AECOM
1 John James Audubon Parkway
Suite210
Amherst, NY 14228
aecom.com

December 28, 2021

Mr. Glenn May, PG
New York State Department of
Environmental Conservation, Region 9
270 Michigan Avenue
Buffalo, NY 14203-2999

Subject: **Bioaugmentation Injection Program Summary Report**
Former Scott Aviation Facility – Area 1 Brownfield Cleanup Program
Lancaster, New York
NYSDEC Site Code No. C915233

Dear Mr. May:

On behalf of Tyco International and its successor Scott Figgie LLC, AECOM Technical Services, Inc. (AECOM) is providing this letter report detailing a summary of the September 2021 bioaugmentation injection program and associated comparison between the pre- and post-bioaugmentation injection groundwater data at the Former Scott Aviation Facility – Area 1 Brownfield Cleanup Program site (the Site) in Lancaster, New York (refer to **Figure 1** for the Site location and **Figure 2** for the Site Layout Map), New York State Department of Environmental Conservation (NYSDEC) Site No. C915233. The objective of this bioaugmentation injection program was to further remediate impacted Site groundwater.

This work was performed in accordance with the NYSDEC-approved Bioaugmentation Injection Work Plan (Work Plan) dated August 30, 2021 (**Attachment 1**).

This summary report provides the following information:

- Introduction and summary of the scope of work.
- A summary of Site remedial action objectives (RAOs).
- Summary of bioaugmentation injection program.
- Pre- and post-bioaugmentation injection groundwater data collection.
- Conclusions.

INTRODUCTION

The bioaugmentation injection program was performed by AECOM's subcontractor Matrix Environmental Technologies, LLC. (METI), with oversight by AECOM. The injectate used was a combination of KB-1® Plus (a bioengineered microbial culture by SiREM containing *Dehalococcoides* (Dhc), which is designed to promote the complete dechlorination of chlorinated ethenes to non-toxic ethene (including the degradation of CFC-113 to non-chlorinated end products)) and KB-1® Primer (a liquid used to prepare anaerobic water to disperse electron donors and protect KB-1® Plus during injection into the targeted aquifer). The injection encompassed an approximate 25-foot by 25-foot area around each of the following monitoring wells: A1-GP06-S, A1-GP10-S/MW-40D, and MW-42S. These monitoring wells are located where the highest total volatile organic compound (VOC) concentrations are detected in Site groundwater.

The scope of work for the bioaugmentation injection program consisted of three tasks: Task 1 – Project Management / Premobilization Activities; Task 2 – Bioaugmentation Injection Program; and Task 3 – Bioaugmentation Injection Program Summary Report. These tasks are summarized below.

Task 1 - Project management activities included updating the health and safety plan, preparing the Bioaugmentation Injection Program Work Plan (**Attachment 1**) and performing other organizational activities to prepare for the implementation of the bioaugmentation injection program. As part of the pre-mobilization activities, AECOM marked out the injection locations for DigSafely New York to complete the utility mark outs.

Task 2 – The bioaugmentation injection program included pre- and post-injection groundwater sampling and the bioaugmentation injections, as detailed in the Work Plan (**Attachment 1**) and summarized below.

Task 3 – The Bioaugmentation Injection Program Summary Report included the writing of this letter report, summarizing the bioaugmentation injection activities, and presenting the pre- and post-bioaugmentation injection groundwater data.

REMEDIAL ACTION OBJECTIVES

The objectives for the Site remedial program have been established though the remedy selection process stated in 6 New York Codes, Rules and Regulations (NYCRR) Part 375. The goal for the remedial program is to restore the Site to pre-disposal conditions to the extent feasible. At a minimum, the remedy must eliminate or mitigate all significant threats to the public health and the environment presented by VOCs identified at the Site through the proper application of scientific and engineering principles.

The RAOs for the groundwater at the Site as listed in the Decision Document are as follows:

- RAOs for Public Health Protection
    - Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
    - Prevent contact with, or inhalation of, VOCs from impacted groundwater.
- RAOs for Environmental Protection
    - Restore ground water aquifer to pre-disposal/pre-release conditions, to the extent practicable.
    - Prevent the discharge of contaminants of concern (COCs) to surface water.
    - Remove the source of ground or surface water COCs.

Contaminants of Concern

Nine COCs in groundwater have been determined through sampling associated with the Remedial Investigation and the Supplemental Remedial Investigation. Per the Decision Document, a “contaminant of concern” is a contaminant that is sufficiently present in frequency and concentration in the environment to require evaluation for remedial action. Not all constituents identified on the Site are COCs. The groundwater COCs identified at the Site and their associated RAOs (Guidance or Standard Values) from NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 protection for source of drinking water (groundwater) standards are listed below

- 1,1,1-Trichloroethane (1,1,1-TCA) – 5 micrograms per liter (µg/L)
- 1,1,2-Trichloroethane – 5 µg/L
- 1,1-Dichloroethane (1,1-DCA) – 5 µg/L
- 1,1-Dichloroethene (1,1-DCE) – 5 µg/L
- 1,2-Dichloroethane – 0.6 µg/L

- cis-1,2-Dichloroethene (cis-1,2-DCE) – 5 µg/L
- Tetrachloroethene (PCE) – 5 µg/L
- Trichloroethene (TCE) – 5 µg/L
- Vinyl chloride (VC) – 2 µg/L

SUMMARY OF BIOAUGMENTATION ACTIVITIES

Utility Survey

Prior to beginning any intrusive activities, AECOM marked out the injection locations with white spray paint and flagging. METI contacted the Underground Facilities Protection Organization (i.e., DigSafely New York) to mark out utilities in the proposed injection areas. There were no utilities identified by DigSafely New York in the injection area. To confirm there were no facility-related utilities in the injection area, AECOM met with facility maintenance to review injection locations and historic subsurface geophysical; no issues were identified. In addition, METI performed real-time ground-penetrating radar surveys around each injection point to obtain information on subsurface conditions and features, including utilities or obstructions. Per the data collected and reviewed, injection locations around monitoring wells A1-GP06-S and A1-GP10-S/MW-40D needed to be adjusted slightly due to a utility (refer to **Figure 3** for bioaugmentation injection locations).

Bioaugmentation Injections

METI mobilized equipment to the Site on September 17, 2021. Bioaugmentation injections were performed September 20, 2021 and September 21, 2021, and demobilization activities were completed on September 22, 2021. The bioaugmentation injection program consisted of injecting KB-1® Plus and KB-1® Primer at nine locations; three injection points where located around each of the three targeted monitoring wells (A1-GP06-S, A1-GP10-S/MW-40D, and MW-42S), with injection points biased to the upgradient groundwater side of each of the wells as shown in **Figure 3**. The total injection area was designed to address suspected VOC impacted groundwater around monitoring wells A1-GP06-S, A1-GP10-S/MW-40D, and MW-42S; these are the locations with the highest total VOC concentrations detected in Site groundwater. Photos collected during the injection activities are presented in **Attachment 2**.

The microbial culture KB-1® Plus and the KB-1® Primer was supplied by SiREM. The KB-1® Plus and the KB-1® Primer were mixed and injected according to the specification sheets with no deviations (refer to **Attachment 1** for SiREM's detailed specifications sheets and detailed mixing and injection procedures).

The bioaugmentation solution was injected in to the subsurface via direct push technology injections, targeting either 3 or 4 discrete intervals ranging between 5 and 20 feet below ground surface (ft bgs) depending on locations. Injection points were advanced using a Geoprobe® 6620DT drill rig, using 1.5-inch diameter drill rods. Each injection point around monitoring wells A1-GP10-S/MW-40D received approximately 200 gallons of KB-1® Plus/Primer (i.e., injectate) which was distributed at 5-foot depth intervals (5, 10, 15, and 20 ft bgs), targeting both the shallow and deep overburden groundwater zones. Each injection point around monitoring wells A1-GP06-S and MW-42S received approximately 150 gallons of injectate and was distributed at three depth intervals (8, 13, and 18 ft bgs), targeting the shallow overburden groundwater zone (refer to **Table 1** for a summary of the nine injection locations, injection intervals, and KB-1® Primer solution and KB-1® Plus bioaugmentation amounts injected).

The KB-1® Primer came in pouches suitable for mixing with approximately 250 gallons of potable water. An appropriate amount of the KB-1® Primer was weighted with a scale provided by SiREM and mixed with the amount of water required for each injection location (i.e., 60 % of a KB-1® Primer pouch for 150 gallons or 80% of a pouch for 200 gallons). The KB-1® Primer water mix was ready to inject when fully dissolved and upon pH and oxygen reduction potential (ORP) readings meeting the specifications designated by SiREM (i.e., 6 to 8.3 standard units for pH, and < -75 milliVolts for ORP).

Injection flow rates for the injections ranged from approximately 3 to 12.5 gallons per minute. The target volume of injections for each discrete interval regardless of location was 50 gallons (to minimize short circuiting or breakthrough). This is the minimum amount of KB-1® Primer water recommended by SiREM to support the KB-1® Plus. At each interval approximately half the injection amount of KB-1® Primer water (25 gallons) was injected. A target amount of KB-1® Plus (approximately 0.6 liters) was then injected using nitrogen gas to push the anaerobic microbial injectate into the targeted interval. The remaining half of the primer water was subsequently injected. Injections were conducted using a bottom-up approach, starting at the lowest designated interval, and raising the rods up the next interval following completion of the lower interval injection.

After each injection location was completed, injection boreholes were backfilled with a mixture of bentonite chips and granules and hydrated to minimize the potential for short circuiting of injection fluids from adjacent injection points to the ground surface.

The target volume for each interval was successfully delivered at each location (refer to **Table 1**). There were minor deviations for the location of injection points around monitoring wells A1-GP06-S and A1-GP10-S/MW-40D due to utilities (refer to **Figure 3** for actual injection locations). There were no deviations to the amounts injected when compared to the Work Plan (**Attachment 1**). Breakthrough was observed during injections at locations A1-GP06-S-B, MW-42S-A, MW-42S-B and MW-42S-C. In all cases breakthrough was very minor with minimal injection loss. When breakthrough was observed, METI stopped the injection and moved to another location. During the injection at monitoring well MW-42S-C, breakthrough was observed around the drill rods; the breakthrough was successfully eliminated by packing bentonite chips/granule mixture around the drill rods.

PRE- AND POST- BIOAUGMENTATION INJECTION GROUNDWATER ANALYTICAL DATA COLLECTION

Groundwater analytical data obtained following the bioaugmentation injections has been compared to the pre-bioaugmentation injection data and evaluated to initially assess the performance of the bioaugmentation injection program. The data have been interpreted to evaluate the effectiveness of the bioaugmentation injections in terms of contaminant reduction and bacteria population.

Pre-Injection Groundwater Data Collection

Total Organic Carbon (TOC) and VOC groundwater samples were collected between April 1 through 6, 2021, as part of the semi-annual (second quarter) 2021 groundwater sampling event, from monitoring wells A1-GP06-S, A1-GP10-S/MW-40D, and MW-42S. The samples collected were submitted to Eurofins TestAmerica for analysis; laboratory report was included in the April 2021 Periodic Review Report (PRR). This data was used to establish a pre-injection baseline for comparison to the post-injection TOC and VOC groundwater data (refer to **Table 2** for monitoring well data).

On August 26, 2021, AECOM collected pre-bioaugmentation injection groundwater samples from monitoring wells A1-GP10-S and MW-42S for volatile fatty acids (VFA) analysis and a groundwater sample from MW-42S for Gene-Trac® analysis. The pre-injection VFA data was used to establish a baseline and monitor the quality and form of fermentation byproducts of electron donors previously injected at the site. The pre-injection Gene-Trac® data was used as a baseline for confirming the post-injection distribution of the primary organisms in the KB-1® Plus culture (Dhc and *Dehalobacter* [Dhb]). The VFA and Gene-Trac® samples were submitted to SiREM for analysis. Sample collection procedures are detailed in the Work Plan (**Attachment 1)**. Pre-injection VFA and Gene-Trac® analytical data are summarized in **Table 3** and **Table 4,** respectively. The associated laboratory data reports are included in **Attachment 3**.

Post-Injection Groundwater Data Collection

During the week of October 18, 2021, approximately 35 days following the bioaugmentation injection, AECOM performed the semi-annual (fourth quarter) 2021 groundwater sampling event. Post-injection TOC and VOC groundwater data from monitoring wells A1-GP06-S, A1-GP10-S/MW-40D, and MW-42S were used for comparison against the previously collected pre-injection groundwater data (refer to **Table 2** for monitoring well data).

The laboratory report will be included in the April 2022 PRR. Below is a summary illustrating the percent reduction of VOC concentrations of COCs between pre- and post-bioaugmentation injection samples collected from monitoring wells.

Contaminants of Concern	A1-GP06-S	A1-GP10-S	MW-42S	MW-40D
1,1,1-Trichloroethane	ND	ND	ND	ND
1,1-Dichloroethane	73%	73%	23%	ND
1,1-Dichloroethene	ND	ND	ND	ND
Vinyl chloride	ND	ND	ND	ND

On December 9, 2021, approximately 80 days following the bioaugmentation injection event, AECOM collected groundwater samples from monitoring wells A1-GP10-S and MW-42S for VFA analysis and one groundwater sample from monitoring well MW-42S for Gene-Trac® analysis. A summary of the post-injection VFA and Gene-Trac® analytical data reports are presented in **Table 3** and **Table 4** respectively; laboratory data reports are included in **Attachment 3**.

CONCLUSIONS

Conclusions for the September 2021 bioaugmentation injection event and the associated pre- and post-injection analytical results are presented in the following subsections.

Volatile Organic Compounds and Total Organic Carbon

A comparison of the pre- and post-injection VOCs in groundwater monitoring wells targeted by the bioaugmentation injection program is presented in **Table 2**. Although the post-injection groundwater data was collected only approximately 35 days following the bioaugmentation injection event, post-injection results show a decrease in most VOC concentrations compared to the pre-injection groundwater VOC concentration data. At monitoring well A1-GP10-S, chloroethane increased from 8,600 to 15,000 µg/L and at monitoring well MW-42S, 1,1,2-trichloro-1,2,2-trifluoroethane increased from 380 µg/L to 430 µg/L. TOC decreased at monitoring wells A1-GP06-S, A1-GP10-S, MW-42S, and MW-40D between pre- and post-injection data. Also, of note is that the concentration of 1,1,1-TCA decreased in monitoring wells A1-GP06-S (from 210 µg/L to non-detect) and A1-GP10-S (2,200 µg/L to non-detect) between the August and December 2021 sampling events. 1,1,1-TCA was not detected in monitoring wells MW-42S or MW-40D during either sampling event. 1,1,1-TCA may inhibit the biodegradation of TCE and associated chlorinated ethenes, and in particular, VC accumulation may occur if 1,1,1-TCA is present. These results indicate that VC accumulation should not be occurring at the site.

A TOC concentration of 20 milligrams per liter (mg/L) is commonly considered the minimum concentration of carbon necessary for effective reductive dechlorination to occur. While the TOC detected in monitoring wells A1-GP06-S, A1-GP10-S, MW-42S, and MW-40D decreased between April 2021 and October 2021, TOC continued to remain above the minimum threshold of 20 mg/L. The bioaugmentation event conducted at the site in September 2021 would not be expected to increase the concentration of TOC in the area targeted by the injections. The TOC detected is the result of natural organic carbon present in site groundwater and also from previous injections of an organic carbon substrate. The most recent organic carbon injection event conducted at the site was performed between 20 and 22 May 2021. At that time, Anaerobic BioChem-Ole' (ABC-Ole') with zero valent iron was injected within a 6,750 square foot area that surrounded or was in close vicinity to the aforementioned monitoring wells.

Volatile Fatty Acids

In addition to a TOC concentration greater than 20 mg/L, the quantification of VFAs is useful to assess the form of TOC present and its availability to promote the reductive dechlorination process. VFAs are fermented by a variety of pathways to produce the hydrogen necessary for complete reductive dechlorination to occur. In general, VFAs should be in excess of 10 to 20 mg/L. Pre- and post-injection VFA data is summarized in **Table 3**; the associated laboratory data reports are included in **Attachment 3**.

Six VFAs were analyzed for by SiREM. Lactate is a component of the ABC-Ole' that was previously injected at the site. Lactate ferments to the VFAs acetate and propionate. Lactate can be used as a qualitative measure of the remaining unused reducing potential of the previously injected ABC-Ole'. For both monitoring wells A1-GP10-S and MW-42S, lactate was not detected during either the August or December 2021 sampling events.

Acetate is fermented from lactate, ABC-Ole', and sugars. Dhb can use acetate as a low energy source while Dhc cannot. Dhb is implicated in the biodegradation of chlorinated ethenes such as PCE and TCE to cis-1,2-DCE and also in the biodegradation of the chlorinated ethane 1,1,1-TCA to 1,1-DCA and subsequently to chloroethane. As a result, the presence of acetate indicates that partial reductive dechlorination can occur. However, complete reductive dechlorination to ethene will not occur without the presence of other VFAs and Dhc. Acetate decreased in monitoring well MW-42S (574 mg/L to 476 mg/L) and increased in monitoring well A1-GP10-S (471 mg/L to 494 mg/L).

Propionate is fermented from lactate, ABC-Ole', and alcohols. Propionate subsequently ferments to produce hydrogen and formate. Hydrogen is the preferred electron acceptor for reductive dechlorination because of the high energy yield. Dhb can use both acetate and hydrogen as an energy while Dhc can only use hydrogen as an energy source. Slow fermentation of propionate results in efficient reductive dechlorination (less methanogenesis) and optimal Dhc growth. It also promotes Dhb growth. Propionate decreased in monitoring well MW-42S (148 mg/L to 118 mg/L) and increased in monitoring well A1-GP10-S (68 mg/L to 151 mg/L).

Formate is created from the fermentation of propionate. Formate is fermented to produce hydrogen and bicarbonate. Formate was not detected in monitoring well MW-42S in August or December 2021. Formate at A1-GP10-S increased from non-detect to 6.3 mg/L between August and December 2021.

Pyruvate is created from the fermentation of sugars. Pyruvate is subsequently fermented to propionate and acetate with some hydrogen production. Pyruvate decreased in monitoring well MW-42S (26 mg/L to 18 mg/L) and increased in monitoring well A1-GP10-S (5.3 mg/L to 15 mg/L).

Butyrate is created from the fermentation of ABC-Ole' and alcohols. Butyrate ferments to produce hydrogen and acetate. Slow fermentation of butyrate results in efficient reductive dechlorination (less methanogenesis) and optimal Dhc growth. It also promotes Dhb growth. Butyrate decreased in monitoring well MW-42S (108 mg/L to 75 mg/L) and increased in monitoring well A1-GP10-S (46 mg/L to 55 mg/L).

Overall, the December 2021 VFA results for both monitoring wells MW-42S and A1-GP10-S indicate the presence of five of the six VFAs that were analyzed for. Most importantly, both propionate and butyrate were present at both wells. Both of these VFAs produce hydrogen when they are fermented, which is essential for complete reductive dechlorination to occur. These results indicate that complete reductive dechlorination to ethene can occur in the vicinity of both wells if Dhc is present in sufficient quantity. Also, the presence of Dhb in sufficient quantity in the vicinity of both wells may help to promote the degradation of 1,1,1-TCA and 1,1-DCA to chloroethane. A discussion of Dhc, Dhb, and reductase results is provided in the next subsection.

Gene-Trac®

Gene-Trac® Dhc is used to detect Dhc in a groundwater sample. The detection of Dhc is significant as Dhc contain the greatest number of reductive dehalogenase genes of any microbial group. Dhc is capable of the reductive dechlorination of PCE, TCE, cis-1,2-DCE, 1,1-DCE, trans-1,2-dichloroethene, and VC. Pre- and post-injection Gene-Trac® data is summarized in **Table 4**; laboratory data reports are included in **Attachment 3**.

Both the pre- and post-injection Gene-Trac® Dhc results indicate 2 x 10^8 Dhc gene copies per liter. Per the technical notes from SiREM regarding interpretation of data (refer to **Attachment 4**), when the density of Dhc gene copies per liter is 1 x 10^7 or higher, this concentration is often associated with significant dechlorination rates.

Gene-Trac® *vcrA*, *bvcA*, and *tceA* quantifies genes that code for reductase enzymes that dechlorinate chlorinated ethenes and other compounds. The *vcrA*, *bvcA*, and *tceA* genes play specific roles in reductive dechlorination. Specifically, the Gene-Trac® *vcrA* and *bvcA* test quantifies VC-reductase genes that produce enzymes that convert VC

to ethene. The *vcrA* reductase gene is reported to be the most commonly identified VC reductase gene in the environment, whereas *bvcA* is generally less common but can predominate in more oxidizing groundwater and possibly where DCE is dominant. The Gene-Trac® *tceA* test quantifies the TCE reductase gene that produces an enzyme that primarily converts TCE to cis-1,2-DCE and VC.

The *vcrA* reductase gene was detected in monitoring well MW-42S at 3 x 10^8 gene copies per liter in August 2021 and at 2 x 10^8 gene copies per liter in December 2021. The *bvcA* reductase gene was detected in monitoring well MW-42S at 2 x 10^5 gene copies per liter in August 2021 and at 1 x 10^5 gene copies per liter in December 2021. The *tceA* reductase gene was detected in monitoring well MW-42S at 2 x 10^7 gene copies per liter in August 2021 and at 8 x 10^6 gene copies per liter in December 2021. Per the technical notes from SiREM, although the concentration *bvcA* and *tceA* is less than 1 x 10^7 gene copies per liter, the potential for complete dechlorination of the chlorinated ethenes remains significant because Dhc and *vcrA* are present at greater than or equal to 1 x 10^7. Additionally, VC stall is unlikely when *vcrA* is detected at greater than 1 x 10^7 gene copies per liter, 1,1,1-TCA is not present, and ethene is detectable. At monitoring well MW-42S, ethene was detected at 3,400 µg/l and 3,500 µg/l in April 2021 and October 2021, respectively.

Gene-Trac® Dhb is used to detect Dhb in a groundwater sample. Dhb are implicated in the biodegradation of the chlorinated ethane 1,1,1-TCA to 1,1-DCA and subsequently to chloroethane. The conversion of chloroethane to ethane is reported but is not widely observed, so it is considered to be unconfirmed. The detection of Dhb indicates that dechlorination activities attributed to Dhb may be active. Increasing concentrations of Dhb are indicative of increased potential for degradation. Dhb was detected at 6 x 10^6 gene copies per liter in August 2021 and increased to 1 x 10^7 gene copies per liter in December 2021.

In summary, Dhc and *vcrA* are present at monitoring well MW-42S at concentrations that indicate a significant potential for complete dechlorination of chlorinated ethenes to occur. Dhb is also present at a concentration that indicates a significant potential for 1,1,1-TCA and 1,1-DCA to dechlorinate to chloroethane. Additional time is needed to evaluate the overall impact of the bioaugmentation event in the vicinity of this well.

Monitored Natural Attenuation

Monitored natural attenuation data from the second quarter 2021 and fourth quarter 2021 groundwater sampling events are summarized in **Table 5**. Per **Table 5**, two of the four wells sampled for MNA parameters within the targeted bioaugmentation area show strong evidence for anerobic biodegradation of chlorinated organics to occur (i.e., monitoring wells MW-42S and A1-GP06-S); the remaining wells (A1-GP10-S and MW-40D) show adequate evidence for anerobic biodegradation of chlorinated organics to occur. An increase in the total screening score (from 11 points to 15 points at A1-GP10-S and from 15 points to 16 points at monitoring well MW-40D) occurred for these two wells.

Recommendations

Based on the information presented above, more time is needed to evaluate the impact of the bioaugmentation injection program. In April 2022, the 2022 semi-annual monitoring event will be performed; groundwater samples from the monitoring well network will be analyzed for VOCs, TOC, and select monitoring wells will be sampled for MNA parameters. Additionally, in April 2022, VFA samples will be collected at monitoring wells MW-42S and A1-GP10-S, and a Gene-Trac® sample will be collected at monitoring well MW-42S; these data will be used to track the performance of the bioaugmentation injection program. Groundwater data from the April 2022 sampling event will be summarized in the 2022 PRR as related to the performance of the 2021 bioaugmentation injection program.

If you have any questions regarding this submission, please do not hesitate to contact me at (716) 923-1125 or via e-mail at dino.zack@aecom.com.

Yours sincerely,

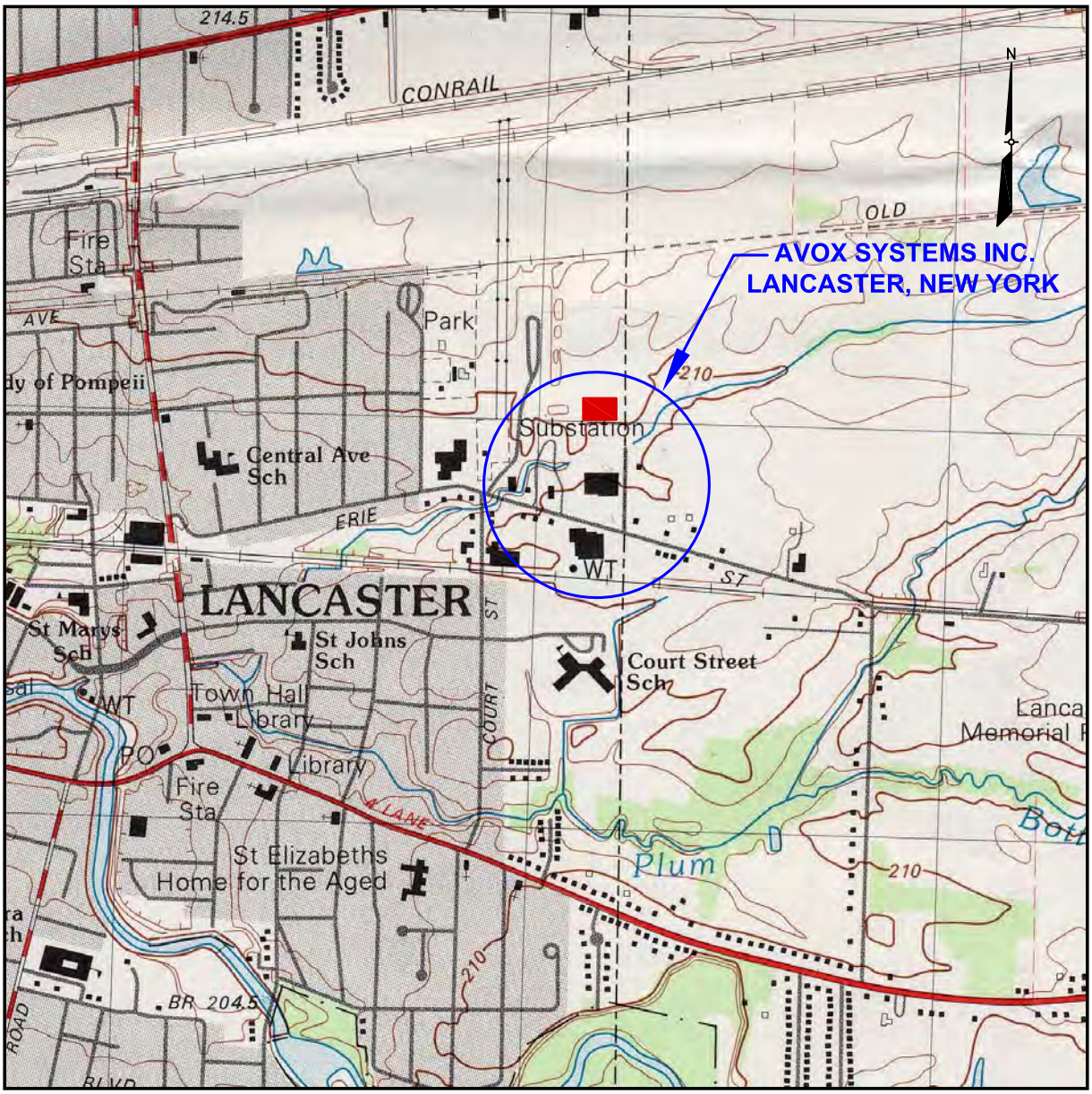
Dino L. Zack, PG, STS
Project Manager

dino.zack@aecom.com

\Enclosures

cc: Mr. Stuart Rixman, GSF Management Company, LLC (electronic copy)
Mr. Troy Chute, GSF Management Company, LLC (electronic copy)
Mr. Raymond DeCarlo, AVOX Systems Inc. (electronic copy)
Mr. Allen Thomalla, AVOX Systems Inc. (electronic copy)
Mr. Hunter Bogdan, AVOX Systems Inc. (electronic copy)
Project File 60536398

Figures



SOURCE:
1982 U.S. GEOLOGIC SURVEY 7.5 X 15 MINUTE TOPOGRAPHIC QUADRANGLE
LANCASTER, NEW YORK

LEGEND

AVOX PLANT 3 ADDED AFTER PUBLICATION OF LANCASTER, NEW YORK TOPOGRAPHIC QUADRANGLE.

0 1000 2000
SCALE IN FEET

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FIGURE 1
SITE LOCATION MAP

FORMER SCOTT AVIATION FACILITY AREA 1
LANCASTER, NEW YORK

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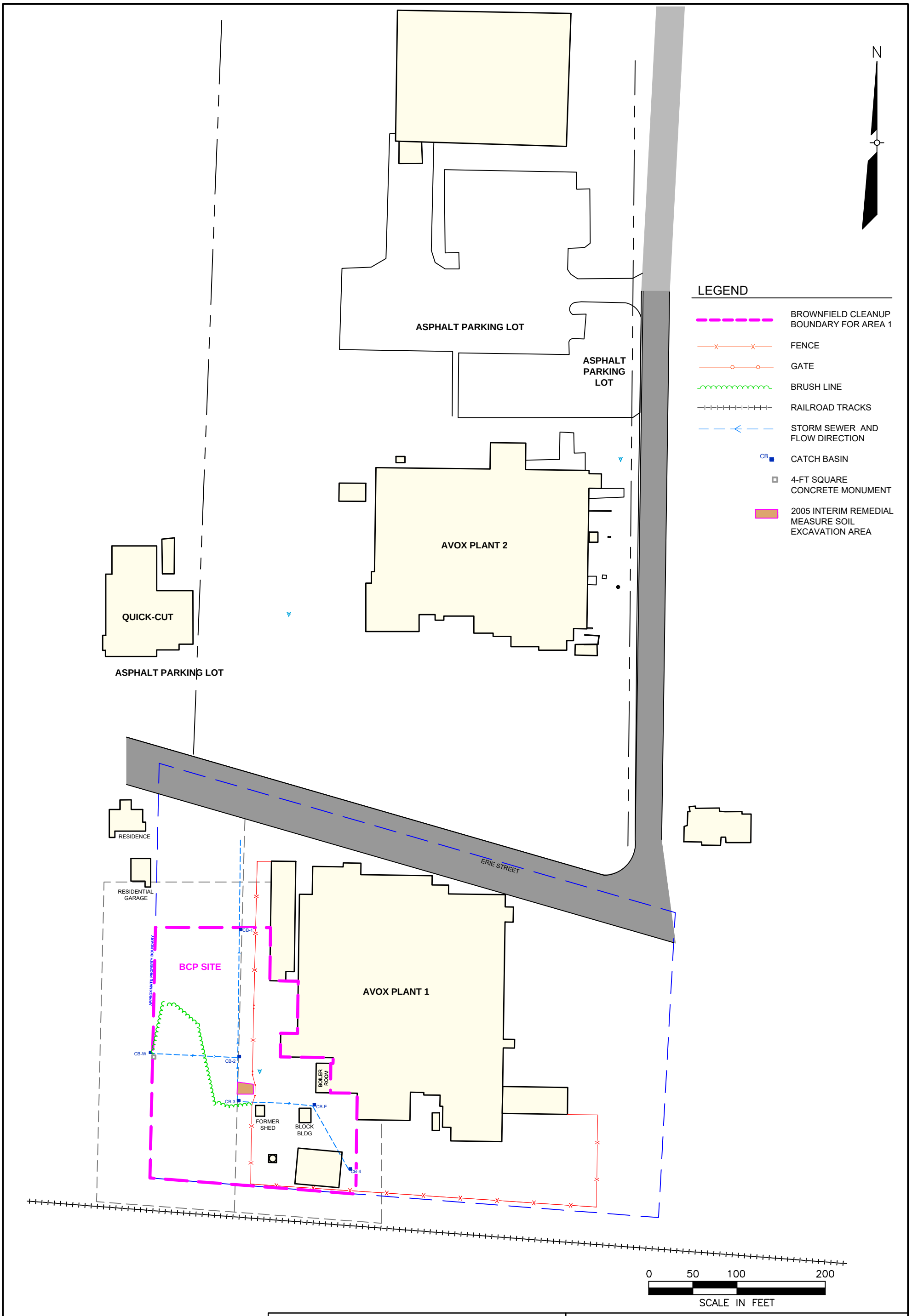

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FIGURE 2
SITE LAYOUT MAP

FORMER SCOTT AVIATION FACILITY AREA 1
LANCASTER, NEW YORK

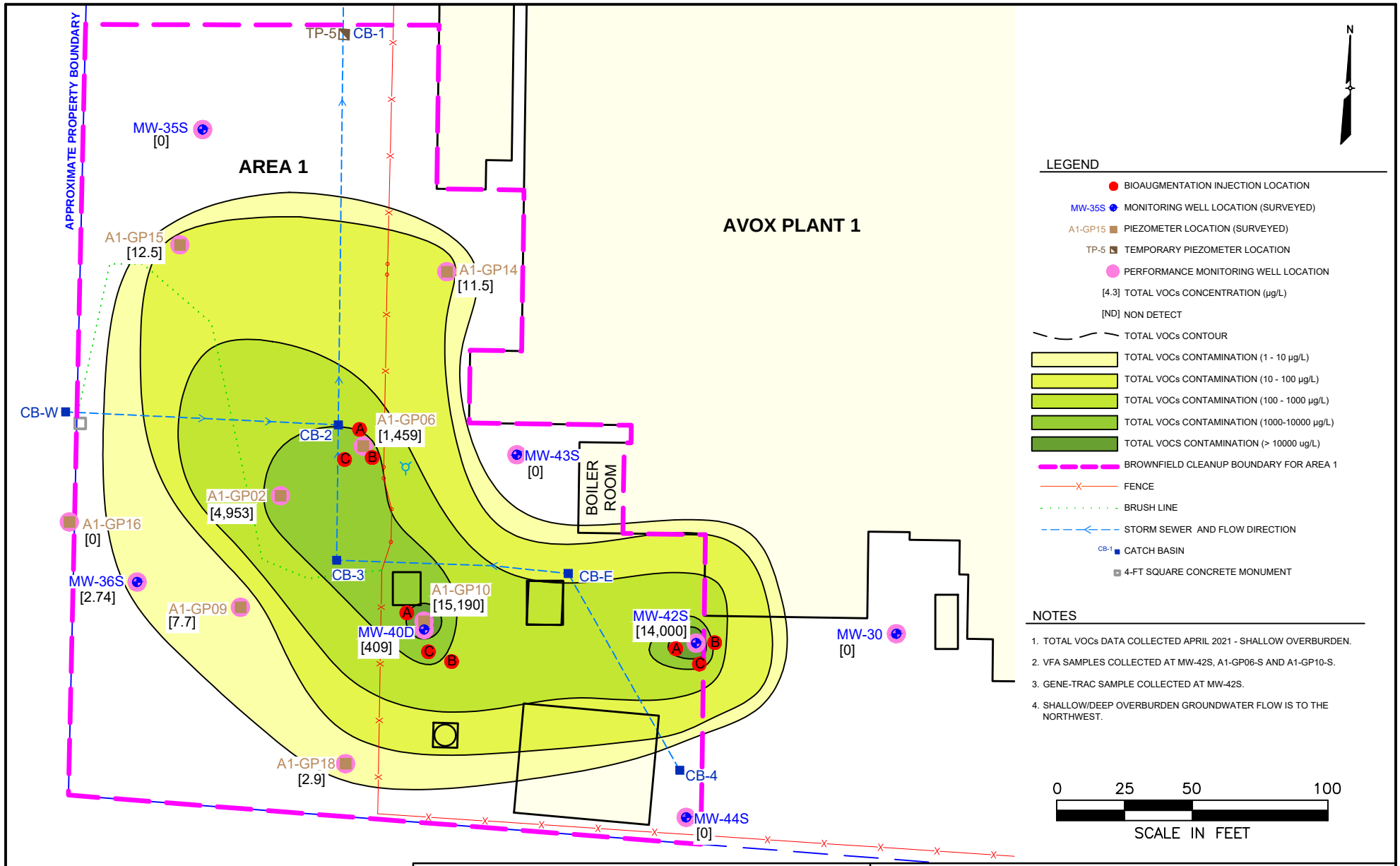

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FIGURE 3
BIOAUGMENTATION INJECTION POINTS

FORMER SCOTT AVIATION FACILITY AREA 1
LANCASTER, NEW YORK

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Tables

Table 1

Bioaugmentation Injection Intervals and Injectate Volumes
Former Scott Aviation Facility - Area 1 BCP Site
NYSDEC Site Code No. C915233
Lancaster, New York

A1-GP06-S

Injection point GP06-A-18' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point GP06-A-13' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point GP06-A-08' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer

Injection point GP06-B-18' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point GP06-B-13' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point GP06-B-08' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer

Injection point GP06-C-18' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point GP06-C-13' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point GP06-C-08' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer

A1-GP10-S

Injection point GP10-A-20' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point GP10-A-15' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point GP10-A-10' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point GP10-A-05' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer

Injection point GP10-B-20' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point GP10-B-15' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point GP10-B-10' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point GP10-B-05' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer

Injection point GP10-C-20' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point GP10-C-15' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point GP10-C-10' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point GP10-C-05' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer

MW-42S

Injection point MW-42S-A-18' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point MW-42S-A-13' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point MW-42S-A-08' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer

Injection point MW-42S-B-18' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point MW-42S-B-13' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point MW-42S-B-08' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer

Injection point MW-42S-C-18' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point MW-42S-C-13' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer
Injection point MW-42S-C-08' – 0.16 gallons KB-1® Plus / 50 gallons KB-1® Primer

Table 2

Pre- and Post-Bioaugmentation Injection Monitoring Well Analytical Data Comparison
Former Scott Aviation Facility - Area 1 BCP Site
NYSDEC Site Code No. C915233
Lancaster, New York

Sample ID	Groundwater	A1-GP06-S	A1-GP06-S	A1-GP10-S	A1-GP10-S	MW-42S	MW-42S	MW-40D	MW-40D
Date Collected	RAO/TOGS 1.1.1	04/02/21	10/22/21	04/02/21	10/27/21	04/02/21	10/27/21	04/02/21	10/27/21
Lab Sample ID	Objective	480-182787-2	480-191326-5	480-182787-3	480-191541-1	480-182787-5	480-191541-7	480-182787-1	480-191541-6
Volatile Organic Compounds by Method 8260 (µg/L)									
1,1-Dichloroethane*	5	**200**	**54**	**3,700**	**1,000**	**710**	**550**	**8.6**	< 8.0 U
1,1-Dichloroethene*	5	< 25 U	< 25 U	**200**	< 200 U	< 200 U	< 200 U	< 8.0 U	< 8.0 U
1,1,1-Trichloroethane*	5	**210**	< 25 U	**2,200**	< 200 U	< 200 U	< 200 U	< 8.0 U	< 8.0 U
1,1,2-Trichloro-1,2,2-trifluoroethane	5	**36**	< 25 U	**490**	< 200 U	**380**	**430**	< 8.0 U	< 8.0 U
Chloroethane	5	**1,000**	**880**	**8,600**	**15,000**	**12,000**	**10,000**	**400**	**230**
Methylene Chloride	5	**13 J**	< 25 U	< 200 U	< 200 U	**100 J**	< 200 U	< 8.0 U	< 8.0 U
Toluene	5	< 25 U	< 25 U	< 200 U	< 200 U	**620**	**570**	< 8.0 U	< 8.0 U
Vinyl chloride*	2	< 25 U	< 25 U	< 200 U	< 200 U	**190 J**	< 200 U	< 8.0 U	< 8.0 U
Total Volatile Organic Compounds	NL	1,459	934	15,190	16,000	14,000	11,550	409	230
Total Organic Carbon	NL	115	84	71.1	42	427	333	166	57

Notes:
Bold font indicates the analyte was detected.
Bold font and bold outline indicates the screening criteria was exceeded.
VOC - Volatile Orgainic Compound
TOC - Total Organic Carbon
Volatile Organic Compounds - Green font indicates decrease in post-injection VOC concentrations and red font indicates increase in post-injection VOC concentrations.
Total Organic Carbon - Red font indicates decrease in post-injection TOC concentrations.
RAO - Remedial Action Objectives
TOGS 1.1.1 - NYSDEC Technical and Operational Guidance Series 1.1.1
* Site-specific RAO per Record of Decision (November 1994).
Volatile Organic Compounds by Environmental Protection Agency Method 8260D (SW-846).
Total Organic Carbon by Environmental Protection Agency Method 9060A (SW-846).
µg/L - microgram per liter.
mg/L - milligrams per liter.
J - Result is less than the reporting limit but greater than or equal to the method detection limit and the concentration is an approximate value.
U - Not detected at or above reporting limit.
NL - Not listed.

Table 3

Pre- and Post-Bioaugmentation Injection VFA Data Comparison
Former Scott Aviation Facility - Area 1 BCP Site
NYSDEC Site Code No. C915233
Lancaster, New York

Sample ID	Sample Date	Sample Dilution Factor	Lactate	Acetate	Propionate	Formate	Butyrate	Pyruvate
			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
MW-42S	8/26/2021	50	<0.39	574	148	<0.22	108	26
MW-42S	12/9/2021	50	<0.39	476	118	<0.22	75	18
A1-GP10-S	8/26/2021	50	<0.39	471	68	<0.22	46	5.3
A1-GP10-S	12/9/2021	50	<0.39	494	151	6.3	55	15

Notes:
VFA - Volatile Fatty Acids
mg/L - milligrams per liter

Table 4

Pre- and Post-Bioaugmentation Injection Gene-Trac Data Comparison
Former Scott Aviation Facility - Area 1 BCP Site
NYSDEC Site Code No. C915233
Lancaster, New York

Sample ID	Sample Date	*Dehalococcoides* (Dhc)		*Dehalobacter* (Dhb)		VC Reductase (*vcrA*)		BAV1 VC Reductase (*bvcA*)		TCE Reductase (*tceA*)	
		Percent Dhc	Enumeration/Liter	Percent Dhb	Gene Copies/Liter	Percent vcrA	Gene Copies/Liter	Percent bvcA	Gene Copies/Liter	Percent tceA	Gene Copies/Liter
MW-42S	8/26/2021	5 - 13 %	2×10^8	0.2 - 0.5 %	6×10^6	8 - 21 %	3×10^8	0.007 - 0.02 %	2×10^5	0.6 - 2 %	2×10^7
MW-42S	12/9/2021	2 - 5 %	2×10^8	0.1 - 0.3 %	1×10^7	2 - 6 %	2×10^8	0.001 - 0.004 %	1×10^5	0.08 - 0.2 %	8×10^6

Table 5

Pre- and Post-Bioaugmentation Injection Bioattenuation Screening Summary
Former Scott Aviation Facility - Area 1 BCP Site
NYSDEC Site Code No. C915233
Lancaster, New York

Parameter	Units	Criteria		Score Value	Monitoring Well Identification													
					A1-GP10-S (source area)		A1-GP10-S (source area)		MW-42S (source area)		MW-42S (source area)		A1-GP06-S (downgradient)		A1-GP06-S (downgradient)		MW-40D (source area)		MW-40D (source area)	
					4/1/21	Score	10/27/21	Score	4/2/21	Score	10/27/21	Score	4/1/21	Score	10/22/21	Score	4/1/21	Score	10/27/21	Score
Dissolved Oxygen	mg/L	< 0.5 mg/L	Tolerated, suppresses the reductive pathway at higher concentrations	3							0.15	3			0.38	3			0.45	3
		> 5 mg/L	Not tolerated; however, VC may be oxidized aerobically	-3	8.7	-3	4.99	0	2.23	-3			3.48	0			2.19	0		
Nitrate	mg/L	< 1 mg/L	At higher concentrations may compete with reductive pathway	2	0.12	2	0.05	2	<0.050	2	0.088	2	<0.050	2	0.019	2	0.035	2	<0.050	2
Ferrous Iron	mg/L	> 1 mg/L	Reductive pathway possible	3	<0.10	0	0.23	0	2.0	3	6.1	3	<0.10	0	<0.10	0	0.57	0	0.74	0
Sulfate	mg/L	< 20 mg/L	At higher concentrations may compete with reductive pathway	2	<10.0	2	2.2	2	<10.0	2	<2.0	2	<10	2	2.2	2	<10	2	<2.0	2
Sulfide	mg/L	> 1 mg/L	Reductive pathway possible	3	<1.0	0	<1.0	0	<1.0	0	<1.0	0	<1.0	0	1.6	3	<1.0	0	<1.0	0
Methane	µg/L	< 500 µg/L	VC oxidizes	0																
		> 500 µg/L	Ultimate reductive daughter product, VC accumulates	3	7,600	3	10,000	3	15,000	3	11,000	3	19,000	3	15,000	3	21,000	3	7,400	3
Ethene	µg/L	> 10 µg/L	Daughter product of VC	2	<150	0	<77	0	3,400	2	3,500	2	<77	0	<150	0	<150	0	<150	0
Ethane	µg/L	> 100 µg/L	Daugher product of Ethene	3	<170	0	<83	0	410	3	680	3	<83	0	<170	0	<170	0	<170	0
ORP	mV	< 50 mV	Reductive pathway possible	1	-36.9	1					-93.2	1	-53	1						
		< -100 mV	Reductive pathway likely	2			-100.1	2	-103.1	2					-131.8	2	-186.4	2	-152.6	2
pH	s.u.	5 < pH < 9	Optimal range for reductive pathway	0	6.65	0	6.85	0	NA	0	6.60	0	6.81	0	7.26	0	7.65	0	7.21	0
		5 > pH > 9	Outside optimal range for reductive pathway	-2																
Temperature	°C	> 20°C	At temperature > 20°C, biochemical process is accelerated	1	7.73	0	14.2	0	8.05	0	17.4	0	7.55	0	13.3	0	9.2	0	13.3	0
TOC	mg/L	> 20 mg/L	Carbon and energy source, drives dechlorination (natural or anthropogenic)	2	71.1	2	41.6	2	427	2	333	2	155	2	84.3	2	166	2	57	2
Carbon Dioxide	µg/L	> 2x background	Ultimate oxidative product	1	93,000	0	120,000	0	47,000	0	65,000	0	47,000	0	74,000	0	42,000	0	64,000	0
Alkalinity	mg/L	> 2x background	Results from interaction of btwn CO_2 and aquifer minerals	1	600	0	563	0	798	0	497	0	632	0	573	0	397	0	374	0
PCE[1]	µg/L	----	N/A	0	<200	0	<200	0	<200	0	<200	0	<25	0	<25	0	<8	0	<8.0	0
TCE[2]	µg/L	----	Material Released	0	<200	0	<200	0	<200	0	<200	0	<25	0	<25	0	<8	0	<8.0	0
DCE[3]	µg/L	----	Daugher product of TCE (score if cis-1,2-DCE is 80% of total DCE)	2	<200	0	<200	0	<200	0	<200	0	<25	0	<25	0	<8	0	<8.0	0
VC[4]	µg/L	----	Daugher product of DCE	2	<200	0	<200	0	190	2	<200	0	<25	0	<25	0	<8	0	<8.0	0
1,1,1-TCA[5]	µg/L	----	Material Released	0	2,200	0	<200	0	<200	0	<200	0	31	0	<25	0	<8	0	<8.0	0
1,1-DCA[6]	µg/L	----	Daugher product of 1,1,1-TCA under reducing conditions	2	3,700	2	1,000	2	710	2	550	2	210	2	54	2	8.6	2	<8.0	0
CA[7]	µg/L	----	Daughter product of 1,1-DCA or VC under reducing conditions	2	8,600	2	15,000	2	12,000	2	10,000	2	1,000	2	880	2	400	2	230	2
			TOTAL SCORE			**11**		**15**		**22**		**25**		**14**		**21**		**15**		**16**

Notes:

DCE = dichloroethene
°C = degrees Celsius
µg/L = micrograms per liter
mg/L = milligrams per liter
mV = millivolts
ORP = oxidation-reduction potential
s.u. = standard unit
PCE = tetrachloroethene
TCE = trichloroethene
TOC = total organic carbon
VC = vinyl chloride
1,1,1-TCA = 1,1,1-trichloroethane
1,1-DCA = 1,1-dichloroethane
CA = chloroethane

* MNA parameters **not** collected so cannot adequately evaluate and score

0 to 5 points: There is inadequate evidence for anaerobic biodegradation of chlorinated organics.
6 to 14 points: There is limited evidence for anaerobic biodegradation of chlorinated organics.
15 to 20 points: There is adequate evidence for anaerobic biodegradation of chlorinated organics.
>20 points: There is strong evidence for anaerobic biodegradation of chlorinated organics.

[1] = Material Released
[2] = Daugher product of PCE
[3] = Daugher product of TCE (score if cis-1,2-DCE is 80% of total DCE)
[4] = Daugher product of DCE
[5] = Material Released
[6] = Daugher product of 1,1,1-TCA under reducing conditions
[7] = Daughter product of 1,1-DCA or VC under reducing conditions

Attachment 1

AECOM
1 John James Audubon Parkway
Suite210
Amherst, NY 14228
aecom.com

September 8, 2021

Mr. Glenn May, PG
New York State Department of
Environmental Conservation, Region 9
270 Michigan Avenue
Buffalo, NY 14203-2999

Subject: **Bioaugmentation Injection Work Plan**
Former Scott Aviation Facility – Area 1 BCP
Lancaster, New York
NYSDEC Site Code No. 9-15-149

Dear Mr. May:

On behalf of Tyco International and its successor Scott Figgie LLC, AECOM Technical Services, Inc. (AECOM) is pleased to provide for your review and approval this letter work plan for completing a bioaugmentation injection event at the Scott Technologies, Inc. – Area 1 Brownfield Cleanup Program (BCP) site (the "Site") in Lancaster, New York (refer to attached **Figure 1** – Site Location Map). The objective of this bioaugmentation injection event is to further remediate impacted Site groundwater. This injection work will be performed by subcontractor Matrix Environmental Technologies, LLC. (Matrix), with oversight provided by AECOM, using KB-1® Plus and KB-1® Primer, which is a bioengineered microbial culture by SiREM that contains Dehalococcoides (DHC), to promote the complete dechlorination of chlorinated ethenes to non-toxic ethene (including the degradation of CFC-113 to non-chlorinated end products). The injection encompasses an approximate 25-foot by 25-foot area around each of the following monitoring wells: A1-GP06, A1-GP10/MW-40D, and MW-42S. These three monitoring wells are where the highest total volatile organic compound (VOC) concentrations are detected in Site groundwater.

This letter work plan provides the following information:

- A Site overview, including Site location, Site land use, Site geology/hydrogeology, previous Site investigation and remediation history, and remedial action objectives (RAOs);
- A summary of the groundwater analytical data including monitored natural attenuation occurring at the Site;
- A detailed scope of work for the proposed bioaugmentation injection of KB-1® Plus and KB-1® Primer; and
- A schedule.

SITE OVERVIEW

The following discussion presents an overview of the Site location, Site land use, Site geology/hydrogeology, previous Site investigation and remediation history, and RAOs.

Site Location

The Site is located in Lancaster, Erie County, New York and is identified as Section 104 Block 5 and Lots 8 and 9 on the Erie County Tax Map. The Site is approximately 1.25 acres in area and is bounded by non-impacted AVOX Systems Inc. (AVOX) land and then Erie Street to the north, railroad tracks to the south, AVOX Plant 1 (currently vacant) to the east, and residential zoned property (with a house) to the west; refer to **Figure 2** – Site Layout Map.

Site Land Use

The Site consists of the following: outbuildings that support Plant 1 (which is not part of the Site), asphalt driveways and parking areas, and lawn and brush-covered areas. Site occupants include only occasional maintenance and shipping/receiving personnel, as manufacturing activities have been moved to the two plants located on the north side of Erie Street.

The properties adjoining the Site and in the neighborhood surrounding the Site include both commercial and residential properties. The properties immediately south of the Site include railroad tracks; the properties immediately north of the Site include commercial properties; the properties immediately east of the Site include AVOX Plant 1 and its parking lot and then residential properties (including vacant land); and the properties to the west of the Site include residential properties.

Site Geology/Hydrogeology

The native soils underlying the Site generally consist of interbedded silts and clays, with discontinuous sporadic fine sand lenses (shallow overburden). A thin coarse-grained layer of weathered shale is located above the bedrock (deep overburden). Overburden thickness ranges from 20 feet (ft) in the southern portion of the Site to 26 ft in the northern portion of the Site.

The average depth to bedrock is approximately 21 ft. Bedrock was observed to consist of black shale of the Marcellus Formation (Hamilton Group).

Existing groundwater monitoring wells are installed at two intervals: shallow overburden and deep overburden. Overburden groundwater is first encountered at the Site in the shallow overburden, and then again just above the bedrock in the deep overburden zone. An observation of the groundwater within the deep overburden, which is present on top of bedrock, indicates a semi-confined state.

The natural flow of groundwater at the Site in both the shallow and deep overburden is to the northwest. The flow direction is most pronounced in the deep overburden, as the shallow overburden groundwater is influenced by seasonal standing water to the southwest, a storm sewer network cutting through the Site, large asphalt areas to the north and east, and Plant 1 to the east.

Site Investigation and Remedial History

The general historical operations that existed in the AVOX Plant 1 building immediately adjacent to the Site were primarily manufacturing, development, testing, and distribution for aircraft and military supplied-air systems. The oldest portion of Plant 1 dates to the early 1950s. That original building was expanded several times, with most of the existing building in place by 1975 except for a small warehouse addition in 1996. Plant 1 historical activities included the chemical cleaning and repainting of oxygen cylinders, the chemical cleaning (with inorganic acid solutions) and chromium coating (in a non-electrolytic “soak bath”) of metallic components of oxygen supply systems, and the fabrication of oxygen-regulating assemblies. Plant 1 also supported a Class 10,000 clean room and a Class 100,000 clean room. The office area contained management, administrative, engineering, training, and other support activities, and a cafeteria.

As of 2010, Plant 1 has no longer been used for production (i.e., painting and plating activities have been terminated). The BCP boundary for the Site is located immediately west/southwest of Plant 1. In general, the pre-remediated areas as described below consisted of low-level metals in the top of the shallow overburden soil immediately south of Plant 1, VOCs in shallow overburden soil at the fence gate southwest of Plant 2, and VOCs in shallow and deep overburden groundwater west/southwest of Plant 1. Note: the BCP boundary, or VOC-impacted groundwater plume, does not extend off the AVOX property.

Below is brief summary of the remedial history at the Site, focusing on groundwater impacts.

Phase I

In 2004, a Phase I Environmental Site Assessment (ESA) was performed at the Site by Earth Tech, Inc. (now AECOM) on behalf of the then owner, Scott Technologies, Inc. The entire facility was sold to the current owner, AVOX, in September 2004. Historical aerial photographs included in the Phase I ESA Report indicated an area of potentially disturbed soil on the west side of Plant 1, south of the existing visitor parking area, and just outside the Plant 1 western perimeter fence line on the adjacent vacant parcel (Earth Tech, April 2004). The Phase I ESA also identified two former underground storage tanks (USTs) that had contained gasoline starting in the early 1970s which were removed from the southeastern portion of the Plant 1 Area in November of 1987; however, no records were found to indicate that any post-excavation sampling was done to demonstrate that the soil and groundwater in the vicinity had not been impacted.

Another former UST that had contained gasoline from an unknown date until the early 1970s was reportedly cleaned and closed in place at that time by filling it with sand. It is believed to be located beneath the current hazardous materials storage shed. No records were found to indicate exactly where that tank is located, when closure occurred, or that any post-closure sampling was done to demonstrate that soil and groundwater in the vicinity had not been impacted. From the early 1950s to about 1973, used sand from a steel-casting foundry operation, located in the western portion of Plant 1, was disposed behind (south of) Plant 1.

Phase II

A Phase II Environmental Site Investigation (ESI) was completed in 2004 for the entire Scott Aviation facility to address environmental concerns described in the Phase I ESA Report, including the area of potentially disturbed soil on the west side of Plant I. During the Phase II ESI, seven test pits were excavated. Residual paint sludge of unknown origin was observed in two of the test pits. The paint sludge area was approximately 150 square ft in size and located just west and south of the vehicle gate located in the western perimeter fence, immediately north of the former water tower. Elevated levels of VOCs and semi-volatile organic compounds (SVOCs) present in the soil immediately below the waste indicated that some leaching of the waste had occurred.

Interim Remedial Measure - Soil Excavation

On June 28, 2005, Earth Tech, in accordance with a New York State Department of Environmental Conservation (NYSDEC)-approved Interim Remedial Measures (IRM) / Supplemental Site Investigation Work Plan, performed an initial excavation of the buried paint sludge material located to the west of Plant 1. A total of 60 cubic yards of soil was excavated to the west of Plant 1, down to the level at which groundwater was encountered, which was approximately 6 ft below ground surface (bgs). Further excavation was not completed during the IRM, as the scope of work only addressed impacted vadose zone soil.

Preliminary Groundwater Assessment

The above investigations identified the general areas of concern at the Site. As a result of the elevated VOC and SVOC soil concentrations detected in the excavation bottom at Area 1 during the 2005 IRM, a Preliminary Groundwater Assessment (PGA) was performed in 2006 and 2007. The purpose of the PGA was to assess the nature and extent of VOCs in groundwater in the vicinity of Area 1. A series of groundwater wells were installed, and samples were collected and analyzed as a part of the PGA. Eighteen temporary piezometers were installed during the PGA to monitor shallow overburden groundwater. Groundwater samples collected from these piezometers contained VOCs, with 18 of these compounds detected at concentrations that exceeded the NYSDEC Technical and Operational Guidance Series (TOGS) 1.1.1 protection for source of drinking water (groundwater) standards (i.e., water class GA). Samples of deep overburden groundwater also contained detections of VOCs, but to a lesser degree than the shallow overburden groundwater.

Remedial Investigation

The BCP Remedial Investigation (RI) was initiated in December 2010 with the completion of soil borings, the installation of monitoring wells, and the collection of soil, groundwater, and vapor samples for chemical analysis. This initial work

was completed during the summer of 2010. A Supplemental RI (SRI), completed in June 2011, included the installation of additional monitoring wells, groundwater sampling, and the evaluation of a storm sewer system that was located throughout the BCP Site. The RI and SRI were conducted to gather the data necessary to complete the characterization of chemical presence in on-Site groundwater, soil, and soil vapor, in order to identify and evaluate necessary and appropriate remedial alternatives.

These studies investigated Area 1 for contamination in surface soil, subsurface soil, groundwater, and impacts to on-Site storm sewers. Constituents of potential concern (COPCs) were identified for groundwater by comparison of maximum detected concentrations for VOCs, SVOCs, metals, pesticides, and polychlorinated bisphenols to NYSDEC TOGS 1.1.1 protection for source of drinking water (groundwater) standards (i.e., water class GA). The results of this comparison to applicable standards are summarized below.

- Groundwater - Analytical data for groundwater samples collected from the shallow and deep overburden wells during the RI and SRI identified the presence of VOCs exceeding NYSDEC TOGS 1.1.1 protection for source of drinking water (groundwater) standards. There were no exceedances of NYSDEC TOGS 1.1.1 protection for source of drinking water (groundwater) standards in the bedrock groundwater. The most frequently detected VOCs were trichloroethene (TCE) and cis-1,2-dichloroethene (cis-1,2-DCE). The greatest VOC concentrations were detected in the area of the previously-excavated source area during the 2005 IRM. At perimeter wells, VOCs were either not detected or were detected at concentrations below or slightly above NYSDEC TOGS 1.1.1 protection for source of drinking water (groundwater) standards for TCE.

- Storm Sewer Catch Basins - A storm sewer with several catch basins is present in Area 1; refer to **Figure 3** for the location of the storm sewer system. VOCs were detected within storm sewer catch basins located on the Site and from water within the storm sewer pipe bedding gravel.

Interim Remedial Measures – 2014

During a conference call between NYSDEC, Scott Figgie, AECOM, and AVOX on February 28, 2014, the NYSDEC recommended moving forward with the BCP cleanup in advance of an approved Final Alternatives Analysis Report by completing four IRMs to address soil and selected groundwater impacts at the Site. They included:

- Excavation and off-Site disposal of shallow soils impacted by metals;

- Excavation and off-Site disposal of subsurface soils impacted by VOCs in some locations;

- Grout sealing on-Site storm sewer joints to prevent groundwater infiltration, and installation of impermeable plugs across the pipe bedding to prevent off Site migration of groundwater; and

- Mitigation of soil vapor intrusion concerns at the AVOX boiler room.

Those four IRMs were described in an IRM Remedial Action Work Plan (RAWP) dated June 4, 2014.

Groundwater Interim Remedial Measure – 2015

In 2014, an IRM pre-design investigation utilizing a combined membrane interface probe (MIP) and hydraulic profiling tool (HPT) was performed in Area 1 in accordance with the MIP/HPT and Baseline Sampling Work Plan (AECOM, October 2014).

On November 24-25, 2014, 11 borings were completed throughout the groundwater plume in Area 1 to a depth of 20 ft bgs, with the objective of verifying the distribution of VOC COPCs within that area. The MIP/HPT was used to collect data at continuous depths at each boring.

The MIP/HPT results were generally consistent with groundwater data collected from June 2010 through June 2011. The data indicated that there are lower VOC concentrations present in the northern portion of the Site and that, where

present, they are limited to the upper 14 ft of the overburden. In the southern portion of the Site, VOC concentrations were greater and also present in significant concentrations throughout the entire 20-ft depth of the soil borings, with the 5-15 ft bgs interval exhibiting the highest VOC concentrations.

Based on the data collected, the remedial approach to address VOCs present in Site groundwater was in-situ enhanced reductive dechlorination (ERD) via direct-push technology (DPT) injections of ABC® amended with ZVI (i.e., ABC+®). The 2015 groundwater IRM for the Site was completed by AECOM subcontractors Matrix and Redox Tech, LLC (Redox), under the oversight of AECOM, in accordance with DER-10. Between March 2015 and May 2015, the groundwater IRM proposed in the March 2015 Final Remedial Action Work Plan – 2015 IRM – Groundwater Treatment (2015 IRM RAWP) was conducted within the footprint of the Site.

Groundwater injection activities consisted of injection of ABC+® into two target depth zones: a 12,600 square ft shallow-only injection zone and a 20,025 square ft combined shallow-deep injection zone. Refer to **Figure 4** for the locations of injection points and depth intervals. Injection of ABC+® was performed through 1.5-inch diameter injection rods that were penetrated into the subsurface with a DPT (e.g., Geoprobe®) rig. At each injection location, several discrete injection intervals were performed, depending upon the vertical remediation target thickness and soil hydraulic conductivity within the contaminated zone. In general, the spacing between injection points was 15 ft. This spacing was selected based on observed subsurface stratigraphy from soil boring logs and in-situ injection on an adjacent property.

A total of 41 injection points were completed to treat the groundwater in the shallow overburden area. Approximately 23,370 pounds of ABC+® were injected to treat this area with approximately 570 pounds of ABC+® injected per point (67% by weight [wt%] ABC® and 33% wt% ZVI). Mixed at approximately a 15 wt% solution, this resulted in approximately 16,000 gallons of solution. Each injection point received approximately 390 gallons of solution divided among the intervals that had the highest permeability.

A total of 79 injection points were required to treat the groundwater in the combined shallow and deep overburden. Approximately 59,800 pounds of ABC+® were used to treat this area, at 757 pounds of ABC+® per injection point (57% wt% ABC+® and 43% wt% ZVI). Mixed at approximately a 15 wt% solution, this resulted in approximately 40,300 gallons of solution. Each injection point received approximately 510 gallons of solution divided among the intervals that had the highest permeability.

Injections were also conducted adjacent to the on-Site storm sewer to significantly reduce VOCs in the vicinity of the sewer and to apply treatment into the sewer pipe bedding itself. The storm sewer-targeted injections occurred on April 13, 2015 and April 14, 2015. Injection points were performed approximately 5 to 6 ft offset (upgradient) from the sewer line to establish a biobarrier that groundwater must flow through before entering the sewer bedding. Injections associated with the storm sewer bedding were completed between 4 and 6 ft bgs. As the sewer bedding (pea gravel) is significantly more permeable than the native soils, the bedding was expected be a path of least resistance for the injected solutions. Therefore, to protect the existing subsurface utility, ERD injections immediately adjacent to the sewer consisted of only ABC® (without ZVI).

VOC groundwater data from subsequent quarterly post-injection sampling events demonstrated a significant reduction of COPCs compared to the RI/SRI data.

Remedial activities for the groundwater IRM were described in the Final Remedial Action Work Plan - 2015 Interim Remedial Measures - Groundwater Treatment.

Supplemental Groundwater Injection

On May 15, 2019, NYSEC approved the 2019 Supplemental Injection Work Plan (AECOM, May 10, 2020). Between May 20, 2019 and May 22, 2019, AECOM and subcontractor Matrix and their teaming partner Redox completed the supplemental groundwater injection event using ABC-Ole® and ZVI.

ABC-Ole® is an emulsified fatty acid product designed to address anaerobic bioremediation sites. It is a modified blend of ABC®, which contains a high fatty acid content ranging from 50-85% ABC®. The addition of ZVI to the ABC-Ole® immediately provides a large drop in oxidative reduction potential in the surrounding groundwater which is conducive to biotic reductive dechlorination. The ZVI also promotes an abiotic reductive dechlorination process where the degradation of the targeted groundwater VOCs occurs via the β-elimination pathway. This pathway does not create the degradation intermediates cis-1,2-DCE and vinyl chloride (VC) which are produced via the biotic reductive dechlorination pathway, and it also does not rely on the presence of DHC to achieve complete VOC destruction.

The combined ABC-Ole® and ZVI mixture was specifically designed to remediate impacted groundwater in an approximate 6,750 square ft area within the approximate 1,000 micrograms per liter (µg/L) total VOC (TVOC) shallow overburden zone contour (which also overlies the 1,000 µg/L TVOC deep overburden zone contour). The area of injection encompassed the area around the most TVOC-impacted monitoring wells located on the Site: A1-GP02, A1-GP06, A1-GP10, MW-42S, MW-38D, and MW-40D. **Figure 5** depicts the supplemental injection area.

The injectate ABC-Ole®, mixed with ZVI, was injected at 30 locations using a DPT drill rig. Each injection point received approximately 240 gallons of injectate. The injectate was distributed at depth intervals 11, 14, 17, and 20 ft bgs, targeting the shallow and deep water bearing units, and was performed from a bottom to top sequence.

Approximately 7,500 pounds of ABC Ole® and 7,500 pounds of ZVI were injected to treat the approximately 10 ft thick zone at approximately 500 pounds of ABC-Ole® and ZVI per point. Mixed at approximately a 20 wt. % solution, this resulted in approximately 7,200 gallons of solution. Each injection point received approximately 240 gallons, divided up among intervals that had the highest permeability.

Storm Sewer Pipe Replacement

Per the NYSDEC approved Storm Sewer Replacement Work Plan dated June 12, 2020, approximately 200 linear ft of storm sewer piping was replaced by Matrix in June of 2020 between CB-4 and CB-E, CB-E and CB-3, and CB-3 and CB-2 (refer to **Figure 3** for the location of catch basins). This work was performed based on the ongoing detections of VOCs in quarterly Site grab samples collected since the 2014 IRM was completed. This section of storm sewer piping was replaced with a new 12-inch diameter SDR35 solid PVC pipe with watertight joints. It was presumed that over time, shallow groundwater entered the storm sewer pipes through pipe joints that may not have been sealed or through previously sealed pipe joints and at catch basins that were no longer watertight.

The impermeable “plugs” along the sections of pipe that were removed during replacement of the storm sewer pipe were re-installed with a grout slurry prior to backfilling activities, to continue to potentially prevent VOC-impacted groundwater from migrating off-Site through the pipe bedding material. In addition, a non-shrinking concrete/grout was used at four catch basins (CB-2, CB-3, CB-E, and CB-4) to seal the connections where the stormwater pipes enter and exit the catch basins.

During excavation activities, soils were scanned with a PID. Soils excavated between CB-E and CB-3 were observed to have elevated PID readings and were segregated and sampled for VOC and metals analysis. Per the analytical data and associated historic soil characterization data from the Site, the impacted soil was characterized as non-hazardous. Approximately 18.76 tons of soil was sent to Waste Management’s landfill in Chaffee, NY for disposal.

During backfilling of the pipe section between CB-E and CB-3 (where the impacted soil was observed), coarse ZVI (80 percent between 150 and 600 microns) was scratch mixed using an excavator with the backfill material placed from the bottom of the excavation to approximately 2 ft bgs (i.e., within the saturated groundwater zone). Due to the concentration of VOCs in groundwater in this area and the size of the excavation required to replace the storm water pipe in this section (approximately 4 ft wide by 5 ft deep by 85 ft long), approximately 1,100 pounds or approximately 1.1 percent by weight of ZVI was used. The depth of soil to be treated by ZVI was approximately 3 ft since the top 2 ft of soil was above the water table, and vadose zone soil is not effectively treated by ZVI.

Remedial Action Objectives

The objectives for the Site remedial program have been established though the remedy selection process stated in 6 NYCRR Part 375. The goal for the remedial program is to restore the Site to pre-disposal conditions to the extent feasible. At a minimum, the remedy must eliminate or mitigate all significant threats to the public health and the environment presented by VOCs identified at the Site through the proper application of scientific and engineering principles.

The RAOs for the groundwater at the Site as listed in the Decision Document (NYSDEC, December 2015) are as follows:

- RAOs for Public Health Protection
    - Prevent ingestion of groundwater with contaminant levels exceeding drinking water standards.
    - Prevent contact with, or inhalation of, VOCs from impacted groundwater.
- RAOs for Environmental Protection
    - Restore ground water aquifer to pre-disposal/pre-release conditions, to the extent practicable.
    - Prevent the discharge of COPCs to surface water.
    - Remove the source of ground or surface water COPCs

Constituents of Potential Concern

Eight COPCs in groundwater have been determined through sampling associated with the RI and SRI. Per the Decision Document (NYSDEC, December 2015), Section 6.1.2 (NYSDEC, December 2015), a “contaminant of concern” is a contaminant that is sufficiently present in frequency and concentration in the environment to require evaluation for remedial action. Not all constituents identified on the Site are COPCs. The groundwater COPCs identified at the Site and their associated RAOs (Guidance or Standard Values) from NYSDEC TOGS 1.1.1 protection for source of drinking water (groundwater) standards are listed below

- 1,1,1-Trichloroethane – 5 µg/L
- 1,1,2-Trichloroethane – 5 µg/L
- 1,1-Dichloroethane – 5 µg/L
- 1,2-Dichloroethane – 5 µg/L
- 1,1-Dichloroethene – 0.6 µg/L
- *1,2-Dichloroethene – 5 µg/L
- Tetrachloroethene – 5 µg/L
- Trichloroethene – 5 µg/L
- Vinyl chloride – 2 µg/L

*Per NYSDEC comment letter dated August 23, 2019, cis-1,2-DCE was added as a Site COPC.

GROUNDWATER ANALYTICAL DATA

Fifteen VOCs were detected in groundwater from the monitoring wells (not including the five on-site storm water catch basins and two temporary piezometers screened in the storm sewer pipe bedding) during the April 2021 sampling event. Eleven of the 15 VOCs detected exceeded either the Site-specific RAOs or the TOGS 1.1.1 groundwater standards at one or more wells. Six of the nine COPCs were detected; all of which reflected a marked decrease in

concentration of the parent VOCs (1,1,1-trichloroethane [1,1-TCA], tetrachloroethene (PCE), and TCE) following the IRMs.

The highest concentrations of VOCs in shallow overburden groundwater were detected at A1-GP-10 and MW-42S. The highest concentrations of VOCs in deep overburden groundwater were detected at MW-40D. Chloroethane, 1,1-dichloroethane (1,1-DCA), VC, and cis-1,2-DCE exhibited the highest overall concentrations in groundwater, all of which are degradation products of 1,1,1-TCA, PCE, and/or TCE. Refer to **Table 1** for April 2021 VOC groundwater data.

Monitored Natural Attenuation

To monitor the effectiveness of the November 2018 supplemental injections over time, monitored natural attenuation (MNA) parameters were continued to be collected from four shallow overburden wells (A1-GP06, A1-GP10, A1-GP18, and MW-42S) and four deep overburden monitoring wells (MW-35D MW-37D, MW-38D, and MW-40D).

Results of the April 2021 MNA samples are summarized in attached **Table 2** (note MNA data were not collected in July 2021). Per **Table 2**, the source wells A1-GP06, A1-GP10, MW-42S, and MW-40D show that there is currently limited to adequate evidence for anerobic biodegradation of chlorinated organics to occur. Below is a summary of the MNA April 2021 data from both the shallow and deep overburden source wells.

Shallow Overburden Source Wells

A1-GP06 - Conditions increased to indicate adequate evidence for anaerobic biodegradation following the May 2019 injection event. Groundwater conditions are now nearing pre-injection conditions. Elevated chloroethane indicates that reductive dechlorination is continuing. Low levels of 1,1,1-TCA and 1,1,2-Trichloro-1,1,2-trifluoroethane continue to be detected; however, this well is downgradient of the May 2019 injection locations.

A1-GP10 - This well has historically been impacted by 1,1,1-TCA and not chlorinated ethenes. The April 2021 bioattenuation screening indicates that groundwater conditions within the vicinity of this well were made more conducive for reductive dechlorination to occur following the second injection event with ABC-Ole+ in May 2019. The latest April 2021 score indicates that conditions are returning back to pre-injection conditions. 1,1,1-TCA concentration remains elevated along with its degradation products 1,1-DCA and CA concentrations.

MW-42S - This well has historically been impacted by 1,1,1-TCA, 1,1,2-Trichloro-1,1,2-trifluoroethane, TCE, and toluene, which potentially indicates a different source. The bioattenuation screening numbers are skewed low initially for this well because certain parameters used for scoring were not collected prior to the April 2020 sampling event. However, the scores using the full suite of parameters indicate adequate and strong evidence for anaerobic biodegradation to occur, and these numbers continue to remain elevated. The ongoing presence of cis-1,2-DCE and VC along with ongoing detections of 1,1,1-TCA and its daughter products may indicate the possible interference of 1,1,1-TCA with the full degradation of cis-1,2-DCE and VC.

Deep Overburden Source Wells

MW-40D - This area has historically been impacted by 1,1,1-TCA and its degradation products 1,1-DCA and CA. Following the first ABC+ injection event in April/May 2015, 1,1,1-TCA was eliminated except for sporadic low level detections. 1,1-DCA increased and then decreased with periodic low level detections. CA has remained relatively consistent following by the first and second injection events. Since the second injection event in May 2019, groundwater conditions increased from limited to adequate evidence for anaerobic biodegradation and are now returning to pre-injection conditions.

As continued monitoring indicates this process may have plateaued, the introduction of bioaugmentation cultures will promote the complete dechlorination of chlorinated ethenes to non-toxic ethene (including the degradation of CFC-113 to non-chlorinated end products).

Dechlorinating Bacteria Analysis

Following the injection of ABC+® in April/May 2015, AECOM deployed "Bio-traps" in select shallow and deep overburden groundwater wells annually to monitor the concentration (i.e., cells/bead) of dechlorinating bacteria. The "Bio-traps" were submitted to Microbial Insights, Inc., in Knoxville, Tennessee for analysis. Per the most recent sampling event conducted in April 2021, the detected shallow overburden groundwater concentrations of DHC, tceA Reductase, and VC Reductase from MW-42S continue to remain elevated in comparison to pre-injection concentrations.

Deep overburden groundwater at MW-38D shows DHC and degradative enzymes concentrations that are indicative of pre-injection concentrations. This indicates that reductive dechlorination may be complete at this location; note there were no detections above the reporting limit for any VOCs at MW-38D and only one deep overburden groundwater monitoring well (MW-40D) had detections exceeding either the Site-specific RAOs or TOGS 1.1.1 groundwater standards (1,1-DCA at 8.6 µg/L and chloroethane at 400 µg/L); MW-40D is targeted in the proposed bioaugmentation injection program. Refer to the table below for annual microflora data collected at shallow overburden monitoring well MW-42S and at deep overburden groundwater monitoring well MW-38D from 2015 through 2021.

Shallow Overburden Dechlorinating Bacteria Data

Sample ID	MW-42S	MW-43S*	MW-42S	MW-42S	MW-42S	MW-42S	MW-42S
Sample Date	7/27/15	7/12/16	4/12/17	4/12/18	5/6/19	4/9/20	4/6/21
Dechlorinating Bacteria (Cells/bead)							
DHC	$<2.50x10^1$	$1.77x10^2$	$3.98x10^4$	$4.04x10^4$	$1.84x10^5$	$7.73x10^1$	$4.22x10^4$
tceA Reductase	$<2.50x10^1$	$1.58x10^1$	$1.28x10^4$	$4.92x10^4$	$6.19x10^3$	$<2.50x10^1$	$1.95x10^3$
BAV1 VC Reductase	$<2.50x10^1$	$<2.50x10^1$	$<2.50x10^1$	$3.3x10^1$	$6.55x10^1$	$<2.50x10^1$	$<2.50x10^1$
VC Reductase	$<2.50x10^1$	$<2.50x10^1$	$1.04x10^3$	$3.56x10^3$	$4.59x10^4$	$7.00x10^0$	$4.77x10^3$

Deep Overburden Dechlorinating Bacteria Data

Sample ID	MW-38D	MW-38D	MW-38D	MW-38D	MW-38D	MW-38D	MW-38D
Sample Date	7/27/15	7/12/16	4/12/17	4/12/18	5/6/19	4/9/20	4/6/21
Dechlorinating Bacteria (Cells/bead)							
DHC	$8.41x10^2$	$4.00x10^4$	$2.52x10^4$	$1.81x10^2$	$6.47x10^2$	$1.09x10^4$	$2.18x10^2$
tceA Reductase	$<2.50x10^1$	$1.78x10^2$	$7.24x10^2$	$6.36x10^1$	$2.36x10^1$	$1.60x10^2$	$3.63x10^1$
BAV1 VC Reductase	$1.20x10^2$	$2.22x10^4$	$2.20x10^2$	$1.25x10^1$	$6.70x10^0$	$<2.50x10^1$	$<2.50x10^1$
VC Reductase	$1.47x10^1$	$6.96x10^2$	$9.12x10^2$	$5.16x10^1$	$1.12x10^2$	$1.08x10^3$	$<2.50x10^1$

* MW-43S was mistakenly sampled instead of MW-42S in July of 2016.

Dechlorinating Chemical Analysis

In addition to the DHC and degradative enzyme results discussed in the section above, the presence and distribution of TCE degradation products (cis-1,2-DCE and VC) and 1,1,1-TCA degradation products (1,1-DCA and chloroethane) provide supportive evidence that the attenuation of TCE and 1,1,1-TCA and their degradation products, via reductive dechlorination, continues to occur in-situ at the Site. The occurrence and concentrations of these degradation products are directly related to the historic distribution of TCE and 1,1,1-TCA in the subsurface. A limited number of other VOCs were sporadically detected in groundwater at the Site during the most recent groundwater sampling event in April 2021, with most of these detections in groundwater located at wells A1-GP02-S, A1-GP06-S, A1-GP10-S, MW-42S, and MW-40D. This is the area targeted for the proposed bioaugmentation injection program.

Total Organic Carbon

During the most recent groundwater sampling event in April 2021, samples were analyzed for total organic carbon (TOC) analysis to monitor the concentration of available carbon sources for the optimum microbial growth. Although TOC concentrations have decreased over time in the areas outside the 2019 supplemental groundwater injection area,

locations within the 2019 supplemental groundwater injection area continue to exhibit elevated TOC concentrations as compared to background. Refer to **Table 1** for a summary of TOC concentrations from April 2021.

SCOPE OF WORK

The scope of work for the proposed bioaugmentation injections consists of three tasks: Task 1 – Project Management / Premobilization Activities; Task 2 – Bioaugmentation Injection; and Task 3 – Bioaugmentation Injection Summary Report. These tasks are described below.

Task 1 – Project Management / Premobilization Activities

Under Task 1, AECOM will provide project management and coordination, oversee premobilization activities, and provide communication with GSF, current Site owner AVOX Systems Inc., and NYSDEC.

The premobilization activities are summarized below:

- Amend the health and safety plan to address the bioaugmentation injection scope of work and physical and chemical elements of concern.
- Prepare a work plan describing the scope of work for the bioaugmentation injection program.
- Issue purchase orders to the injection subcontractor (Matrix) and the microbial culture manufacturer (SiREM).
- Prepare forms for use by AECOM personnel to document daily health and safety meetings, injection tracking, and/or other daily general notes.
- Mark out injection locations for Dig Safely 811 utility mark outs. Note previous geophysical surveys completed for utility locations will be referenced during mark out of the injection points.

Task 2 – Bioaugmentation Injection

AECOM will collect groundwater grab samples from A1-GP10 and MW-42S for volatile fatty acids (VFA) analysis, both prior to completing the bioaugmentation injections and 90 days following the injections. The data will be used to establish a baseline and monitor the quality and form of fermentation byproducts of electron donors to manage potential reapplication requirements. In addition, AECOM will collect a groundwater grab sample from MW-42S prior to completing the bioaugmentation injections and also 90 days following the injection event for Gen-Trac analysis to confirm the successful introduction and distribution of the organisms in the KB-1® Plus culture. The VFA and Gen-Trac samples will be submitted to SiREM for analysis. Refer to **Attachment 1** for the sample collection procedures.

The microbial culture KB-1® Plus and the KB-1® Primer (used to prepare anaerobic water to disperse electron donors and protect anaerobic bioaugmentation cultures during injection into the subsurface) will be supplied by SiREM; refer to **Attachment 2** for specifications (material safety sheets are included in the Site specific health and safety plan (HASP)). The KB-1® Plus and the KB-1® Primer will be mixed and injected by Matrix at nine locations using a direct push technology drill rig (refer to **Attachment 3** for the SiREM's detailed mixing and injection procedures). As shown in **Figure 6**, three injection points will be located around each of the three targeted monitoring wells (A1-GP06, A1-GP10/MW-40D, and MW-42), with injection points biased to the upgradient groundwater side of each of the wells.

Each injection point around monitoring wells A1-GP10/MW-40D will receive approximately 200 gallons of KB-1® Plus/Primer (i.e., injectate) and will be distributed at four depth intervals (5, 10, 15 and 20 ft bgs), targeting both the shallow and deep overburden groundwater zones. Each of the injection points around monitoring wells A1-GP06 and MW-42S will receive approximately 150 gallons of injectate and will be distributed at three depth intervals (5, 10, and 15 ft bgs), targeting the shallow overburden groundwater zone. Refer to **Table 3** for a summary of injection depths and injectate volumes. The injections are expected to take three 10-hour days to complete. Following the injection, Matrix

will complete site restoration activities (i.e., rake and seed as needed and plug injection boreholes). AECOM will oversee and track the injection program and restoration activities with support from the AECOM project engineer as needed.

Task 3 – Bioaugmentation Injection Summary Report

Following the completion of the bioaugmentation injection program (i.e., receipt of the post-injection 90-day sample data from SiREM), AECOM will draft a brief letter report for submittal to NYSDEC. The report will describe the activities performed and summarize the pre- and post-injection VFA and Gen-Trac data. In addition, the summary report will compare the April 2021 VOC groundwater data (pre-bioaugmentation injection) against the October 2021 VOC groundwater data (post-bioaugmentation injection) to demonstrate the ongoing dechlorination process. The final bioaugmentation injection summary report is expected to be finalized and submitted to NYSDEC prior to December 31, 2021.

HEALTH AND SAFETY PLAN

The Site-specific HASP was updated and approved by AECOM's District Safety, Health and Environment Manager on August 26, 2021 and includes safety precautions regarding the bioaugmentation injections. A copy of the HASP is available on Site.

SCHEDULE

Following NYSDEC approval of this work plan, the bioaugmentation injection program will be initiated. AECOM is tentatively scheduled to begin the injections in September 2021; however, the pre-injection groundwater samples will be collected in August 2021.

If you have any questions regarding this submission, please do not hesitate to contact me at (716) 923-1125 or via e-mail at dino.zack@aecom.com.

Yours sincerely,

Dino L. Zack, PG, STS
Project Manager

\Enclosures

cc: Mr. Stuart Rixman, GSF Management Company, LLC (electronic copy)
Mr. Troy Chute, GSF Management Company, LLC (electronic copy)
Mr. Raymond DeCarlo, AVOX Systems Inc. (electronic copy)
Mr. Allen Thomalla, AVOX Systems Inc. (electronic copy)
Mr. Hunter Bogdan, AVOX Systems Inc. (electronic copy)
Project File 60538931

Tables

Table 1

Summary of Monitoring Well Analytical Data - April 2021
Former Scott Aviation Facility
NYSDEC Site Code No. C915233
Lancaster, New York

Sample ID	Groundwater	A1-GP02-S	A1-GP06-S	A1-GP09-S	A1-GP10-S	A1-GP14-S	A1-GP15-S	A1-GP16-S
Date Collected	RAO/TOGS 1.1.1	04/01/21	04/01/21	04/01/21	04/01/21	04/01/21	04/01/21	04/01/21
Lab Sample ID	Objective	480-182787-8	480-182787-2	480-182787-10	480-182787-3	480-182787-11	480-182787-9	480-182787-12
Volatile Organic Compounds by Method 8260 (µg/L)								
1,1-Dichloroethane*	5	< 40 U	**200**	< 2.0 U	**3,700**	< 2.0 U	**0.52**	< 4.0 U
1,1-Dichloroethene*	5	< 40 U	< 25 U	< 2.0 U	**200**	< 2.0 U	< 1.0 U	< 4.0 U
1,1,1-Trichloroethane*	5	< 40 U	**210**	< 2.0 U	**2,200**	< 2.0 U	< 1.0 U	< 4.0 U
1,1,2-Trichloro-1,2,2-trifluoroethane	5	< 40 U	**36**	< 2.0 U	**490**	< 2.0 U	< 1.0 U	< 4.0 U
1,2-Dichloroethane*	0.6	< 40 U	< 25 U	< 2.0 U	< 200 U	< 2.0 U	< 1.0 U	< 4.0 U
2-Butanone (MIBK)	50	< 400 U	< 130 U	< 20 U	< 1,000 U	< 10 U	< 10 U	< 40 U
2-Hexanone	50	< 200 U	< 130 U	< 10 U	< 1,000 U	< 10 U	< 5.0 U	< 20 U
Acetone	50	< 400 U	< 250 U	**6.1 J**	< 2,000 U	**6.4 J**	**12**	< 40 U
Carbon Disulfide	60	< 40 U	< 25 U	< 2.0 U	< 200 U	< 2.0 U	< 1.0 U	< 4.0 U
Chloroethane	5	< 40 U	**1,000**	< 2.0 U	**8,600**	< 2.0 U	< 1.0 U	< 4.0 U
Chloromethane	5	< 40 U	< 25 U	< 2.0 U	< 200 U	< 2.0 U	< 1.0 U	< 4.0 U
cis-1,2-Dichloroethene*	5	**340**	< 25 U	< 2.0 U	< 200 U	< 2.0 U	< 1.0 U	< 4.0 U
Ethylbenzene	5	**57**	< 25 U	< 2.0 U	< 200 U	< 2.0 U	< 1.0 U	< 4.0 U
Methylene Chloride	5	< 40 U	**13 J**	**1.6 J**	< 200 U	**2.7**	< 1.0 U	< 4.0 U
Toluene	5	< 40 U	< 25 U	< 2.0 U	< 200 U	< 2.0 U	< 1.0 U	< 4.0 U
Trichloroethene*	5	< 40 U	< 25 U	< 2.0 U	< 200 U	**2.4**	< 1.0 U	< 4.0 U
Vinyl chloride*	2	**4,500**	< 25 U	< 2.0 U	< 200 U	< 2.0 U	< 1.0 U	< 4.0 U
Xylenes, Total	5	**56 J**	< 50 U	< 4.0 U	< 400 U	< 4.0 U	< 2.0 U	< 8.0 U
Total Volatile Organic Compounds	NL	4,953	1,459	7.7	15,190	11.5	12.5	0
Total Organic Carbon	NL	9.0	155	28.8	71.1	4.8	3.0	21

Table 1

Summary of Monitoring Well Analytical Data - April 2021
Former Scott Aviation Facility
NYSDEC Site Code No. C915233
Lancaster, New York

Sample ID	Groundwater	A1-GP18-S		MW-30		MW-35S		MW-36S		MW-42S		MW-43S	
Date Collected	RAO/TOGS 1.1.1	04/01/21		04/05/21		04/05/21		04/06/21		04/01/21		04/01/21	
Lab Sample ID	Objective	480-182787-4		480-182636-4		480-182636-5		480-182888-2		480-182787-5		480-182787-6	
Volatile Organic Compounds by Method 8260 (µg/L)													
1,1-Dichloroethane*	5	< 1.0	U	< 1.0	U	< 1.0	U	**0.54**	**J**	**710**		< 4.0	U
1,1-Dichloroethene*	5	< 1.0	U	< 1.0	U	< 1.0	U	< 1.0	U	< 200	U	< 4.0	U
1,1,1-Trichloroethane*	5	< 1.0	U	< 1.0	U	< 1.0	U	< 1.0	U	< 200	U	< 4.0	U
1,1,2-Trichloro-1,2,2-trifluoroethane	5	< 1.0	U	< 1.0	U	< 1.0	U	< 1.0	U	**380**		< 4.0	U
1,2-Dichloroethane*	0.6	< 1.0	U	< 1.0	U	< 1.0	U	< 1.0	U	< 200	U	< 4.0	U
2-Butanone (MIBK)	50	**2.9**	**J**	< 10	U	< 10	U	< 10	U	< 2,000	U	< 40	U
2-Hexanone	50	< 5.0	U	< 5.0	U	< 5.0	U	< 5.0	U	< 1,000	U	< 20	U
Acetone	50	< 10	U	< 10	U	< 10	U	< 10	U	< 2,000	U	< 40	U
Carbon Disulfide	60	< 1.0	U	< 1.0	U	< 1.0	U	< 1.0	U	< 200	U	< 4.0	U
Chloroethane	5	< 1.0	U	< 1.0	U	< 1.0	U	< 1.0	U	**12,000**		< 4.0	U
Chloromethane	5	< 1.0	U	< 1.0	U	< 1.0	U	< 1.0	U	< 200	U	< 4.0	U
cis-1,2-Dichloroethene*	5	< 1.0	U	< 1.0	U	< 1.0	U	**2.2**		< 200	U	< 4.0	U
Ethylbenzene	5	< 1.0	U	< 1.0	U	< 1.0	U	< 1.0	U	< 200	U	< 4.0	U
Methylene Chloride	5	< 1.0	U	< 1.0	U	< 1.0	U	< 1.0	U	**100**	**J**	< 4.0	U
Toluene	5	< 1.0	U	< 1.0	U	< 1.0	U	< 1.0	U	**620**		< 4.0	U
Trichloroethene*	5	< 1.0	U	< 1.0	U	< 1.0	U	< 1.0	U	< 200	U	< 4.0	U
Vinyl chloride*	2	< 1.0	U	< 1.0	U	< 1.0	U	< 1.0	U	**190**	**J**	< 4.0	U
Xylenes, Total	5	< 2.0	U	< 2.0	U	< 2.0	U	< 2.0	U	< 400	U	< 8.0	U
Total Volatile Organic Compounds	NL	2.9		0		0		2.7		14,000		0	
Total Organic Carbon	NL	3.8		2.7		4.3		4.3		427		8.9	

Table 1

Summary of Monitoring Well Analytical Data - April 2021
Former Scott Aviation Facility
NYSDEC Site Code No. C915233
Lancaster, New York

Sample ID	Groundwater	MW-44S	MW-35D	MW-36D	MW-37D	MW-38D	MW-39D	MW-40D
Date Collected	RAO/TOGS 1.1.1	04/01/21	04/05/21	04/06/21	04/05/21	04/05/21	04/05/21	04/01/21
Lab Sample ID	Objective	480-182787-7	480-182836-2	480-182888-1	480-182636-6	480-182636-3	480-182636-7	480-182787-1
Volatile Organic Compounds by Method 8260 (µg/L)								
1,1-Dichloroethane*	5	< 1.0 U	< 1.0 U	< 4.0 U	< 1.0 U	< 8.0 U	< 1.0 U	**8.6**
1,1-Dichloroethene*	5	< 1.0 U	< 1.0 U	< 4.0 U	< 1.0 U	< 8.0 U	< 1.0 U	< 8.0 U
1,1,1-Trichloroethane*	5	< 1.0 U	< 1.0 U	< 4.0 U	< 1.0 U	< 8.0 U	< 1.0 U	< 8.0 U
1,1,2-Trichloro-1,2,2-trifluoroethane	5	< 1.0 U	< 1.0 U	< 4.0 U	< 1.0 U	< 8.0 U	< 1.0 U	< 8.0 U
1,2-Dichloroethane*	0.6	< 1.0 U	< 1.0 U	< 4.0 U	< 1.0 U	< 8.0 U	< 1.0 U	< 8.0 U
2-Butanone (MIBK)	50	< 10 U	< 10 U	< 40 U	< 10 U	< 80 U	**5.4 J**	< 80 U
2-Hexanone	50	< 5.0 U	< 5.0 U	< 20 U	< 5.0 U	< 40 U	**4.3 J**	< 40 U
Acetone	50	< 10 U	< 10 U	< 40 U	< 10 U	< 80 U	**6.4**	< 80 U
Carbon Disulfide	60	< 1.0 U	< 1.0 U	< 4.0 U	< 1.0 U	< 8.0 U	< 1.0 U	< 8.0 U
Chloroethane	5	< 1.0 U	< 1.0 U	< 4.0 U	< 1.0 U	< 8.0 U	**1.6**	**400**
Chloromethane	5	< 1.0 U	< 1.0 U	< 4.0 U	< 1.0 U	< 8.0 U	< 1.0 U	< 8.0 U
cis-1,2-Dichloroethene*	5	< 1.0 U	< 1.0 U	< 4.0 U	< 1.0 U	< 8.0 U	< 1.0 U	< 8.0 U
Ethylbenzene	5	< 1.0 U	< 1.0 U	< 4.0 U	< 1.0 U	< 8.0 U	< 1.0 U	< 8.0 U
Methylene Chloride	5	< 1.0 U	< 1.0 U	< 4.0 U	< 1.0 U	< 8.0 U	< 1.0 U	< 8.0 U
Toluene	5	< 1.0 U	< 1.0 U	< 4.0 U	< 1.0 U	< 8.0 U	< 1.0 U	< 8.0 U
Trichloroethene*	5	< 1.0 U	< 1.0 U	< 4.0 U	< 1.0 U	< 8.0 U	< 1.0 U	< 8.0 U
Vinyl chloride*	2	< 1.0 U	< 1.0 U	< 4.0 U	< 1.0 U	< 8.0 U	< 1.0 U	< 8.0 U
Xylenes, Total	5	< 2.0 U	< 2.0 U	< 8.0 U	< 2.0 U	< 16 U	< 2.0 U	< 16 U
Total Volatile Organic Compounds	NL	0	0	0	0	0	18	409
Total Organic Carbon	NL	1.4	7.4	12.9	2.7	25.3	251	16

Notes:
Bold font indicates the analyte was detected.
Bold font and bold outline indicates the screening criteria was exceeded.
* Site-specific Contaminants of Concern per Decision Document (December 2015). Per NYSDEC comment letter dated August 29, 2019, cis-1,2-DCE was added as a Site-specific Contaminants of Concern.
J - Analyte detected at a level less than the reporting limit and greater than or equal to the method detection limit. Concentrations within this range are estimated.
U - Not detected at or above reporting limit.
NL - Not listed

Table 2
Bioattenuation Screening Summary - April 2021
Scott Figgie Area 1 Site
Lancaster, New York

Parameter	Units	Criteria	Score Value	Monitoring Well Identification															
				A1-GP18-S (sidegradient/ background)		A1-GP10-S (source area)		MW-42S (source area)		A1-GP06-S (downgradient)		MW-37D (sidegradient/ background)		MW-40D (source area)		MW-38D (downgradient)		MW-35D (far downgradient)	
				4/1/21	Score	4/1/21	Score	4/2/21	Score	4/2/21	Score	4/5/21	Score	4/2/21	Score	4/5/21	Score	4/5/21	Score
Dissolved Oxygen	mg/L	< 0.5 mg/L	3	2.74	0			2.23	0	3.48	0	2.19	0	2.19	0	2.08	0		
		> 5 mg/L	-3			8.7	-3											6.71	-3
Nitrate	mg/L	< 1 mg/L	2	0.45	2	0.12	2	ND	0	ND	0			0.035J	2	ND	2	0.091	2
Ferrous Iron	mg/L	> 1 mg/L	3	0.33	0	4.9	3	42.8	3	ND	0			0.57	0	ND	0	0.094	0
Sulfate	mg/L	< 20 mg/L	2	62.1	0	ND	2	ND	0	ND	0			ND	0	14.0	0	9.5	0
Sulfide	mg/L	> 1 mg/L	3	ND	0	ND	0	ND	0	ND	0			ND	0	ND	0	ND	0
Methane	µg/L	< 500 µg/L	0															230	0
		> 500 µg/L	3	20,000	3	7,600	3	15,000	3	19,000	3			21,000	3	20,000	3		
Ethene	µg/L	> 10 µg/L	2	ND	0	ND	0	3,400	2	ND	0			ND	0	ND	0	ND	0
Ethane	µg/L	> 100 µg/L	3	ND	0	ND	0	410	3	ND	0			ND	0	ND	0	ND	0
ORP	mV	< 50 mV	1	-54.6	1	-36.9	1			-53	1	-53.5	1			-87.4	1	75.2	0
		< -100 mV	2					-103.1	2					-186.4	2				
pH	s.u.	5 < pH < 9	0	6.97	0	6.65	0			6.81	0	7.32	0	7.65	0	7.43	0	8.55	0
		5 > pH > 9	-2					12.53	-2										
Temperature	°C	> 20°C	1	5.99	0	7.73	0	8.05	0	7.55	0	9.93	0	9.2	0	10.41	0	11.15	0
TOC	mg/L	> 20 mg/L	2	3.8	0	71.1	2	427	2	155.0	2	2.7	0	166	2	25.2	2	7.4	0
Carbon Dioxide	µg/L	> 2x background	1	70,000	0	93,000	0	47,000	0	47,000	0			42,000	1	98,000	0	12,000	0
Alkalinity	mg/L	> 2x background	1	454	0	600	0	798	0	632	0			NS	0	640	0	227	0
PCE[1]	µg/L	----	0	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0
TCE[2]	µg/L	----	0	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0
DCE[3]	µg/L	----	2	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0	ND	0
VC[4]	µg/L	----	2	ND	0	ND	0	190J	2	ND	0	ND	0	ND	0	ND	0	ND	0
1,1,1-TCA[5]	µg/L	----	0	ND	0	2,200	0	ND	0	31	0	ND	0	ND	0	ND	0	ND	0
1,1-DCA[6]	µg/L	----	2	ND	0	3,700	2	710	2	210	2	ND	0	9	2	ND	0	ND	0
CA[7]	µg/L	----	2	ND	0	8,600	2	12,000	2	1,000	2	ND	0	400	2	ND	0	ND	0
					6		**14**		**19**		**10**		**1**		**14**		**8**		**-1**

Notes:

DCE = dichloroethene
°C = degrees Celsius
µg/L = micrograms per liter
mg/L = milligrams per liter
mV = millivolts
ORP = oxidation-reduction potential
s.u. = standard unit
PCE = tetrachloroethene
TCE = trichloroethene

* MNA parameters **not** collected so cannot adequately evaluate and score

0 to 5 points: There is inadequate evidence for anaerobic biodegradation of chlorinated organics.
6 to 14 points: There is limited evidence for anaerobic biodegradation of chlorinated organics.
15 to 20 points: There is adequate evidence for anaerobic biodegradation of chlorinated organics.
>20 points: There is strong evidence for anaerobic biodegradation of chlorinated organics.

This is a background monitoring well (TVOC = 0 ug/L)

Injection of ABC-Ole+ occurred during the Week of May 20, 2019.

[1] = Material Released
[2] = Daugher product of PCE
[3] = Daugher product of TCE (score if cis-1,2-DCE is 80% of total DCE)
[4] = Daugher product of DCE
[5] = Material Released
[6] = Daugher product of 1,1,1-TCA under reducing conditions
[7] = Daughter product of 1,1-DCA or VC under reducing conditions

Table 3
Bioaugmentation Injection Intervals and Injectate Volumes

A1-GP06

Injection point GP06-A-18' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point GP06-A-13' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point GP06-A-08' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer

Injection point GP06-B-18' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point GP06-B-13' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point GP06-B-08' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer

Injection point GP06-C-18' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point GP06-C-13' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point GP06-C-08' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer

A1-GP10

Injection point GP10-A-20' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point GP10-A-15' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point GP10-A-10' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point GP10-A-05' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer

Injection point GP10-B-20' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point GP10-B-15' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point GP10-B-10' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point GP10-B-05' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer

Injection point GP10-C-20' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point GP10-C-15' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point GP10-C-10' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point GP10-C-05' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer

MW-42S

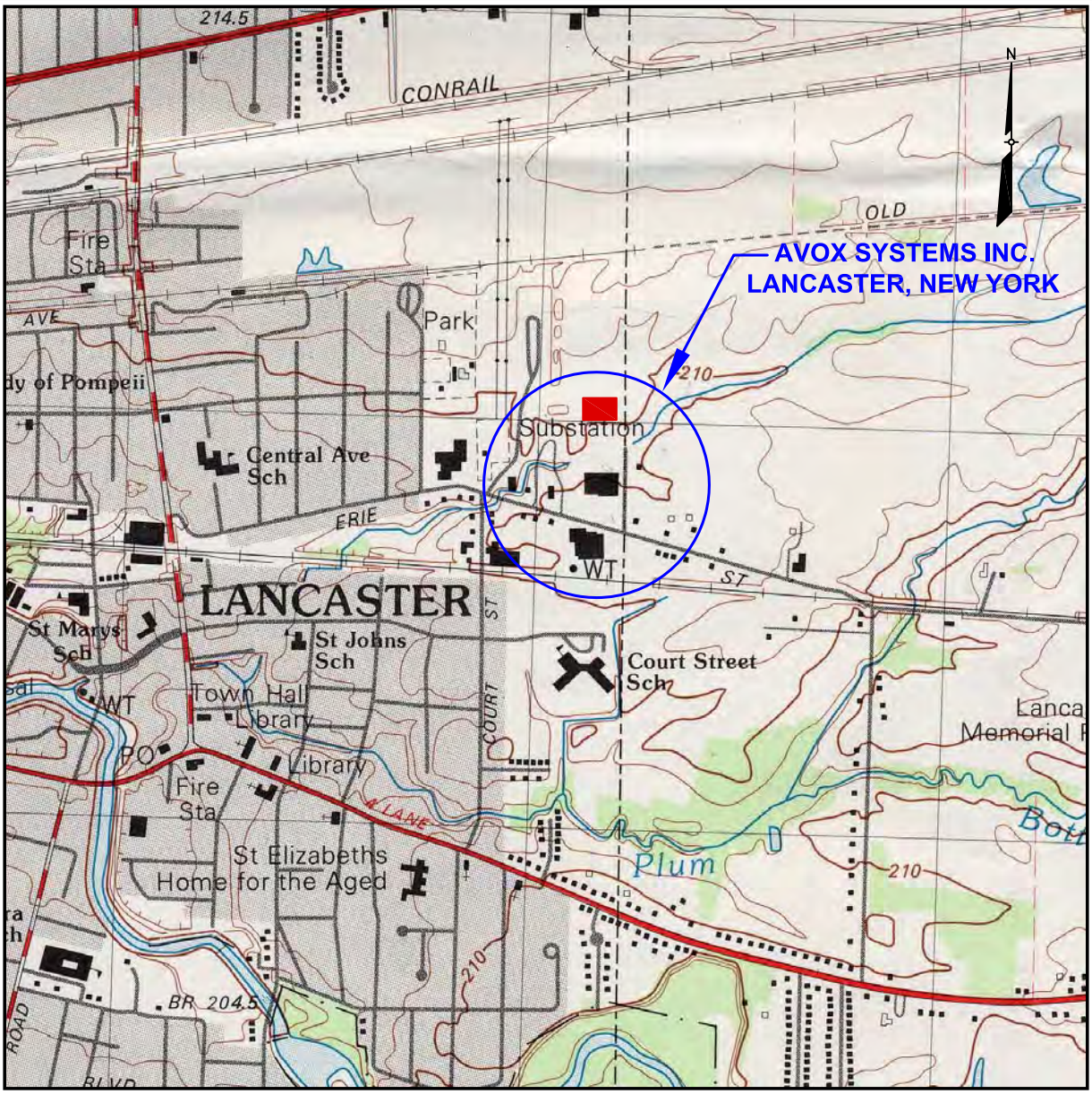
Injection point MW-42S-A-18' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point MW-42S-A-13' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point MW-42S-A-08' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer

Injection point MW-42S-B-18' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point MW-42S-B-13' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point MW-42S-B-08' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer

Injection point MW-42S-C-18' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point MW-42S-C-13' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer
Injection point MW-42S-C-08' – 0.6 liters KB-1 Plus / 50 gallons KB-1 Primer

Note:
Injection volumes are based on 6 packets of KB-1® Plus mixed with 20 liters of KB-1® Primer.

Figures



SOURCE:
1982 U.S. GEOLOGIC SURVEY 7.5 X 15 MINUTE TOPOGRAPHIC QUADRANGLE
LANCASTER, NEW YORK

LEGEND

AVOX PLANT 3 ADDED AFTER PUBLICATION OF LANCASTER, NEW YORK TOPOGRAPHIC QUADRANGLE.

0 1000 2000
SCALE IN FEET

AECOM

FIGURE 1
SITE LOCATION MAP

FORMER SCOTT AVIATION FACILITY AREA 1
LANCASTER, NEW YORK

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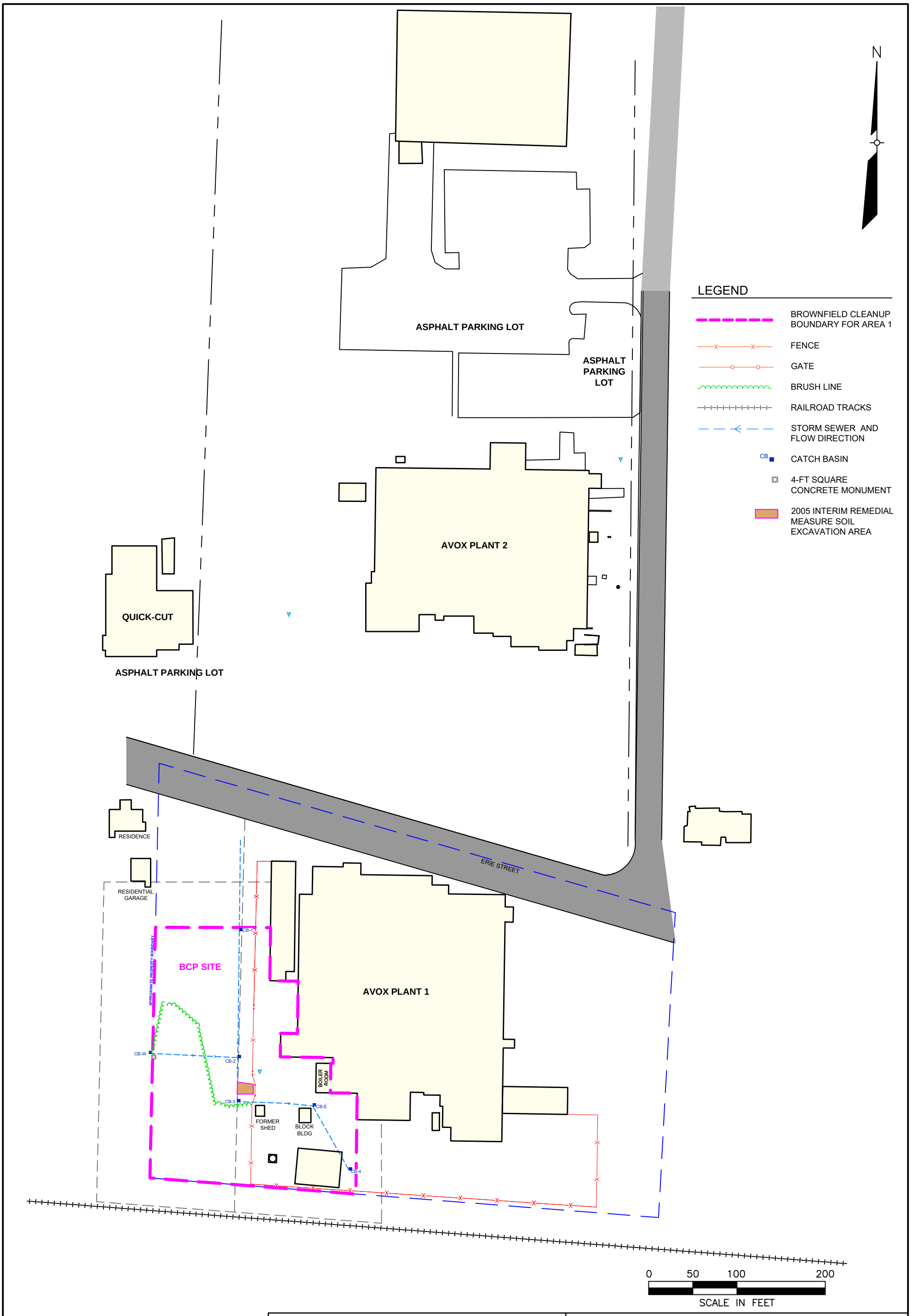

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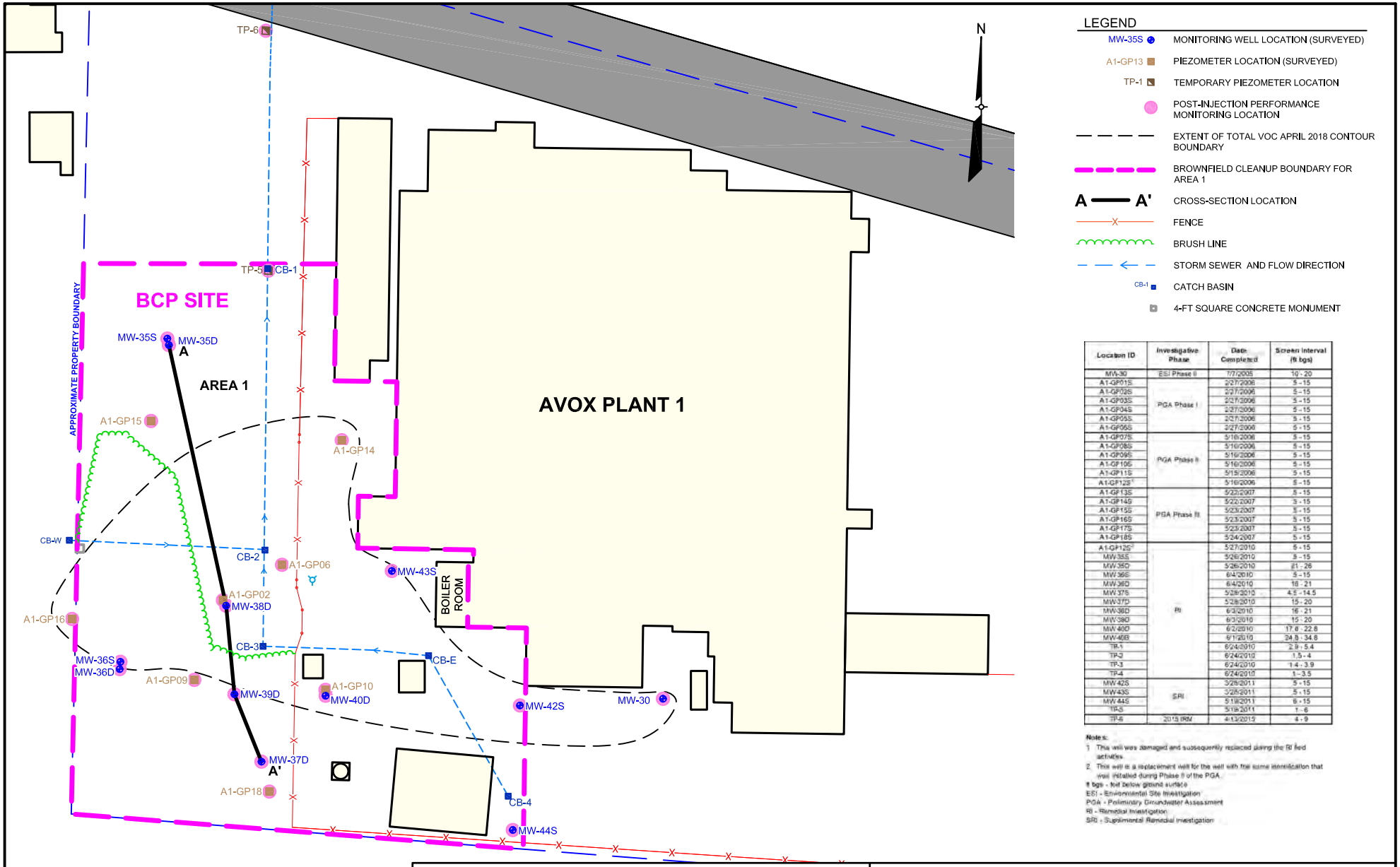
FIGURE 2
SITE LAYOUT MAP

FORMER SCOTT AVIATION FACILITY AREA 1
LANCASTER, NEW YORK



LEGEND

- MW-35S — MONITORING WELL LOCATION (SURVEYED)
- A1-GP13 — PIEZOMETER LOCATION (SURVEYED)
- TP-1 — TEMPORARY PIEZOMETER LOCATION
- POST-INJECTION PERFORMANCE MONITORING LOCATION
- EXTENT OF TOTAL VOC APRIL 2018 CONTOUR BOUNDARY
- BROWNFIELD CLEANUP BOUNDARY FOR AREA 1
- A — A' CROSS-SECTION LOCATION
- FENCE
- BRUSH LINE
- STORM SEWER AND FLOW DIRECTION
- CB-1 CATCH BASIN
- 4-FT SQUARE CONCRETE MONUMENT

Location ID	Investigative Phase	Date Completed	Screen Interval (ft bgs)
MW-30	ESI Phase II	7/7/2005	10 - 20
A1-GP01S	PGA Phase I	2/27/2006	5 - 15
A1-GP02S		2/27/2006	5 - 15
A1-GP03S		2/27/2006	5 - 15
A1-GP04S		2/27/2006	5 - 15
A1-GP05S		2/27/2006	5 - 15
A1-GP06S		2/27/2006	5 - 15
A1-GP07S	PGA Phase II	5/16/2006	5 - 15
A1-GP08S		5/16/2006	5 - 15
A1-GP09S		5/16/2006	5 - 15
A1-GP10S		5/16/2006	5 - 15
A1-GP11S		5/15/2006	5 - 15
A1-GP12S[1]		5/16/2006	5 - 15
A1-GP13S	PGA Phase III	5/22/2007	5 - 15
A1-GP14S		5/22/2007	5 - 15
A1-GP15S		5/23/2007	5 - 15
A1-GP16S		5/23/2007	5 - 15
A1-GP17S		5/23/2007	5 - 15
A1-GP18S		5/24/2007	5 - 15
A1-GP12S[2]	RI	5/27/2010	5 - 15
MW-35S		5/26/2010	5 - 15
MW-35D		5/26/2010	21 - 26
MW-36S		6/4/2010	5 - 15
MW-36D		6/4/2010	16 - 21
MW-37S		5/28/2010	4.5 - 14.5
MW-37D		5/28/2010	15 - 20
MW-38D		6/3/2010	16 - 21
MW-39D		6/3/2010	15 - 20
MW-40D		6/2/2010	17.6 - 22.6
MW-40S		6/1/2010	24.8 - 34.8
TP-1		6/24/2010	2.9 - 5.4
TP-2		6/24/2010	1.5 - 4
TP-3		6/24/2010	1.4 - 3.9
TP-4		6/24/2010	1 - 3.5
MW-42S	SRI	3/28/2011	5 - 15
MW-43S		3/28/2011	5 - 15
MW-44S		5/18/2011	6 - 15
TP-5		5/19/2011	1 - 6
TP-6	2015 IRM	4/13/2015	4 - 9

Notes:
1. This well was damaged and subsequently replaced during the RI field activities.
2. This well is a replacement well for the well with the same identification that was installed during Phase II of the PGA.

ft bgs - feet below ground surface
ESI - Environmental Site Investigation
PGA - Preliminary Groundwater Assessment
RI - Remedial Investigation
SRI - Supplimental Remedial Investigation

AECOM

FIGURE 3
MONITORING WELL, PIEZOMETER AND CATCH BASIN LOCATIONS

FORMER SCOTT AVIATION FACILITY AREA 1
LANCASTER, NEW YORK

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7/22/2020 8:45 PM

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AREA 1

AVOX PLANT 1

BOILER ROOM

MIP-1 MIP-2 MIP-3 MIP-4 MIP-5 MIP-6 MIP-7 MIP-8 MIP-9 MIP-10 MIP-11

N

LEGEND

- MIP-11 MIPHPT BORING LOCATION ZONE
- BROWNFIELD CLEANUP BOUNDARY FOR AREA 1
- FENCE
- BRUSH LINE
- STORM SEWER AND FLOW DIRECTION
- SEWER LINE INJECTION: 4, 5, 6 ft.
- MIP-1: 4, 6, 7, 10, 11, 12, 13, 14, 15, 16, 18, 20 ft.
- MIP-2: 7, 8, 11, 12 , 13, 14, 15, 16, 18, 20 ft.
- MIP-2: 7, 8, 11, 12 ft.
- MIP-3: 5, 7, 9, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20 ft.
- MIP-3: 5, 7, 9, 10, 12, 13, 14 ft.
- MIP-4: 4, 6, 8, 11 ft.
- MIP-6: 3, 4, 5, 6, 7, 8, 9, 10, 12, 14 ft.
- MIP-7: 7, 8, 10 ft.
- MIP- 8: 4, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20 ft.
- MIP-9: 3, 5, 8 ft.
- MIP-10: 8, 10, 12, 13, 14, 15, 16, 17, 18, 19, 20 ft.
- MIP-10: 8, 10, 12, 13, 14 ft.
- MIP-11: 2, 5, 6, 8, 10, 11, 12, 13, 14, 15, 16, 18, 20, 22 ft.
- MIP-11: 2, 5, 6, 8, 10, 11, 12, 13, 14 ft.
- NO INJECTION/INACCESSIBLE

0 20 40 80

SCALE IN FEET

AECOM

FIGURE 4
2015 IRM INJECTION ZONE DETAILS

FORMER SCOTT AVIATION FACILITY AREA 1 LANCASTER, NEW YORK

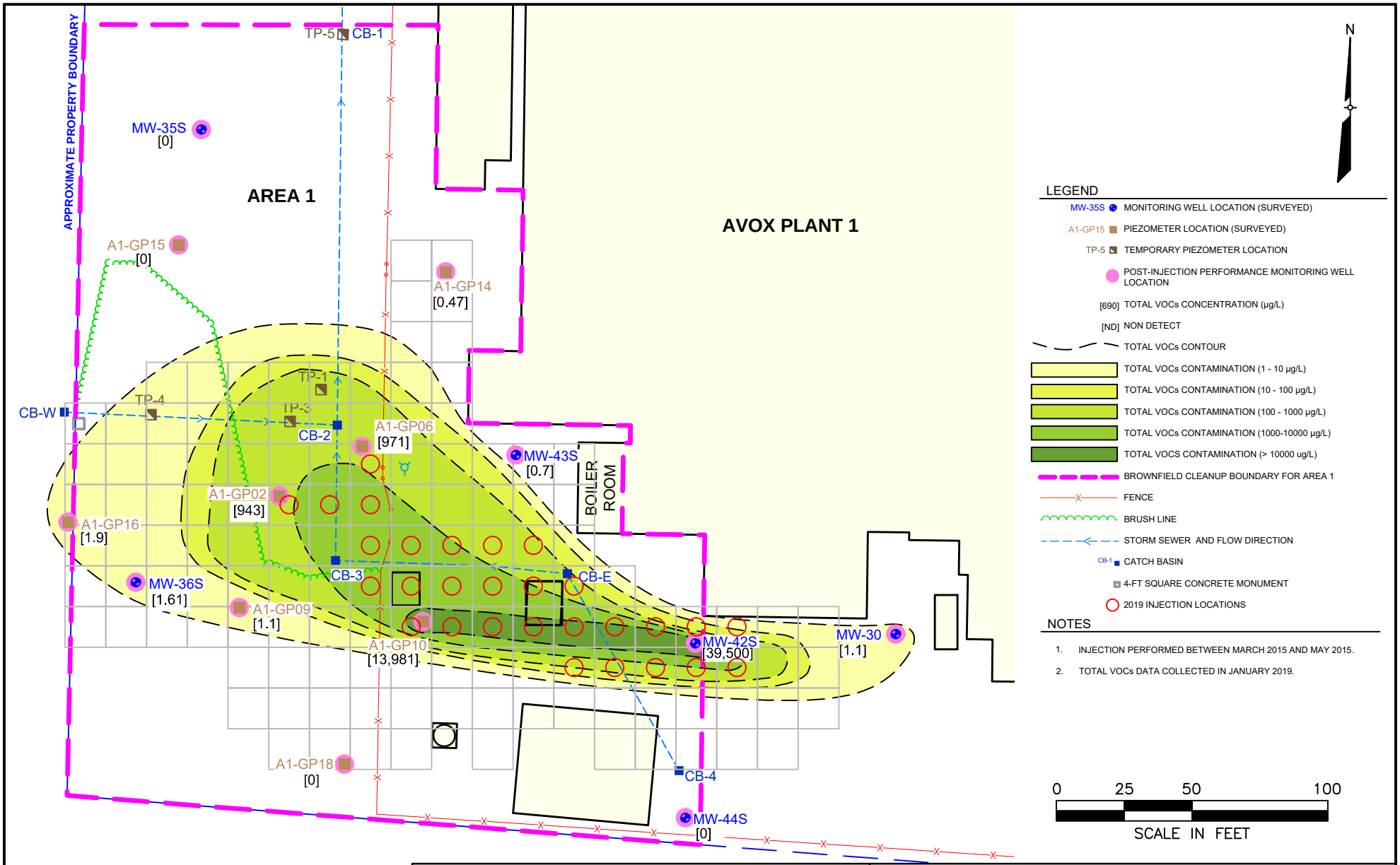

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FIGURE 5
2019 SUPPLEMENTAL GROUNDWATER INJECTION AREA

FORMER SCOTT AVIATION FACILITY AREA 1 LANCASTER, NEW YORK

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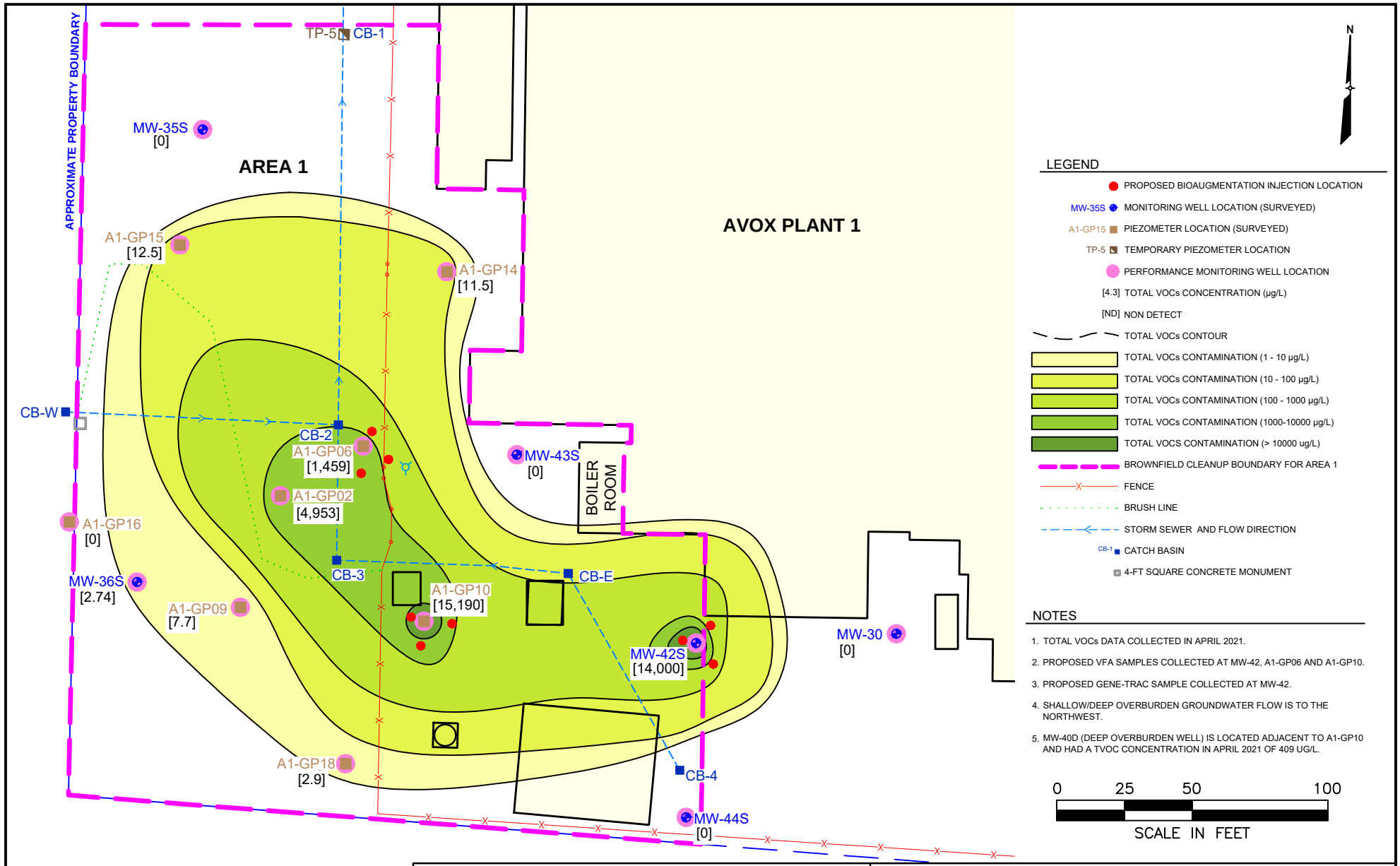

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FIGURE 6
PROPOSED BIOAUGMENTATION INJECTION LOCATIONS

FORMER SCOTT AVIATION FACILITY AREA 1
LANCASTER, NEW YORK

Attachment 1

SiREM
Leading Science · Lasting Solutions

GROUNDWATER COLLECTION AND SHIPPING PROTOCOL FOR VOLATILE FATTY ACIDS & DISSOLVED HYDROCARBON GASES ANALYSIS

This document provides procedures for collecting and shipping volatile fatty acids (VFA) samples and dissolved hydrocarbon gases (DHG) samples.

Sampling Supplies: SiREM provides sampling supplies (VOA vials, blue ice, coolers, shipping documents) free of charge upon request, please provide 3 days advance notice for this service. Customers are responsible for return shipping charges for the samples.

***For shipping inquiries and sampling supplies please use our online form*:**

http://siremlab.com/sampling-supply-form/

Or contact:

- Ximena Druar: 519-515-0838/xdruar@siremlab.com
- Jennifer Wilkinson: 519-822-2265/jwilkinson@siremlab.com

Sample Collection: Prior to sample collection, sampling points should be purged using industry-accepted groundwater purging protocols to obtain representative groundwater. Duplicate samples are collected in 40 mL VOA vials that are unpreserved for VFA analysis, or preserved with hydrochloric (HCl) acid for DHG analysis.

1) Vials should be completely filled with no headspace (to the extent possible). Fill the VOA vial so there is a convex meniscus above the rim of the vial making sure not to overflow, to ensure that the preservative (HCl) is not washed out in the case of DHG analysis.

2) Cap each vial tightly and invert to confirm the absence of air bubbles. If air bubbles are present, uncap the vial and add a few more drops of sample and re-check for bubbles.

3) Fill two 40 mL VOA vials for each sample location.

4) Samples should be stored at 4ºC and shipped on blue ice or double bagged wet ice in a plastic or Styrofoam cooler.

Sample Labeling and Handling: Samples should be clearly labeled using permanent marker with sample ID and sampling date and individually sealed in bubble wrap and then placed in a cooler with blue ice packs (preferred). If wet ice is used it should be double bagged. Sample hold time is 14 days at 4ºC.

Chain-of-Custody: See Attachment 1 for a sample chain-of-custody, printable chain of custody forms are available online at http://siremlab.com/forms/ the completed chain-of-custody should be placed in a zip-lock bag inside the cooler. If applicable, purchase order number and quotation number should be entered in the chain of custody. Please indicate which analysis is requested.

Shipping: Ship samples by priority overnight courier to SiREM Knoxville, TN (address below). When using FedEx, if a shipment value exceeding $100 is declared additional charges may apply. Please see terms and conditions on reverse of waybill or contact FedEx directly for more information.

Shipping Documentation: A US domestic waybill is required. See Attachment 2 for sample FedEx waybill.

Section 1: Fill in date, complete shipping address and include your FedEx account number
Section 2: Your internal reference number/project number (if required)
Section 3: To address is: (already completed)

SiREM Knoxville
180A Market Place Boulevard
Knoxville, TN 37922

Section 4a: Express package Service – mark FedEx priority overnight
Section 5: Other packaging
Section 7: Payment and by Sender
Section 8: Signature

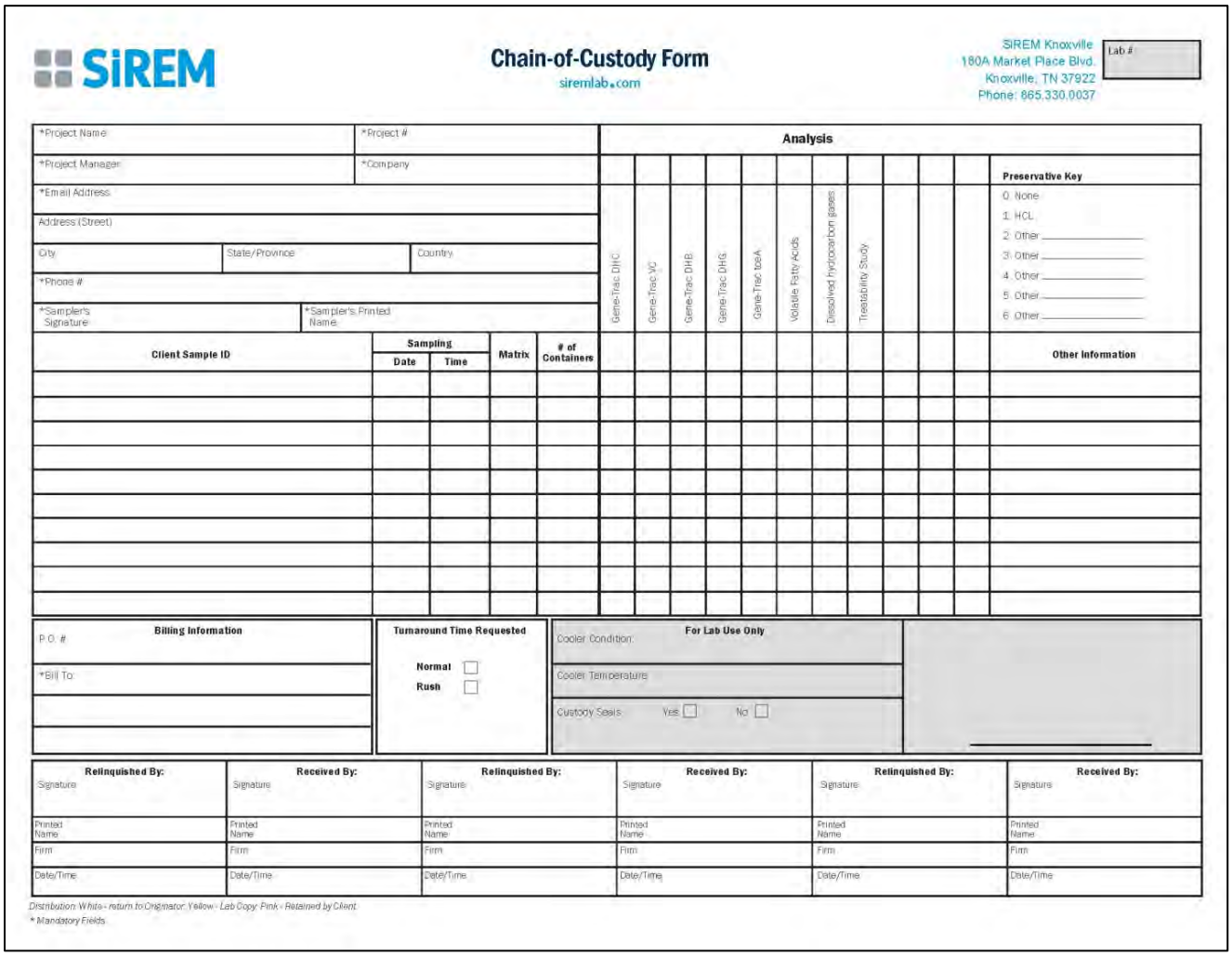
Place completed waybill in plastic sleeve on exterior of cooler.

Technical Inquiries: Should you require technical assistance with sampling or if you have questions regarding the analysis, data interpretation etc. please contact:

- Jeff Roberts 519-515-0840/jroberts@siremlab.com
- Phil Dennis 519-515-0836/pdennis@siremlab.com

Attachments: (1) Sample Chain-of-Custody
(2) Sample FedEx Domestic US Air Waybill

Attachment 1: Sample Chain-of-Custody



SiREM

Chain-of-Custody Form

siremlab.com

SiREM Knoxville
180A Market Place Blvd.
Knoxville, TN 37922
Phone: 865.330.0037

Lab #

*Project Name | *Project #

*Project Manager | *Company

*Email Address

Address (Street)

City | State/Province | Country

*Phone #

*Sampler's Signature | *Sampler's Printed Name

Analysis

Gene-Trac DHC | Gene-Trac VC | Gene-Trac DHB | Gene-Trac DHG | Gene-Trac tceA | Volatile Fatty Acids | Dissolved Hydrocarbon gases | Treatability Study

Preservative Key

0. None
1. HCL
2. Other
3. Other
4. Other
5. Other
6. Other

Client Sample ID	Sampling Date	Sampling Time	Matrix	# of Containers	Other Information

Billing Information

P.O. #

*Bill To:

Turnaround Time Requested

Normal ☐
Rush ☐

For Lab Use Only

Cooler Condition:

Cooler Temperature:

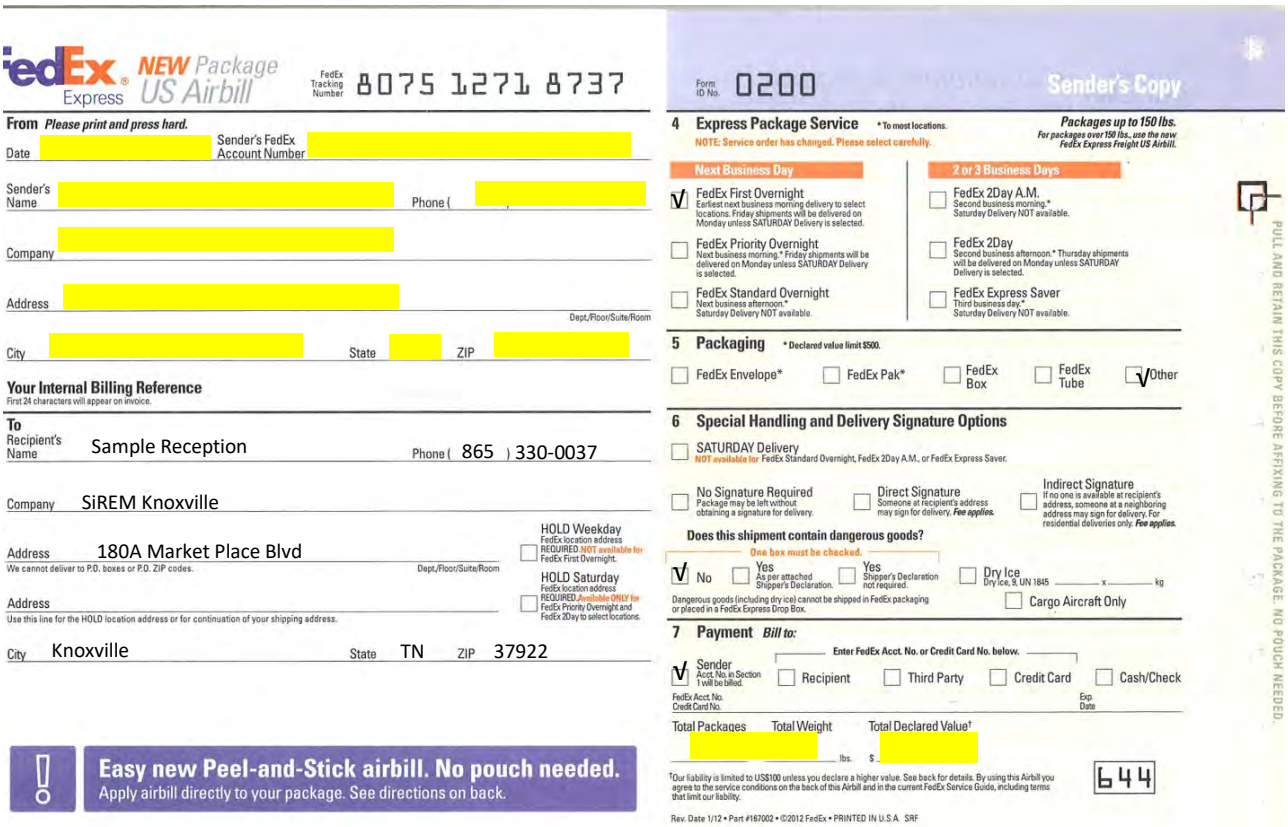
Custody Seals: Yes ☐ No ☐

Relinquished By:	Received By:	Relinquished By:	Received By:	Relinquished By:	Received By:
Signature	Signature	Signature	Signature	Signature	Signature
Printed Name	Printed Name	Printed Name	Printed Name	Printed Name	Printed Name
Firm	Firm	Firm	Firm	Firm	Firm
Date/Time	Date/Time	Date/Time	Date/Time	Date/Time	Date/Time

Distribution: White - return to Originator; Yellow - Lab Copy; Pink - Retained by Client.

** Mandatory Fields*

Attachment 2: Sample Domestic Waybill



FedEx Express NEW Package US Airbill

FedEx Tracking Number 8075 1271 8737

Form ID No. 0200 Sender's Copy

From *Please print and press hard.*

Date [redacted] Sender's FedEx Account Number [redacted]

Sender's Name [redacted] Phone ([redacted]

Company [redacted]

Address [redacted] Dept./Floor/Suite/Room

City [redacted] State [redacted] ZIP [redacted]

Your Internal Billing Reference
First 24 characters will appear on invoice.

To
Recipient's Name Sample Reception Phone (865) 330-0037

Company SiREM Knoxville

Address 180A Market Place Blvd Dept./Floor/Suite/Room
We cannot deliver to P.O. boxes or P.O. ZIP codes.

Address
Use this line for the HOLD location address or for continuation of your shipping address.

City Knoxville State TN ZIP 37922

HOLD Weekday FedEx location address REQUIRED. NOT available for FedEx First Overnight.

HOLD Saturday FedEx location address REQUIRED. Available ONLY for FedEx Priority Overnight and FedEx 2Day to select locations.

Easy new Peel-and-Stick airbill. No pouch needed.
Apply airbill directly to your package. See directions on back.

4 Express Package Service * To most locations.
NOTE: Service order has changed. Please select carefully.
Packages up to 150 lbs. For packages over 150 lbs., use the new FedEx Express Freight US Airbill.

Next Business Day

- [x] FedEx First Overnight — Earliest next business morning delivery to select locations. Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- [ ] FedEx Priority Overnight — Next business morning.* Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- [ ] FedEx Standard Overnight — Next business afternoon.* Saturday Delivery NOT available.

2 or 3 Business Days

- [ ] FedEx 2Day A.M. — Second business morning.* Saturday Delivery NOT available.
- [ ] FedEx 2Day — Second business afternoon.* Thursday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- [ ] FedEx Express Saver — Third business day.* Saturday Delivery NOT available.

5 Packaging * Declared value limit $500.

- [ ] FedEx Envelope*
- [ ] FedEx Pak*
- [ ] FedEx Box
- [ ] FedEx Tube
- [x] Other

6 Special Handling and Delivery Signature Options

- [ ] SATURDAY Delivery — NOT available for FedEx Standard Overnight, FedEx 2Day A.M., or FedEx Express Saver.

- [ ] No Signature Required — Package may be left without obtaining a signature for delivery.
- [ ] Direct Signature — Someone at recipient's address may sign for delivery. Fee applies.
- [ ] Indirect Signature — If no one is available at recipient's address, someone at a neighboring address may sign for delivery. For residential deliveries only. Fee applies.

Does this shipment contain dangerous goods?
One box must be checked.

- [x] No
- [ ] Yes — As per attached Shipper's Declaration.
- [ ] Yes — Shipper's Declaration not required.
- [ ] Dry Ice — Dry Ice, 9, UN 1845 ____ x ____ kg

Dangerous goods (including dry ice) cannot be shipped in FedEx packaging or placed in a FedEx Express Drop Box.

- [ ] Cargo Aircraft Only

7 Payment *Bill to:*
Enter FedEx Acct. No. or Credit Card No. below.

- [x] Sender — Acct. No. in Section 1 will be billed.
- [ ] Recipient
- [ ] Third Party
- [ ] Credit Card
- [ ] Cash/Check

FedEx Acct. No. / Credit Card No. Exp. Date

Total Packages Total Weight Total Declared Value†
[redacted] lbs. $ [redacted]

†Our liability is limited to US$100 unless you declare a higher value. See back for details. By using this Airbill you agree to the service conditions on the back of this Airbill and in the current FedEx Service Guide, including terms that limit our liability.

644

Rev. Date 1/12 • Part #167002 • ©2012 FedEx • PRINTED IN U.S.A. SRF

PULL AND RETAIN THIS COPY BEFORE AFFIXING TO THE PACKAGE. NO POUCH NEEDED.

SiREM Knoxville
180A Market Place Boulevard
Knoxville, TN, 37922

GROUNDWATER SAMPLE COLLECTION AND SHIPPING FOR GENE-TRAC® ANALYSIS

This document provides sampling and shipping instructions for Gene-Trac® quantitative polymerase chain reaction (qPCR) (e.g., Gene-Trac® Dhc or FGA analysis) and Gene-Trac® next generation sequencing (NGS) tests performed on groundwater.

Sample Collection Methods: There are two groundwater sampling methods for Gene-Trac®:

- Method A: conventional groundwater sample collection; and
- Method B: field filtration (i.e., groundwater solids collected on a filter).

Both methods yield equivalent results; however, shipping charges for the field filters will be lower due to reduced size and weight of the samples retuned to the lab.

Ordering Sampling Supplies: SiREM is pleased to provide sampling supplies (containers or filters, coolers, ice packs upon request) free of charge. Note: Please provide 7 days advance notice for this service, otherwise a $50 shipping surcharge may apply. Please contact Ximena Druar 519-515-0838 / xdruar@siremlab.com or use our ***online sample kit order portal*** http://www.siremlab.com/sampling-supply-form to order sampling supplies.

Figure 1: Gene-Trac samples can be provided as either 1 L Wide mouth (HDPE) bottles (left) or Sterivex® filters (right). **Each filter is provided in an outer storage tube that contains the filter, a screw cap and a sample label**

Table 1: **Sample Requirements for Gene-Trac® qPCR Testing and NGS Analysis**

	Method A: Groundwater Sample	Method B: Field Filtration	Hold Time
Gene-Trac® qPCR Tests (e.g., Dhc/FGA)	One-1L Wide mouth Nalgene	One -Sterivex® filter with up to 1 L water passed through	7 days at 4°C
Gene-Trac® NGS	Two-1L Wide mouth Nalgene	Two-Sterivex® filters with up to 1 L water passed through	7 days at 4°C

Collecting Samples

For all Gene-Trac® (qPCR) tests, only one bottle or filter is required per sample. Please note that for next generation sequencing (NGS) analysis duplicate samples are required to provide sufficient biomass for analysis (SeeTable 1)

Groundwater Purging: Prior to groundwater sample collection, sampling points should be purged using industry-accepted well purging protocols to obtain representative groundwater. Note: turbidity in groundwater samples is not a concern.

Method A: Conventional Groundwater Samples in 1 Liter Bottles

Following purging, 1-liter (L) groundwater samples are collected in large mouth 1L high-density polyethylene (HDPE) bottles (e.g., Nalgene or equivalent) with minimal headspace. No preservatives are required; samples should be stored and shipped at 4ºC on blue or double bagged wet ice. The hold time is 7 days.

Method B: Field Filtration

1) Following ground water purging, remove Sterivex filter from storage container and insert luer-lock adapter (white barbed fitting) into pump effluent tubing (1/4"-5/16" inside diameter) and securely fasten using a hose clamp if required (Figure 1B).

2) Remove the white rubber nipple cover from the effluent end of the filter (do not discard cap-this will be used to seal after sampling).

3) Turn on pump and direct filter discharge into a graduated container (Figure 1B). Pass up to 1L of water through the filter. Note that the filter often clogs before a full 1L of sample is filtered. If this occurs, record the measured volume of water passed through the filter (in milliliters [mL]) on the label provided (Figure 1A) and the provided chain of custody. Shut off the pump.

4) Cap the effluent end of the filter (while full of water) with the small white nipple cap provided; decouple the tubing/luer-lock fitting from the influent end of the filter and seal the filter unit with the white screw-cap (Figure 1C). Place the sealed filter in the storage tube, label with the sample location, date and total volume of groundwater passed through the filter. The filter should be stored and shipped at 4ºC in the provided cooler (Figure 1D).

5) Remove the luer-lock fitting in the pump tubing and discard. Dispose of effluent groundwater in accordance with applicable site procedures.

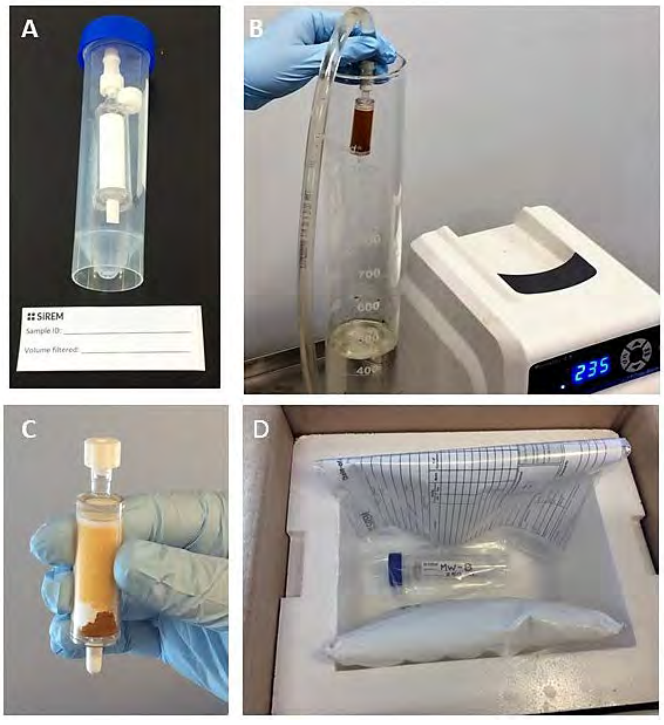


Figure 2: Use and Shipping of Field Filters

Labelling, Storage and Shipping

Sample Labelling and Handling: Samples should be clearly labeled (including sample ID and date) and individually sealed in re-sealable freezer bags provided and placed in a cooler with cool packs. If wet ice is used it must be double bagged. Sample hold time for 1L groundwater and filter samples is 7 days at 4ºC.

Chain-of-Custody: Include the total volume passed through the filter for each sample (Method B only), the applicable purchase order number and quotation number where applicable. Please indicate which analysis is requested by noting the test method (refer to Attachment 1 for a list of Gene-Trac® analyses provided by SiREM). The completed chain-of-custody (Attachment 2) should be placed in a zip-lock bag inside the cooler with the samples.

Shipping: For samples originating in the USA ship samples by priority overnight courier to SiREM Knoxville, TN (address below). Samples should be given a nominal value of no more than $10.

Please note that SiREM is not open on Saturdays

The following shipping document is required:

Domestic Waybill (e.g., FedEx) see sample FedEx waybill (Attachment 3). Complete shipper specific information, other information should be completed as indicated.

Section 1: Fill in date, complete shipping address and include your FedEx account number
Section 2: Your internal reference number/project number (if required)
Section 3: To address is: (already completed)

SiREM Knoxville
180A Market Place Boulevard
Knoxville, TN 37922

Section 4a: Express package Service – mark FedEx priority overnight
Section 5: Other packaging
Section 7: Payment and by Sender
Section 8: Signature

Technical Inquiries:

- Ximena Druar 519-515-0838
  xdruar@siremlab.com
- Phil Dennis 519-515-0836
  pdennis@siremlab.com

Attachments: (1) Available Gene-Trac® Tests
(2) SiREM Chain-of-Custody
(3) Example FedEx Waybill

SiREM

Attachment 1: Available Gene-Trac® Tests

Contaminant Class	Redox	Gene-Trac® Test Name	Target	Relevance
Chlorinated Ethenes	Anaerobic	Dhc	*Dehalococcoides*	Dechlorinates PCE, TCE, all DCE isomers, VC
		Dhb	*Dehalobacter*	Dechlorination of PCE &TCE to cDCE
		Dsm	*Desulfuromonas*	Dechlorination of PCE & TCE to cDCE
		Dsb	*Desulfitobacterium*	Partial dechlorination of PCE and TCE to cDCE
		Geo	*Geobacter*	Dechlorinates PCE to cDCE/biogeochemical degradation
		Dhg	*Dehalogenimonas*	Dechlorination of tDCE to VC and VC to ethene
		Chloroethene FGA	Vinyl Chloride Reductase (*vcrA*)	Dechlorination of cDCE & VC to ethene
			BAV1 Reductase (*bvcA*)	Dechlorination of cDCE and VC to ethene
			Trichloroethene Reductase (*tceA*)	Dechlorination of PCE and TCE to cDCE and VC
	Aerobic	Polaromonas	*Polaromonas*	Aerobic dechlorination of cDCE
		etn	*etnE*	Aerobic degradation of VC
Chlorinated Ethanes	Anaerobic	Dhb	*Dehalobacter*	Dechlorinates 1,1,1-TCA/1,2-DCA /1,1,2-TCA/ 1,1,2,2-TeCA
		Dhg	*Dehalogenimonas*	Dechlorinates 1,2- DCA, 1,1,2,2-TeCA , 1,1,2-TCA
		Dhc	*Dehalococcoides*	Dechlorinates 1,2-DCA to ethene
		Dsb	*Desulfitobacterium*	Dechlorinates 1,1,2-TCA &1,2-DCA
		cfrA/dcrA	Dichloroethane Dehalogenase (*dcrA*)	Dechlorinates 1,1,1-TCA & 1,1-DCA
	Aerobic	sMMO	Soluble Methane Monooxygenase	Co-metabolism of 1,1,1-TCA & 1,1-DCA by methanotrophs
		PMO	Propane Monooxygenase	Co-metabolism of chlorinated ethanes by propanotrophs
		dhlA	Haloalkane Dehalogenase (*dhlA*)	Aerobic dechlorination of 1,2-DCA
Chlorinated Methanes	Anaerobic	Dhb	*Dehalobacter*	Dechlorination of chloroform to DCM; DCM to acetate
		cfrA/dcrA	Chloroform Reductase (*cfrA*)	Converts chloroform to dichloromethane
	Aerobic	sMMO	Soluble Methane Monooxygenase	Co-metabolism of chloroform & dichloromethane
Chlorinated Propanes	Anaerobic	Dhg	*Dehalogenimonas*	Converts TCP to allyl chloride; DCP to propene
		Dhc	*Dehalococcoides*	Converts DCP to propene
		Dhb	*Dehalobacter*	Converts DCP to propene
		Dsb	*Desulfitobacterium*	Dechlorination of TCP & DCP
Chlorinated Benzenes	Anaerobic	Dhc	*Dehalococcoides*	Partial dechlorination of HCB/PCB
		Dhb	*Dehalobacter*	Reductive dechlorination of DCB, MCB
Chlorinated Phenols	Anaerobic	Dhc	*Dehalococcoides*	Dechlorination of 2,3-dichlorophenol, TCP and PCP
PCBs	Anaerobic	Dhc	*Dehalococcoides*	Dechlorinates select Arochlor 1260 congeners
		Dhb	*Dehalobacter*	Dechlorinates 2,3,4-trichorobiphenyl; 2,3,4,5-tetrachlorobiphenyl
		Dhg	*Dehalogenimonas*	Dechlorinates select Arochlor 1260 congeners
BTEX	Anaerobic	SRB	Sulfate reducing bacteria (*dsrA*)	Partners to ORM-2 in anaerobic benzene degradation
		ORM-2	*Deltaproteobacterium ORM-2*	Anaerobic benzene degrader (SO_4/CH_4 reducing conditions)
		Pepto-ben	Benzene degrading *Peptococcaceae*	Anaerobic benzene degrader under NO_3 reducing conditions
		abcA	Benzene Carboxylase *(abcA)*	Involved in benzene ring cleavage
Fuel Oxygenates	Aerobic	MTBE/TBA	*Methylibium petroleiphilum* PM1	MTBE/TBE degrading microorganism
			tert-butyl alcohol hydroxylase (*mdpJ*)	Active on TBA in aerobic MTBE degradation pathway
			HIBA mutase (*hcmA*)	Active on 2-HIBA in aerobic MTBE degradation pathway
1,4-Dioxane	Aerobic metabolism	1,4-dioxane	Dioxane monooxygenase (*dxmb*)	Energy yielding 1,4-dioxane degradation
		1,4-dioxane	Aldehyde Dehydrogenase	Energy yielding 1,4-dioxane degradation
	Aerobic Cometabolism	pMMO	Particulate Methane Monooxygenase	Co-oxidation of 1,4-dioxane in presence of methane
		sMMO	Soluble Methane Monooxygenase	Co-oxidation of 1,4-dioxane
		PMO	Propane Monooxygenase	Co-oxidation of 1,4-dioxane in presence of propane
Nitrogen	Anaerobic	Anammox	Major anammox genera	Anaerobic co-removal of ammonium and nitrite
Prokaryotic Groups	Variable	Universal	Bacteria	Quantifies *Bacteria*-measure of total biomass
		Arch	Archaea	Quantifies *Archaea* biomass
		SRB	Sulfate reducing bacteria (*dsrA*)	Anaerobic hydrocarbon oxidation/biogeochemical reduction/MIC
		NGS	*Bacteria/Archaea*	Comprehensive characterization of microbial communities

Attachment 2:

SiREM Chain-of-Custody

SiREM

Chain-of-Custody Form

siremlab.com

130 Stone Rd. W
Guelph, ON N1G 3Z2
(519) 822-2265

Lab #

*Project Name	*Project #
*Project Manager	*Company
*Email Address	
Address (Street)	
City	State/Province	Country
*Phone #	
*Sampler's Signature	*Sampler's Printed Name

Analysis

Gene-Trac DHC	Gene-Trac FGA	Gene-Trac DHB	Gene-Trac NGS								

Preservative Key

0. None
1. HCL
2. Other _____
3. Other _____
4. Other _____
5. Other _____
6. Other _____

Client Sample ID	Sampling		Matrix	# of Containers	Other Information
	Date	Time			

Billing Information

P.O. #

*Bill To:

Turnaround Time Requested

Normal ☐

Rush ☐

For Lab Use Only

Cooler Condition:

Cooler Temperature:

Custody Seals: Yes ☐ No ☐

For Lab Use Only

Proposal #: _____

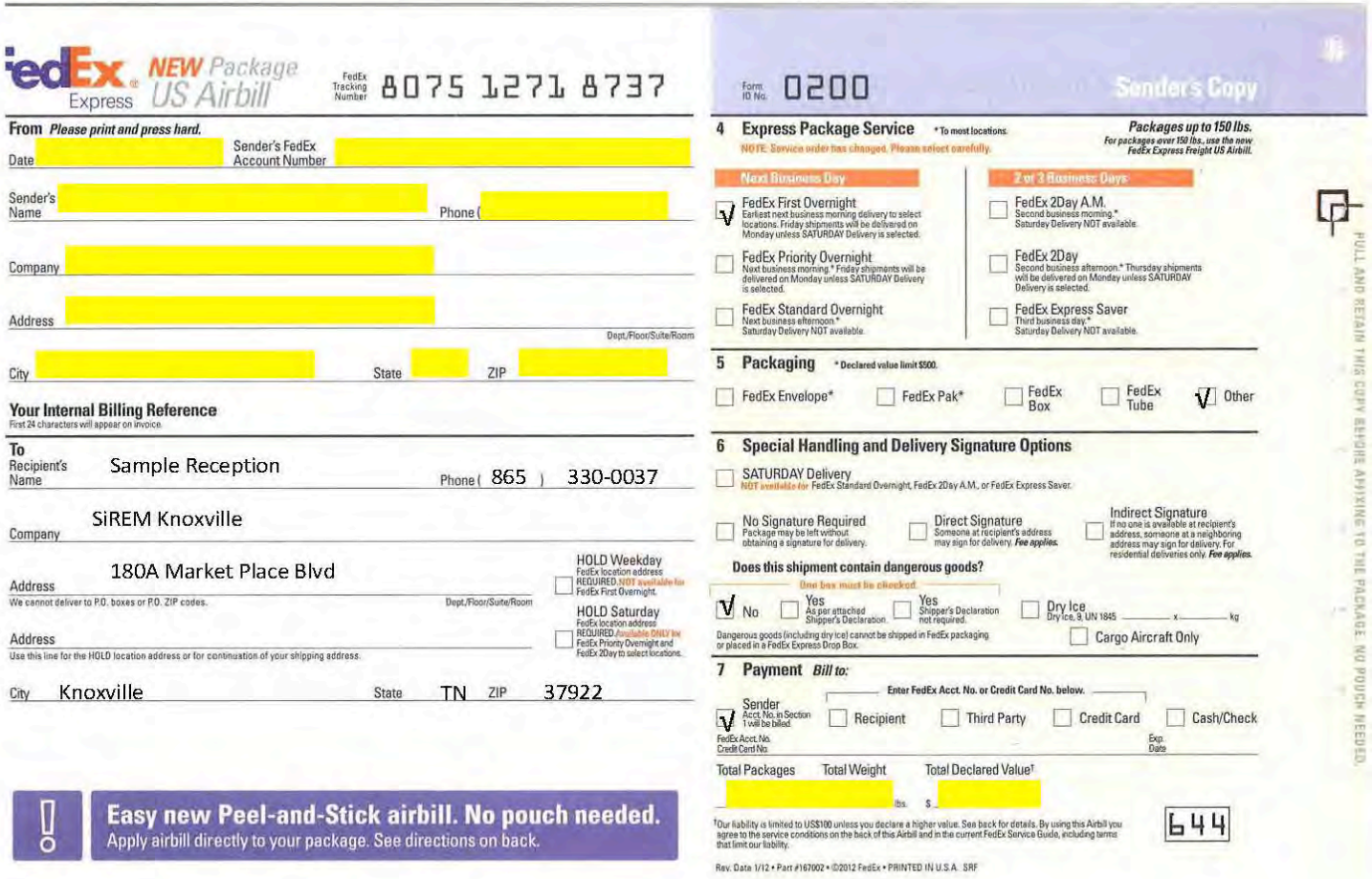
Relinquished By:	Received By:	Relinquished By:	Received By:	Relinquished By:	Received By:
Signature	Signature	Signature	Signature	Signature	Signature
Printed Name	Printed Name	Printed Name	Printed Name	Printed Name	Printed Name
Firm	Firm	Firm	Firm	Firm	Firm
Date/Time	Date/Time	Date/Time	Date/Time	Date/Time	Date/Time

Distribution: White - return to Originator: Yellow - Lab Copy: Pink - Retained by Client

** Mandatory Fields*

Attachment 3:

Example FedEx Waybill



FedEx Express NEW Package US Airbill

FedEx Tracking Number 8075 1271 8737

Form ID No. 0200 Sender's Copy

From *Please print and press hard.*

Date

Sender's FedEx Account Number

Sender's Name

Phone (

Company

Address

Dept./Floor/Suite/Room

City State ZIP

Your Internal Billing Reference
First 24 characters will appear on invoice.

To
Recipient's Name: Sample Reception
Phone (865) 330-0037

Company: SiREM Knoxville

Address: 180A Market Place Blvd
We cannot deliver to P.O. boxes or P.O. ZIP codes.
Dept./Floor/Suite/Room

Address
Use this line for the HOLD location address or for continuation of your shipping address.

City: Knoxville State: TN ZIP: 37922

HOLD Weekday
FedEx location address REQUIRED. NOT available for FedEx First Overnight.

HOLD Saturday
FedEx location address REQUIRED. Available ONLY for FedEx Priority Overnight and FedEx 2Day to select locations.

Easy new Peel-and-Stick airbill. No pouch needed.
Apply airbill directly to your package. See directions on back.

4 Express Package Service * To most locations.
NOTE: Service order has changed. Please select carefully.
Packages up to 150 lbs.
For packages over 150 lbs., use the new FedEx Express Freight US Airbill.

Next Business Day

- [√] FedEx First Overnight — Earliest next business morning delivery to select locations. Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- [ ] FedEx Priority Overnight — Next business morning.* Friday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- [ ] FedEx Standard Overnight — Next business afternoon.* Saturday Delivery NOT available.

2 or 3 Business Days

- [ ] FedEx 2Day A.M. — Second business morning.* Saturday Delivery NOT available.
- [ ] FedEx 2Day — Second business afternoon.* Thursday shipments will be delivered on Monday unless SATURDAY Delivery is selected.
- [ ] FedEx Express Saver — Third business day.* Saturday Delivery NOT available.

5 Packaging * Declared value limit $500.

[ ] FedEx Envelope* [ ] FedEx Pak* [ ] FedEx Box [ ] FedEx Tube [√] Other

6 Special Handling and Delivery Signature Options

[ ] SATURDAY Delivery
NOT available for FedEx Standard Overnight, FedEx 2Day A.M., or FedEx Express Saver.

[ ] No Signature Required — Package may be left without obtaining a signature for delivery.
[ ] Direct Signature — Someone at recipient's address may sign for delivery. *Fee applies.*
[ ] Indirect Signature — If no one is available at recipient's address, someone at a neighboring address may sign for delivery. For residential deliveries only. *Fee applies.*

Does this shipment contain dangerous goods?
One box must be checked.

[√] No [ ] Yes As per attached Shipper's Declaration. [ ] Yes Shipper's Declaration not required. [ ] Dry Ice Dry Ice, 9, UN 1845 ____ x ____ kg

Dangerous goods (including dry ice) cannot be shipped in FedEx packaging or placed in a FedEx Express Drop Box.

[ ] Cargo Aircraft Only

7 Payment *Bill to:*
Enter FedEx Acct. No. or Credit Card No. below.

[√] Sender Acct. No. in Section 1 will be billed. [ ] Recipient [ ] Third Party [ ] Credit Card [ ] Cash/Check

FedEx Acct. No. / Credit Card No. Exp. Date

Total Packages Total Weight Total Declared Value†
lbs. $

†Our liability is limited to US$100 unless you declare a higher value. See back for details. By using this Airbill you agree to the service conditions on the back of this Airbill and in the current FedEx Service Guide, including terms that limit our liability.

644

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Attachment 2

KB-1 plus

Bioaugmentation Cultures

Use KB-1® Plus for Bioaugmentation at Mixed Chlorinated Solvent Sites

toll free: 1-866-251-1747
phone: (519) 822-2265

Contact SiREM for a quotation or more information on our line of leading bioaugmentation products.

siremlab.com

KB-1® Plus bioaugmentation cultures are custom-blended microbial formulations capable of biodegradation of chlorinated solvents including complex contaminant mixtures. These cultures have been developed by SiREM in collaboration with the University of Toronto[1,2] and the United States Geological Survey[3].

KB-1® Plus Cultures are used for the Remediation of:

- Chlorinated ethanes (1,1,1-trichloroethane and 1,1-dichloroethane to chloroethane) (1,1,2,2-tetrachloroethane, 1,1,2-trichloroethane and 1,2-dichloroethane to ethene);
- Chlorinated methanes (carbon tetrachloride, chloroform and dichloromethane to non-chlorinated end products);
- Chlorinated propanes (1,2,3-trichloropropane and 1,2-dichloropropane to allyl alcohol and propene);
- Chlorofluorocarbons (1,1,2-trichloro-1,2,2-trifluoroethane);
- Explosives (RDX); and
- Chlorinated ethenes (tetrachloroethene, trichloroethene, dichloroethene isomers and vinyl chloride to ethene)

A key benefit of KB-1® Plus cultures is their effectiveness on contaminant mixtures. First, specialized microbes degrade inhibitory compounds (e.g., 1,1,1-TCA /chloroform/CFCs), followed by the complete degradation of the remaining chlorinated compounds (e.g., chlorinated ethenes).

SiREM's bioremediation culture capabilities are always growing. If you have a site with compounds not on this list and are interested in advanced bioremediation approaches, please contact SiREM to enquire about our expanding culture capabilities and latest innovations in groundwater remediation.

Benefits of KB-1® Plus include:

- First rate technical support ensures a successful bioaugmentation application
- Custom blended formulations optimize biodegradation for chlorinated VOC mixtures
- Only a single application required
- Works with all commonly used electron donors
- Natural microbial culture (not genetically modified)
- Pathogen free
- Rigorous quality control ensures each shipment is effective, stable and safe
- Shipped in specially designed vessels that prevent exposure to air and are safe and easy to handle

All KB-1® Plus purchases include:

- KB-1® Plus Guarantee*
- Complimentary Gene-Trac® *Dehalococcoides*, *Dehalobacter* and *Dehalogenimonas* tests to verify the successful delivery, growth and persistence of KB-1® Plus microbes in site groundwater

References

[1]Grostern, A. and E. A. Edwards. 2006. Growth of *Dehalobacter* and *Dehalococcoides* spp. during Degradation of Chlorinated Ethanes. *Appl. Environ. Microbiol.* 72: 428–436.

[2]Grostern, A., M. Duhamel, S. Dworatzek and E. A. Edwards. 2010. Chloroform respiration to dichloromethane by a *Dehalobacter* population. *Environmental Microbiology.*

[3]Jones E. J. P., M. A. Voytek, M.M. Lorah, J. D. Kirshtein. 2006. Characterization of a Microbial Consortium Capable of Rapid and Simultaneous Dechlorination of 1,1,2,2-Tetrachloroethane and Chlorinated Ethane and Ethene Intermediates. *Bioremediation Journal,* Volume 10: 153-168.

**some conditions apply*

SiREM

KB-1® Primer – Instruction Sheet

KB-1® Primer is used to prepare anaerobic water to disperse electron donors and protect anaerobic bioaugmentation cultures during injection into aquifers. KB-1® Primer is provided:

- In pre-weighed pouches that are designed to treat 250 gallons (or ~ 1,000 Liters) of water;
- In pre-weighed pouches that are designed to treat 1,000 gallons (or ~3,800 Liters) of water; or
- In 50-pound buckets that can be weighed in the field for custom sizes.

The recommended dosing is 0.8 g/L of KB-1® Primer in water. KB-1® Primer at this dosing rate is designed to reduce water to <-75 mV ORP within two hours well keeping the pH in the 6.0 to 8.5 range. The ORP will continue to decrease with time, the more time the KB-1® Primer has to react the better its performance will be.

PREPARING TOTES/TANKS OF ANAEROBIC WATER

- Start by filling the tote/tank with water (ground or municipal water source) up to approximately 25% of the volume
- While the tote/tank is filling with water, prepare the KB-1® Primer slurry;
  - Add contents of the KB-1® Primer pouch to an empty pail and fill partially with water. If using KB-1® Primer from a bucket, weigh the amount of KB-1® Primer required for the tote/tank, add into the empty pail and fill partially with water.
  - Mix the pail thoroughly – in most cases the action of the water filling the bucket will provide enough mixing to make the slurry. If required, paint mixers are an effective method for mixing the KB-1® Primer slurry.
- Pour the slurry into the tote/tank, rinsing out any undissolved solids
- Finish filling the tote/tank. Fill the tote/tank as full as possible to limit headspace. Cover the tote/tank with a vented lid.

KB-1® PRIMER WATER STORAGE

- Keep a minimal headspace within the tote/tank to reduce possible oxygen exposure
- When a minimal headspace is not possible, purge the headspace with nitrogen/argon gas

TIPS FOR OPTIMAL KB-1® PRIMER PERFORMANCE

- Avoid mixing KB-1® Primer continuously for long periods of time as it may reintroduce oxygen into the solution.
- Avoid adding KB-1® Primer powder to a full tote/tank without first making the slurry as it may not dissolve fully, resulting in reduced product performance.
- If electron donor solution is being made anaerobic with KB-1® Primer; it is recommended to prepare the KB-1® Primer water in the tote/tank first. After the water has achieved reducing conditions it can be used to prepare the electron donor solution.

For additional information refer to the KB-1® Primer safety data sheet (SDS)
Contact SiREM for Customer Support
Toll free: 1-866-251-1747
Bioaugmentation Coordinator, Corey Scales: (519) 515-0848

Attachment 3

SiREM
Leading Science · Lasting Solutions

KB-1® PRIMER

Anaerobic Injection Water Preparation

Rapidly Prepare Anaerobic Injection Water for Remediation Applications

Field technician preparing anaerobic injection water with KB-1® Primer slurry

KB-1® Primer is used to prepare anaerobic water to disperse electron donors and protect anaerobic bioaugmentation cultures during injection into aquifers. In the past, production of anaerobic water was time consuming, and often produced water with solids that required filtration and that had pH impacts. SiREM has developed KB-1® Primer as an easy to use product to facilitate anaerobic conditions during remediation injections.

KB-1® and KB-1® Plus cultures contain microorganisms that promote dechlorination of chlorinated solvents. These cultures are strictly anaerobic, which can present challenges during injection into non-reducing aquifers and when electron donor and bioaugmentation cultures are applied simultaneously. KB-1® Primer does not adversely impact bioaugmentation culture activity or viability.

Use KB-1® Primer to:

- Rapidly prepare anaerobic water from municipal water supplies
- Inject anaerobic bioaugmentation cultures and electron donor simultaneously
- Save money on lengthy tank rentals/incubation periods

KB-1® Primer: Safe and Simple to Use

- Conveniently packaged in foil pouches
- Easily dissolved; no need to filter water
- Works within hours of application in most water types
- Prepare anaerobic water even at low temperatures

Anaerobic injection water prepared with KB-1® Primer meets the following criteria:

- ORP less than -75 mV
- pH between 6 and 8
- provides the conditions to maintain healthy dechlorinating populations

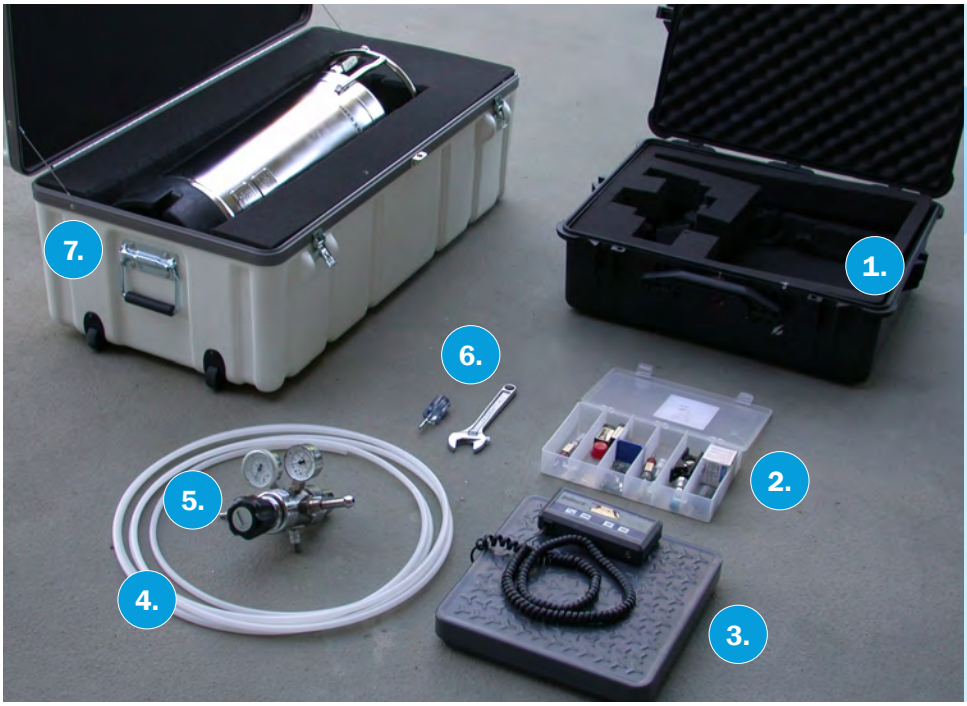
KB-1® Primer powder is shipped in vacuum sealed pouches

Contact SiREM for more information on KB-1® Primer and our other leading remediation products and testing services.

toll free: 1-866-251-1747
phone: (519) 822-2265

SiREM

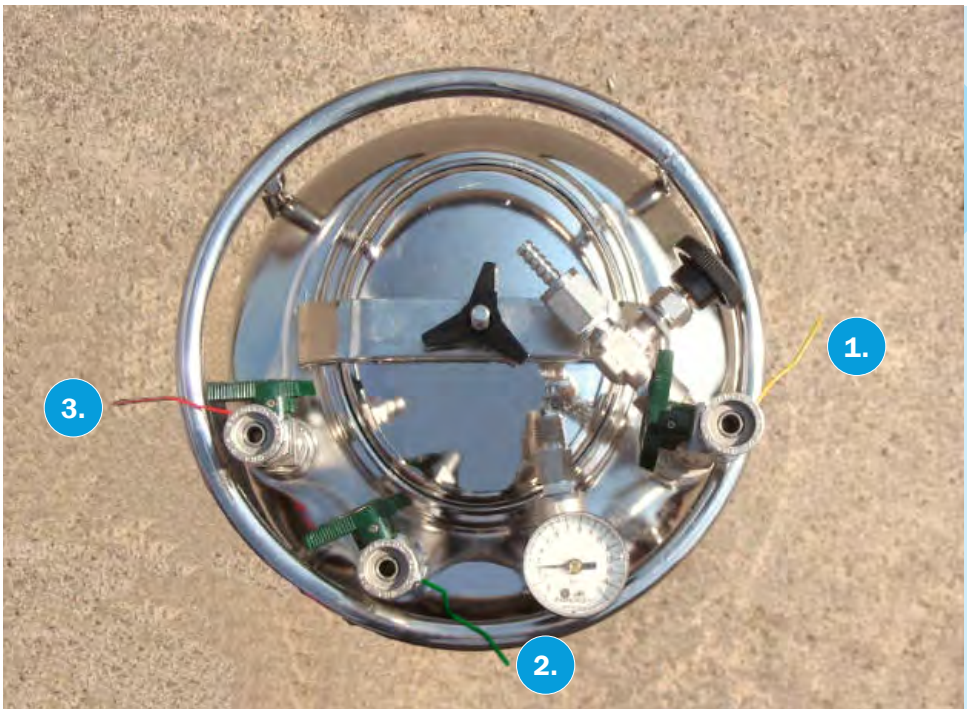
KB-1® Injection Summary



TOOL KIT CONTENTS

1. Toolkit Case
2. Quick Connect Fittings
3. Scale
4. Tubing
5. Regulator
6. Tools
7. KB-1® Vessel in Overpack Case

*Please note that the nitrogen/argon gas cylinder is not included with the culture shipment. Gas can be obtained from a local gas supplier.



VESSEL PORT FUNCTIONS

1. **Inoculation Port (YELLOW)**
   To allow KB-1® to flow out of the vessel.
2. **Purge Port (GREEN)**
   To purge tubing with inert gas.
3. **Pressurization Port (RED)**
   To pressurize KB-1® vessel.

SiREM

KB-1® Injection Summary

SETUP TO PURGE INJECTION TUBING

1. Gas In: The inert gas tubing remains in the pressurization port **(RED)** for the duration of the injection.

2. Gas Out: Initially the tubing used to inject the KB-1® will be connected to the purge port **(GREEN).**

SETUP TO INJECT KB-1®

1. Gas In: The pressurization port **(RED)** remains in the open position for the duration of the injection.

2. KB-1® Out: The KB-1® injection tubing is moved from the purge port **(GREEN)** to the KB-1® inoculation port **(YELLOW)**.

USING THE SCALE

Turn scale on by pressing the lbs/kg button and ON buttons simultaneously

Change the units to kg by pressing lbs/kg button

Press Zero/Hold to tare scale

Place KB-1® vessel on scale and record the weight

Weight will decrease with each injection of KB-1®

SiREM

KB-1® Injection Summary

ANAEROBIC WATER DRIVEN KB-1® INJECTION SETUP

1. Gas Tubing
2. KB-1® Injection Tubing
3. Female Quick Connect (1/4" Male NPT)
4. Ball Valve with ¼" Female NPT Fitting*
5. T-Fitting*
6. Ball Valve*
7. Anaerobic water line*

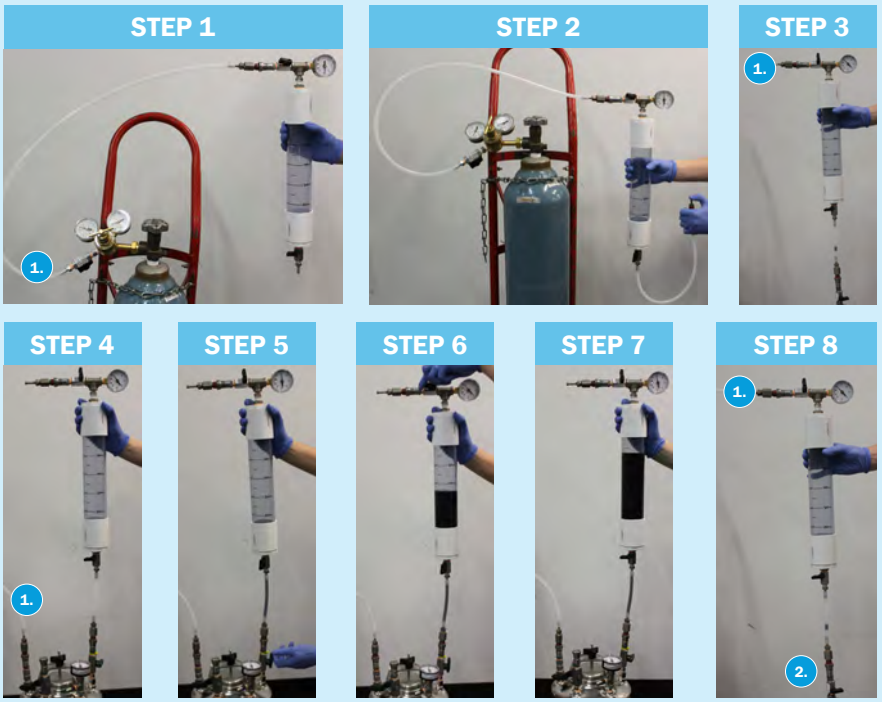
*not included with shipment

SiREM

KB-1® Injection Summary

KB-1® INJECTION DISPENSER OPERATION

1. **Gas Line**
2. **Female Quick Connect**
   (item #3 as shown in anaerobic water driven KB-1 injection set-up)



Step 1: Cut the length of tubing that will span from the gas cylinder to the culture vessel (5-10' should be sufficient). Attach one end to the hosebarb on the regulator and the other to the hosebarb on a quick connect. Connect the quick connect to the top port of the injection dispenser.

Step 2: Cut the length of tubing that will span from the injection dispenser to the injection location (5-10' should be sufficient). Attach one end to the hosebarb on the injection dispenser and the other to the hosebarb on a quick connect. Open the valve on the gas cylinder, followed by the regulator, the top of the injection dispenser and finally the bottom of the injection dispenser. Push on the bottom of the quick connect to allow gas to flow through the injection equipment.

Step 3: Close the bottom port on the injection dispenser and allow pressure to build to 5 psi in the dispenser. Close the top port of the injection dispenser.

Step 4: Connect the bottom quick connect into the inoculation port **(YELLOW)**. Move the gas line from the top of the injection dispenser to the pressurization port **(RED)** on the culture vessel. Connect a quick connect into the top port of the injection dispenser.

Step 5: Open the inoculation port **(YELLOW)** and allow KB-1® to flow into the injection dispenser to the desired volume.

Step 6: Pressure will increase as the injection dispenser fills. Release the pressure by opening the top port. Close the top port before the target volume is reached, this will ensure that there is always pressure in the dispenser.

Step 7: Once the target volume is reached close the bottom port and remove the quick connect from the top port.

Step 8: Move the injection dispenser from the inoculation port **(YELLOW)** to the port on the anaerobic water line set up. Connect the gas line to the top of the injection dispenser. Open the top port followed by the bottom port of the injection dispenser. Once the culture has been injected, close the bottom port followed by the top port to keep pressure in the injection dispenser.

Step 9: Repeat steps 4-8 until all injections are complete.

Step 10: Once the injections are complete, pack the vessel(s) in the white over pack(s) & place all tools into the tool kit. Contact Corey Scales at 519-515-0848 for return shipping instructions and paperwork.

For additional information refer to the Culture safety data sheet (SDS)
Contact SiREM for Customer Support
Toll free: 1-866-251-1747
Bioaugmentation Coordinator, Corey Scales: (519) 515-0848

Attachment 2

AECOM

BIOAUGMENTATION PHOTOGRAPH LOG

Client Name: Scott Figgie / GFS Management Company, LLC **Project No.:** 60536398-1	**Site Location:** Former Scott Aviation Facility – Area 1 BCP Lancaster, New York	**NYSDEC Project No.: C915233**

Photo No.	**Date:**
1	9/17/21

Direction Photo Taken:

Southeast

Description:

METI using GPR to identify plant utilities prior to advancing injection borings.

Photo No.	**Date:**
2	9/17/21

Direction Photo Taken:

North

Description:

METI weighting out KB-1® Primer to prepare anaerobic water.

Photo No. 3	Date: 9/17/21
Direction Photo Taken: West	
Description: METI using Nitrogen gas to inject KB-1® Plus bioengineered microbial culture at A1-GP06-S.	

Photo No. 4	Date: 9/20/21
Direction Photo Taken: Northwest	
Description: METI using Geoprobe® 6620DT to advance injection point at MW-42S.	

Photo No. 5	Date: 9/20/21
Direction Photo Taken: North	
Description: Slight breakthrough of injectate around injection boring at MW-42S-C. Note bentonite chips placed around drill rods to seal borehole annulus.	

Photo No. 6	Date: 9/21/21
Direction Photo Taken: South	
Description: METI injecting at A1-GP10-S/MW-40D. Note GPR in foreground used to verify location of Plant utilities prior to advancing injection point.	

Attachment 3

Technical Note 1.5:
Interpretation of Gene-Trac® Dhc, *vcrA*, *bvcA and tceA* Assays

This note provides technical background and guidelines for interpretation of the following Gene-Trac® assays:

(1) Gene-Trac® Dhc

(2) Gene-Trac® *vcrA*

(3) Gene-Trac® *bvcA*

(4) Gene-Trac® *tceA*

Gene-Trac® Dhc-Total *Dehalococcoides* Test

Background

Gene-Trac® Dhc is a quantitative polymerase chain reaction (qPCR) test for the microbial species *Dehalococcoides mccartyi* (i.e., *Dehalococcoides* [Dhc]). The Gene-Trac® Dhc test targets sequences of the 16S ribosomal ribonucleic acid (16S rRNA) gene unique to Dhc. Note the 16S rRNA gene does not directly participate in dechlorination, but is used as a molecular fingerprint in the identification and quantification of a wide variety of microbial groups. The detection of Dhc in environmental samples is significant as Dhc contain the greatest number of reductive dehalogenase genes of any microbial group (Tas et al., 2010). Dhc are capable of reductive dechlorination of a wide variety compounds/compound classes including:

- Chlorinated ethenes (tetrachloroethene [PCE], trichloroethene [TCE] , cis-1,2-dichloroethene [*c*DCE], 1,1-dichloroethene [1,1-DCE], trans-1,2-dichloroethene [*t*DCE, vinyl chloride [VC]) (Duhamel et al., 2002);
- 1,2-dichloroethane (1,2-DCA) to ethene (Grostern and Edwards, 2006);
- Selected polychlorinated biphenyl [PCB] congeners (Bedard et al., 2007);
- Selected chlorinated benzene compounds (Adrian et al., 2000; Fennell et al., 2004);
- Chlorophenols and polychlorinated dibenzo-*p*-dioxins (Fennell et al., 2004) and;
- 1,2-dibromoethane (Magnusson et al., 2000).

In addition to screening for diverse dechlorinating activities, Gene-Trac® Dhc can also be used to assess the *in situ* growth of Dhc containing bioaugmentation cultures such as KB-1® (Major et al., 2002).

Gene-Trac® Dhc Results Interpretation

Negative (Non-detect [ND]) Gene-Trac® Dhc Test Results

The absence of Dhc is associated with a lack of dechlorination or only partial reductive dechlorination of chlorinated ethenes. Where Dhc are absent the accumulation of cDCE is commonly observed, particularly after electron donor addition, often due to the presence of partial dechlorinators (e.g., *Dehalobacter, Geobacter*). Bioaugmentation with Dhc containing cultures (e.g., KB-1®) often improves bioremediation performance at sites lacking indigenous Dhc.

Positive (Detect) Gene-Trac® Dhc Test Results

The detection of Dhc is correlated with the complete biological dechlorination of chlorinated ethenes to non-toxic ethene at contaminated sites (Hendrickson et al., 2002). A positive Gene-Trac® Dhc test indicates that Dhc DNA was detected and is correlated with the occurrence of reductive dechlorination. Note, not all Dhc can convert vinyl chloride to ethene; this capability can be determined by quantifying the functional genes (*vcrA*, *bvcA, tceA*) (see following section). In most cases Dhc must be present at sufficient concentrations in order for significant dechlorination to be observed, guidelines for expected impacts on chlorinated ethenes at various Dhc concentrations in groundwater are indicated below.

- **10^4 Dhc gene copies per liter (or lower):** indicates low concentrations of Dhc which may indicate site conditions that are sub-optimal for high rates of dechlorination. Increases in Dhc concentrations at the site may be possible if conditions are optimized (e.g., electron donor addition/pH adjustment).

- **10^5-10^6 Dhc gene copies per liter:** indicates the sample contains moderate concentrations of Dhc which may, or may not, be associated with observable dechlorination activity.

- **1 x 10^7 Dhc gene copies per liter (or above):** indicates that the sample contains high concentrations of Dhc often associated with significant dechlorination rates (Lu et al., 2006).

- **10^9-10^{10} Dhc gene copies per liter:** are generally the highest observed for groundwater samples and are associated with very high rates of dechlorination

Interpretation of Functional Gene Assays for *vcrA*, *bvcA* and *tceA*

Background

Gene-Trac® *vcrA*, *bvcA* and *tceA* tests are provided combined as a functional gene assay package. These tests quantify genes that code for enzymes that dechlorinate chlorinated ethenes and other compounds. The *vcrA*, *bvcA* and *tceA* genes play specific roles in reductive dechlorination, specifically *tceA* converts TCE and cDCE to VC and *vcrA* and *bvcA* convert cDCE and VC to non-toxic ethene (Figure 1).

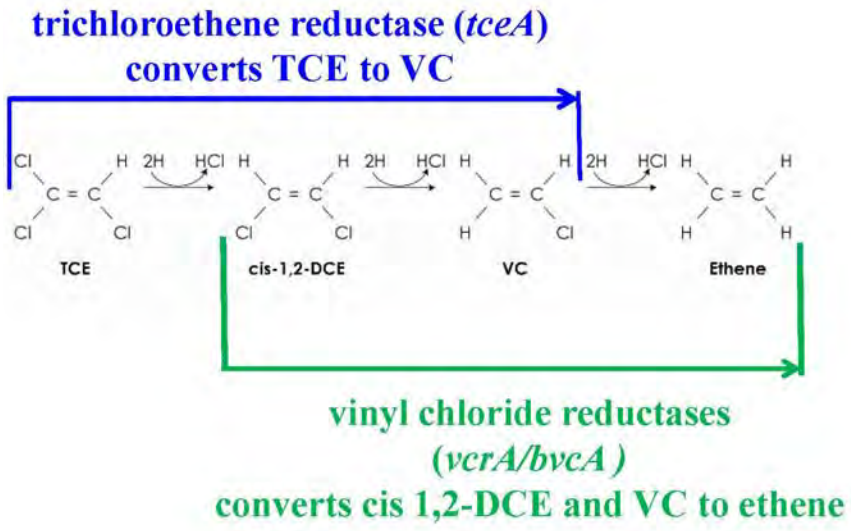
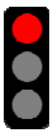


Figure 1: Major (energy yielding) activities against chlorinated ethene of enzymes coded for by the *tceA, vcrA* and *bvcA* genes.

Results Interpretation

Table 1 provides interpretation guidelines for different scenarios for Gene-Trac® Dhc, *vcrA*, *bvcA and tceA* tests. In general, accumulation of VC is more likely where Gene-Trac® *vcrA/bvcA* results are ND, or significantly lower than Gene-Trac® Dhc/*tceA*. Where abundance of *vcrA*/*bvcA* is similar to total Dhc the chances of VC accumulation are reduced.

Table 1: Interpretation of Gene-Trac® Dhc, *vcrA*, bvcA, *tceA* test results

Gene Copies/L				Summary	Interpretation	Remediation Implications	
Dhc	*vcrA*	*bvcA*	*tceA*				
ND	ND	ND	ND	ND for Dhc and functional genes	Site lacks Dhc	Complete dechlorination unlikely, may observe cis-DCE accumulation Site may require bioaugmentation	
≥1 x 10^7	≥1 x 10^7	≥1 x 10^7	≥1 x 10^7	Dhc and *vcrA/bvcA/tceA* are the same	Entire Dhc population has *tceA*, *vcrA* and *bvcA* gene	Potential for complete dechlorination very high. VC stall unlikely-sites with *vcr*A above 1 x 10^7/L typically have detectable ethene	
≥1 x 10^7	ND	≥1 x 10^7	ND	Total Dhc and *bvcA*/are the same *vcrA*/*tceA* ND	Dhc at high concentrations entire Dhc population has *bvcA* gene	Potential for complete dechlorination high. VC stall unlikely	
≥1 x 10^7	≥1 x 10^7	ND	ND	Total Dhc and *vcrA*/are the same *bvcA*/*tceA* ND	Dhc at high concentrations entire Dhc population has *vcrA* gene	Potential for complete dechlorination high. VC stall unlikely-sites with *vcr*A above 1 x 10^7/L often have detectable ethene	
≥1 x 10^7	ND	ND	≥1 x 10^7	Total Dhc high; *vcrA* and *bvcA* non-detect *tceA* same as Dhc	High concentration of Dhc, entire Dhc population has *tceA* but lacks the *vcrA/bvcA* genes	Likelihood for VC accumulation high as *vcrA* and *bvcA* both ND	
1 x 10^7	1 x 10^5	1 x 10^6	1 x 10^7	Total Dhc and *tceA* is significantly higher 10-100 fold) than *vcrA/bvcA*	*Dhc* population consists of different types, some with the *vcrA/* gene (10%) some with *bvcA* gene (1%) all contain *tceA* gene	VC-accumulation possible; Dhc:*vcrA:bvcA:tceA* ratios may evolve over the course of remediation	
1 x 10^7	1 x 10^7	1 x 10^6	ND	Total Dhc is high *vcrA*/*bvcA* high *tceA* ND	*tceA* negative population	cDCE to ethene dechlorination likely PCE and TCE dechlorination possible via *pceA* commonly found in other dechlorinators such as *Dehalobacter*	

 = favorable for complete dechlorination,  = some potential for VC stall  = complete dechlorination unlikely

Gene-Trac® *vcrA*/*bvcA*

Gene-Trac® *vcrA and bvcA* tests quantify VC-reductase genes that produce enzymes that convert VC to non-toxic ethene; a critical step in reductive dechlorination. The VC reductase genes (*vcrA, bvcA*) (Müller et al., 2004; Krajmalnik-Brown et al., 2004) produce enzymes found in many (but not all) Dhc. The *vcrA* gene is reported to be the most commonly identified VC reductase gene in the environment, whereas *bvcA* is generally less common but can predominate especially in more oxidizing groundwater (van der Zaan et al., 2010) and possibly where DCE is dominant. The *vcrA* gene can be used for tracking bioaugmentation cultures including KB-1® and is typically present at a 1:1 ratio with total Dhc whereas the *bvcA* gene is not predominant in the KB-1® culture and is present at less than a 1:1 ratio with total Dhc, therefore *bvcA* is not generally used for tracking KB-1® bioaugmentation and may be negative even after bioaugmentation with KB-1®.

Positive Gene-Trac® *vcrA*, *bvcA* Tests

Positive Gene-Trac® *vcrA* or *bvcA* tests indicate that the Dhc population has the *vcrA* and/or the *bvcA* gene and complete dechlorination to ethene is likely. As a minimal requirement, *vcrA* and/or *bvcA* copies exceeding 10^5/L combined with observed increases over time (i.e., cell growth) are required for robust VC dechlorination (van der Zaan et al., 2010). In one study, more than 90% of samples where *vcrA* enumeration exceeded 1 x 10^7 gene copies/L of groundwater had detectable ethene (Dennis, 2009). The enzyme produced by the *bvcA* genes has also been shown to degrade 1,2-DCA directly to ethene (Grostern and Edwards 2009) and the *bvcA* is used for tracking the KB-1® 1,2-DCA culture.

Non-Detect in Gene-Trac® *vcrA*/*bvcA* Test

A ND in the Gene-Trac® *vcrA* and *bvcA* test indicates that *vcrA/bvcA* gene sequences in the sample were below the detection limit of the assay. In cases where *vcrA/bvcA* are ND the chances of VC accumulation are increased compared to samples with detectable *vcrA*/*bvcA*. In such cases, *tceA* may promote limited and slow cometabolic degradation of VC to ethene (Lee et al., 2008) that may account for (generally low) detections of ethene where *vcrA* and *bvcA* are ND.

Gene-Trac® *tceA*

Gene-Trac® *tceA* test targets the trichloroethene reductase gene that produces an enzyme that primarily converts TCE to *c*DCE and VC. Studies have shown that this gene is commonly expressed under more oxidized conditions compared to *vcrA* (van der Zaan et al., 2010). Note the *tceA* gene is not predominant in the KB-1® culture and therefore *tceA* is not used for tracking KB-1® bioaugmentation.

Positive *tceA* test

A positive *tceA* test indicates that the Dhc population has the potential to dechlorinate TCE to cDCE and VC and VC to ethene cometabolically at relatively slow rates (Lee et al. 2008). Detection of *tceA* in the absence of *vcrA*/*bvcA* also indicates an increased likelihood for VC accumulation. The enzyme produced by *tceA* is also reported to dehalogenate 1,2-DCA and 1,2 dibromoethane (Magnussen et al., 2000).

Negative *tceA* test

A ND *tceA* test indicates that the Dhc population may lack the ability to convert TCE to cDCE and VC, nevertheless, conversion of PCE to cDCE is relatively common amongst other dechlorinators that harbor the *pceA* gene (Maillard et al., 2003; Wagner et al., 2012*)*. Therefore *tceA is* not essential for complete dechlorination of TCE provided that *pceA* harboring microorganisms are present. Gene-Trac® Dhb (*Dehalobacter)* and Gene-Trac® Geo (*Geobacter*) can be used to quantify these common *pceA* containing microorganisms.

Sites with mixed Dhc populations

At some sites the Dhc population is homogenous while other sites have Dhc populations that are mixtures of different Dhc types. These scenarios can lead to differing proportions for Gene-Trac® Dhc *vcrA bvcA* and *tceA* test results. If the numerical results of Gene-Trac® *vcrA, bvcA or tceA* tests are identical to those obtained in the Gene-Trac® Dhc test it suggests that the entire Dhc population contains that gene. In other cases, Gene-Trac® *vcrA, bvcA, tceA* results may differ significantly (i.e., more than an order of magnitude) from total Dhc. For example, the *vcrA* gene may be 100-fold lower than the total Dhc. This scenario would suggest that only 1% of the Dhc population harbors the *vcrA* gene and the remaining 99% of the Dhc population does not contain the *vcrA* gene. In such cases the proportions of the functional genes may change over time (e.g., the proportion of *vcrA* may increase as the VC concentration increases favoring Dhc that contain *vcrA*).

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SiREM Technical Note 1.6:

Interpretation of Gene-Trac®-*Dhb* and Gene-Trac®-*cfrA* Assays

Background

This technical note provides background information and guidelines for interpretation of the following Gene-Trac® tests:

(1) Gene-Trac®-*Dhb* (*Dehalobacter)*, and

(2) Gene-Trac®-*cfrA* functional gene.

These tests are used to assess: (1) the activities of indigenous microorganisms, and (2) the impact of bioaugmentation with the KB-1® Plus cultures that contain high concentrations of *Dhb*. SiREM Technical Note 1.4 - *Quantitative Gene-Trac® Assay Test Procedure and Reporting Overview* provides detailed information on general aspects Gene-Trac® test procedures and reporting including data qualifiers and commonly used notes.

Gene-Trac®-*Dhb* and *cfrA* Biodegradation Pathways

Dehalobacter (*Dhb*) and its functional genes *cfrA*/*dcrA* are implicated in the biodegradation of chlorinated ethenes, ethanes and methanes. Gene-Trac®-*Dhb* is a quantitative polymerase chain reaction (qPCR) test targeting 16S rRNA gene sequences unique to *Dhb*. Gene-Trac®-*cfrA* targets two key *Dhb* functional genes (*cfrA* and *dcrA*) that produce enzymes that participate in degradation pathways for chloroform and 1,1,1-trichlorethane (1,1,1-TCA).

Dhb are implicated in the biodegradation of tetrachlorethene (PCE) and trichloroethene (TCE) to cis-1,2-dichloroethene (cDCE) (Figure 1), 1,1,1-TCA to 1,1-dichloroethane (1,1-DCA) to chloroethane (Figure 2), 1,2-dichloroethane (1,2-DCA) to ethene (Figure 3), chloroform (CF) to dichloromethane (DCM) and fermentation to acetate (Figure 4), 1,1,2,2-tetrachloroethane (TeCA) degradation to trans-1,2-dichloroethene (tDCE), and 1,1,2-trichlorethane (1,1,2-TCA) and 1,1,2-TCA to vinyl chloride (VC) (Figure 5).

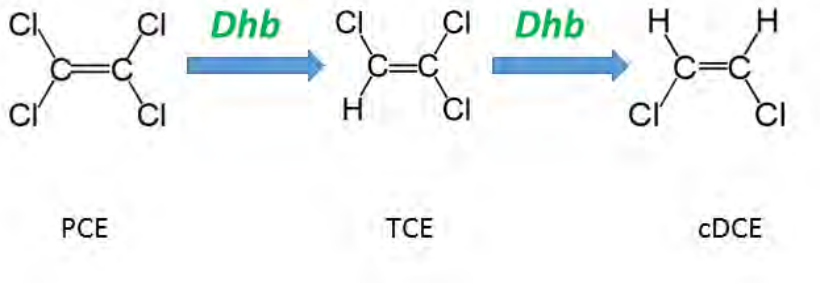

Figure 1: *Dhb* can dechlorinate PCE and TCE to cDCE.

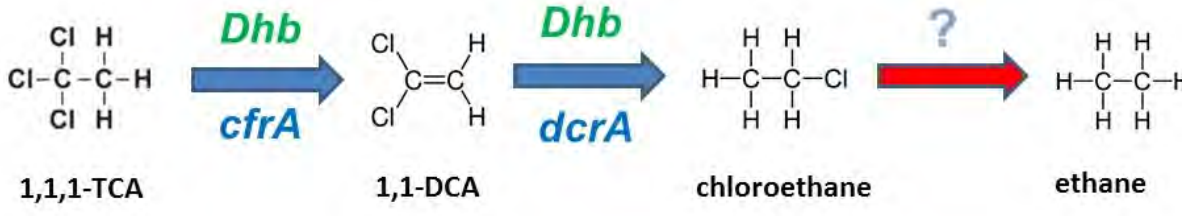

Figure 2: Pathway for the biodegradation of chlorinated ethanes. The *Dhb cfrA* gene mediates dechlorination of 1,1,1-TCA to 1,1-DCA, 1,1,-DCA to chloroethane is mediated by the *dcrA* gene. The conversion of chloroethane to ethane is reported but is not widely observed and is considered unconfirmed.

Figure 3: *Dhb* converts 1,2-DCA to ethene by dihaloelimination, this reaction is also performed by *Dehalococcoides* (Gene-Trac®-*Dhc*) and *Dehalogenimonas* (Gene-Trac®-*Dhg*)

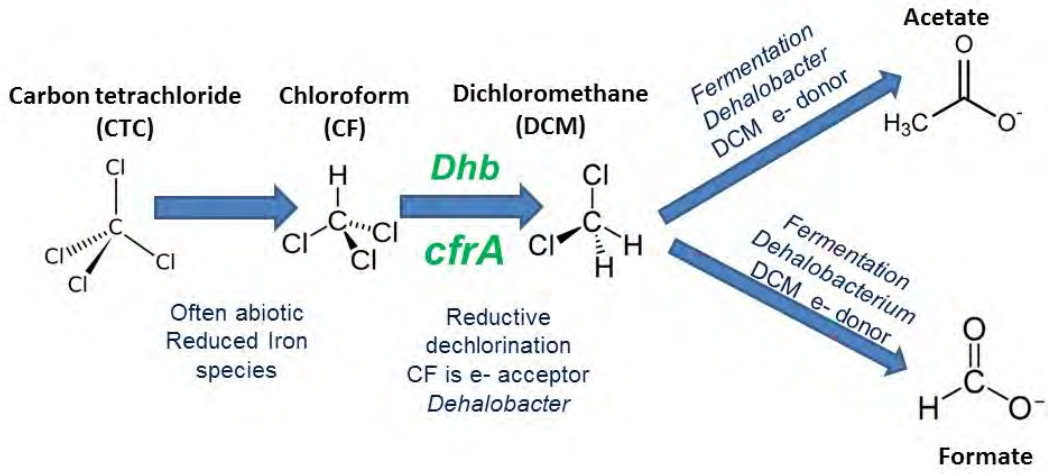

Figure 4: Dechlorination of chlorinated methanes. CTC is converted to CF abiotically. CF can be degraded to DCM by reductive dechlorination by *Dhb* species containing the *cfrA* functional gene. DCM is fermented to acetate by *Dhb.*

Attachment 4

SiREM
Leading Science · Lasting Solutions

130 Stone Rd. W
Guelph, ON N1G 3Z2
(519) 822-2265

Analytical Results

Client: AECOM
Client Project Number: 60536398-1
Date Samples Received: August 27, 2021
Date Samples Analyzed: September 13, 2021

SiREM File Reference: S-8337

Client Sample ID	SiREM Reference ID	Client Sample Date	Sample Dilution Factor	Lactate	Acetate	Propionate	Formate	Butyrate	Pyruvate
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
MW-42S	21-6046	26-Aug-21	50	<0.39	574	148	<0.22	108	26
A1-GP10	21-6047	26-Aug-21	50	<0.39	471	68	<0.22	46	5.3
		QL	50	0.39	0.54	0.31	0.22	0.41	0.69

Comments:
QL = Quantitation limit
< = compound analysed for but not detected, associated value is QL. Sample QL is corrected for dilution.

Analyst:

Kela Ashworth, B.Sc.
Senior Laboratory Technician

Results approved:

Michael Healey, B.Sc.
Treatability and SP3™ Services Coordinator

Date:

14-Sep-21

SiREM

Chain-of-Custody Form

siremlab.com

180B Market Place Blvd
Knoxville, TN 37922
1-865-291-4718 or 1-866-251-1747

Lab # S-8337

*Project Name: Scott Fissie Area 1 SCP	*Project #: 60536398-1
*Project Manager: Dino Zack	*Company: AECOM
*Email Address: dino.zack@aecom.com	
Address (Street): One John James Audubon Parkway	
City: Amherst	State/Province: NY	Country: USA
*Phone #: 716 866 8222	
*Sampler's Signature: Dino Zack	*Sampler's Printed Name: Dino Zack

Client Sample ID	Sampling Date	Sampling Time	Matrix	# of Containers	Gene-Trac DHC	Gene-Trac FGA	Gene-Trac DHB	Gene-Trac DHGM	Gene-Trac SRB	Volatile Fatty Acids	Dissolved hydrocarbon gases	Treatability Study	Other Information
MW-425	8/26/21	0940	GW	3	X	X	X			X			BK-076022
AI-GP10	8/26/21	1000	GW	2						X			

Analysis

Preservative Key
0. None
1. HCL
2. Other
3. Other
4. Other
5. Other
6. Other

Billing Information
P.O. #
*Bill To:

Turnaround Time Requested
Normal [X]
Rush [ ]

For Lab Use Only
Cooler Condition: Intact (Wet ice)
Cooler Temperature: 4.0°C → CT=4.2°C KX000980
Custody Seals: Yes [X] No [ ]

For Lab Use Only
Proposal #:

Relinquished By:	Received By:	Relinquished By:	Received By:	Relinquished By:	Received By:
Signature: Dino Zack	Signature: Kaitland Cracchiola	Signature:	Signature:	Signature:	Signature:
Printed Name: Dino Zack	Printed Name: Kaitland Cracchiola	Printed Name:	Printed Name:	Printed Name:	Printed Name:
Firm: AECOM	Firm: SiREM	Firm:	Firm:	Firm:	Firm:
Date/Time: 8/26/21 1100hrs	Date/Time: 08/27/21 1052	Date/Time:	Date/Time:	Date/Time:	Date/Time:

Distribution: White - return to Originator: Yellow - Lab Copy: Pink - Retained by Client

** Mandatory Fields*

SiREM
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130 Stone Rd. W
Guelph, ON N1G 3Z2
(519) 822-2265

Analytical Results

Client: AECOM
Client Project Number: 60536398
Date Samples Received: December 10, 2021
Date Samples Analyzed: December 20, 2021

SiREM File Reference: S-8745

Client Sample ID	SiREM Reference ID	Client Sample Date	Sample Dilution Factor	Lactate	Acetate	Propionate	Formate	Butyrate	Pyruvate
				mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
MW-42S	21-8386	09-Dec-21	50	<0.39	476	118	<0.22	75	18
A1-GP10	21-8387	09-Dec-21	50	<0.39	494	151	6.3	55	15
QL	50		0.39	0.54	0.31	0.22	0.41	0.69	

Comments:
QL = Quantitation limit
< = compound analysed for but not detected, associated value is QL. Sample QL is corrected for dilution.

Analyst:

Rachel Hallman, B.Sc.
Laboratory Technician

Results approved:

Michael Healey, B.Sc.
Treatability and SP3™ Services Coordinator

Date:

22-Dec-21

SiREM
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Certificate of Analysis: Gene-Trac® *Dehalococcoides* Assay

Customer: Dino Zack, AECOM
Project: Scott Figgie Area 1BCP
Customer Reference: 60536398-1

SiREM Reference: S-8337
Report Date: 13-Sep-21
Data Files: QS3A-DHCT-TM-QPCR-1915
QS3A-DB-DHC-TM-QPCR-1230

Table 1a: Test Results

Sample ID	*Dehalococcoides* (Dhc)	
	Percent Dhc(1)	Enumeration/Liter(2)
MW-42S	5 - 13 %	2×10^8

See final page for notes.

Analyst: Taylor Aris, B.Sc.
Laboratory Technician II

Approved: Ximena Druar, B.Sc.
Genetic Testing Supervisor

Certificate of Analysis: Gene-Trac® Functional Gene Assay

Customer: Dino Zack, AECOM
Project: Scott Figgie Area 1BCP
Customer Reference: 60536398-1

SiREM Reference: S-8337
Report Date: 13-Sep-21
Data Files: QS3A-FGA-QPCR-1266
QS3A-DB-FGA-QPCR-0957

Table 1b: Test Results

Sample ID	VC Reductase (*vcrA*)		BAV1 VC Reductase (*bvcA*)		TCE Reductase (*tceA*)	
	Percent *vcrA* (3)	Gene Copies/Liter	Percent *bvcA* (3)	Gene Copies/Liter	Percent *tceA* (3)	Gene Copies/Liter
MW-42S	8 - 21 %	3×10^8	0.007 - 0.02 %	2×10^5	0.6 - 2 %	2×10^7

See final page for notes.

Analyst: Taylor Aris
Taylor Aris, B.Sc.
Laboratory Technician II

Approved: Ximena Druar
Ximena Druar, B.Sc.
Genetic Testing Coordinator

SiREM
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Certificate of Analysis: Gene-Trac® *Dehalobacter* Assay

Customer: Dino Zack, AECOM
Project: Scott Figgie Area 1BCP
Customer Reference: 60536398-1

SiREM Reference: S-8337
Report Date: 13-Sep-21
Data Files: iQ5B-DHB-QPCR-0562
iQ5B-DB-DHB-QPCR-0369

Table 1c: Test Results

Sample ID	*Dehalobacter* (Dhb)	
	Percent Dhb[(1)]	Gene Copies/Liter
MW-42S	0.2 - 0.5 %	6×10^6

See final page for notes.

Analyst: Taylor Aris, B.Sc.
Laboratory Technician II

Approved: Ximena Druar, B.Sc.
Genetic Testing Coordinator

Table 2: Detailed Test Parameters, Test Reference S-8337

Customer Sample ID	MW-42S
SiREM Dhc Test ID	DHC-21793
SiREM FGA Test ID	FGA-10755
SiREM Dhb Test ID	DHB-2660
Date Sampled [4]	26-Aug-21
Matrix	Groundwater
Date Received [4]	27-Aug-21
Sample Temperature	4.0 °C
Filtration Date [4]	30-Aug-21
Volume Used for DNA Extraction	100 mL
DNA Extraction Date	8-Sep-21
DNA Concentration in Sample (extractable)	7350 ng/L
PCR Amplifiable DNA	Detected
Dhc qPCR Date Analyzed	9-Sep-21
FGA qPCR Date Analyzed	9-Sep-21
Dhb qPCR Date Analyzed	8-Sep-21
Laboratory Controls (see Tables 3, 4 & 5)	Passed
Comments	- -

See final page for notes.

Table 3: Gene-Trac Dhc Control Results, Test Reference S-8337

Laboratory Control	Analysis Date	Control Description	Dhc 16S rRNA		Comments
			Spiked Gene Copies per Liter	Recovered Gene Copies per Liter	
Positive Control Low Concentration	9-Sep-21	Genomic DNA (CSLD-1553)	1.4×10^{6}	1.6×10^{6}	Passed
Positive Control High Concentration	9-Sep-21	Genomic DNA (CSHD-1553)	1.8×10^{8}	2.4×10^{8}	Passed
Extraction Control	9-Sep-21	Extraction Control (KB-0831)	1.0×10^{11}	1.6×10^{11}	Passed
DNA Extraction Blank	9-Sep-21	Sterile Water (EB-3882)	0	2.6×10^{3} U	Passed
Negative Control	9-Sep-21	Reagent Blank (TBD-1512)	0	2.6×10^{3} U	Passed

See final page for notes.

Table 4: Gene-Trac FGA Control Results, Test Reference S-8337

Laboratory Control	Analysis Date	Control Description	*vcrA*		*bvcA*		*tceA*		Comments
			Spiked Gene Copies per Liter	Recovered Gene Copies per liter	Spiked Gene Copies per liter	Recovered Gene Copies per liter	Spiked Gene Copies per liter	Recovered Gene Copies per liter	
Positive Control Low Concentration	9-Sep-21	Genomic DNA (CSLF-1134)	2.5×10^6	2.9×10^6	5.4×10^5	8.2×10^5 (5)	6.5×10^5	1.5×10^6 (5)	See Note 5
Positive Control High Concentration	9-Sep-21	Genomic DNA (CSHF-1134)	4.7×10^8	5.1×10^8	1.3×10^8	1.4×10^8	1.7×10^8	2.0×10^8	Passed
DNA Extraction Blank	9-Sep-21	Sterile Water (EB-3882)	0	2.6×10^3 U	0	2.6×10^3 U	0	2.6×10^3 U	Passed
Negative Control	9-Sep-21	Reagent Blank (TBF-1105)	0	2.6×10^3 U	0	2.6×10^3 U	0	2.6×10^3 U	Passed

See final page for notes.

Table 5: Gene-Trac Dhb Control Results, Test Reference S-8337

Laboratory Control	Analysis Date	Control Description	Dhb 16S rRNA		Comments
			Spiked Gene Copies per Liter	Recovered Gene Copies per Liter	
Positive Control Low Concentration	8-Sep-21	Genomic DNA (CSLDB-0521)	2.9×10^7	3.7×10^7	Passed
Positive Control High Concentration	8-Sep-21	Genomic DNA (CSHDB-0521)	5.1×10^9	4.7×10^9	Passed
DNA Extraction Blank	8-Sep-21	Sterile Water (EB-3882)	0	2.6×10^3 U	Passed
Negative Control	8-Sep-21	Test Reagent Blank (TBDB-0521)	0	2.6×10^3 U	Passed

See final page for notes.

Notes:
Dhc = *Dehalococcoides*
vcrA = VC reductase
bvcA = BAV1 VC reductase
tceA = TCE reductase
FGA = functional gene assay
Dhb = *Dehalobacter*
J The associated value is an estimated quantity between the method detection limit and quantitation limit.
U Not detected, associated value is the quantitation limit.
B Analyte was detected in the method blank within an order of magnitude of the test sample.
E Extracted genomic DNA was not detected in the sample.
I Sample inhibited the test reaction based on inability to PCR amplify extracted DNA with universal primers.
ng/L = nanograms per liter
mL = milliliter
NA = not applicable
ND = not detected
DNA = deoxyribonucleic acid
16S rRNA = 16S ribosomal ribonucleic acid
PCR = polymerase chain reaction
qPCR = quantitative PCR
°C = degrees Celsius

[1] Percent *Dehalococcoides* (Dhc) or *Dehalobacter* (Dhb) in microbial population. This value is calculated by dividing the number of Dhc or Dhb 16S ribosomal ribonucleic acid (rRNA) gene copies by the total number of bacteria as estimated by the mass of DNA extracted from the sample. Range represents normal variation in Dhc enumeration.
[2] Based on quantification of Dhc or Dhb 16S rRNA gene copies. Dhc or Dhb are generally reported to contain one 16S rRNA gene copy per cell; therefore, this number is often interpreted to represent the number of Dhc or Dhb cells present in the sample.

[3] Percent of functional gene in microbial population. This value is calculated by dividing the functional gene copies quantified by the total number of estimated prokaryotes in the sample (based on the total quantity of DNA extracted from the sample). A value of 100% would suggest that all microbes in the sample contain the gene.

[4] Samples are stabilized by freezing at -80 °C upon sample reception (field filters) or in-lab filtration (groundwater). Hold time not exceeded if sampling date is within 14 days of date received or filtration date.

[5] Control was outside recovery limit guidelines (+/- 50%), however, test results are deemed acceptable if one of two positive controls fall within the recovery limit guidelines.

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Chain-of-Custody Form

siremlab.com

180B Market Place Blvd
Knoxville, TN 37922
1-865-291-4718 or 1-866-251-1747

Lab # S-8337

*Project Name: Scott Fissie Area 1 SCP	*Project #: 60536398-1
*Project Manager: Dino Zack	*Company: AECOM
*Email Address: dino.zack@aecom.com	
Address (Street): One John James Audubon Parkway	
City: Amherst	State/Province: NY	Country: USA
*Phone #: 716 866 8222	
*Sampler's Signature: Dino Zack	*Sampler's Printed Name: Dino Zack

Client Sample ID	Sampling Date	Sampling Time	Matrix	# of Containers	Gene-Trac DHC	Gene-Trac FGA	Gene-Trac DHB	Gene-Trac DHGM	Gene-Trac SRB	Volatile Fatty Acids	Dissolved hydrocarbon gases	Treatability Study	Other Information
MW-425	8/26/21	0940	GW	3	X	X	X			X			BK-076022
AI-GP10	8/26/21	1000	GW	2						X			

Analysis

Preservative Key
0. None
1. HCL
2. Other
3. Other
4. Other
5. Other
6. Other

Billing Information
P.O. #
*Bill To:

Turnaround Time Requested
Normal [X]
Rush [ ]

For Lab Use Only
Cooler Condition: Intact (Wet ice)
Cooler Temperature: 4.0°C → CT=4.2°C KX000980
Custody Seals: Yes [X] No [ ]

For Lab Use Only
Proposal #:

Relinquished By:	Received By:	Relinquished By:	Received By:	Relinquished By:	Received By:
Signature: Dino Zack	Signature: Kaitland Cracchiola	Signature:	Signature:	Signature:	Signature:
Printed Name: Dino Zack	Printed Name: Kaitland Cracchiola	Printed Name:	Printed Name:	Printed Name:	Printed Name:
Firm: AECOM	Firm: SiREM	Firm:	Firm:	Firm:	Firm:
Date/Time: 8/26/21 1100hrs	Date/Time: 08/27/21 1052	Date/Time:	Date/Time:	Date/Time:	Date/Time:

Distribution: White - return to Originator: Yellow - Lab Copy: Pink - Retained by Client

** Mandatory Fields*

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130 Stone Rd. W
Guelph, ON N1G 3Z2
(519) 822-2265

Certificate of Analysis: Gene-Trac® *Dehalococcoides* Assay

Customer: Dino Zack, AECOM
Project: Scott Figgie Area 1 BCP
Customer Reference: 60536398

SiREM Reference: S-8745
Report Date: 22-Dec-21
Data Files: QS3A-DHCT-TM-QPCR-1963
QS3A-DB-DHC-TM-QPCR-1279

Table 1a: Test Results

Sample ID	*Dehalococcoides* (Dhc)	
	Percent Dhc[(1)]	Enumeration/Liter[(2)]
MW-42S	2 - 5 %	2×10^8

See final page for notes.

Analyst: Taylor Aris, B.Sc.
Laboratory Technician II

Approved: Ximena Druar, B.Sc.
Genetic Testing Supervisor

SiREM
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Certificate of Analysis: Gene-Trac® Functional Gene Assay

Customer: Dino Zack, AECOM
Project: Scott Figgie Area 1 BCP
Customer Reference: 60536398

SiREM Reference: S-8745
Report Date: 22-Dec-21
Data Files: QS3A-FGA-QPCR-1295
QS3A-DB-FGA-QPCR-0986

Table 1b: Test Results

Sample ID	VC Reductase (*vcrA*)		BAV1 VC Reductase (*bvcA*)		TCE Reductase (*tceA*)	
	Percent *vcrA* (3)	Gene Copies/Liter	Percent *bvcA* (3)	Gene Copies/Liter	Percent *tceA* (3)	Gene Copies/Liter
MW-42S	2 - 6 %	2×10^8	0.001 - 0.004 %	1×10^5	0.08 - 0.2 %	8×10^6

See final page for notes.

Analyst: Taylor Aris, B.Sc.
Laboratory Technician II

Approved: Ximena Druar, B.Sc.
Genetic Testing Supervisor

SiREM
Leading Science · Lasting Solutions

Certificate of Analysis: Gene-Trac® *Dehalobacter* Assay

Customer: Dino Zack, AECOM
Project: Scott Figgie Area 1 BCP
Customer Reference: 60536398

SiREM Reference: S-8745
Report Date: 22-Dec-21
Data Files: iQ5C-DHB-QPCR-0577
iQ5C-DB-DHB-QPCR-0384

Table 1c: Test Results

Sample ID	*Dehalobacter* (Dhb)	
	Percent Dhb[(1)]	Gene Copies/Liter
MW-42S	0.1 - 0.3 %	1×10^7

See final page for notes.

Analyst: Taylor Aris, B.Sc.
Laboratory Technician II

Approved: Ximena Druar, B.Sc.
Genetic Testing Supervisor

Table 2: Detailed Test Parameters, Test Reference S-8745

Customer Sample ID	MW-42S
SiREM Dhc Test ID	DHC-22681
SiREM FGA Test ID	FGA-11258
SiREM Dhb Test ID	DHB-2778
Date Sampled [4]	9-Dec-21
Matrix	Groundwater
Date Received [4]	10-Dec-21
Sample Temperature	5.6 °C
Filtration Date [4]	10-Dec-21
Volume Used for DNA Extraction	100 mL
DNA Extraction Date	20-Dec-21
DNA Concentration in Sample (extractable)	21000 ng/L
PCR Amplifiable DNA	Detected
Dhc qPCR Date Analyzed	21-Dec-21
FGA qPCR Date Analyzed	20-Dec-21
Dhb qPCR Date Analyzed	21-Dec-21
Laboratory Controls (see Tables 3, 4 & 5)	Passed
Comments	- -

See final page for notes.

Table 3: Gene-Trac Dhc Control Results, Test Reference S-8745

Laboratory Control	Analysis Date	Control Description	Dhc 16S rRNA		Comments
			Spiked Gene Copies per Liter	Recovered Gene Copies per Liter	
Positive Control Low Concentration	21-Dec-21	Genomic DNA (CSLD-1601)	3.9×10^{6}	2.0×10^{6}	Passed
Positive Control High Concentration	21-Dec-21	Genomic DNA (CSHD-1601)	5.2×10^{8}	3.6×10^{8}	Passed
Extraction Control	20-Dec-21	Extraction Control (KB-0846)	7.0×10^{10}	8.8×10^{10}	Passed
DNA Extraction Blank	21-Dec-21	Sterile Water (FB-3967)	0	1.0×10^{3} U	Passed
Negative Control	21-Dec-21	Reagent Blank (TBD-1560)	0	1.0×10^{3} U	Passed

See final page for notes.

Table 4: Gene-Trac FGA Control Results, Test Reference S-8745

Laboratory Control	Analysis Date	Control Description	*vcrA*		*bvcA*		*tceA*		Comments
			Spiked Gene Copies per Liter	Recovered Gene Copies per liter	Spiked Gene Copies per liter	Recovered Gene Copies per liter	Spiked Gene Copies per liter	Recovered Gene Copies per liter	
Positive Control Low Concentration	20-Dec-21	Genomic DNA (CSLF-1163)	6.0×10^6	3.9×10^6	5.7×10^5	2.7×10^5 (5)	3.6×10^5	4.0×10^5	See Note 5
Positive Control High Concentration	20-Dec-21	Genomic DNA (CSHF-1163)	5.9×10^8	6.6×10^8	5.7×10^7	7.8×10^7	4.7×10^7	4.8×10^7	Passed
DNA Extraction Blank	20-Dec-21	Sterile Water (FB-3967)	0	1.0×10^3 U	0	1.0×10^3 U	0	1.0×10^3 U	Passed
Negative Control	20-Dec-21	Reagent Blank (TBF-1134)	0	1.0×10^3 U	0	1.0×10^3 U	0	1.0×10^3 U	Passed

See final page for notes.

Table 5: Gene-Trac Dhb Control Results, Test Reference S-8745

Laboratory Control	Analysis Date	Control Description	Dhb 16S rRNA		Comments
			Spiked Gene Copies per Liter	Recovered Gene Copies per Liter	
Positive Control Low Concentration	21-Dec-21	Genomic DNA (CSLDB-0536)	1.7×10^{6}	2.0×10^{6}	Passed
Positive Control High Concentration	21-Dec-21	Genomic DNA (CSHDB-0536)	2.4×10^{8}	2.7×10^{8}	Passed
DNA Extraction Blank	21-Dec-21	Sterile Water (FB-3967)	0	1.0×10^{3} U	Passed
Negative Control	21-Dec-21	Test Reagent Blank (TBDB-0536)	0	1.0×10^{3} U	Passed

See final page for notes.

Notes:
Dhc = *Dehalococcoides*
vcrA = VC reductase
bvcA = BAV1 VC reductase
tceA = TCE reductase
FGA = functional gene assay
Dhb = *Dehalobacter*
J The associated value is an estimated quantity between the detection limit and quantitation limit.
U Not detected, associated value is the detection limit.
B Analyte was detected in the method blank within an order of magnitude of the test sample.
E Extracted genomic DNA was not detected in the sample.
I Sample inhibited the test reaction based on inability to PCR amplify extracted DNA with universal primers.
ng/L = nanograms per liter
mL = milliliter
NA = not applicable
ND = not detected
DNA = deoxyribonucleic acid
16S rRNA = 16S ribosomal ribonucleic acid
PCR = polymerase chain reaction
qPCR = quantitative PCR
°C = degrees Celsius

[1] Percent *Dehalococcoides* (Dhc) or *Dehalobacter* (Dhb) in microbial population. This value is calculated by dividing the number of Dhc or Dhb 16S ribosomal ribonucleic acid (rRNA) gene copies by the total number of bacteria as estimated by the mass of DNA extracted from the sample. Range represents normal variation in Dhc enumeration.
[2] Based on quantification of Dhc or Dhb 16S rRNA gene copies. Dhc or Dhb are generally reported to contain one 16S rRNA gene copy per cell; therefore, this number is often interpreted to represent the number of Dhc or Dhb cells present in the sample.

[3] Percent of functional gene in microbial population. This value is calculated by dividing the functional gene copies quantified by the total number of estimated prokaryotes in the sample (based on the total quantity of DNA extracted from the sample). A value of 100% would suggest that all microbes in the sample contain the gene.

[4] Samples are stabilized by freezing at -80 °C upon sample reception (field filters) or in-lab filtration (groundwater). Hold time not exceeded if sampling date is within 14 days of date received or filtration date.

[5] Control was outside recovery limit guidelines (+/- 50%), however, test results are deemed acceptable if one of two positive controls fall within the recovery limit guidelines.

SiREM

Chain-of-Custody Form

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180B Market Place Blvd
Knoxville, TN 37922
1-865-291-4718 or 1-866-251-1747

Lab # S-8745

*Project Name	Scott Figgis Area 1 BCP
*Project #	60536398
*Project Manager	Dino Zack
*Company	AECOM
*Email Address	dino.zack@aecom.com
Address (Street)	One John James Audubon Parkway Suite 210
City	Amherst
State/Province	NY
Country	US
*Phone #	716 866-8222
*Sampler's Signature	
*Sampler's Printed Name	Dino Zack

Client Sample ID	Sampling Date	Sampling Time	Matrix	# of Containers	Gene-Trac DHC	Gene-Trac FGA	Gene-Trac DHB	Gene-Trac DHGM	Gene-Trac SRB	Volatile Fatty Acids	Dissolved hydrocarbon gases	Treatability Study	Other Information
MW-42S BK07934	12/4/21	1000	Gw	3	X	X	X			X			Dhc + Ucm, BucA, tceA + DHB
A1 GP 10	12/9/21	1030	Gw	2						X			#1 w/ air bubbles

Analysis

Preservative Key
0. None
1. HCL
2. Other
3. Other
4. Other
5. Other
6. Other

Billing Information
P.O. #
*Bill To: AECOM

Turnaround Time Requested
Normal ☑
Rush ☐

For Lab Use Only
Cooler Condition: Intact
Cooler Temperature: 5.6 KK00056
Custody Seals: Yes ☑ No ☐

For Lab Use Only
Proposal #:

Relinquished By:	Received By:	Relinquished By:	Received By:	Relinquished By:	Received By:
Signature	Signature Kyra Williams	Signature	Signature	Signature	Signature
Printed Name AECOM Dino Zack	Printed Name Kyra Williams	Printed Name	Printed Name	Printed Name	Printed Name
Firm	Firm SiREM	Firm	Firm	Firm	Firm
Date/Time 12/9/21 1030	Date/Time 12/10/21 0915	Date/Time	Date/Time	Date/Time	Date/Time

Distribution: White - return to Originator; Yellow - Lab Copy; Pink - Retained by Client

* Mandatory Fields

SiREM

Chain-of-Custody Form

siremlab.com

1808 Market Place Blvd
Knoxville, TN 37922
1-865-291-4718 or 1-866-251-1747

Lab #: S-8745

*Project Name	Scott Figgie Area 1 BCP
*Project #	60536898
*Project Manager	Dino Zack
*Company	AECom
*Email Address	dino.zack@aecom.com
Address (Street)	one john james audubon parkway suite 210
City	Amhurst
State/Province	NY
Country	US
*Phone #	716-866-8222
*Sampler's Signature	[signature]
*Sampler's Printed Name	Kaitland cracchiola

Analysis

Client Sample ID	Sampling Date	Sampling Time	Matrix	# of Containers	Gene-Trac DHC	Gene-Trac FGA	Gene-Trac DHB	Gene-Trac DHGM	Gene-Trac SRB	Volatile Fatty Acids	Dissolved hydrocarbon gases	Treatability Study				Other Information
MW-42S	12/10/21 / 12/13/21	1500 / 1100	filter / vials	3	X	X	X			X						DHC, VCrA, bvcA, TceA, Dnb
A1 6P10	12/13/21	1100	vials	2						X						#1 w/air bubbles

KC 12/13/21

Preservative Key

0. None
1. HCL
2. Other
3. Other
4. Other
5. Other
6. Other

Billing Information

P.O. #

*Bill To:

Turnaround Time Requested

Normal ☐
Rush ☐

For Lab Use Only

Cooler Condition: good

Cooler Temperature: -21.5°C

Custody Seals: Yes ☐ No ☑

For Lab Use Only

Proposal #:

	Relinquished By:	Received By:	Relinquished By:	Received By:	Relinquished By:	Received By:
Signature	[signature]	[signature]				
Printed Name	kaitland cracchiola	Bethany Kinsman				
Firm	SiREM	SiREM				
Date/Time	12/13/21 1500	Dec. 15. 21 3:20pm				

Distribution: White - return to Originator; Yellow - Lab Copy; Pink - Retained by Client

* Mandatory Fields