2018 ANNUAL MONITORING REPORT

GREER TANK FACILITY
2921 WEST INTERNATIONAL AIRPORT ROAD
ANCHORAGE, ALASKA

September 2019

Prepared for:

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ACRONYMS AND ABBREVIATIONS

AAC................Alaska Administrative Code
ADEC.............Alaska Department of Environmental Conservation
ALS................ALS Environmental
bgs.................below ground surface
COC...............contaminants of concern
CSP................Contaminated Sites Program
DO..................dissolved oxygen
DCE...............dichloroethane
Dowl..............Dowl Engineers
EA..................enhanced attenuation
EBR................enhanced bio-remediation
EPA................United States Environmental Protection Agency
GC/L..............gene copies per liter
GCL................groundwater cleanup levels
Greer.............Greer Tank Facility
IDW................investigation-derived waste
mg/L...............milligrams per liter
MNA...............monitored natural attenuation
MRL...............method reporting limit
ND..................not detected
O&M...............operation and maintenance
PCE................tetrachloroethylene
PPE................personal protective equipment
QC..................quality control
Rescon...........Rescon Alaska, LLC
RV..................recreational vehicle
SDG...............sample delivery group
SI....................site investigation
the site...........the two properties of concern
Stanley...........Stanley Automotive
SVE................soil vapor extraction
TCE................trichloroethylene
Terrasat..........Terrasat Environmental
ug/l.................micrograms per liter
ug/m^3.............micrograms per cubic meter
VOC...............volatile organic compounds
^oC...................degrees Celsius

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1. INTRODUCTION

Rescon Alaska, LLC (Rescon) has prepared this Annual Monitoring Report to detail environmental monitoring activities conducted at the Greer Tank Facility (Greer) and the adjacent Stanley Automotive (Stanley) property in Anchorage, Alaska in 2018 and 2019. The monitoring activities were conducted at the two properties (herein also collectively referred to as “the site”) to assess the progress of active remediation processes on chlorinated solvent contamination in the subsurface soil and groundwater. Rescon conducted the monitoring activities on behalf of Alaska National Insurance Company (herein referred to as “the Client”). The site is managed under the Alaska Department of Environmental Conservation (ADEC) Contaminated Sites Program (CSP) (CSP File No. 2100.38.369/ Hazard ID: 1204).

1.1. Site Description

The Greer property is located at 2921 West International Airport Road in Anchorage, Alaska in a commercial/industrial area in west Anchorage (Figure 1). The Greer property consists of an irregular-shaped building surrounded by an unpaved storage yard. The business operations consist of bulk storage tank fabrication and painting. The site-building houses a guest lobby, office space, restrooms and a metal fabrication shop. Two hangar tents north of the shop area are utilized for painting and sand blasting activities (Figure 2).

The Stanley property is located adjacent to the northwest boundary of the Greer property. The two lots are separated by an approximately 4-foot-high concrete retaining wall. The Stanley property consists of one rectangular building housing several businesses as shown on Figure 2. The remaining property surrounding the building is predominantly paved asphalt. A chain link fence encloses a portion of the property to the north of the building. The portion of the property to the south and east of the building is utilized for visitor parking and storage of rental recreational vehicles (RVs).

The elevation of the site is approximately 80 feet above mean sea level. The Stanley property sits approximately 4 feet lower than the Greer property on the north side of the retaining wall. The rest of the properties are generally flat with little noticeable relief. The water table in the area has been documented between 7 to 11 feet below the ground surface (bgs).

1.2. Site History

The Greer property has been occupied by Greer Tank and Welding, since 1972. Limited historical records include discussion of two potential chlorinated solvent releases at the Greer property. During the winter of 1979-1980, a fire ignited at the facility burning the western portion of the property building. At the time of the fire, up to three 55-gallon drums of paint thinner and a vat containing solvent were located in the western end of the building. It was unconfirmed whether any contaminants were released to the environment during the fire. A second incident occurred during the summer of 1981 or

1982, when a forklift punctured a 55-gallon drum containing tetrachloroethylene (PCE), releasing an estimated 40 gallons of PCE directly to the soil. Resulting from those two and potentially other unreported incidents, several chlorinated compounds, including PCE and the subsequent PCE degradation compounds have been documented in the soil and groundwater at the site.

1.2.1. Terrasat: 1992 - 1993

Terrasat Environmental (Terrasat) conducted a site characterization of the two properties in 1992. The characterization consisted of the advancement of soil borings and the installation of monitoring wells on the properties to investigate the extent of contamination. Laboratory analysis detected concentrations of methylene chloride and PCE in the soil and groundwater above the respective ADEC cleanup criteria. In 1993, Terrasat conducted a soil-vapor extraction (SVE) pilot test to evaluate SVE as a potential remedial solution for the site. Following completion of the evaluation, Terrasat concluded that the system was effective in extracting volatile contaminants from the subsurface soil. Terrasat did not install a full-scale weatherized SVE system, however, the pilot test system was left on site for seasonal operation during the summer months.

1.2.2. Dowl Engineers: 1993 - 2013

Dowl Engineers (Dowl) assumed management of the remediation effort at the site in 1994. After periodic operation of the pilot test SVE system from 1993 to 1995, Dowl calculated that the unit had extracted approximately 93 to 103 pounds of PCE from the contaminated area. The SVE unit was decommissioned in 1997 on the grounds that operation of the unit was not extracting PCE at levels to justify its use.

In the summer of 2009, Dowl conducted a site reconnaissance and groundwater monitoring effort at the Stanley property. The groundwater sample results indicated that concentrations of PCE and trichloroethylene (TCE) were present in the groundwater on the Stanley property above ADEC cleanup levels (Dowl 2009).

1.2.3. Rescon: 2013 – 2014 Groundwater and Vapor Intrusion Investigation

Rescon assumed management of the environmental investigation and monitoring at the site in 2013. Rescon continued the groundwater-monitoring program and installed two additional wells (MW-120 and MW-121 - Figure 2) to delineate the extent of the groundwater contaminant plume. Utilizing water table elevation data from the existing site wells and MW-121, Rescon concluded that the groundwater at the site flows to the northwest.

While installing the east well (MW-120), Rescon discovered that the groundwater in that area (approximately 80 feet east of the Stanley building) was approximately 5 feet lower than the groundwater in the rest of the site wells to the west. The difference in water table elevation indicated the presence of a perched aquifer covering the western half of the Greer property and all but the eastern portion of the Stanley property.

Rescon investigated the vapor intrusion concern for both site buildings in 2013 and 2014. The analytical results from the monitoring efforts reported that the contaminant concentrations in the soil gas and indoor air were either not detected or were well below the respective ADEC target levels during multiple sampling events, eliminating the vapor intrusion concern for the site.

1.2.4. Rescon: 2014 Effort to Delineate the Extent of Contamination

Rescon conducted a site investigation (SI) in August 2014 to collect up-to-date information about the condition of the subsurface contamination for the development of potential remedial alternatives. The SI was conducted to define the vertical and lateral extent of contaminated soil on the two properties, investigate the groundwater beneath the perched aquifer for the presence of chlorinated hydrocarbons, and approximate the eastern limit of the perched aquifer.

1.2.5. Rescon: 2015 Further Delineation and Baseline Data Collection

Rescon performed further subsurface investigation activities at the site in May 2015 to support the implementation of the remedial strategies (Rescon 2015a). The May 2015 investigation effort consisted of the following:

- Advancement of additional soil borings to better define the extent of the PCE contaminated soil.
- Installation of three groundwater monitoring wells on the Greer property and the collection of baseline groundwater samples from six site wells for an evaluation of the groundwater chemistry in advance of an injection of an enhanced attenuation (EA) amendment.
- Operation of a temporary SVE pilot test system to collect site-specific extraction data necessary for the design of a full-scale SVE system at the site.

Rescon installed three new wells on the property to provide up-gradient monitoring locations of the contaminant plumes, as well as to collect baseline groundwater geochemistry data in advance of the remedial activities. The three new wells on the Greer property were designated MW-122, 123 and 124 as shown on Figure 2. Terrasat had previously installed monitoring wells on the Greer property in the early 1990s. However, the wells were either lost or damaged and could not be relocated.

Groundwater samples were collected from the three new wells and MW-4 for analysis of volatile organic compound (VOC) concentrations. Additionally, samples were also collected from the three new wells, and the existing wells MW-4, MW-106 and MW-121 for analysis of monitored natural attenuation (MNA) parameter concentrations. The results of the VOC and MNA sampling event indicated the existing groundwater chemistry was insufficient to promote natural attenuation of the site contaminants.

1.2.6. 2015 Remedial Activities

Rescon implemented a multi-faceted remedial strategy in 2015 to address the chlorinated solvent contamination in the soil and groundwater on the two site properties

(Rescon 2016). The remedial implementation consisted of the injection of a chemical enhanced bioremediation (EBR) inoculant into the saturated zone throughout the site, the installation of an SVE system to remediate the vadose zone soil and the excavation of approximately 10 cubic yards of soil for offsite disposal at an approved treatment, storage and disposal facility.

1.2.7. 2016 Remedial Progress Monitoring

The 2015 Cleanup Plan outlined requirements for ongoing monitoring to track the remedial progress at the site (Rescon 2015b). The requirements included biannual monitoring of the groundwater for one year, followed by annual monitoring thereafter and periodic monitoring of the SVE system. Rescon conducted the groundwater monitoring events in May and December of 2016. Rescon also performed monthly monitoring of the SVE system, as well as collected an effluent sample from the system during the 8-month operations and maintenance (O&M) visit.

The results of the 2016 groundwater-sampling event evidenced measurable contaminant reduction following the 2015 EBR injection (Rescon 2017). The PCE concentrations at MW-4 and MW-104 declined by more than ten times the pre-injection levels. Additionally, following an initial spike in the TCE concentration at MW-4 in November 2015, the compound was not detected at the well in 2016. Meanwhile, the wells reported corresponding increases in the subsequent degradation compounds (the dichloroethane [DCE] isomers and vinyl chloride).

In addition, the SVE effluent sample results indicated that the SVE system was effectively removing PCE from the vadose zone source area at the site. Rescon estimates that 5.423 kilograms (11.95 pounds) of PCE were removed from the subsurface throughout the initial eight months of operation.

1.2.8. 2017 Remedial Progress Monitoring

1.2.8.1. Subsurface Soil Investigation

Rescon conducted follow-on environmental investigation activities in July 2017 to evaluate the levels of PCE contamination remaining in the vadose zone soils and to assess the effectiveness of the SVE system. Seven soil borings were advanced in direct proximity to the 2014 soil boring locations that contained the relatively highest PCE concentrations. Soil samples were collected from the depth intervals of each boring that corresponded with the respective 2014 sample depths to enable a comparison of the PCE concentrations between the two events.

Results from the 2017 investigation were compared to results from the 2014 pre-SVE system samples. The comparison indicated that PCE concentrations within the shallower, less consolidated soils decreased by an average of 80%, while the more-compacted soils in the 15-17 feet bgs depth interval (on the Greer property) decreased by an average of 20%.

The analytical results indicated concentrations of PCE remained above the ADEC Table B1 Method Two, Migration to Groundwater, Soil Cleanup Level in all of the borings except for SB-31, which is located on the Stanley property. The PCE concentrations were highest at the northwest corner of the Greer property (SB-7 and SB-8) (Rescon 2018a).

1.2.8.2. Annual Monitoring

Rescon performed groundwater monitoring in December 2017 to assess the contaminant concentrations in the groundwater and to evaluate the remedial progress of the EBR injection. Groundwater samples were collected from monitoring wells MW-4, MW-104, MW-106, MW-120, and MW-121. Monitoring well MW-120, located on the eastern portion of the Stanley property, was included to collect analytical data hydrologically cross-gradient of the contaminant plume. The groundwater sample collected from MW-4 was used to quantify the injected microbial population and nutrient concentration per liter of groundwater at the site. An analytical air sample was also collected from the remediation system effluent to measure the concentration of volatile compounds extracted by the system operation. This sample was collected to ensure the remedial action objectives of the contaminant extraction were continuing to be met.

The results of the sampling events provide evidence that reductive dechlorination, as a result of the 2015 EBR injections, continues to occur. PCE concentrations were well below the ADEC Table C Groundwater Cleanup Level (GCL) at monitoring wells MW-4 and MW-104, but remained above the GCL at MW-106. Fluctuations in PCE degradation-compound concentrations were observed in the three source-area wells. Concentrations of cis-1,2-DCE decreased at MW-4 and MW-104 since initial spikes in May 2016 (post-EBR injection), yet remained above the ADEC GCL at MW-4. The concentration at MW-106 slightly increased since the observed spike in the parent-compound (PCE) concentration in December 2016. Vinyl chloride concentrations also increased at wells MW-4 and MW-106, while the concentration decreased at MW-104. All vinyl chloride concentrations remained above the ADEC GCL at the source-area wells.

Results from the EBR performance-monitoring sample collected from MW-4 indicated that the remaining concentration of microbial nutrient was 12.72 milligrams per liter (mg/L). The observed concentration of total organic carbon, which includes the microbial nutrient, was 21.1 mg/L. This concentration had significantly reduced from post-injection levels and was lower than the desired concentration, of 100 mg/L, for optimal dechlorination progress.

The SVE effluent sample results indicated that the SVE system continued to effectively remove PCE from the vadose zone source area at the site. Rescon estimated that 6.828 kilograms (15.05 pounds) of PCE were removed from the subsurface throughout the initial 21 months of operation (Rescon 2018b; Table 4).

1.2.9. 2018 Subsurface Soil Investigation

Rescon performed a second subsurface soil investigation in September 2018 to assess the current levels of PCE contamination remaining in the vadose zone soils at the site in order to monitor the effectiveness of the SVE system. Review of analytical results from the 2018 subsurface soil investigation indicated that PCE concentrations continue to decrease in the vadose zone soil, but remain above the ADEC SCL at two of the historical soil boring locations on the northwestern portion of the Greer property (at SB-3 and SB-9). The 2018 PCE concentrations were compared to results from the 2014 site investigation, which was performed prior to the SVE system installation. The comparison indicates an average decrease of 66% in PCE concentrations in the vadose zone soil. Further review of analytical results indicates there was a 30% reduction in the PCE concentration at SB-37 (to below the ADEC SCL), between 2017 and 2018. However, there was a 40% increase in the PCE concentration at SB-9, between 2017 and 2018. This increase is likely due to natural variability within the subsurface soil, and is not an indicator of reduced effectiveness of the SVE system. All concentrations reported in 2018 were below levels reported in 2014, prior to startup of the SVE system. These data provide evidence that the SVE system continues to remediate PCE contamination in the vadose zone soil at this site.

1.3. Contaminants of Concern

The contaminants of concern (COCs) identified at the site consist of PCE, the subsequent PCE breakdown products, including; TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride.

1.4. Regulatory Framework

The regulatory framework for the annual monitoring events was developed under consideration of the following regulations and guidance documents:

- 18 Alaska Administrative Code (AAC) 75, ADEC Oil and Other Hazardous Substances Pollution Control, dated October 2018.
- 18 AAC 78, ADEC Underground Storage Tank Regulations, dated September 2018.
- ADEC Field Sampling Guidance document, dated August 2017.

The groundwater samples were evaluated using the ADEC groundwater cleanup levels listed in Table C of 18 AAC 75.345.

2. EBR AND PRB INJECTION ACTIVITIES

Rescon conducted a second subsurface, in-situ treatment / injection event in October 2018. This second event was deemed necessary due to the deterioration of anaerobic conditions measured in the groundwater in 2017. The treatment consisted of a two-part application, including a reintroduction of the EBR amendment along with a permeable reactive barrier (PRB) injection in order to degrade the persistent chlorinated compounds, and promote anaerobic geochemical conditions for long term dechlorination of contaminant compounds. The treatment approach for this injection event is summarized below.

Rescon coordinated with PeroxyChem to formulate a treatment strategy for the site. The following variables were utilized in determining the volume of EBR and PRB needed for this event.

- Treatment area dimensions (to calculate treatment area volume),
- Soil porosity (to calculate groundwater volume),
- Soil bulk density (to calculate soil mass),
- Subsurface hydraulic conductivity and groundwater flow velocity (to calculate distance of inflowing groundwater over design life),
- Effective soil porosity for groundwater flow (to calculate volume of water passing through treatment zone over design life),
- Groundwater geochemical data (to calculate concentration of competing electron acceptors),
- pH data (to assess need for buffer, to raise pH to 7 [for microbe survivability]),
- Current groundwater and soil contaminant (and electron acceptor) concentrations (to calculate H_2 demand in order to determine the correct electron donor and chemical reductant dosing),
- Calculated electron donor volume (to determined pH buffer amount necessary to buffer the pH of the electron donor injectate solution to circum-neutral [for microbial survivability]), and
- Current microbial concentration in groundwater (to determine volume of additional microbial inoculant).

The EBR amendment was injected into the aquifer at multiple locations throughout the site in order to promote natural attenuation of contaminants and to chemically reduce soil and groundwater contamination within the saturated zone. The EBR injection points were spaced within sufficient proximity to one another to ensure complete lateral coverage of the injection area based on a conservative radius of influence estimate for each location.

A PRB included the injection of reactive materials into the aquifer proximal to and down gradient of the contaminant source area. The PRB removes or breaks down dissolved-phase plume contaminants in the groundwater as it flows from the contaminant source-area and through the barrier. The project objectives, scope of work, and a description of the remedial implements is provided in the sections below. Copies of the field notes and field data sheets are provided in Appendix A. A photograph log, documenting the injection activities is provided in Appendix B.

2.1. Project Objectives

Rescon established two specific project objectives for the injection effort:

- Promote attenuation of the chlorinated-solvent-impacted groundwater on the Stanley and Greer properties by utilizing EBR to reduce concentrations of PCE and the subsequent degradation compounds (TCE, DCE, cis-1,2-DCE, trans-1,2-DCE, and vinyl chloride) to below their respective ADEC Table C Groundwater Cleanup Levels (ADEC 2018a).
- Apply a PRB along the Greer / Stanley property line to remove and/or prevent the migration of contaminants in the groundwater moving from the source areas on the Greer-property to the down-gradient Stanley property.

2.2. Scope of Work

Rescon executed the following tasks in order to meet the project objectives:

- Coordinated with property owners to gain access to the site.
- Marked EBR and PRB injection point locations.
- Coordinated a utility locate.
- Re-positioned any EBR and/or PRB injection point(s) in close proximity to any subsurface utility lines.
- Coordinated with property tenants to ensure injection activities are conducted in a way that minimizes disruptions to their daily operations.
- Injected EBR amendment into the saturated zone throughout the site at 45 locations.
- Injected PRB amendment into the saturated zone at 38 locations along 190 feet of the Greer / Stanley property boundary.

2.3. EBR Components

The EBR amendment is a four-part solution consisting of an electron donor, a microbial culture, a chemical reductant, and a pH buffer, which are described below.

2.3.1. Electron Donor

The electron donor solution called Emulsified Lecithin Substrate (ELS) Concentrate (by Peroxychem) is a food-based carbon designed to enhance the anaerobic bioremediation capacity to promote attenuation of the chlorinated compounds. The electron donor solution provides a surplus carbon source that will be readily consumed by the aerobic microbes, promoting microbial reproduction, and increasing the consumption of the dissolved oxygen. The amendment will effectively create a condition in which the available oxygen is exhausted, creating an anaerobic condition where by reductive dechlorination processes through biodegradation and/or abiotic degradation can occur.

2.3.2. Microbial Culture

The microbial culture solution selected for this site is Dehalococcoides (Dhc). Dhc contains a natural microbe species that, under anaerobic conditions, readily dechlorinates chlorinated compounds. Dhc is a low pH acclimated culture that is designed for PCE degradation at sub-optimal pH, such as is found at this site.

2.3.3. Chemical Reductant

The EHC-Liquid Reagent is an *in situ* chemical reduction agent. The reductant consists of a soluble source of ferrous iron that creates strong reducing conditions that promote both biotic and abiotic dechlorination reactions.

2.3.4. pH Buffer

The microbial culture was applied together with the electron donor and chemical reductant solution. The solution was pH buffered to create optimal conditions for microbial growth. Based on laboratory tests, potassium bicarbonate, a fully soluble buffer, applied at a rate of 25 lbs / 11 kg per drum (420 lb) of ELS Concentrate, will buffer the pH of the injectate solution to circum-neutral.

2.4. PRB Components

2.4.1. Electron Donor/Chemical Reductant

The PRB solution consists of a three-part solution (EHC, organic carbon and zero valent iron [ZVI]) designed for effective long-term contaminant reduction. EHC *in situ* chemical reduction reagent is a controlled-release organic carbon and zero-valent iron used for the treatment of groundwater impacted by chlorinated solvents by stimulating both abiotic and biotic dechlorination mechanisms. EHC has an estimated lifetime of greater than five years in the subsurface, which makes it ideal for placement as a PRB.

The addition of organic carbon to the subsurface supports the growth of bacteria in the groundwater environment. As the bacteria feed on the organic portion of EHC, they release a variety of volatile fatty acids, which diffuse into the groundwater plume, and serve as electron donors for other bacteria, including dehalogenators. Additionally, the bacteria consume dissolved oxygen and other electron acceptors, as they feed, thereby reducing the redox potential in groundwater.

The ZVI particles provide substantial reactive surface area that stimulate chemical dechlorination. Furthermore, as the ZVI corrodes, ferrous iron is released into the groundwater. As the dissolved iron travels into areas with higher redox potential, it precipitates out as a number of ferrous and ferric precipitates, including, but not limited to iron oxide and sulfide. These ferrous iron precipitates have been proven to be reactive with chlorinated compounds and stimulate abiotic dechlorination mechanisms in an extended area down gradient of the points of application.

2.5. EBR and PRB Injections

The EBR and PRB amendments were injected through temporary injection points installed into the subsurface, groundwater-saturated zone using a direct push drill rig operated by Geotek Alaska. The project team installed 45 EBR and 38 PRB injection points on the two properties. EBR injections were equally spaced across the site within, and proximal to, the subsurface PCE plumes. The PRB injections were placed along the property boundary / retaining wall between the Greer and Stanley properties. The approximate locations of the injection points are shown on Figure 3. The points were placed equidistant from each other throughout the site in order to provide consistent placement of the amendments site-wide.

The EBR and PRB amendments were mixed with tap water in a mixing tank onsite. Prior to adding the amendments, sodium ascorbate was mixed into the water and allowed to sit overnight. The sodium ascorbate was used to reduce or eliminate oxygen and chlorine, which can negatively affect the survivability of the microbial culture. The amendments were pumped into the subsurface using a low-pressure diaphragm pump. The injection points were constructed using 1-foot-long stainless steel with slotted screens attached to a 1.5-inch diameter drill rod. The slotted screen injection points reduced the overall pressure per injection point thereby minimizing surface-breakthrough and enabled a wide vertical coverage of amendment throughout the affected area. Rescon utilized a piping manifold equipped with flow control valves to inject the amendments into multiple injection points simultaneously. This dispersed delivery method provided an even distribution of the amendment and prevented overloading a single injection point. Approximately 60 to 80 gallons of EBR amendment was injected at each point across the site, and approximately 60 gallons of PRB was injected at each point along the property boundary.

The depth-to-groundwater was measured in monitoring wells proximal to groups of proposed injection points in order to determine an injection depth that was approximately four feet below the groundwater table. EBR injection depths ranged as follows.

- 11 ft to 13.5 ft bgs in the perched aquifer on the western portion of the Stanley property;
- 17 ft to 18 ft bgs on the eastern side of the Stanley property;
- 18 ft in the perched aquifer on the western portion of the Greer property (four feet higher ground elevation); and
- 23 ft bgs on the eastern side of the Stanley property (four feet higher ground elevation).

PRB injection depths ranged as follows.

- 13 ft to 15 ft bgs in the perched aquifer on the western portion of the Stanley property; and
- 18 ft bgs on the eastern side of the site Stanley property.

3. 2018 MONITORING ACTIVITIES

The monitoring activities performed at the site properties in 2018 and 2019 consisted of groundwater and SVE effluent air sampling, as well as general O&M tasks. A description of each of the activities is provided below. Copies of the field notes and groundwater sample data sheets are provided in Appendix A. O&M forms documenting the SVE system performance, as well as adjustments, are provided in Appendix B.

3.1. Groundwater Monitoring

Rescon conducted groundwater-sampling activities on 23 and 25 January 2019 to assess the contaminant concentrations in the groundwater and evaluate the remedial progress of the 2018 EBR and PRB injections. Groundwater samples were collected from wells MW-4, MW-106, MW-120, and MW-121 on the Stanley property. The existing monitoring well MW-113, located near the northeastern corner of the Stanley building, was added to the groundwater-sampling suite in order to collect analytical data hydrologically down-gradient of the contaminant plume, in consideration of historically elevated COCs in wells MW-4, MW-104, and MW-106. MW-104 was not sampled during this monitoring event, as unseasonably warm temperatures generated melt water that submerged and filled the flush-mount well monument. It was not possible to continuously remove the melt water to below the well casing (and compression cap) in order to prevent surface water infiltration into the casing.

The four groundwater-monitoring wells were purged and sampled in accordance with the ADEC-approved work plan (Rescon 2015b). The depth to groundwater was measured at each well, prior to sample collection, using a Solinst-brand electronic water level meter. Standard water quality parameters (pH, temperature, specific conductance, dissolved oxygen, and oxidation reduction potential) were measured, using an YSI 556 water quality meter equipped with a flow-through cell, and recorded on the groundwater monitoring forms. After the groundwater parameters achieved the stabilization criteria detailed in the ADEC Field Sampling Guidance, groundwater samples were collected utilizing low-flow sampling procedures (ADEC 2017).

The groundwater samples were submitted for the following analyses:

- VOCs by U.S. Environmental Protection Agency (EPA) Method 8260C,
- Total Organic Carbon by SM 5310C,
- Chloride by Method 300.0, and
- Methane, Ethane, and Ethene by RSK 175

A quality control sample (field duplicate) was collected and prepared to assess potential errors introduced during sample collection, handling, and analysis. The field duplicate sample was collected for each analytical method and submitted blind to the project laboratory.

All samples were placed in a cooler with sufficient gel ice to keep sample temperatures at 4 degrees Celsius (°C) ±2 °C until delivery to the ADEC-approved laboratory under standard chain-of-custody procedures. A lab-provided trip blank was transported with the cooler for each monitoring event. A copy of the chain-of-custody is included with the laboratory analytical reports provided in Appendix D.

A volume of additional groundwater was collected from each well to assess MNA parameters and evidence for anaerobic biodegradation. Nitrate, sulfate, and ferrous iron concentrations were measured at each well utilizing the Hach DR900 Multi-Parameter Portable Colorimeter. The field test parameter measurements were recorded on well-specific sample data sheets (Appendix A), as well is in Table 3.

Additionally, groundwater was collected from well MW-4 and submitted to the SiREM laboratory for the following analyses to assess the EBR amendment status:

- Gene-Trac *Dehalococcoides* Assay
- Gene-Trac Functional Gene Assay
- Volatile Fatty Acids Analysis

3.2. SVE Effluent Sampling

Rescon collected an air sample from the SVE system effluent on 21 January 2019 to measure the concentrations of volatile COC compounds currently being extracted by the operation of the system. The sample was collected from a previously-installed sample port on the SVE system's exhaust stack. Polyethylene tubing was connected from the sample port to a 6-liter, 100% batch-certified, summa canister and secured on both ends with pneumatic push-to-connect and/or compression-style fittings. The sample port and sample canister valves were then opened to collect the air sample. The valves were closed when the vacuum gauge, attached to the sample canister, indicated a vacuum of at least 5 inches Hg still remained in the canister. The sample was submitted to an ADEC-approved laboratory for analysis of VOC concentrations using EPA Method TO-15. The sample was collected approximately 38 months after system startup to continue to evaluate remedial progress and ensure the remedial action objectives continue to be met by the system operation.

3.3. SVE System Periodic Operations and Maintenance

Rescon performed periodic O&M assessments of the SVE system during the months of February 2018 through January 2019. During these assessments, Rescon balanced and/or optimized the airflow in the conveyance lines to ensure optimal contaminant removal. This was accomplished by adjusting the flow rates to the extraction points in order to achieve adequate vacuum influence across the site. Additional tasks included flow line and moisture separator draining, flow meter cleaning, and a general system inspection.

In January 2018, the electric motor malfunctioned resulting in a temporary system shut down. The motor was repaired and reinstalled and the system was reenergized in early March 2018.

Continued periodic monitoring of the system remains necessary, as the system continues to be affected by intermittent power outages at the Greer Tank facility. This is due to the electrical service for the system being provided as a sub-panel pulled from Greer's main service panel in their building.

System measurements, changes to the system conditions, and tasks performed were documented on site-specific O&M data sheets. Copies of the completed O&M data sheets are provided in Appendix B.

3.4. Deviations

As noted in Section 3.1, monitoring well MW-104 was unable to be sampled due to flooded conditions at the well at the time of the groundwater sampling event. The field team substituted the down-gradient well MW-113 for MW-104 to assess the groundwater further from the well and the source area.

Additionally, a peristaltic pump (rather than a submersible pump) was utilized to collect the groundwater sample from MW-4, as this well has been a low yielding monitoring well. Collecting a groundwater sample (from a low yielding well) with a positive-pressure, submersible centrifugal pump is often not possible, as a continuous supply of water is needed to "push" water (through the tubing) to the surface (and into the sample containers). A peristaltic pump (suction lift) can be utilized to "pull" the groundwater to the ground surface at low-yield wells exhibiting low rates of recharge. However, VOC data obtained using a peristaltic pump should be considered biased low.

3.5. Investigative Derived Waste

The investigation derived waste (IDW) for the 2018 groundwater-monitoring event (performed in January 2019) consisted of purge and decontamination water, disposable sampling equipment, and administrative waste (paper towels, spent personal protective equipment [PPE] etc.). The purge and decontamination water were placed into an onsite, 55-gallon, open-topped steel drum. The drum was labeled with content and contact information, as well as the generation date. When subsequent monitoring events completely fill the drum, Rescon will request approval from ADEC to dispose of the contents as Resource Conservation and Recovery Act U-listed hazardous waste, U-210, per the EPA guidance document titled *Management of Remediation Waste Under RCRA* (EPA 1998b). The remaining solid waste IDW, including disposable personal PPE, sample tubing, and paper towels, was disposed of in a refuse dumpster onsite.

4. MONITORING RESULTS

ALS Environmental [ALS), a National Environmental Laboratory Accreditation Program - approved laboratory, of Kelso, Washington, performed the analysis of the groundwater samples. The groundwater samples were analyzed for VOC concentrations using EPA analytical method 8260. ALS also performed the analysis of the MNA parameters that could not be measured in the field. The ALS laboratory in Simi Valley, California performed the analysis of the exhaust air samples using EPA method TO-15. In addition, the SiREM laboratory, in Knoxville, Tennessee, conducted EBR performance analyses. The laboratory analytical reports are provided in Appendix D, and their respective ADEC Laboratory Data Review Checklists are provided in Appendix E.

4.1. Groundwater Monitoring Results – VOC Concentrations

A summary of the analytical results for the groundwater samples collected in January 2019 is provided in Table 1. The associated laboratory analytical reports are included in Appendix D. The analytical results from the four monitoring wells were compared to the ADEC Table C GCLs in 18 AAC 75 Oil and Other Hazardous Substances Pollution Control (ADEC 2018). Any cleanup level exceedances are highlighted in Table 1 and described below.

In addition, a comparison of the historical COC concentrations at the wells situated within and down-gradient of the contaminant plume is presented on Table 2 with markers signifying the amendment injection events. A summary of the analytical results for the site COCs is provided below.

- PCE was detected in samples from wells MW-4 and MW-106. Detectable concentrations ranged from 2.7 ug/L to 110 micrograms per liter (ug/L). The concentration of 110 ug/L at well MW-106 constituted the only exceedance of the ADEC groundwater cleanup level (GCL) of 41 ug/L. A review of historical data on Table 2 indicates that the PCE concentrations at MW-4 and MW106 have increased from their respective 2017 values of 0.35 ug/L and 87 ug/L. Concentrations of PCE were not detected in the other two wells sampled during the event.
- TCE was also only detected in samples from wells MW-4 and MW-106. Detectable concentrations ranged from 0.70 ug/L to 3.9 ug/L. The concentration of 3.9 ug/L at well MW-106 was the only exceedance of the ADEC groundwater cleanup level (GCL) of 2.8 ug/L. Similarly, to the PCE results, the TCE concentrations at MW-4 and MW106 increased from their respective 2017 values of 0.14 ug/L and 2.6 ug/L.
- Detectable concentrations of the three DCE isomers were detected in samples from MW-4 and MW-106, but at levels below their respective ADEC GCLs. A review of historical data on Table 2 indicates concentrations of cis-1,2-DCE and trans-1,2- DCE decreased in groundwater at MW-4, but increased in groundwater at MW-106, in comparison to 2017 concentrations.

- Vinyl chloride was detected in samples from monitoring wells MW-4 and MW-106. The detected concentrations ranged from 0.65 to 3.3 ug/L and exceeded the ADEC GCL of 0.19 ug/L at both monitoring well locations. A review of the historical data on Table 2 indicates a decrease in vinyl chloride concentration (from 7.4 ug/L to 3.3 ug/L) in groundwater at MW-4, and an increase in the vinyl chloride concentration (from 0.48 ug/L to 0.65 ug/L) in groundwater at MW-106, in comparison to 2017 concentrations.

4.2. Groundwater Monitoring Results – MNA Parameter Concentrations

Table 3 presents the results of the MNA parameters along with an interpretation of the potential for anaerobic biodegradation based on the parameter results. The parameter concentrations in Table 3 were determined using a combination of field-testing (i.e. YSI 556 Water Quality Meter and Hach test kits) and laboratory analysis. The table includes the parameter results for the most recent pre- and post-injection monitoring events for comparison of the changes to the degradation potential at each well, over time.

The interpretations of the dechlorination potential for each well on Table 3 were developed based on an aggregation of the natural-attenuation scoring criterion of each MNA parameter. Rescon utilized the scoring criteria for interpreting dechlorination potential as established in the EPA Guidance Document: *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Groundwater* (EPA 1998). The scoring criteria presented in Tables 2.3 of the guidance document assigned a comparable weighted value for quantifying the potential attenuation capability for each parameter. Table 2.4 in the document assigned an overall interpretation of the attenuation potential based on the sum of the parameter weighted values. Table 2.4 developed four interpretation categories (Inadequate, Limited, Adequate and Strong) for determining evidence for dechlorination based on the total of the parameter weighted values. Table 3, in this report, utilizes that scoring criteria for the individual and composite parameter weighted values to determine the biodegradation potential at each well during each monitoring event.

Review of the composite MNA scoring classifications for source area wells MW-4, MW-104, and MW-106 have historically fluctuated between Limited and Adequate evidence of dechlorination following the EBR injection. The results from the most recent monitoring event in January 2019 indicated limited dechlorination conditions at the two source-area wells (MW-4 and MW-106 only, as MW-104 was not sampled), as follows:

- The total weighted value score for MW-4 has increased 1 point since December 2017, indicating evidence for biodegradation at this well remains Limited. However, the current value remains over two times the pre-injection score, indicating a definitive augmentation of reductive indicators at the well.
- The total weighted value score for MW-106 has decreased 1 point since December 2017, indicating evidence for biodegradation at this well remains

Limited. The current value remains over three times the pre-injection score, indicating a definitive augmentation of reductive indicators at the well.

4.3. EBR Performance Monitoring Results

One groundwater sample was collected from well MW-4 and submitted for analyses to assess the current EBR amendment status (after the 2018 EBR injections) in the contaminant source area. The analyses quantified the microbial population and microbial nutrient (electron donor) concentration per liter of groundwater. The microbial nutrient, or volatile fatty acids (VFA), analysis indicated a total concentration of 1,584 milligrams per liter [mg/l], which is a marked increase from the 2017 concentration of 12.72 mg/l, as seen below.

- 1,316 mg/kg acetate;
- 185 mg/kg butyrate;
- 73 mg/kg propionate; and
- 10 mg/kg pyruvate.

A Gene-Trac Dhc-Total *Dehalococcoides* Assay indicated a *Dehalococcoides mccartyi* population of $1X10^6$ microbes per liter of water. Additionally, a Gene-Trac Functional Gene Assay indicated the following gene concentrations (for enzymes that dechlorinate ethenes and other compounds):

- vcrA: $2X10^6$ gene copies per liter (GC/L).
- bvcA: $2X10^5$ GC/L.
- tceA: $1X10^6$ GC/L.

4.4. SVE Effluent Air Monitoring Results

One air sample was collected from the SVE exhaust on 21 January 2019, which was approximately 38 months from initial system startup. The concentrations of the COCs in the system effluent were 1,200 micrograms per cubic meter (ug/m^3) (PCE), 6.9 ug/m^3 (TCE), 17 ug/m^3 (cis-1,2-DCE), and 10 ug/m^3 (trans-1,2-DCE). A summary of the effluent concentrations is provided in Table 4 and the complete laboratory analytical report is included in Appendix D.

5. QUALITY ASSURANCE REVIEW

5.1. Data Quality Summary

Rescon conducted a review of analytical data quality for this project. Rescon evaluated the precision, accuracy, sensitivity, representativeness, comparability, and completeness of the data by reviewing laboratory-supplied quality control (QC) information as well as conducting independent quality assurance checks on the data.

Groundwater samples were analyzed for VOCs by EPA Method 8260C. Sample results were reported by ALS Environmental of Kelso, WA in sample delivery group (SDG) K1900812. Rescon conducted a data quality review and completed an Alaska Department of Environmental Conservation (ADEC) laboratory data review checklist for the SDG (see Appendix E). This data quality summary presents findings of data quality review relevant to samples collected from the Greer Tank Yard – PCE site. QC anomalies relating to samples collected from this site are discussed in the QC checklist and summarized here.

Groundwater samples were also analyzed for chloride by EPA Method 300.0, TOC by SM5310C, and dissolved gases (methane, ethane, ethene) by RSK 175. These results were not reviewed, as they were collected to assess for the potential for anaerobic degradation of contaminants only and will not be compared to project action limits for project decision making. Additionally, air sample results from the SVE exhaust sample (reported by ALS Simi Valley in SDG P1900420) were not reviewed, as they were collected for system performance monitoring only.

5.2. Sample Receipt, Custody, and Holding Times

Samples were received in good condition, within the acceptable temperature range. Sample-custody paperwork was complete and custody seals were intact. There were no sample-receiving or sample-custody anomalies that affected data quality for this project. Sample holding times were met for each sample and analysis.

5.3. Analytical Sensitivity

Limits of detection (LODs) for site contaminants of concern (COCs) were compared to relevant ADEC groundwater cleanup levels (GCLs) from Title 18 Alaska Administrative Code Chapter 75. LODs were below relevant GCLs for all non-detect results for site COCs.

5.4. Accuracy and Precision

Laboratory QC information indicated sufficient analytical accuracy and precision. Laboratory control sample (LCS), LCS duplicate (LCSD), matrix spike (MS), MS duplicate (MSD), laboratory duplicate, and/or surrogate recoveries and/or relative percent differences (RPDs) were within laboratory control limits for each analysis. The RPDs were calculates utilizing the calculation included in section 6.e.iii of the ADEC's Laboratory Data Review Checklist. The RPDs for the COCs detected in the field-duplicate sample were less that the recommended 30% for water and indicated adequate overall precision for the sampling event.

5.5. Representativeness

Representativeness describes the degree to which data accurately and precisely represent site characteristics. Representativeness is affected by factors such as sample frequency and matrix or contaminant heterogeneity, as well as analytical performance (including sensitivity, accuracy, and precision) and sample cross-contamination.

Samples were collected in accordance with an approved work plan. No results were affected by blank contamination and no results were qualified due to a QC anomaly or failure. Overall precision and accuracy were deemed adequate. Overall representativeness is deemed generally acceptable for the purposes of this project.

5.6. Comparability

Comparability describes whether two data sets can be considered equivalent with respect to project goals. Comparability is affected by factors such as sampling methodology and analytical performance (including sensitivity, accuracy, and precision). Comparability was evaluated by checking that standard analytical methods were employed and analytical performance was acceptable. Data review findings generally support that the dataset is comparable; however, comparability should be evaluated by the project team considering sample collection methodology and historic results alongside data quality and analytical methodology.

6. CONCLUSIONS AND RECOMMENDATIONS

6.1. Groundwater Monitoring

The objective of the initial 2015 EA injection was to initiate dechlorination and promote attenuation of the PCE contamination in the site's saturated zone. Prior to the injection, the groundwater within the contaminant plume consisted of mainly PCE contamination with some low concentrations of TCE and cis-1,2-DCE. The EA injection was intended to disrupt that condition and initiate the PCE degradation process. The 2015 implementation of the EA amendment was effective in producing declining PCE concentrations in the source area wells while also resulting in temporarily increasing concentrations of the PCE degradation products (TCE, the DCE isomers and vinyl chloride). However, recent monitoring results in 2017 evidenced a deterioration of the conditions necessary for reductive dechlorination.

The objectives of the 2018 EBR and PRB injections were to re-prime the subsurface geochemistry for optimal reductive dechlorination, as well to reduce the concentration of PCE (and associated degradation daughter products) in groundwater flowing from the source area (on the Greer property) to the Stanley property.

The results of the January 2019 groundwater-sampling event continue to evidence ongoing reductive dechlorination at the site (see Charts 1 – 3). Analytical results from monitoring wells MW-4 and MW-104 indicate PCE concentrations are generally stable (and below the 41 ug/kg cleanup level) and degradation daughter products continue to decrease. Although the PCE concentration increased in source-area well MW-106, the continued detections of degradation daughter products in samples from the well indicate dechlorination is occurring. The PCE concentration at MW-106 (in 2017) had decreased by 21% from the 2016 level, but rebounded in January 2019. This was possibly due to the injection of over 5,000 gallons of EBR and PRB amendment into the saturated zone in 2018, which could have temporarily raised the groundwater table into the contaminated vadose zone where additional contaminants could have been dissolved into the groundwater. The approximate extents of current contaminant plumes (PCE, TCE, and vinyl chloride), based on the January 2019 analytical results, are illustrated on Figure 4.

Fluctuations in PCE degradation daughter product concentrations were noted in the two source-area wells sampled. Due to the effects of the significant amendment volume injection in 2018, as noted above, further monitoring is recommended to better evaluate the overall trends in the degradation compounds in the groundwater.

Review of the MNA parameter results on Table 3 continues to present evidence for anaerobic biodegradation at the source area wells; however, the weighted MNA values at wells MW-4 and MW-104 continue to indicate evidence is Limited. These low values are mainly due to a few parameters. An increase in dissolved oxygen (DO) concentrations at both MW-4 and MW-6 negatively affects the anaerobic bacteria. They can be present in environments with a DO concentration less than 1 mg/l; however, they generally do not function optimally at dissolved oxygen concentrations greater than 0.5 mg/l. At MW-4, the pH is slightly too acidic (< pH of 5) for optimal performance of the microbial culture (at MW-4). Also, groundwater samples from MW-106 were not submitted for VFA analysis. If VFAs are present, this would provide further evidence in support of sustained reductive dichlorination conditions.

The most-recent 2018 EBR injections are expected to result in lowered DO (due to the introduction of additional electron donor), increased pH (due to the addition of a pH buffer), and increased VFAs (due to the introduction of the Enhanced Lecithin Substrate).

Rescon recommends that the groundwater continue to be monitored for MNA and VOCs annually until offsite groundwater contaminant concentrations reduce below the ADEC GCLs. Rescon also recommends performing an additional groundwater sampling event in the October/November of 2019 to evaluate spring variations in contaminant concentrations and groundwater flow direction, as well as to monitor the progress of the 2018 injections.

6.2. EBR Performance Monitoring Results

One groundwater sample was collected from well MW-4 to quantify the injected microbial population and total VFA (electron donor) concentration per liter of groundwater at this location at the site.

The total concentration of VFAs (after the 2018 EBR injection) was 1,584 mg/l, which is a marked increase from the 2017 concentration of 12.72 mg/l. Volatile fatty acids are produced by the degradation (fermentation) of the primary substrate (injected electron donor solution) and indicate microbial activity, as well as substrate distribution. Furthermore, VFAs can be fermented to produce hydrogen for anaerobic dechlorination. A lack of VFAs (less than 1 mg/L) usually indicates that additional substrate (electron donor) is required (Air Force Center for Environmental Excellence, Naval Facilities Engineering Service Center, and Environmental Security Technology Certification Program, 2004).

The Gene-Trac Dhc-Total *Dehalococcoides* Assay indicates a Dhc population of $1X10^6$ microbes per liter of water. A moderate concentration of Dhc, such as this, may be associated with observable dechlorination activity (a concentration greater than $1X10^7$ microbes per liter is optimum for significant-to-high rates of dechlorination). Dhc contain the greatest number of reductive dehalogenase genes of any microbial group and are capable of reductive dechlorination of PCE and the associated degradation daughter products.

The Gene-Trac Functional Gene Assay indicates the Dhc population has concentrations of all functional genes (vcrA, bvcA, and tceA). The tceA gene was detected, at a concentration of $1X10^6$ gene copies per liter, and indicates that the Dhc population has the potential to dechlorinate TCE and cDCE to vinyl chloride. Detected concentrations of the vcrA gene ($2X10^6$ gene copies per liter) and the bvcA gene ($2X10^5$ gene copies per liter) indicate cDCE and vinyl chloride dechlorination to ethene is likely. A vcrA and/or bvcA gene concentration similar to the total Dhc concentration indicates vinyl chloride accumulation is less likely (SiRem, 2019).

Anaerobic microbial populations thrive in the absence of oxygen (DO less than 0.5 mg/l), and can be negatively impacted by DO concentrations greater than 1 mg/l. To ensure the maintenance of optimal anaerobic conditions, an adequate source of primary substrate (electron donor) should be continually available, as the biodegradation of the primary substrate will reduce available oxygen as it is used as an electron acceptor (EPA, 1998).

Rescon recommends that the groundwater continue to be assessed for microbial population and nutrient concentration annually to ensure the maintenance of optimal remedial conditions.

6.3. Vadose Zone Contamination – SVE Operation

The estimated contaminant mass removal rate was calculated using the vapor contaminant concentrations and the corresponding SVE system flow rate. The cumulative contaminant mass removed was then calculated by taking an average of the two most recent mass removal rates and multiplying by the length of time that had elapsed between the two events.

The most-recent calculation indicates that the SVE system continues to effectively remove PCE (and degradation daughter products) from the vadose zone source area at the site. Rescon estimates that 3.7 kilograms (8.1 pounds) of PCE were removed from the subsurface since the last SVE effluent monitoring event on 11 August 2017 (17 month period). Cumulatively, 14.9 kilograms (32.8 pounds) of PCE were removed from the subsurface throughout the SVE system's 38 months of operation.

The PCE concentrations in the effluent started at 47,000 ug/m^3 and decreased to 1,200 ug/m^3. This initial high contaminant concentration, followed by a steady decline in contaminant concentrations is the typical trend of an SVE system startup (see Chart 4). As the readily available contaminants are stripped from the subsurface, the contaminant removal will become limited by the rate that contaminants diffuse from the soil. Rescon recommends the following:

- Collect effluent air samples from the six individual extraction lines, rather than collect one effluent sample from the SVE system's combined-exhaust port. The data from this effort will be used to determine which of the six extraction points contain relatively higher concentrations of PCE. Based on this information, vacuum will be increased on lines with higher PCE, while vacuum will be decreased on lines with lower concentrations of PCE.
- Continue to perform periodic O&M assessments of the SVE system to ensure continued optimal contaminant removal.

7. REFERENCES

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TABLES

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TABLE 1
GROUNDWATER COC ANALYTICAL RESULTS
2018 ANNUAL MONITORING REPORT
GREER TANK
ANCHORAGE, ALASKA

Sample ID:	**ADEC Table C Groundwater Cleanup Level(1)**	**MW-4**		**MW-106**	**MW-121**	**MW-113**	**Trip Blank[2]**
Sample Time:		**1400**	**MW-1 @ 1500**	**1435**	**1135**	**1235**	**NA**
Sample Date:		**01/25/2019**	**1/25/19**	**01/23/2019**	**01/23/2019**	**01/23/2019**	**01/23/2019**
Volatile Organic Compounds (EPA 8260C)		All results in μg/L					
Tetrachloroethene	41	**2.7**	**2.5**	**110 D**	ND	ND	ND
Trichloroethene	2.8	**0.70**	**0.60**	**3.9**	ND	ND	ND
1,1-Dichloroethene	280	ND	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	36	**26**	**23**	**23**	ND	ND	ND
trans-1,2-Dichloroethene	360	**2.5**	**2.3**	**0.20 J**	ND	ND	ND
Vinyl chloride	0.19	**3.3**	**3.0**	**0.65**	ND	ND	ND

Notes and Abbreviations:

(1) ADEC Table C Groundwater Cleanup Levels; 18 AAC 75 "Oil and Hazardous Substances Pollution Control"; November 2017.

Results above ADEC cleanup values are red, underlined & bolded. Detected results are bolded.

Only contaminants of concern are tabulated above; remaining results were not detected or were below cleanup levels.

ADEC = Alaska Department of Environmental Conservation

bgs = Below ground surface

COC = contaminanats of concern

μg/L = micrograms per liter

D = The reported result is from a dilution

J = The result is an estimated value

ND = Analyte was analyzed for, but not detected at or above the method reporting limit and/or the method detection limit

TABLE 2
HISTORICAL ANALYTICAL RESULTS
2018 ANNUAL MONITORING REPORT
GREER TANK
ANCHORAGE, ALASKA

Date Collected			2011	Aug-13	May-15		Nov-15	May-16	Dec-16	Dec-17		Jan-19
Well Location	**Analyte**	**ADEC Table C Groundwater Cleanup Level[1]**	**Results in ug/L**									
MW-4	Tetrachloroethene	41	**108**	**134**	**150**	2015 EBR INJECTION	**120**	**0.15 J**	**0.37 J**	**0.35 J**	2018 EBR & PRB INJECTION	**2.7**
	Trichloroethene	2.8	**2.1**	**2.2**	**3.8**		**9.8**	ND	ND	**0.14 J**		**0.70**
	1,1-Dichloroethene	280	ND	ND	ND		**0.080 J**	**0.96 J**	**0.22 J**	**0.10 J**		ND
	cis-1,2-Dichloroethene	36	ND	**1.39**	**21**		**42**	**420** *D*	**180** *D*	**80**		**26**
	trans-1,2-Dichloroethene	360	ND	ND	**0.25**		**6.1**	**7.7**	**6.5**	**4.5**		**2.5**
	Vinyl chloride	0.19	ND	ND	ND		**1.5**	**3.4**	**5**	**7.4**		**3.3**
MW-104	Tetrachloroethene	41	--	**37.6***	NS		NS	**0.31 J**	**0.46 J**	**0.33**		NS
	Trichloroethene	2.8	--	**0.4**	NS		NS	ND	**0.11 J**	ND		NS
	1,1-Dichloroethene	280	--	ND	NS		NS	**0.16 J**	ND	ND		NS
	cis-1,2-Dichloroethene	36	--	ND	NS		NS	**58**	**13**	**5.2**		NS
	trans-1,2-Dichloroethene	360	--	ND	NS		NS	**0.47**	**0.56**	**0.22**		NS
	Vinyl chloride	0.19	--	ND	NS		NS	**1.1**	**2.8**	**0.71**		NS
MW-106	Tetrachloroethene	41	**61**	**46.9**	NS		NS	**29**	**110**	**87 D**		**110 D**
	Trichloroethene	2.8	**1.4**	**1.18**	NS		NS	**0.63**	**1.3**	**2.6**		**3.9**
	1,1-Dichloroethene	280	ND	ND	NS		NS	ND	ND	ND		ND
	cis-1,2-Dichloroethene	36	**7.7**	**6.21**	NS		NS	**3.5**	**5.9**	**12**		**23**
	trans-1,2-Dichloroethene	360	ND	ND	NS		NS	**0.14 J**	ND	**0.11**		**0.20 J**
	Vinyl chloride	0.19	ND	ND	NS		NS	ND	ND	**0.48**		**0.65**
MW-121	Tetrachloroethene	41	NS	ND	NS		NS	ND	ND	ND		ND
	Trichloroethene	2.8	NS	ND	NS		NS	ND	ND	ND		ND
	1,1-Dichloroethene	280	NS	ND	NS		NS	ND	ND	ND		ND
	cis-1,2-Dichloroethene	36	NS	ND	NS		NS	ND	ND	ND		ND
	trans-1,2-Dichloroethene	360	NS	ND	NS		NS	ND	ND	ND		ND
	Vinyl chloride	0.19	NS	ND	NS		NS	ND	ND	ND		ND
MW-113	Tetrachloroethene	41	NS	NS	NS		NS	NS	NS	NS		ND
	Trichloroethene	2.8	NS	NS	NS		NS	NS	NS	NS		ND
	1,1-Dichloroethene	280	NS	NS	NS		NS	NS	NS	NS		ND
	cis-1,2-Dichloroethene	36	NS	NS	NS		NS	NS	NS	NS		ND
	trans-1,2-Dichloroethene	360	NS	NS	NS		NS	NS	NS	NS		ND
	Vinyl chloride	0.19	NS	NS	NS		NS	NS	NS	NS		ND

Notes and Abbreviations:

[1] ADEC Table C Groundwater Cleanup Levels; 18 AAC 75 "Oil and Hazardous Substances Pollution Control"; November 2017.

Results above ADEC cleanup values are red, underlined & bolded. Detected results are bolded.

Only contaminants of concern are tabulated above

ADEC = Alaska Department of Environmental Conservation

bgs = Below ground surface

µg/L = micrograms per liter

D = The reported result is from a dilution

J = The result is an estimated value

ND = Analyte was analyzed for, but not detected at or above the method reporting limit and/or the method detection limit

NS = Not sampled

(--) = No data available

* = Detected concentration exceeded previous ADEC cleanup level (i.e. prior to 2016 revision)

TABLE 3
GROUNDWATER - MONITORED NATURAL ATTENUATION PARAMETER RESULTS
2018 ANNUAL MONITORING REPORT
GREER TANK
ANCHORAGE, ALASKA

Greer Tank MNA Parameter Results (unless stated, results reported in mg/L)

MNA Parameters		DO	ORP (mV)	Nitrate	Iron II	Sulfate	Methane	pH (pH units)	TOC	Chloride	VFA	BTEX	PCE	TCE	DCE	VC	Chloroethane	Ethene/Ethane	Total Weighted MNA Value	Evidence for Anaerobic Biodegradation at Well
Units		mg/L	mV	mg/L	mg/L	mg/L	mg/L	pH (pH units)	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L		
Scoring Criteria[1]		< 0.5 = 3	< 50 = 1	< 1 = 2	> 1 = 3	< 20 = 2	< 0.5 = 0	5 < pH < 9 = 0	> 20 = 2	> 2x Bkgd = 2	> 0.1 = 2	> 0.1 = 2	NA	2*	2*Φ	2*	2*	> 0.01 = 2		
		> 5 = -3	< -100 = 2				> 0.5 = 3	5 > pH > 9 = -2										> 0.1 = 3		
Impacted Wells - Stanley Property																				
MW-4	May-15	2.34	65.1	1.8	0.03	4	ND	6.43	3.92	12.8	NS	0.00039	0.15	0.0038	0.02125	ND	ND	ND	6	Limited
	MNA Score	0	0	0	0	2	0	0	0	0	0	0		2	2	0	0	0		
	Nov-15	0.45	-113.0	OR	0.94	0	0.00056	6.52	201	3.6	NS	0.00159	0.12	0.0098	0.04818	0.0015	ND	0.00084	15	Adequate
	MNA Score	3	2	0	0	2	0	0	2	0	0	0		2	2	2	0	0		
	May-16	0.18	-92.0	OR	1.15	0	0.100	6.37	54	4.8	NS	0.00145	0.0015	ND	0.429	0.0037	ND	0.00056	14	Limited
	MNA Score	3	0	0	3	2	0	0	2	0	0	0		0	2	2	0	0		
	Dec-16	0.12	-8.8	OR	1.11	0	3.400	6.18	45	8.09	NS	0.00145	0.0007	ND	0.18672	0.005	ND	ND	17	Adequate
	MNA Score	3	0	0	3	2	3	0	2	0	0	0		0	2	2	0	0		
	Dec-17	0.62	58.2	3.5	0.8	0	4.8	5.59	21.1	2.92	NS	0.0011	0.00035	0.00014	0.0079 [2]	0.0072	ND	0.0024	13	Limited
	MNA Score	0	0	0	0	2	3	0	2	0	0	0		2	2	2	0	0		
	Jan-19	2.28	-7.7	2.6	0.98	0	2.4	4.98	550	8.57	1584	0.0039	0.00270	0.00070	0.0287	0.0033	ND	0.0065	14	Limited
	MNA Score	0	1	0	0	2	3	-2	2	0	2	0		2	2	2	0	0		
MW-104	May-16	0.42	-97.7	NC	NC	NC	1.100	6.77	NC	NC	NS	0.0002	0.00031	ND	0.05863	0.0011	ND	ND	10	Limited
	MNA Score	3	0	0	0	0	3	0	0	0	0	0		0	2	2	0	0		
	Dec-16	0.25	-57.3	OR	1.15	0	2.400	6.32	19.6	1.47	NS	0.00045	0.00046	0.00011	0.01356	0.0028	ND	0.0018	17	Adequate
	MNA Score	3	0	0	3	2	3	0	0	0	0	0		2	2	2	0	0		
	Dec-17	0.77	74.9	OR	1.15	0	2.2	5.87	15.9	2.25	NS	0.000872	0.00033	ND	0.005.2 [2]	0.00071	ND	0.0008	12	Limited
	MNA Score	0	0	0	3	2	3	0	0	0	0	0		0	2	2	0	0		
MW-106	May-15	6.03	83.0	1.3	0.01	2	0.330	6.13	3.39	18.2	NS	ND	0.0469	0.00118	0.00621	ND	ND	ND0	3	Inadequate
	MNA Score	-3	0	0	0	2	0	0	0	0	0	0		2	2	0	0	0		
	May-16	1.30	96.2	OR	0.05	0	0.007	6.43	1.73	1.27	NS	0.00017	0.029	0.00063	0.00364	ND	ND	ND	6	Limited
	MNA Score	0	0	0	0	2	0	0	0	0	0	0		2	2	0	0	0		
	Dec-16	1.21	161.7	0.0	0.02	4	0.087	5.96	5.2	7.3	NS	0.00008	0.110	0.0013	0.0059	ND	ND	ND	8	Limited
	MNA Score	0	0	2	0	2	0	0	0	0	0	0		2	2	0	0	0		
	Dec-17	0.67	7.5	3.2	0.08	5	3.8	6.30	5	9.33	NS	0.000664	0.087	2.6	0.0012	0.00048	ND	ND	12	Limited
	MNA Score	0	1	0	0	2	3	0	0	0	0	0		2	2	2	0	0		
	Jan-19	1.14	160.8	3.3	0.05	0	9.7	6.13	6.2	6.58	NS	0.000732	0.110	0.0039	0.0233	0.00065	ND	0.0042	11	Limited
	MNA Score	0	0	0	0	2	3	0	0	0	0	0		2	2	2	0	0		

Notes:
* - Points awarded only if it is known that the compound is a daugther product (i.e., not the constituent source)
Φ - If cis is > 80% of total DCE it is likely a daughter product. Presence of 1,1-DCE can be result of chemical reaction product of TCA
1 - MNA parameter scoring based on the criteria listed in Tables 2.3 and 2.4 of the EPA Guidance Document: *Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water*

Interpretation of Potential for Anaerobic Degradation via reductive dechlorination based on Total Weighted MNA Values

Total Weighted MNA Value	Interpretation
0 to 5	Inadequate Evidence for Anaerobic Biodegradation of Chlorinated Organics.
6 to 14	Limited Evidence for Anaerobic Biodegradation of Chlorinated Organics.
15 to 20	Adequate Evidence for Anaerobic Biodegradation of Chlorinated Organics.
> 20	Strong Evidence for Anaerobic Biodegradation of Chlorinated Organics.

RESCON alaska

TABLE 4
SVE EXHAUST COC ANALYTICAL RESULTS
2018 ANNUAL MONITORING REPORT
GREER TANK
ANCHORAGE, ALASKA

Sample ID:	**EFF-01**		**EFF-2**		**EFF-3**		**EFF-4**		**EFF-5**		**EFF-6**		**EFF-7**	
Sample Time:	**14:00**		**10:00**		**15:35**		**10:45**		**13:40**		**10:15**		**15:15**	
Sample Date:	**11/10/15**		**11/11/15**		**11/19/15**		**12/18/15**		**7/13/16**		**8/11/17**		**1/21/19**	
Initial Flow (CFM)	**56**		**59**		**60**		**55**		**83**		**72**		**72**	
Time Since Startup (hours)	**4**		**24**		**222**		**913**		**5908**		**15360**		**28037**	
Volatile Organic Compounds (EPA TO-15)	all results in μg/m^3	Grams of Contaminant Removed	all results in μg/m^3	Grams of Contaminant Removed	all results in μg/m^3	Grams of Contaminant Removed	all results in μg/m^3	Grams of Contaminant Removed	all results in μg/m^3	Grams of Contaminant Removed	all results in μg/m^3	Grams of Contaminant Removed	all results in μg/m^3	Grams of Contaminant Removed
Tetrachloroethene	47,000	17.89	38,000	100.70	22,000	699.83	7,440	1,714.89	5,600	5,423.51	3,600	11,236.88	1,200	14,958.70
Trichloroethene	480	0.18	280	0.92	ND	3.70	ND	3.70	ND	3.70	21	15.84	6.9	37.47
1,1-Dichloroethene	ND	0.00	ND	0.00	ND	0.00	ND	0.00	ND	0.00	ND	0.00	ND	0.00
cis-1,2-Dichloroethene	1,200	0.46	840	2.44	270	13.50	122	26.95	72.9	81.10	39	152.23	17	195.65
trans-1,2-Dichloroethene	7,600	2.89	2,800	12.93	1,200	52.83	617	115.01	341	379.11	68	645.68	10	706.16
Vinyl chloride	ND	0.00	ND	0.00	ND	0.00	ND	0.00	ND	0.00	ND	0.00	ND	0.00

Notes and Abbreviations:

Only contaminants of concern are tabulated above; remaining results were not detected or were below cleanup levels.

COC = contaminants of concern

μg/m^3 = micrograms per cubic meter

ND = Analyte was analyzed for, but not detected at or above the method reporting limit and/or the method detection limit

VOCs = volatile organic compounds

FIGURES

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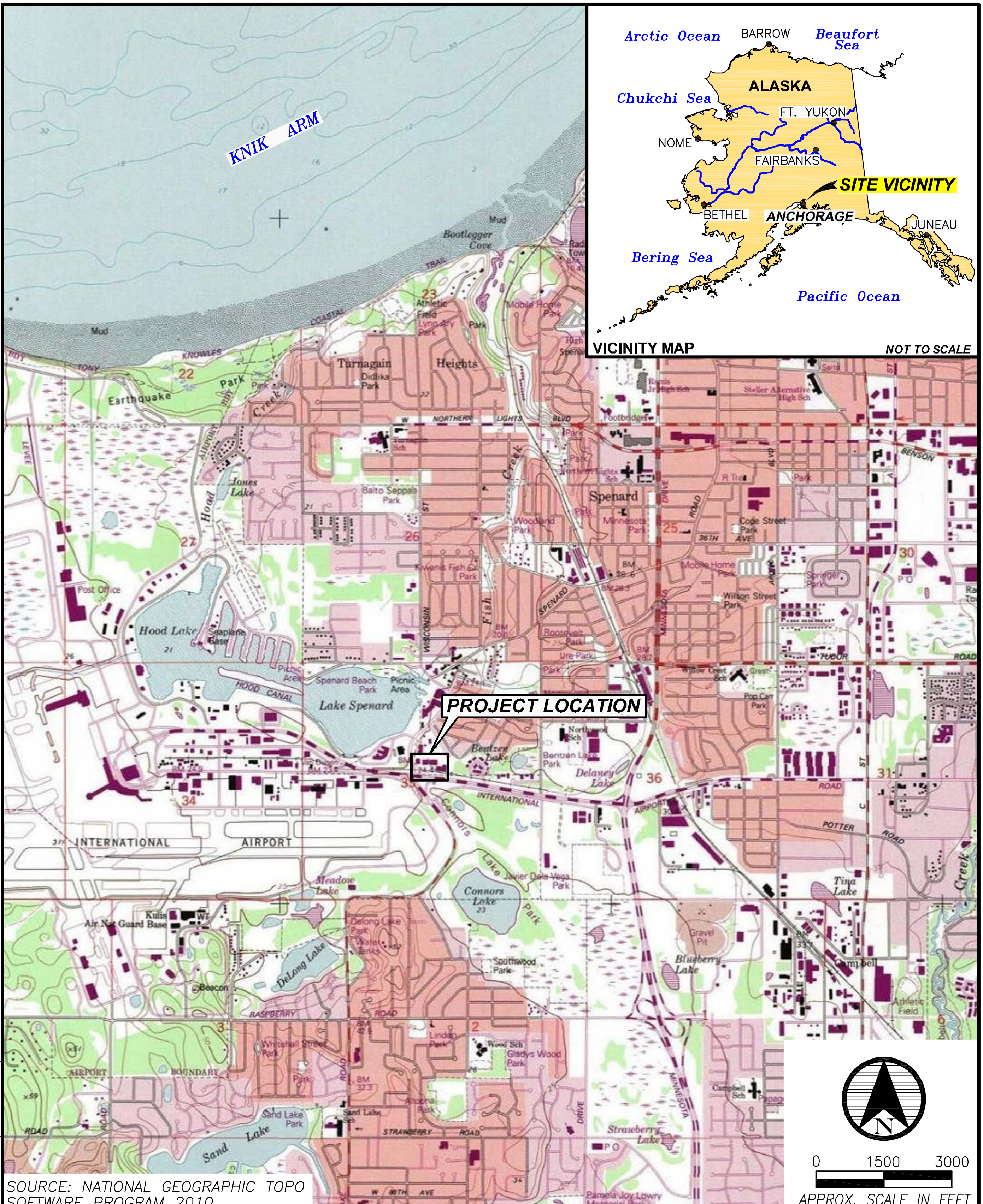

SOURCE: NATIONAL GEOGRAPHIC TOPO SOFTWARE PROGRAM 2010.

DATE: SEPT. 2019 REV.: - CHKD: R.M.B. DRAWN: C.E.H. PROJ. No.: 07-001	RESCON alaska 8361 PETERSBURG STREET ANCHORAGE, ALASKA 99507 907-677-7423	**SITE LOCATION MAP** 2018 ANNUAL MONITORING REPORT GREER TANK AND WELDING, INC. Anchorage, Alaska	**FIGURE** 1

PATH: 2019 Dwgs\19 Rescon\19 Greer\07-001 GREER GWR FILE: 07-001-GR-GWM-F1.DWG PLOTTED: 9/25/19.

MW-113	1/23/19
PCE	ND
TCE	ND
1,1-DCE	ND
cDCE	ND
tDCE	ND
VC	ND

MW-121	12/29/16	12/27/17	1/23/19
PCE	ND	ND	ND
TCE	ND	ND	ND
1,1-DCE	ND	ND	ND
cDCE	ND	ND	ND
tDCE	ND	ND	ND
VC	ND	ND	ND

MW-104	12/29/16	12/15/17
PCE	0.46	0.33
TCE	0.11	ND
1,1-DCE	ND	ND
cDCE	13	5.2
tDCE	0.56	0.22
VC	**2.8**	**0.71**

MW-120	12/15/17
PCE	ND
TCE	ND
1,1-DCE	ND
cDCE	0.070
tDCE	ND
VC	ND

MW-106	12/29/16	12/27/17	1/23/19
PCE	**110**	**87**	**110**
TCE	1.3	2.6	**3.9**
1,1-DCE	ND	ND	ND
cDCE	5.9	12	23
tDCE	ND	0.11	0.20
VC	ND	**0.48**	**0.65**

MW-4	12/29/16	12/15/17	1/25/19
PCE	0.7	0.35	2.7
TCE	ND	0.14	0.70
1,1-DCE	0.22	0.10	ND
cDCE	**180**	**80**	26
tDCE	6.5	4.5	2.5
VC	**5**	**7.4**	**3.3**

LEGEND

⊕	EXISTING MONITORING WELL LOCATION
PCE	TETRACHLOROETHYLENE (ug/L)
TCE	TRICHLOROETHENE (ug/L)
1,1-DCE	1,2-DICHLOROETHENE (ug/L)
cDCE	cis-1,2-DICHLOROETHENE (ug/L)
tDCE	trans-1,2-DICHLOROETHENE (ug/L)
VC	VINYL CHLORIDE (ug/L)

NOTE:
BOLD/RED TEXT = VALUE ABOVE ADEC TABLE C GROUNDWATER CLEANUP LEVEL.

SOURCE: IMAGE FROM GOOGLE EARTH PROFESSIONAL DATED 7/1/14.

PATH: 2019 Dwgs\19 Rescon\19 Greer\07-001 GREER GWR FILE: 07-001-GR-GWM-F1.DWG PLOTTED: 9/25/19.

FIGURE 2

GROUNDWATER MONITORING RESULTS

2018 ANNUAL MONITORING REPORT
GREER TANK AND WELDING, INC.
Anchorage, Alaska

RESCON alaska
8361 PETERSBURG STREET
ANCHORAGE, ALASKA 99507
907-677-7423

DATE: SEPT. 2019
REV.: –
CHKD: R.M.B.
DRAWN: C.E.H.
PROJ. No.: 07-001

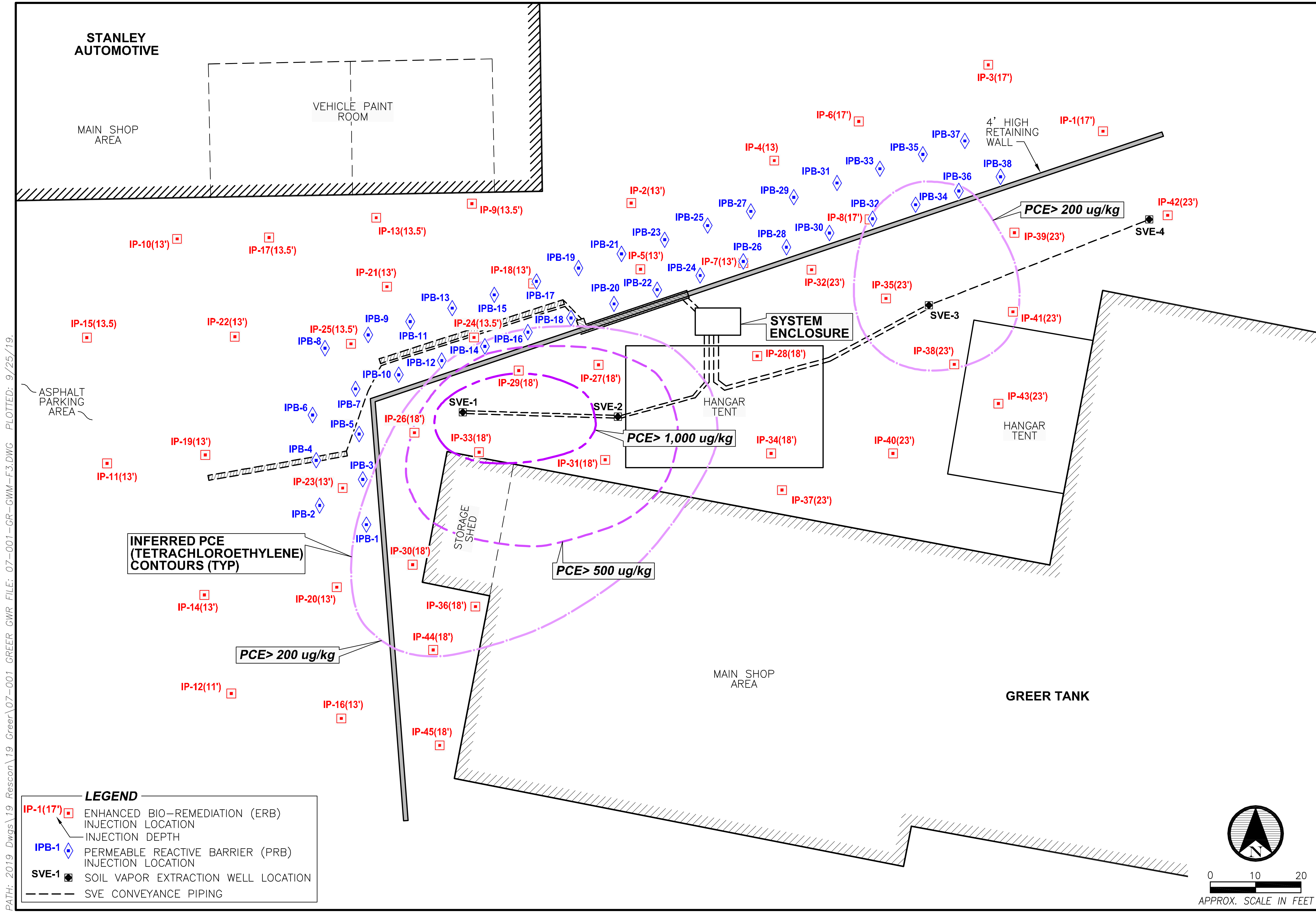

FIGURE 3

EBR AND PRB INJECTION LOCATIONS

2018 ANNUAL MONITORING REPORT
GREER TANK AND WELDING, INC.
Anchorage, Alaska

RESCON alaska
8361 PETERSBURG STREET
ANCHORAGE, ALASKA 99507
907-677-7423

DATE: SEPT. 2019
REV.: –
CHKD: R.M.B.
DRAWN: C.E.H.
PROJ. No.: 07-001

SOURCE: IMAGE FROM GOOGLE EARTH PROFESSIONAL DATED 7/1/14.

FIGURE 4

PCE, TCE, AND VINYL CHLORIDE PLUMES

2018 ANNUAL MONITORING REPORT
GREER TANK AND WELDING, INC.
Anchorage, Alaska

RESCON alaska
8361 PETERSBURG STREET
ANCHORAGE, ALASKA 99507
907-677-7423

DATE: SEPT. 2019
REV.: –
CHKD: R.M.B.
DRAWN: C.E.H.
PROJ. No.: 07–001

PATH: 2019 Dwgs\19 Rescon\19 Greer\07–001 GREER GWR FILE: 07–001–GR–GWM–F3.DWG PLOTTED: 9/25/19.

CHARTS

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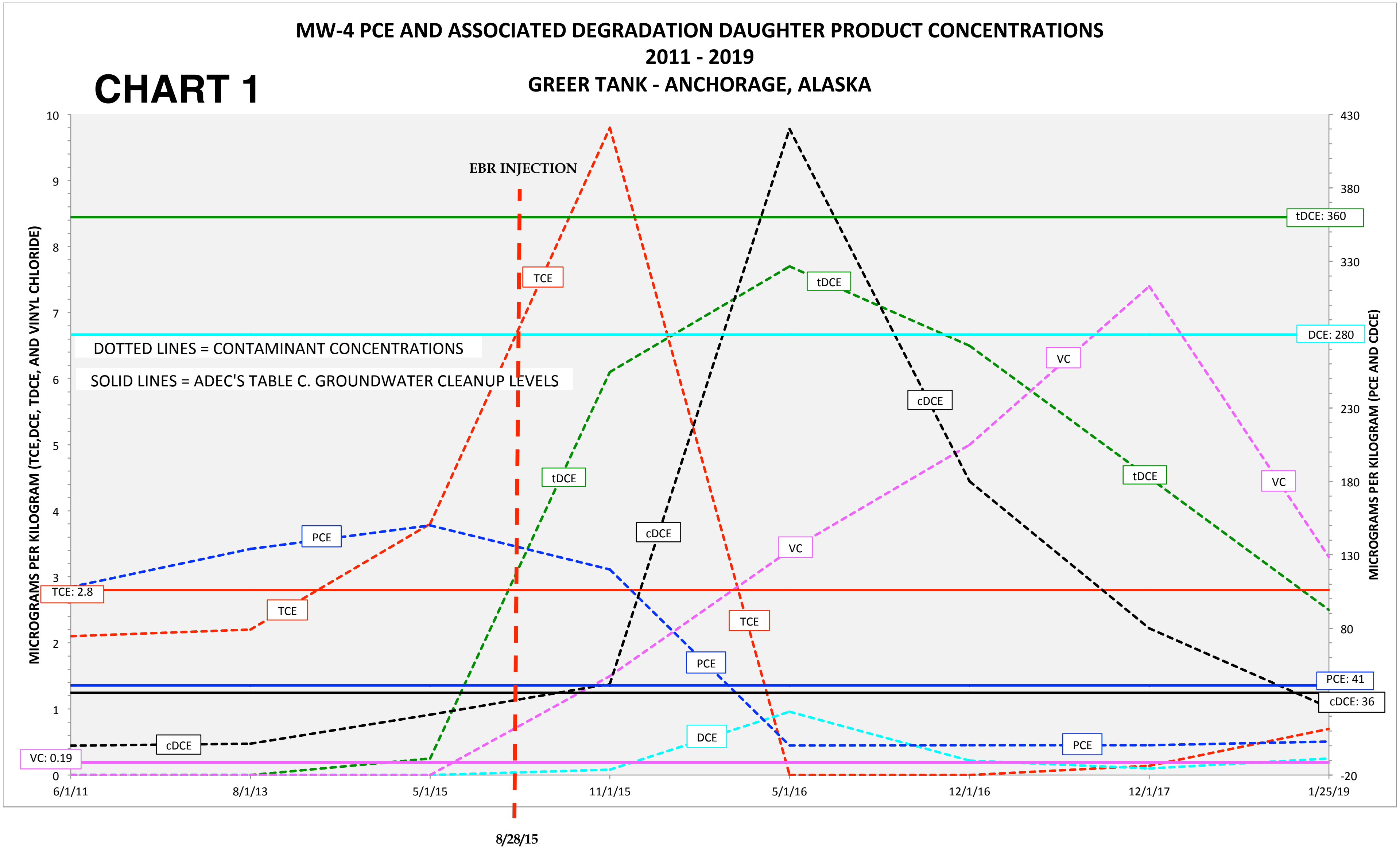
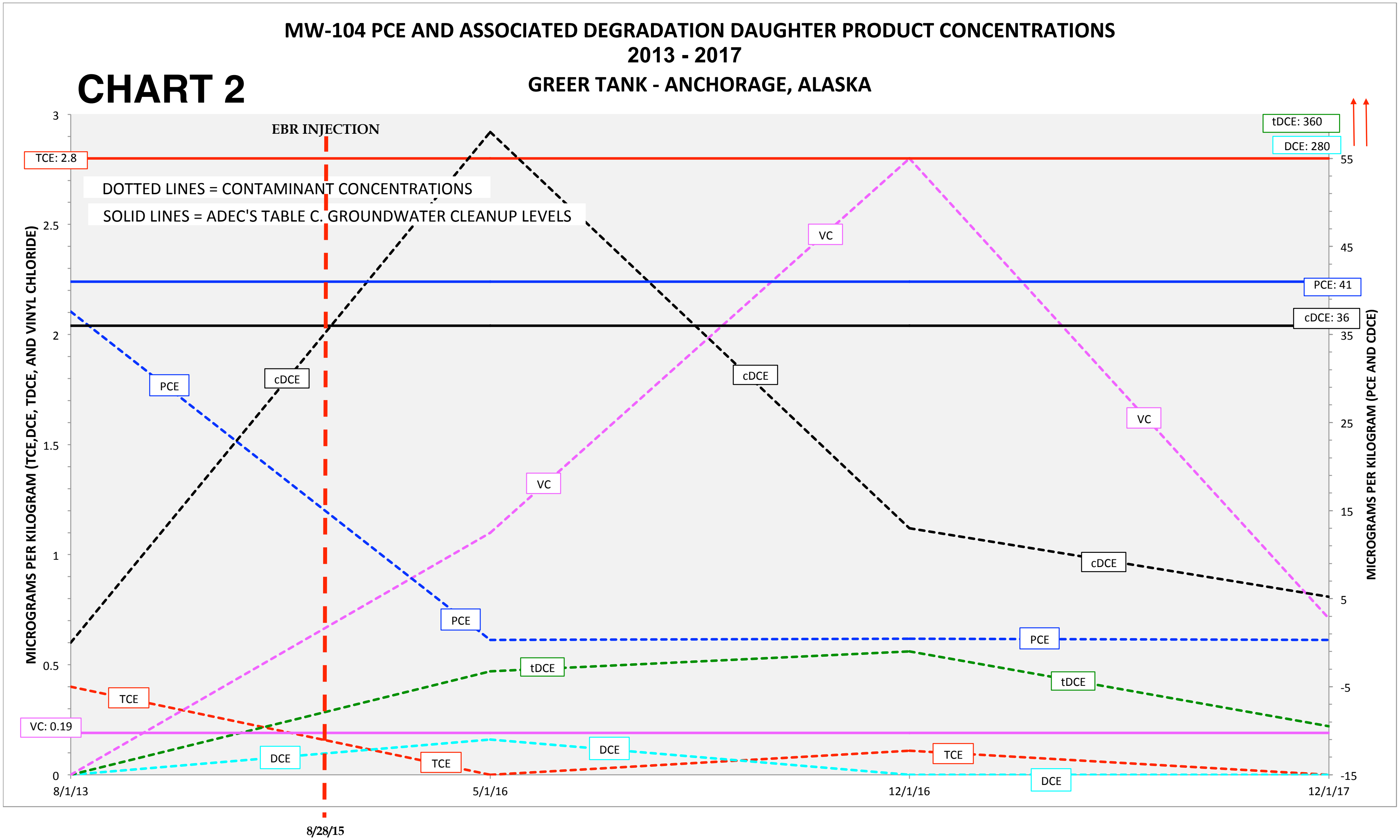
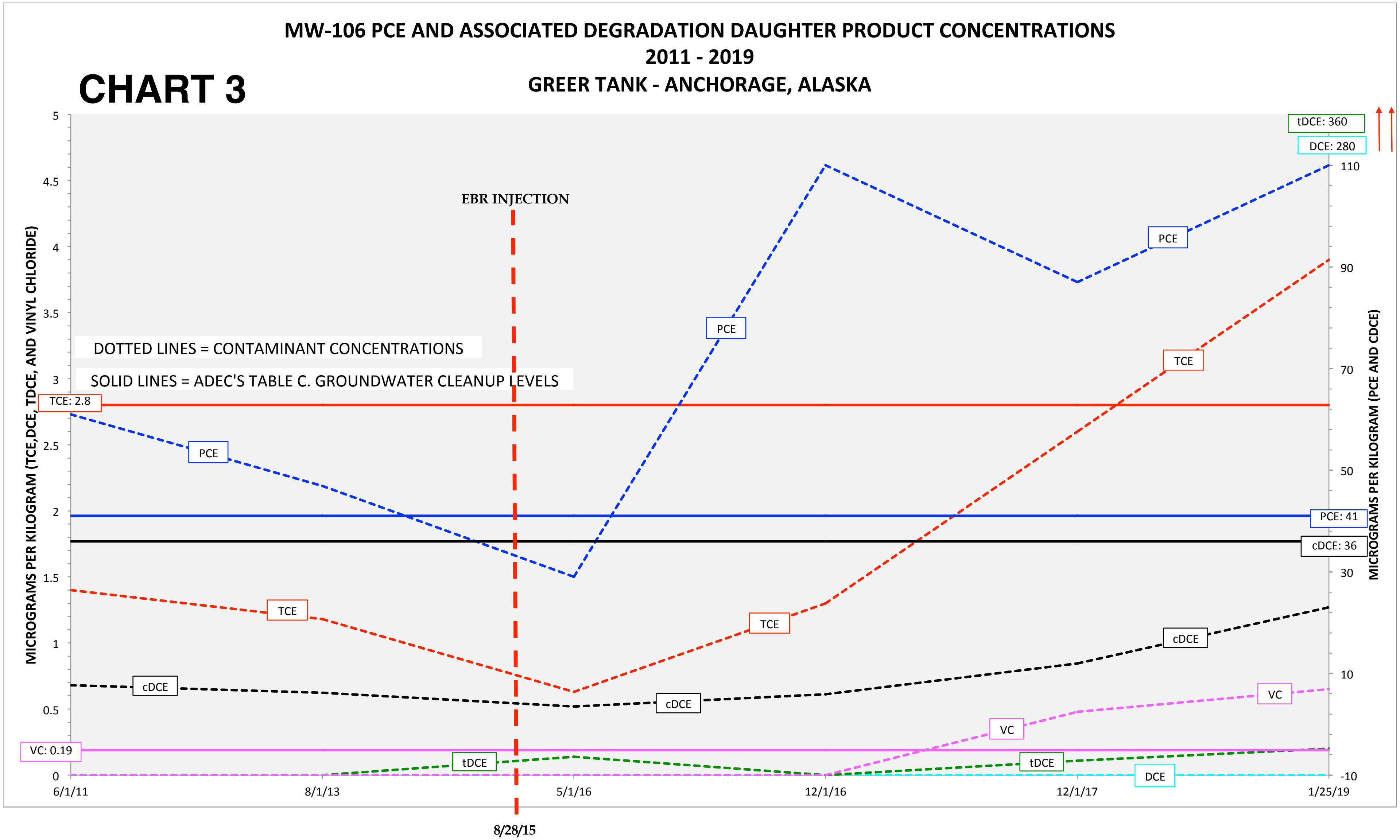
CHART 1



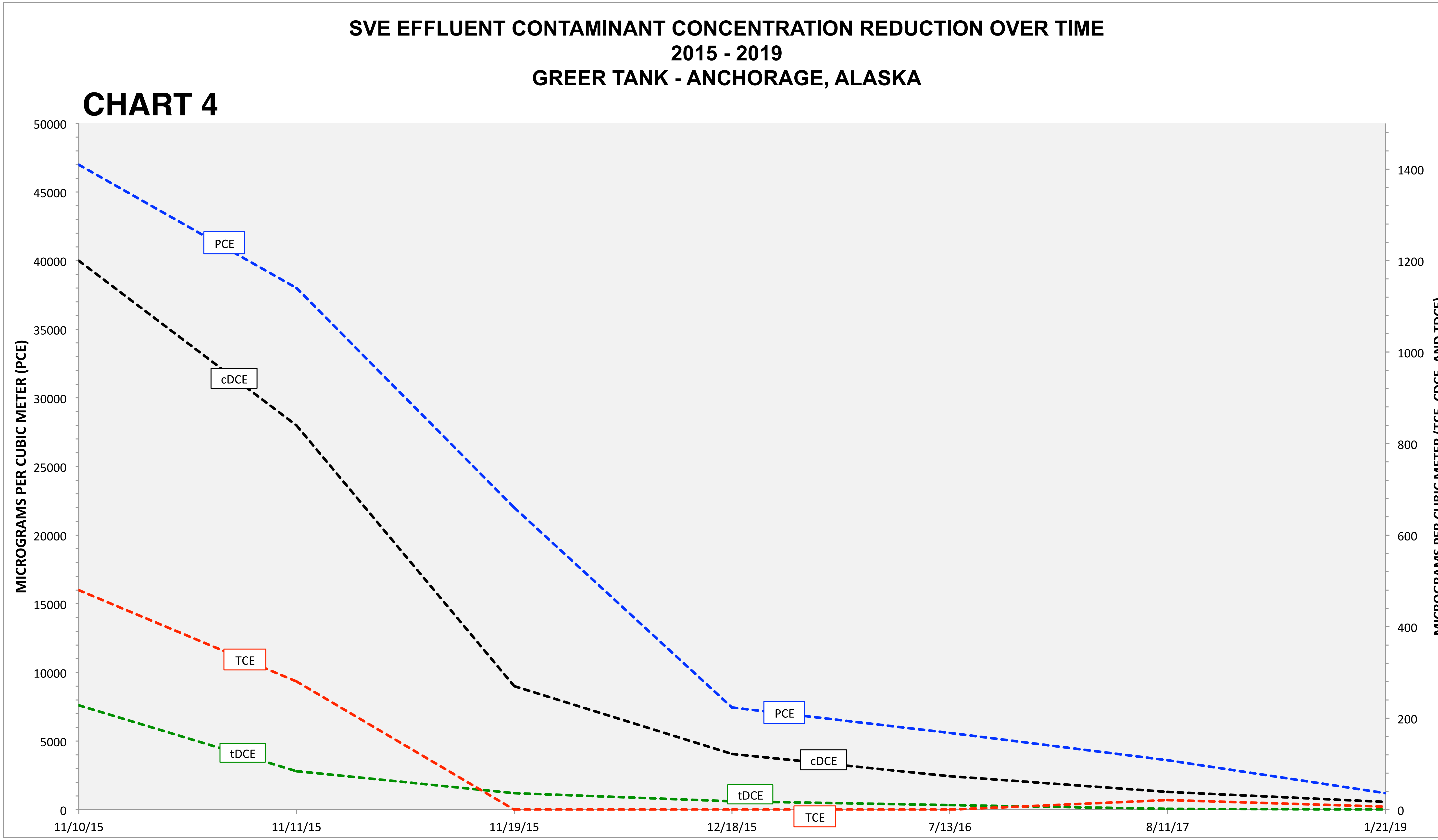
MW-4 PCE AND ASSOCIATED DEGRADATION DAUGHTER PRODUCT CONCENTRATIONS
2011 - 2019
GREER TANK - ANCHORAGE, ALASKA
MICROGRAMS PER KILOGRAM (TCE,DCE, TDCE, AND VINYL CHLORIDE)
MICROGRAMS PER KILOGRAM (PCE AND CDCE)
EBR INJECTION
8/28/15
DOTTED LINES = CONTAMINANT CONCENTRATIONS
SOLID LINES = ADEC'S TABLE C. GROUNDWATER CLEANUP LEVELS
tDCE: 360
DCE: 280
TCE: 2.8
PCE: 41
cDCE: 36
VC: 0.19
TCE
tDCE
cDCE
PCE
VC
DCE
6/1/11
8/1/13
5/1/15
11/1/15
5/1/16
12/1/16
12/1/17
1/25/19
0
1
2
3
4
5
6
7
8
9
10
-20
80
130
180
230
330
380
430



MW-104 PCE AND ASSOCIATED DEGRADATION DAUGHTER PRODUCT CONCENTRATIONS
2013 - 2017
GREER TANK - ANCHORAGE, ALASKA
CHART 2
EBR INJECTION
DOTTED LINES = CONTAMINANT CONCENTRATIONS
SOLID LINES = ADEC'S TABLE C. GROUNDWATER CLEANUP LEVELS
TCE: 2.8
tDCE: 360
DCE: 280
PCE: 41
cDCE: 36
VC: 0.19
PCE
cDCE
VC
TCE
tDCE
DCE
MICROGRAMS PER KILOGRAM (TCE,DCE, TDCE, AND VINYL CHLORIDE)
MICROGRAMS PER KILOGRAM (PCE AND CDCE)
8/1/13
5/1/16
12/1/16
12/1/17
8/28/15



MW-106 PCE AND ASSOCIATED DEGRADATION DAUGHTER PRODUCT CONCENTRATIONS
2011 - 2019
GREER TANK - ANCHORAGE, ALASKA
CHART 3
EBR INJECTION
DOTTED LINES = CONTAMINANT CONCENTRATIONS
SOLID LINES = ADEC'S TABLE C. GROUNDWATER CLEANUP LEVELS
TCE: 2.8
VC: 0.19
tDCE: 360
DCE: 280
PCE: 41
cDCE: 36
PCE
TCE
cDCE
tDCE
VC
DCE
MICROGRAMS PER KILOGRAM (TCE,DCE, TDCE, AND VINYL CHLORIDE)
MICROGRAMS PER KILOGRAM (PCE AND CDCE)
6/1/11
8/1/13
5/1/16
12/1/16
12/1/17
1/25/19
8/28/15



SVE EFFLUENT CONTAMINANT CONCENTRATION REDUCTION OVER TIME
2015 - 2019
GREER TANK - ANCHORAGE, ALASKA
CHART 4
MICROGRAMS PER CUBIC METER (PCE)
MICROGRAMS PER CUBIC METER (TCE, CDCE, AND TDCE)
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
1400
1200
1000
800
600
400
200
0
11/10/15
11/11/15
11/19/15
12/18/15
7/13/16
8/11/17
1/21/19
PCE
cDCE
TCE
tDCE

APPENDIX A

Field Notes and Sample Data Sheets

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APPENDIX B

Photographic Log

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APPENDIX C

SVE System O&M Sheets

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APPENDIX D

Laboratory Analytical Reports

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APPENDIX E

ADEC Laboratory Data Review Checklists

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