicate additional substrate is required to sustain the anaerobic treatment zone. TOC has been increasing to optimal concentrations between 20 and 50 mg/L in some of the key hot spot wells (i.e., MW-4R and MW-7). TOC concentrations in the other hot spot wells, MW-5R, MW-21R, and HZ-MW-14S, show a slow increase in concentrations but still less than the desired range. However, PCE, TCE, and DCE concentrations have been decreasing in these wells despite the less-than-ideal TOC concentrations (Table 4). An increase in substrate dosage and application would likely help to further reduce CVOC concentrations and is recommended.
* **ORP:** ORP of groundwater provides data on whether anaerobic conditions are present. Reducing conditions are required for anaerobic dechlorination. ORP is used in conjunction with other geochemical parameters to determine whether groundwater conditions are optimal for anerobic biodegradation. ORP has been negative or seen to be decreasing over time in the majority of key wells at the time of sampling.
* **DO:** DO should be depleted in an anaerobic bioremediation system. DO of <0.5 mg/L generally indicates an anaerobic pathway suitable for anaerobic dechlorination to occur. DO has been <0.5 mg/L in all key wells at time of sampling.
* A low DO in conjunction with a negative ORP (refer to above bullet point) indicates that the substrate is at an ideal environment for additional injections of TOC to be effective in reductive dechlorination.
* **DHC:** DHC is a group of bacteria that can break down chlorinated organic compounds that can be detected. This group of bacteria can experience an increase in population as a consequence of adding electron donors to create anaerobic conditions. Microbial DNA testing has been conducted annually for the past 3 years, including 2024, and results show that there is a sustained microbial population capable of biodegradation (Attachment 5).
* **Ammonia:** Ammonia can represent a form of biologically available nitrogen. Used to determine whether groundwater environment is sufficiently reducing nitrogen and is an indicator parameter only. Since optimization changes were made, ammonia concentrations are less than the PQL for all the hot spot wells and detected at very low levels in wells outside the radius of influence. This indicates that the nitrogen is being reduced and there is ongoing natural attenuation at locations outside the radius of influence.
* **Alternate Electron Acceptors:** Nitrate, manganese, and ferrous iron are alternate electron acceptors for microbial respiration in the absence of oxygen.
* **Nitrate:** Depleted levels of nitrate (relative to background, <1 mg/L) indicate that the groundwater environment is sufficiently reducing nitrate. Key hot spot wells at the Site have decreasing, low-level, or nondetect results for nitrate. Wells outside the CVOC plume, such as S-MW-1 and MW-23, have elevated nitrate concentrations when compared with wells within the CVOC plume.
* **Manganese**: An increase in dissolved manganese or total manganese indicates that the groundwater environment is sufficiently reducing to sustain manganese reduction and for anaerobic dechlorination to occur. Key hot spot wells at the Site are overall increasing in dissolved manganese concentrations.
* **Ferrous iron**: Elevated levels of ferrous iron indicate that the groundwater environment is sufficiently reducing to sustain iron reduction and for anaerobic dechlorination to occur. All key hot spot wells at the Site have detections of ferrous iron at elevated concentrations when compared with wells outside the CVOC plume.
* **Sulfate:** Sulfate is an alternate electron acceptor for microbial respiration in the absence of oxygen, nitrate, manganese, and ferrous iron. Depleted concentrations of sulfate (<20 mg/L) relative to background indicates that the groundwater environment is sufficiently reducing to sustain sulfate reduction and for anaerobic dechlorination to occur. Hot spot wells, such as MW-4R, MW-5R, HZ-MW-14S, and HZ-MW-15D, have sulfate concentrations less than 20 mg/L, while the remaining hotspot wells have sulfate concentrations at or greater than 20 mg/L. However, while sulfate concentrations less than 20 mg/L are desirable, those concentrations are not required for anaerobic dechlorination to occur.

### CVOC Composition Profile and Total Molar Mass Concentrations

Understanding changes in CVOC compositional profiles and total molar concentrations are crucial for understanding if biodegradation is occurring. Changes in compositional profiles and molar mass can be used to show the decline of moles over time using data collected from one well over multiple years.

CVOCs go through chemical degradation processes that produce daughter compounds, and the dechlorination process progressively lowers the molecular weight as chlorine atoms are removed. It is important to note that these reactions occur at various rates depending on geochemical conditions, and geochemical conditions can vary laterally and vertically. Typically, CVOC concentrations for PCE, TCE, DCE, and VC are shown in µg/L—either individually, or sometimes summed as total CVOCs. If the dechlorination process is faster for PCE to degrade to TCE and the degradation process for TCE is slow, then TCE concentrations will continue to increase as PCE becomes TCE; however, the total mass concentration (in µg/L) appears to decrease because heavier contaminants continue to be converted to lighter contaminants via dechlorination. To verify that the total amount of contamination (i.e., PCE, TCE, DCE, and VC) is actually decreasing, molar concentrations must be considered. To do this, one can convert the mass concentrations (µg/L) to molar concentrations (micromoles per liter).

Furthermore, changes in molar concentrations and relative proportions of CVOCs can be visualized by using stacked bar charts, where the relative proportions of each constituent (PCE, TCE, DCE, and VC) is consistently represented in the same color and constituents are stacked in the same order with PCE at the bottom and VC at the top. Plotting CVOC data in this method can demonstrate the system’s influence on the CVOC plume. The following sections use this schematic tool to illustrate the effect that the system optimization adjustments have had on CVOC concentrations at the Site.

### Shallow Aquifer

To better understand the relationship between TOC concentrations, CVOC concentrations, and molar mass present at the Site, the data from three key wells in the shallow aquifer was plotted into stack charts using the method described above. The first well that was identified as a good example for the dechlorination process facilitated by the bioremediation and recirculation system was MW-6, presented in Figure 16. In this figure, PCE and its daughter products are shown in different colors over time as a percentage of the total molecular concentration. The total molar mass is plotted as a dark blue line. The green line shows the TOC concentrations over time, and the shaded region between 20 to 50 mg/L shows the optimal TOC concentrations. Figure 16 illustrates that between May 2019 and January 2021, the TOC concentrations are within the optimal range (20 to 50 mg/L) that coincide with a significant decline of total molar concentrations, and there is a greater proportion of daughter products DCE and VC, which indicate that the dechlorination process is occurring. While the TOC concentration may not currently be in the ideal range, the conditions in the well are overall as they should be with low DO and negative ORP. Given these conditions, it is expected that the total molar concentration of the VOCs will continue to decrease.

The data from MW-6 suggest that the system is effective but only if optimal TOC concentrations are achieved. In April 2024, none of the other wells contained TOC concentrations within the desired range; therefore, it was concluded that the CarBstrate was being injected at too low of a concentration across the Site to be effective. System optimization changes included injecting CarBstrate in a more concentrated area and focused on an area with the greatest CVOC concentrations instead of being diluted across the whole Site. This change was made immediately after the April 2024 sampling event.

Stacked molar composition charts were developed for two wells, MW-7 and MW-4R, that were within the area with the greatest CVOC concentrations and have positively responded to optimization of the treatment system. Results for MW-7 and MW-4R are presented in Figures 17 and 18, respectively. In Figure 17, showing MW-7, the line representing the total molecular concentration shows a decline in total molar mass beginning in 2014; however, there was a rebound in total CVOC molar mass in 2022, which is likely related to the system being offline during the initial construction of the building. Prior September 2024 sampling event, TOC concentrations were not within the desired range. However, after system adjustments were made in late April 2024, the TOC concentration shows a sharp increase, reaching the ideal TOC range for the first time. As a result, the total molar concentrations declined to an all-time low, with PCE concentrations decreasing from 1,600 µg/L in April 2024 to 2.2 µg/L in September 2024 for MW-7. In addition, Figure 17 shows that anaerobic biodegradation of chlorinated compounds is occurring due to the total molar composition consisting of a larger percentage of DCE and VC, as shown during the September 2024 event. Despite the increase in DCE and VC concentrations, the total molar concentration has declined significantly and ethene concentrations are detected (Table 1), which indicates that VC is being dechlorinated to the final degradation product, ethene. The conditions in this well are overall as they should be with low DO, negative ORP, and increasing TOC. Given these conditions, it is expected that the total molecular concentration of the CVOCs will continue to biodegrade to ethene.

TOC and total molar data for MW-4R show similar results in Figure 18. The total molecular concentration shows a gradual decline in total mass from 2019 to 2021, with a slight rebound in total molar concentration in 2022 related to the system being offline during construction. However, a significant decline in total CVOC molar mass shown for the September 2024 sampling event, reaching an all-time low. The decline in total molar concentration coincides with a sharp increase of TOC concentrations, since the April sampling event, which are slightly higher but meet the ideal TOC range for the first time. Similar to MW-7, Figure 18 shows that anaerobic biodegradation of chlorinated compounds is occurring due to the larger percentage of DCE and VC shown during the September 2024 event. Furthermore, the detection of ethene in MW-4R indicate that VC is being dechlorinated. The conditions in this well are overall as they should be with low DO, negative ORP, and increasing TOC. Given these conditions, it is expected that the total molecular concentration of the VOCs will continue to biodegrade to ethene.

### Intermediate Aquifer

Compared with the shallow aquifer, the intermediate aquifer has fewer injection and extraction wells that are more spread out from each other and nearby monitoring. Because of these factors, there has been slower plume degradation within this aquifer. Generally, the water quality conditions are supportive of anerobic dechlorination, with negative ORP and low DO, but require higher concentrations of TOC to increase the rate of breakdown. TOC concentrations in intermediate wells remain fairly stable over the last couple of years and have not shown the same increase in concentration as the shallow aquifer wells. In particular, HZ-MW-15D has consistently contained the highest concentration of CVOCs, and while those concentrations are decreasing, there is more progress to be made. Proposed optimization steps to address this hot spot are described in further detail below.

Between the April and September monitoring events, it was determined that well S-MW-3RR had been damaged and was no longer screened across the intermediate aquifer. The depth of the well was consistently measured as 19 feet; however, the boring log for this well indicates that the total depth was down to 39 feet. It is unknown exactly when this well was cut off from its intended depth and aquifer, but it is likely that the groundwater results collected during the April monitoring event time are not representative of the intermediate aquifer. Prior to the September monitoring event, this well was redrilled and replaced with S-MW-3RRR nearby, maintaining the original angle under the building of 30 degrees from vertical and installed at a depth of 39 feet with a 15-foot screen.

### Deep Aquifer

A slight decrease in concentrations was observed in MW-39 which remains the only deep well with concentrations above CULs for PCE and TCE. MW-34 only exceeds the VC CUL by less than an order of magnitude, but concentrations have also continued to trend downward. The remaining deep well, MW-29, was only sampled once in 2024 due to construction activities blocking access during the April sampling event, but CVOC results at MW-29 were less than their respected PQLs.

There are no injection or extraction wells in the deep aquifer to apply CarBstrate to the affected areas via the treatment system, but the recommendations below outline potential options for these locations.

### Recommendations

The current system operation appears to be effective in addressing the area with the greatest CVOC concentrations in the shallow aquifer, and it is recommended that this operation continues to achieve dechlorination of DCE and VC within this area. To address the remaining areas of contamination, the following options have been compiled and can be implemented individually or in combination without impacting the success of the current operations.

On a weekly or every 2 weeks schedule, an additional batch of CarBstrate can be prepared in the mixing tank inside the remediation shed for use in targeted injections at Injection Well 22i, to address the hotspot at MW-40, and at Injection Well 18iR, to address CVOC concentrations in MW-27. Two 50-pound bags would be mixed with about 150 gallons of water and slowly metered directly into the two wells over a couple of hours. MW-40 already shows agreeable conditions (DO less than 1 mg/L and negative ORP) for anaerobic degradation and will benefit from the supplemental TOC injections. MW-27 does not currently have desired reducing conditions (ORP is positive), but can be monitored and sampled on a routine basis after injections commence in this areas to ensure improving conditions are taking place. The CarBstrate injections in Injection Well 18iR will likely assist in achieving negative ORP at MW-27. This addition would be the simplest to implement during weekly O&M.

Because of the construction of the building, no additional injection or extraction wells can be added at this point, and the limited configuration of the bioremediation recirculation system can only reach so much of the site. To address remaining hotspots, other options have been brainstormed with the treatment system subcontractor, ETEC, Inc. There are three well locations that are not strategically placed close to an injection well or extraction well in the associated aquifer: S-MW-5R, HZ-MW-15D, and MW-39.

S-MW-5R is screened in the shallow aquifer and located inside the northern perimeter of the building in a room that appears to be a loading bay. There are no injection or extraction wells in the vicinity of this well; the concentrations in this well appear to be stagnant, and TOC concentrations are low or not detected. A solution to address contamination at this location is to gravity feed a 55-gallon batch of CarBstrate into the well over the course of several hours after each semiannual groundwater monitoring event.

HZ-MW-15D is screened in the intermediate aquifer and located inside the public garage level near the north-center of the building. Despite the nearby active injection well and extraction well on the opposite sides of HZ-MW-15D, the radius of influence may not be great enough to properly impact the well. A slight decrease in concentration has been observed, but a gravity feed of CarBstrate as described above conducted twice annually may further assist in the anaerobic degradation in this location.

MW-39 is screened in the deep aquifer and located in the north bound lane of 98th Avenue on the west side of the building. While there is an adjacent injection well (22i), it is screened in the shallow aquifer, and the injections do not affect TOC concentrations within the intermediate or deep aquifers. As described above, this is a good candidate for CarBstrate being gravity fed into the well, as it already shows reducing conditions with low DO and negative ORP. Because this well is in the roadway, the CarBstrate mixture could be added while the road is closed for semiannual groundwater monitoring and after the well has been sampled.

Lastly, one intermediate well, MW-20R, has recently shown an increase in PCE concentration. There are two nearby injection wells that can be turned on if needed later once the shallow aquifer has been more fully addressed.

The three pillars of Interstate Technology & Regulatory Council guidance on Optimizing Injection Strategies and In Situ Remediation (2022) are dose, delivery, and amendment. At this site, the amendment appears to be effective under the optimized operation, which includes an increased dose to a focused delivery area. The above recommendations would increase dosage and improve delivery of the amendment in the areas that continue to have concentrations exceeding the CULs.

The above recommendations were discussed with Ecology and the City on November 13, 2024. It was agreed that the current optimization changes to the system are effective, and these recommendations will likely be effective as well. These additional optimization recommendations will be initiated in April 2025 in coordination with the City and ETEC, Inc.

Floyd|Snider will continue to perform semiannual groundwater monitoring and weekly operations and maintenance, which will be documented in an annual groundwater memorandum.

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techfocus/default.focus/sec/bioremediation/cat/anaerobic\_bioremediation\_(direct)/.

## List of Attachments

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Table 2 Intermediate Aquifer Data

Table 3 Deep Aquifer Data

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Figure 2 Site Map

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Figure 4 Intermediate Aquifer Zone Wells (25–35 ft bgs)

Figure 5 Deep Aquifer Zone Wells (35–55 ft bgs)

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Figure 16 MW-6 Molar Composition

Figure 17 MW-7 Molar Composition

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Attachment 1 Groundwater Sampling Field Forms and O&M Forms

Attachment 2 Laboratory Analytical Report and Data Validation Memorandum

Attachment 3 Groundwater Sampling Low-Flow Standard Guideline

Attachment 4 Historical Site Data from Kane Environmental

Attachment 5 2024 Microbial Insights Report

Attachment 6 Data Validation Summaries

Attachment 7 Quality Assurance Project Plan