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By ______

Letter of Transmittal

TO: Shelly Billingsley
Director of Public Works
City of Kenosha
625 52nd Street, Room 305
Kenosha, WI 53140

Paul Grittner, WDNR Project Manager
c/o DNR Service Center
Attention: Jennifer Dorman
2300 N. Dr Martin Luther King Jr Drive
Milwaukee, WI 53212

Date: December 20, 2019

Project reference: Former Chrysler Kenosha Engine Plant
Groundwater Remediation
WDNR FID 230004500
BRRTS #02-30-000327

Project number: 60576836

Addressee	Number of Copies	Number of electronic copies or Upload to WDNR directory	Description/Comments
City of Kenosha	1	1	1) Response to Comments letter 2) Groundwater Remedial Design Report -Revision 1
Department of Natural Resources	1		1) Response to Comments letter 2) Groundwater Remedial Design Report

Please contact me if you have questions about the documents.

Lanette Altenbach, P.G., C.P.G.

AECOM Imagine it. Delivered.

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December 20, 2019

Your Reference
02-30-000327

Our Reference
60576836

Paul Grittner
Wisconsin Department of Natural Resources
141 NW Barstow Street,
Room 180
Waukesha, WI 53188

Response to Comment Letter Dated September 23, 2019

Dear Mr. Grittner;

On behalf of the City of Kenosha, AECOM is providing responses to comments provided in a September 23, 2019 letter to Ms. Shelly Billingsley on the Groundwater Remedial Design Report for the former Kenosha Engine Plant (KEP). Your comments included requested modifications to the plan and questioned components of the plan. The purpose of this letter is to provide you with the answers to the questions and to document the modification that is included in the revised Groundwater Remedial Design Report. Your comments are provided in italics before the subsequent response.

Comment

1) *The Report must discuss how the need to operate the groundwater extraction systems will be assessed after the in-situ treatment is conducted, and under what conditions the systems will be turned off (or turned back on again).*

Response

The groundwater extraction systems were installed to control groundwater flow from the site and as such provide little long-term treatment. Since each of the three operating systems are in the immediate areas proposed for treatment, the current plan is that the systems will not be operated during the treatment period, to prevent removal of the treatment from the aquifer.

The goal of the groundwater treatment is to remove the need to pump groundwater for flow control.

A discussion will be added to Section 3.3 Implementation, to describe how the systems will be turned off, but will remain operational as a contingency measure, should the treatment not be effective, or generate an unforeseen condition requiring groundwater capture. The groundwater monitoring proposed for the perimeter of each treatment area will be used to evaluate the need to implement the operation of the system. It is fully anticipated that the groundwater treatment will be successful in removing the need for a groundwater flow control system and when natural attenuation has been demonstrated, a request will be made to decommission the treatment systems permanently.

Comment

2) *The Report must explain how the groundwater contaminant plume limits depicted on the figures were generated and identify the data they are based on.*

Response

The groundwater plume limits are based primarily on the 2015 NR 716 site investigation conducted by AECOM. As part of the 2015 site investigation more than 20 years of historical data was reviewed and incorporated where appropriate to develop the estimated area of groundwater contamination. The 2015 site investigation report included groundwater plume maps for various contaminants and were divided between the water table wells and the piezometers. Further, an interactive map, created in Adobe for use with Adobe Reader was provided to the department so that the various layers could be turned on and off, to aid in the understanding of where the groundwater plume exists. The plume extents were based simply on the detection of an analyte in the monitoring location and did not consider concentrations.

Soil remediation was conducted in 2016 and 2017 to remove the areas of highest petroleum and chlorinated VOCs identified in the vadose zone based on the data collected in the 2015 Site Investigation. These excavations helped us further refine the area of the plumes such as the LNAPL identified at monitoring well MW-10 on the north side of the site. When the excavation opened the area around MW-10 a concrete vault surrounding monitoring well MW-10 was observed and explained why the only well with LNAPL in that area was MW-10. The monitoring well, the contaminated soil and the vault were removed to complete the remediation of LNAPL in that area. Other excavations such as E10T as described in the July 2018 Remedial Action Documentation Report, identified a larger area of TCE impact in the vadose zone and the soil concentrations at the base of the excavation (which in most cases were saturated soil) were used to identify the groundwater plume extent.

Next, the groundwater analytical data from December 2014 (the most complete data set available for groundwater VOC concentrations) data were entered into the Earth Volumetric Studio (EVS) software to develop a 3-dimensional (3D) logarithmic distribution model of PCE concentrations in groundwater within the subsurface pore space. EVS analyzed the data by generating a 3D grid, or mesh, of the model boundary. The model boundary consisted of the data set's convex hull plus a boundary offset. The intersections of the mesh are called nodes. Known contaminant concentrations were used to estimate nodal concentrations via kriging, a geostatistical method that generates estimated values between known data points. These concentrations were then processed to generate a 3D visualization of the estimated contaminant concentrations above the Enforcement Standards (ES). Soil porosity, contaminant density, and contaminant concentration data were used to estimate the plume volume and contaminant mass above the ES.

This discussion of the groundwater plumes and how Figures 8-10 were generated will be added to Section 2.3.2 in the Remedial Design Report.

Comment

3) *A reduction of contaminant mass by 90% cannot be used as the goal of a successful remediation treatment as this may not be needed to obtain case closure. A successful groundwater remediation will produce a contaminant plume that is decreasing in degree and extent and is not migrating outside the boundaries of the site when the groundwater extraction systems are not operating. This would satisfy the requirements of Wis. Admin. Code§ NR 726.05(6)(a)6) and is consistent with the goal proposed in the DNR approved RAOR.*

Response

As stated above, the goal of treatment is to remove the need to control groundwater flow through pump and treatment system. These systems are expensive to maintain and operate and do not provide treatment to the aquifer, only to the pumped water prior to discharge. Pump and treatment have been proven to be ineffective as reducing/removing groundwater contamination. The overall goal for the former Kenosha Engine Plant site is to promote redevelopment of the property. Lesser groundwater treatment could continue to stigmatize the site and prevent redevelopment.

Wis. Admin. Code§ NR 726.05 Criterial for closure for Sites or Facilities with Groundwater contamination (6)(a)6) states: *The concentration and mass of a substance and its breakdown products in groundwater have been reduced to naturally occurring physical, chemical and biological processes as necessary to adequately protect public health and the environment,* *and prevent groundwater contamination from migrating beyond the boundaries of the property or properties which are required to be entered onto the department database.* Using the administrative code to suggest that less treatment would be acceptable (as a means of reducing costs) overlooks the long-term costs that would occur after treatment to demonstrate natural attenuation through groundwater monitoring. Lesser treatment may result with an inability to achieve a stable or receding groundwater contaminant plume and then case closure would not be achieved.

A reduction of the contaminant mass by 90% does not imply that the groundwater concentrations will be near the ES. In order to publicly bid groundwater remediation, a measurable goal must be given to the contractor, so that both the responsible party and the remediation contractor can determine when the work is complete and provide a measure for payment. There are many ways to calculate mass reduction, which is why, part of the bidding request for proposal will require the remedial contractor to propose a method for calculation. Then we can evaluate the method to see if it will be acceptable. This avoids selecting a method that the contractor would claim didn't work with their proposed remediation.

Comment

Kenosha may take any additional steps to improve this site beyond the minimum needed to obtain case closure. However, the DNR will not approve of Ready for Reuse funding for these additional actions.

Response

The City of Kenosha is working cooperatively with the Department of Natural Resources to address the contamination present at the site. Only the groundwater recovery systems are preventing migration of contamination across the City and to Lake Michigan. As stated earlier, the operation and maintenance of the groundwater control systems is costly and much of the equipment is nearly beyond its useful lifetime. Instead of expending the funding to renew an expensive system, a remedy has been proposed so that these treatment systems can be discontinued.

Nothing in the proposed groundwater remediation design includes "additional steps to improve this site beyond the minimum needed to obtain case closure…" Of the 100-acre KEP site more than 38 acres are affected by groundwater contamination orders of magnitude above Wisconsin's groundwater quality ES. The planned treatment is designed to remove enough contaminant mass to arrest contaminant migration so the pump and treatment systems can be decommissioned and Monitored Natural Attenuation can be demonstrated to meet closure requirements.

Comment

4) *The Report must state that upon choosing a contractor, AECOM will present a treatment plan for the DNR to review. A treatment plan must be approved by the DNR if the costs to implement it are to be reimbursed through the Ready for Reuse Program. It will be the responsibility of AECOM to demonstrate why the prescribed treatment is being selected to reduce groundwater contamination.*

Response

The report will include the statement that the proposed treatment plan accepted by the City of Kenosha will be submitted to the WDNR for approval of expenses under the Ready for Reuse program.

Comment

5) *The Site Investigation Report (AECOM, February 2015) identified five apparent source areas for CVOC groundwater contamination. These areas must be identified on appropriate Report figures to ensure that they will be specifically targeted for treatment. It is unclear as to whether the in-situ treatment strategy will need to be applied to the entirety of the Treatment Area 1, or if targeting specific portions within this area would produce*

the needed results. An efficient and targeted treatment regimen in this area would be preferred by the DNR over one designed to target the entire area. As noted above, a proposed treatment regimen will need to be presented to the DNR for review and approval. This proposal will need to justify that the scope of the treatment is required to obtain the remediation goals.

Response

Yes, five areas of groundwater contamination are shown for the KEP in the 2015 Site Investigation Report. However, one of the five areas (MW-34A, MW-36A and MW-603) did not have CVOC exceedances over the enforcement standard. Further, the size and shape of the areas was further refined using a 3-D statistical approached using EVS as described in the response to Comment 2. The four zones for treatment are labeled and shown in Figure 10 included in the Groundwater Remedial Design Report.

As shown by the ISCO pilot test, treatment of a small area resulted in reduced concentrations of contaminants within the treatment zone, but beyond the treatment zone, the concentrations increased after treatment, a likely result of the "specific portion treatment area" causing mobilization of contaminants otherwise bound to subsurface strata (particularly the silt layer located above the clay till).

AECOM has not proposed a treatment layout, because each contractor that provides a bid for the project will provide their own proposals for treatment layouts based on the chemicals they are proposing for treatment. Remediation contractors understand that treatment sometimes mobilizes contaminants and thus, focusing on small areas may not reduce the cost of treatment. There is a wide variety of chemicals, methods of application and application sequences that can be used for treatment.

Comment

6) *The DNR requests that additional wells and piezometers be proposed to ensure that the monitoring network will define the limits of groundwater contamination and track plume behavior over time. The monitoring well and piezometer network should be expanded to encircle the groundwater plume limits of Area 1 depicted on Figure 10 of the Report. The monitoring well network must also ensure that all areas where groundwater contamination has been identified will be assessed during future sampling events. At a minimum, this would require that monitoring wells be installed within Area 2, Area 3, and areas of the site with groundwater contamination that exist outside of defined treatment Areas. The installation of additional piezometer(s) should be proposed in Area 4. Depicting the location of proposed monitoring wells and the location of piezometers on separate maps, in relation to the plume limits detected on the shallow or deeper portion of the aquifer, would be useful in demonstrating that the proposed network would be adequate to assess the groundwater plume.*

Response

The plume in Area 1 is ringed with proposed monitoring wells and piezometers and the distance between wells and/or well pairs ranges from 200 to 300 feet. Three additional well pairs are located within Area 1. Figure 10A has been added to the design report with the contaminant plume's interpolated groundwater concentrations removed, so that the proposed monitoring wells and the outlined treatment areas are clearly visible. When a proposed treatment plan is selected, both the well locations and density will be reviewed and modified if necessary.

Areas 2 and 3 are sufficiently small; groundwater samples from monitoring wells within the plume would likely be biased substantially by the injected treatment product and injection process and would not necessarily be able to accurately monitor the contaminant plume.

The site investigation was accepted as complete and the identified areas for groundwater treatment are the only areas that require monitoring at this time. Additionally, the wells at the perimeter of the KEP have been and will continue to be monitored on a semi-annual basis.

The lateral extents of the contaminant plumes depicted are for the full aquifer thickness and a 3-D representation – not a two-layer system, therefore, the concentrations of both the water table wells and the piezometers (which represent concentrations at the base of the shallow aquifer) were used to depict the plume in three-dimensional space. Figure 9 is a cross-sectional view of the three-dimensional representation of the groundwater plume. The first layer at the top is the unsaturated soil from zero to 12 feet below ground surface. The first layer shows areas of the surface where contaminants were not excavated because their concentrations were below threshold values chosen prior to soil remediation. The second layer depicts clay below the fill, its thickness varies from three to 10 feet thick, with an average thickness of two feet. The third layer is sand that has an average thickness of 10 feet. The fourth layer is a sandy silt, where some of the higher concentrations of TCE were observed in soil samples. The bottom layer is the top of the clay till, a lateral extensive unit found across much of the City. VOCs were not detected in soil samples taken from the till found at 19 to 25 feet bgs.

The sandy silt layer depicted on Figure 9 is the best depiction of the contaminant plume at depth. When compared to the plume boundaries in the two layers above the sandy silt, the extents are very similar. Thus, the depicted monitoring wells and piezometers as shown on Figure 10A provide coverage for the contaminant plume at the water table and at the bottom of the shallow aquifer.

Comment

The majority of the recommended wells will be installed within or around identified groundwater plumes. Proposed wells MW-69R, MW-70R, MW-71R, and PZ-69R are not positioned in these locations. The purpose of these wells should be explained in the Report.

Response

MW-69R, MW-70R and MW-71R were part of the perimeter groundwater monitoring program and historically have not detected contaminants of concern (i.e. "clean wells"). These wells were supposed to have been protected during soil remediation, but the remedial contractor damaged the wells beyond repair, so they were abandoned. They have not yet been reinstalled because additional soil remediation was conducted in that vicinity, so the replacements were planned to be implemented when drilling as part of the pre-groundwater remediation well installation to save on driller mobilization costs. The position of the proposed wells will be provided in the design report.

Comment

Additional monitoring wells and piezometers may need to be installed after the in-situ treatment is conducted if it becomes apparent that more sampling points are needed to determine the effectiveness of the groundwater remediation.

Response

Comment noted.

Comment

7) *The DNR agrees that a pre-remedial groundwater sampling event to assess baseline VOC concentrations should be conducted. Groundwater sampling for VOC analysis should be conducted at all on-site monitoring wells and piezometers on a quarterly basis after the in-situ treatment has been completed to determine its effectiveness and assess whether continued monitoring is needed. This sampling approach may be modified (by changing the number of wells sampled, contaminants tested for, rate of sample collection, etc.) with DNR approval as dictated by sample results.*

Response

Comment noted

The perimeter monitoring wells have been on a semi-annual sampling program and that program has been proposed to continue. A section will be added to the groundwater monitoring plan (in Section 4) to describe the perimeter monitoring. A table listing the perimeter wells will also be added.

Comment

8) *The DNR does not agree that the entire list of analytes listed on Table 1 of the Report must be collected from all on-site wells to assess initial groundwater conditions prior to treatment. Non-VOC analytical data should be collected during the baseline sampling event only if needed to supplement existing data collected during the site investigation or pilot tests for planning a treatment strategy. A list of specific sampling locations and analytes based on the treatment plan and existing groundwater analytical data should be proposed as part of the future in-situ treatment plan.*

Response

The non-VOC analytes shown were those that were required by the WDNR for the injection permit monitoring and two separate lists were provided to cover either oxidation or reduction treatment methods. Baseline sampling for these parameters permits evaluation of the post-treatment results.

If a modification to the proposed groundwater monitoring is necessitated by the proposed remedial treatment, a modified monitoring schedule will be submitted.

Comment

The effectiveness of the groundwater treatment will be demonstrated through decreasing concentrations of VOCs. Additional analytes should mainly be collected if needed to determine why a treatment strategy is not producing the expected results. If specific data is needed to assess groundwater chemistry to optimize an ongoing treatment process it should be proposed as part of the treatment plan. Additional groundwater analysis can be proposed as a change to an approved sampling schedule if it later becomes apparent that additional data is needed to assess how the treatment has affected groundwater chemistry.

Response

Comment noted.

Comment

9) *At a minimum, the annual groundwater monitoring report must provide the information required by Wis. Admin. Code § NR 724.1 7(3m) and must discuss whether:*
   - o *the groundwater monitoring well network is adequate to assess the effectiveness of groundwater treatment when considering groundwater flow direction, groundwater flow velocity, and the degree and extent of contamination measured in the wells;*
   - o *additional monitoring wells or piezometers are needed to assess groundwater;*
   - o *in-situ treatment has been effective at reducing contaminant mass;*
   - o *addition remedial actions are needed to treat sources of groundwater contamination;*
   - o *groundwater contamination is migrating offsite;*
   - o *the groundwater extraction systems must operate;*
   - o *changes to the groundwater sampling plan (number of wells, sampling frequency, analytes tested for, etc.) should be made.*

If it becomes immediately apparent that changes to the monitoring plan are needed they should be proposed immediately and not delayed until the regularly scheduled annual report. The DNR may also request changes to the monitoring plan after it reviews sample data.

Response

Comment noted. However, the groundwater monitoring proposed in the design report is not intended to be a long-term monitoring plan, because the groundwater remediation design is not for an active treatment system, but for a remedy that will remove the need for long term monitoring.

Additionally, while reporting will be conducted in accordance with the Wisconsin Administrative Code, a reporting timeframe of 60 days after receipt of the lab results is requested to give the consultant time to tabulate and validate the data, and for the City to review the results.

Comment

The Report must state that groundwater analytical results (laboratory reports and updated data tables) will be provided to the DNR within 10 days of receiving laboratory data to ensure compliance with the requirements of Wis. Admin. Code§ NR 724.17(3m).

Response

A 10-day reporting requirement for laboratory data for the number of wells planned for the KEP will require extraordinary effort to conduct the QA/QC review of the lab data, address any concerns with the lab, tabulate the data, prepare the required figures, and evaluate groundwater information for concentration trends. More importantly, the 10-day reporting requirement does not provide sufficient time for City personnel to review the data prior to submission to the WDNR.

AECOM, on behalf of the City, is requesting a 60-day report submittal time. Given the volume of analytical data, and the extent of the evaluation required, a 10-day reporting requirement is not adequate to prepare the report. The short timeline also leaves little or no review time the City. AECOM believes a minimally extended preparation time will result in a more thorough and comprehensive report that benefits both the City and the WDNR.

Comment

Other Progress reports must be provided to the DNR as proposed in part 6.0 of the Report. The Report must state the reports will meet the minimum requirements for documenting completion of a remedial action as outlined in Wis. Admin. Code§ NR 724.15.

Response

A remediation completion report is planned as described in Section 5.1. The citation of NR724 will be revised and a description of when this document will be submitted will be added to Section 5.1.

Comment

An updated Remedial Design Report (Groundwater) that addresses the above items must be provided for review and approval before any action that will be funded by the Ready for Reuse program is taken at this site. The DNR has also reviewed the Technical Specification and Plans document. As it mainly pertains to an agreement between AECOM and their future contractors the DNR will not comment on the contents of the document or provide approval, other than Remedial Design Report (Groundwater) which is attached to the Technical Specifications.

Response

Comment noted. An updated Remedial Design Report (Groundwater) is included with this response to comments.

Comment

The DNR also makes the following recommendations regarding the groundwater investigation at this site.

1) *Analytical data collected from monitoring wells and piezometers should not be depicted on the same figures or assessed together. Contouring contaminant concentrations of sample data collected from shallow and deep wells separately is needed to demonstrate the initial*

extent of contamination within different portions of the aquifer, plan a treatment strategy, demonstrate how the remedial action has changed the extent of contamination, and whether the well and piezometer network is adequate to define the extent of the contaminant plume. Unless it can be demonstrated that there is no significant difference between groundwater contamination at the top and bottom of the shallow aquifer, separate figures must be provided depicting contaminant concentrations measured at monitoring wells and piezometers separately.

Response

Comment noted. The treatment strategy is to treat the entire thickness (8-22 feet) of the upper aquifer. The aquifer is not so thick as to make this a prime consideration in the strategy (and cost of) treatment.

Comment

2) *Case closure will be dependent on demonstrating that the degree and extent of all groundwater contaminants (such as metals, polycyclic aromatic hydrocarbons, petroleum VOCs, etc.) has been defined.Sampling the existing and proposed wells for these other contaminants should be considered if existing data cannot demonstrate that no further investigation is needed to define the extent of this contamination. This sampling would not be eligible for Ready for Reuse reimbursement.*

Response

Comment noted. It is recognized that the amount of ready for reuse funding available will not likely cover costs beyond groundwater treatment.

Comment

3) *It is unclear how it was determined that CVOC contamination is not present in the underlying clay on top of which the piezometers are screened or that the vertical extent of CVOC contamination has been defined. This will need to be demonstrated to ensure that the site investigation is complete, and that additional remedial actions will not be needed to address contamination at these depths. Additional investigation needed to assess the vertical extent of contamination would not be eligible for Ready for Reuse reimbursement.*

Response

The site investigation was considered complete, except for the VPLE issues beyond the KEP (and former Chrysler) boundaries. Because the KEP site was withdrawn from the VPLE process, a letter regarding the WDNR's review of the site investigation was not prepared. However, the remedial plan as proposed in the remedial action options report was approved and documented.

The site investigation report (2015) provides the soil laboratory analytical results for the soil samples collected from the clay till at most piezometer piezometers locations. Contaminant concentrations were either not detected or too low to be considered an indicator of a dense non-aqueous phase liquid in the top of the clay till. Piezometers deeper in the clay till were not required because impacts were not identified on top of the clay till. TCE was identified at the highest concentrations in the silty sand lens present approximately three feet above the clay till at approximately 16 to 18 feet below ground surface).

Comment

The potential for vapor intrusion to affect neighborhood buildings will need to be reassessed once the extent of CVOC contamination at this site has been confirmed through post-treatment monitoring. The vapor assessment should be conducted as outlined in DNR guidance document RR-800, "Addressing Vapor Intrusion at Remediation & Redevelopment Sites in Wisconsin". Information obtained during earlier vapor sampling events can be referenced as part of this assessment but should not be relied upon solely to determine the need to investigate the risk posed by vapor intrusion.

Response

Comment noted.

A revised Remedial Design Report (Groundwater) is submitted with this letter. We have addressed your comments and look forward to receiving an approval to proceed with groundwater remediation. The bidding process will take approximately 60 days and post-bid submittals will be made to you with the selected remedial technology. Since the ready for reuse grant expires in August 2020, it is our goal to move this project forward.

Please contact either of the undersigned if you have questions about this letter.

Yours sincerely,

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cc: Shelly Billingsley, Director of Public Works, City of Kenosha

AECOM Imagine it. Delivered.

Remedial Design Report (Groundwater) Revision 1

Former Kenosha Engine Plant
5555 - 30th Avenue, Kenosha, Wisconsin

City of Kenosha

WDNR FID 230004500, BRRTS #02-30-000327

Project number: 60576836

December 20, 2019

Quality information

Prepared by	Checked by	Verified by	Approved by
Lanette Altenbach, P.G., CPG Senior Hydrogeologist	Kevin L. Brehm, P.E. Principal Engineer	Kristine Casper, P.G. Program Manager	Lanette Altenbach P.G., CPG Project Manager

In conformance with NR 712.09 submittal certification requirements:
"I, Lanette Altenbach, hereby certify that I am a hydrogeologist as that term is defined in s. NR 712.03 (1), Wis. Adm. Code, am registered in accordance with the requirements of ch. GHSS 2, Wis. Adm. Code, or licensed in accordance with the requirements of ch. GHSS 3, Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."

Reviewed By: Lanette Altenbach, P.G., CPG
Senior Hydrogeologist

WISCONSIN
LANETTE L. ALTENBACH
G 167
MILWAUKEE, WI
PROFESSIONAL GEOLOGIST

"I, Kevin Brehm, hereby certify that I am a registered professional engineer in the State of Wisconsin, registered in accordance with the requirements of ch. A-E4, Wis. Adm. Code; that this document has been prepared in accordance with the Rules of Professional Conduct in ch.A-E8, Wis. Adm. Code, and that, to the best of my knowledge, all of the information contained in this document is correct and the document was prepared in compliance with all applicable requirements in chs. NR 700 to 726, Wis. Adm. Code."

Reviewed By: Kevin L. Brehm, P.E.
Principal Engineer

WISCONSIN
Kevin L. Brehm
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Prepared for:

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Table of Contents

Tables

Figures

List of Appendices

List of Acronyms

%	Percent
AECOM	AECOM Technical Services, Inc.
bgs	below ground surface
cm/sec	centimeters/second
COC	contaminants of concern
c-DCE	cis-1,2-dichloroethene
DHC	*Dehalococcoides spp.*
ERD	Enhanced Reductive Dechlorination
g/kg	grams of (ISCO treatment chemistry) per kilogram (of soil)
ISCO	In-Situ Chemical Oxidation
KEP	Kenosha Engine Plant
mL/min	milliliters per minute
OSHA	Occupational Safety and Health Administration
PCE	Tetrachloroethene (or also tetrachloroethylene)
RADR	Remedial Action Documentation Report
RAOR	Remedial Action Options Report
TCE	Trichloroethene (or also trichloroethylene), a common chlorinated volatile organic compound used in the degreasing of metal parts and equipment.
µg/L	micrograms per kilogram
USEPA	United Stated Environmental Protection Agency
VOCs	volatile organic compounds
WAC	Wisconsin Administrative Code
VC	vinyl chloride
WDNR	Wisconsin Department of Natural Resources
WPDES	Wisconsin Pollutant Discharge Elimination System

Executive Summary

AECOM Technical Services, Inc. (AECOM) has prepared this groundwater remedial design report for the City of Kenosha to address impacts to groundwater from automotive manufacturing operations at the former Kenosha Engine Plant (KEP). The KEP is located at 5555 - 30th Avenue in the city of Kenosha, Kenosha County, Wisconsin on approximately 100 acres of land The property is currently vacant. Three groundwater treatment systems are housed in small treatment buildings that include Sump 6 (northeast corner), Central (Sumps 18 and 23) and Southern (Sumps 7 and 17R). The site is relatively level and soil remediation (select areas of vadose zone excavation) has been completed.

Historic environmental impacts resulting from manufacturing operations were reported to the Wisconsin Department of Natural Resource (WDNR) at the time they occurred and/or were discovered by the site operator. To some extent, these impacts were investigated, and remedial efforts were conducted at the time of the reported releases. Investigations were conducted in the 1990's prior to demolition of buildings where manufacturing operations were discontinued. In 2010, manufacturing operations were permanently discontinued as part of the bankruptcy of the Chrysler Corporation. The bankruptcy court ordered the establishment of a bankruptcy trust to administer decommissioning of the plant, sales of equipment, and razing of the buildings. Site investigation and soil remediation were conducted after the site was abandoned (to the City) as the end of the bankruptcy process.

Fill material of varying thickness covers the entire site; below, the site geology consists of glacio-lacustrine sand and silt that comprises the upper or shallow aquifer unit of the water table. Beneath the sand aquifer is the clay till that acts as an aquitard to the deeper bedrock aquifers due to its low hydraulic conductivity and permeability, moderate thickness, density, and regional extent.

The water table at KEP typically occurs at a depth of 8 to 11 feet below ground surface (bgs). Horizontal groundwater flow is generally toward the northeast, east, and southeast across the site, both at the water table and just above the clay-till boundary. The groundwater flow direction is fairly consistent throughout the year with a general eastward flow modified by the effect of the existing groundwater recovery systems. There is little seasonal variation. Groundwater impacts are present in the shallow sand and in deeper silt portions of the unconsolidated aquifer. The existing groundwater recovery systems are not treating the sources of the groundwater contamination but are primarily controlling groundwater flow and limiting migration of contamination. More active groundwater treatment at the source areas is necessary to reduce contaminant mass to generate stable or receding groundwater plume conditions such that site closure can be achieved.

Treatability and pilot test studies were conducted to evaluate various in-situ treatment options. Both in-situ chemical oxidation (ISCO) and/or enhanced reductive dechlorination (ERD) were able to treat the groundwater impacts. The proposed plan for groundwater remediation is for in-situ treatment at each of the following four areas:

- Treatment Area 1 is the largest groundwater plume and is located over the central portion of the site.
- Treatment Area 2 is located along the northern property boundary around MW-31.
- Treatment Area 3 is a small area located south of the main gate at the end of 26th Avenue.
- Treatment Area 4 is the Jockey parking lot.

The existing perimeter monitoring well/piezometers will be used to monitor remediation and new monitoring wells and piezometers will be installed to monitor the each of the groundwater treatment areas. The specific remedial approach for each treatment area will be provided as part of a technical bid process to select the lowest, most responsive and qualified bidder to conduct a performance-based groundwater remediation.

1. Introduction

AECOM Technical Services, Inc. (AECOM) has prepared this groundwater remedial design report for the City of Kenosha to address impacts to groundwater from automotive manufacturing operations at the former Kenosha Engine Plant (KEP). The remedial design report for soil was submitted separately. This report was prepared to meet Wisconsin Administrative Code (WAC) NR 724 requirements.

1.1 Contact Information

Owner

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262-653-4150

Consultant

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1.2 Site Location and Description

The KEP is located in the southeast ¼ of Section 36, Township 2 North, Range 22 East (Figure 1). The KEP includes approximately 100 acres of land and is located at 5555 - 30th Avenue in the city of Kenosha, Kenosha County, Wisconsin. The property is currently vacant; however, three groundwater treatment systems are housed in small treatment buildings that include Sump 6 (northeast corner), Central (Sumps 18 and 23) and Southern (Sumps 7 and 17R) as depicted on Figure 2. The site is relatively level and soil remediation (select areas of vadose zone excavation) has been completed. The remaining surface paving is being removed, the site will be graded to ensure proper drainage on site and a temporary vegetated cap will be placed on the site until redevelopment occurs. This site grading and surface work is anticipated to be mostly completed in the summer of 2019.

The overall site layout, including the existing perimeter monitoring well network, groundwater recovery systems, and surrounding properties, is shown in Figure 2. Figure 3 depicts existing utilities and access roads. Existing and proposed site grades are depicted in Figure 4.

2. Background

Historic operations at the site included complete automobile manufacturing and assembly, while more recent operations were focused on the manufacture of automotive engines. The KEP buildings were demolished in 2013 and the building floors were retained to act as a temporary cap over impacted soil and groundwater. Soil remediation activities were commenced in 2016 and the final soil excavation was completed in September 2018. Currently, the remaining paving was removed in late 2018 and early 2019 while final grading and temporary cap placement started in the spring of 2019 and is expected to be completed mid-summer. The temporary cap will remain in place until redevelopment occurs.

2.1 Site Investigation

Historic environmental impacts resulting from manufacturing operations were reported to the Wisconsin Department of Natural Resource (WDNR) at the time they occurred and/or were discovered by the site operator. To some extent, these impacts were investigated, and remedial efforts were conducted at the time of the reported releases. Investigations were conducted in the 1990's prior to demolition of buildings where manufacturing operations were discontinued. Underground storage tanks were upgraded or removed and limited remediation was conducted. The remediation typically consisted of soil removal and disposal followed by the installation of groundwater recovery systems when groundwater releases were observed.

In 2009 the former owner declared bankruptcy and in 2010 manufacturing operations were permanently discontinued. The bankruptcy court ordered the establishment of a bankruptcy trust to administer decommissioning of the plant, sales of equipment, and razing of the buildings. The building floors and paved areas between buildings were retained to act as a cap over impacted soil and groundwater during subsequent remediation. During liquidation activities, Phase I and Phase II Environmental Site Assessments were conducted by the City of Kenosha in 2011 and 2012, prior to the site's abandonment under the bankruptcy court order in January 2013. Site investigation activities incorporated the results of the Phase II ESAs and were initiated after the property was transferred to the City. The investigation was completed in 2014 in general conformance with WAC NR 716, (AECOM, March 2015).

2.2 Geology

Fill material of varying thickness covers the entire site; below, the site geology consists of glacio-lacustrine sand and silt that comprises the upper or shallow aquifer unit of the water table. Beneath the sand aquifer is the clay till that acts as an aquitard to the deeper bedrock aquifers due to its low hydraulic conductivity and permeability, moderate thickness, density, and regional extent. This clay till may contain groundwater at some locations but is not capable of containing or transmitting significant quantities groundwater. The lithology encountered at the sites includes the following:

- Fill – generally consisting of clay, sand, silt, crushed gravel, and in some areas, foundry sand. The majority of the concrete, brick, wood, and demolition debris fill to a depth of four feet below street grade was removed during the soil excavation work conducted in 2016 – 2018. The fill ranges in thickness from approximately 1.5 to 18.5 feet deep, with an average thickness of 7 to 9 feet.
- Silty Clay/Clayey Silt – a discontinuous thin layer of silty clay and clayey silt underlies the fill unit. This layer is generally described as very dark brown to black, dry to moist, slightly-cohesive, low-plasticity, and soft.

- Sand/Silty Sand – this generally consists of a brown, dry to wet, loose to dense sands and silts and comprises the “shallow sand” or “water table” portion of the unconsolidated aquifer. This unit ranges in thickness from 10 to 18 feet bgs.
- Silt/Clayey Silt – a discontinuous layer of lacustrine silt and/or clay separates the silty sand aquifer from the glacial clay till below. This lacustrine layer is one-two feet thick, occurring at approximately 18 to 19 feet bgs and is discontinuous, found most continuously in the western side of the KEP. The unit is generally described as grayish brown, wet, cohesive, medium plasticity, and firm to stiff. This unit comprises the “deeper silt” or “piezometer” portion of the unconsolidated aquifer.
- Clay till – a glacial till layer, which consists of dark gray, wet, cohesive, plastic, and hard clay with stones. This unit is typically encountered at depths of 22 feet (on the west side) to 35 feet (on the east side) bgs and constitutes the lower vertical boundary of groundwater impact.

2.3 Hydrogeology

The water table at KEP typically occurs at a depth of 8 to 11 feet below ground surface (bgs). Horizontal groundwater flow is generally toward the northeast, east, and southeast across the site, both at the water table and just above the clay-till boundary. The groundwater flow direction is fairly consistent throughout the year with a general eastward flow modified by the effect of the existing groundwater recovery systems. There is little seasonal variation. The most recent groundwater elevations are depicted in Figures 5 and 6, the potentiometric surface for the water table monitoring wells and piezometers, respectively.

Site-wide vertical gradients are generally low (less than 0.001 to 0.11) and generally downward, although some upward gradients occurred (likely due to recharge events and other natural influences). At the time of the site investigation there were five groundwater recovery systems that influenced local areas of flow on-site and maintained hydraulic containment of impacted groundwater on-site.

In 2016 during the ISCO pilot test, located on the west central portion of the KEP, horizontal hydraulic gradients at the KEP ranged from 0.002 to 0.01 in the shallow sand portion of the aquifer and 0.002 to 0.008 in the deeper silt portion of the aquifer. The hydraulic conductivity is approximately 10^{-2} centimeters/second (cm/sec) in the upper sand portion of the unconsolidated aquifer (water table) and 10^{-3} cm/sec to 10^{-4} cm/sec in the deeper silt portion of the unconsolidated aquifer. The average linear velocity of groundwater across the KEP is approximately 175 feet per year in the shallow sand portion of the aquifer (at the water table) and approximately 30 feet per year in the deeper silt portion of the aquifer (near the clay till interface).

In 2017 during the ERD pilot test conducted near the center of the KEP the horizontal hydraulic gradients ranged from 0.002 to 0.004 in the shallow sand portion of the aquifer and 0.002 to 0.007 in the deeper silt portion of the aquifer. The hydraulic conductivity is approximately 10^{-2} centimeters/second (cm/sec) in the upper sand portion of the unconsolidated aquifer (water table) and 10^{-3} cm/sec to 10^{-4} cm/sec in the deeper silt portion of the unconsolidated aquifer. The average linear velocity of groundwater across the KEP ranged from 160 to 790 feet per year in the shallow sand portion of the aquifer (at the water table) and 2.4 to 9.6 feet per year near in the deeper silt portion of the aquifer (near the clay till interface).

Vertical gradients during operation of the groundwater recovery system in this area were consistently downward (0.005 to 0.01). After suspension of the groundwater recovery system, vertical gradients have been variable between 0.01 downward and 0.02 upward, likely due to recharge events and other natural influences.

2.4 Summary of Prior Remedial Actions

Historically, remedial activities conducted at the KEP by Chrysler responded to reported releases to the environment and subsurface conditions encountered during reconstruction of the facility. These remedial activities typically included soil excavation and installation/operation of groundwater recovery systems as documented in prior reports. In many cases the remedial activities were not complete remediation but were implemented as source-control measures. The residual impacts remaining after implementation of these historic remedial efforts were considered as impacted areas during the evaluation of the 2014 site investigation data.

In addition to the historic excavation activities conducted by Chrysler, remedial excavation of targeted areas was conducted in multiple phases between 2012 and 2018 by the City of Kenosha. Three of the original five groundwater recovery systems continue to operate at the KEP to reduce the potential for off-site groundwater migration. Additional details regarding prior remedial actions conducted at the KEP are summarized in the *Remedial Action Options Report* (RAOR; AECOM, April 2015) and *Remedial Action Documentation Report: Phase I Groups, A, B, C, E, G, H and J* (RADR; AECOM, July 2018). Areas where vadose-zone soils were removed as part of soil remediation are depicted in Figure 7.

2.5 Conceptual Site Model

The KEP site has more than 100-year history of manufacturing. Industrial operations originated with a bicycle manufacturer that advanced to truck manufacturing (for the World War I efforts) then automotive manufacturing, as technology and consumer needs changed. The KEP has been reconfigured many times in its history and some of that history is buried in former building footprints.

2.5.1 Contaminants of Concern

Automotive manufacturing uses many petroleum-based fluids, and prior to 1980 chlorinated solvents were also used to remove the oily petroleum residues from the manufactured product. Since 1980, water-based solvents were used for degreasing. Uses of the liquids resulted in releases to the environment over the years. As identified by the site investigation the following are the contaminants of concern (COC):

- Petroleum Volatile Organic Compounds (VOCs): Benzene, naphthalene and, to a lesser extent, xylenes.
- Chlorinated VOCs: Tetrachloroethene (PCE, in several isolated and limited areas), trichloroethene (TCE, the primary COC), and their dechlorinated breakdown compounds, cis-1,2-dichloroethene (DCE) and vinyl chloride (VC).

2.5.2 Extent of Groundwater Impacts

Groundwater impacts are present in the shallow sand and in deeper silt portions of the unconsolidated aquifer. The existing groundwater recovery systems are not treating the sources of the groundwater contamination but are primarily controlling groundwater flow and limiting migration of contamination. More active groundwater treatment at the source areas is necessary to reduce contaminant mass to generate stable or receding groundwater plume conditions such that site closure could be achieved.

Source areas of TCE in groundwater have been identified throughout the site. TCE in these source areas is degrading, as evidenced by the higher concentrations of c-DCE and VC; however, the natural site conditions are not conducive to efficient or complete degradation.

The groundwater plume limits are based primarily on the 2015 NR 716 site investigation conducted by AECOM. As part of the 2015 site investigation more than 20 years of historical data was reviewed and incorporated where appropriate to develop the estimated area of groundwater contamination. The 2015 site investigation report included groundwater plume maps for various contaminants and were divided between the water table wells and the piezometers. The plume extents were based simply on the detection of an analyte in the monitoring location and did not consider concentrations.

Soil remediation was conducted in 2016 and 2017 to remove the areas of highest petroleum and chlorinated VOCs identified in the vadose zone based on the data collected in the 2015 Site Investigation. These excavations helped us further refine the area of the plumes such as the LNAPL identified at monitoring well MW-10 on the north side of the site. When the excavation opened the area around MW-10 a concrete vault surrounding monitoring well MW-10 was observed and explained why the only well with LNAPL in that area was MW-10. The monitoring well, the contaminated soil and the vault were removed to complete the remediation of LNAPL in that area. Other excavations such as E10T as described in the July 2018 Remedial Action Documentation Report, identified a larger area of TCE impact in the vadose zone and the soil concentrations at the base of the excavation (which in most cases were saturated soil) were used to identify the groundwater plume extent.

The groundwater analytical data from December 2014 (the most complete data set available for groundwater VOC concentrations) data were entered into the Earth Volumetric Studio (EVS) software to develop a 3-dimensional (3D) logarithmic distribution model of PCE concentrations in groundwater within the subsurface pore space. EVS analyzed the data by generating a 3D grid, or mesh, of the model boundary. The model boundary consisted of the data set's convex hull plus a boundary offset. The intersections of the mesh are called nodes. Known contaminant concentrations were used to estimate nodal concentrations via kriging, a geostatistical method that generates estimated values between known data points. These concentrations were then processed to generate a 3D visualization of the estimated contaminant concentrations above the ES. Soil porosity, contaminant density, and contaminant concentration data were used to estimate the plume volume and contaminant mass above the ES.

Figure 8 depicts the extent of the three-dimensional plume present across the KEP. Figure 9 is an exploded view of the groundwater plume in three-dimensions and is labeled to depict which subsurface soil type and the relative concentrations in the layer. Figure 10 depicts the proposed locations for monitoring the groundwater at the water table and at the base of the aquifer. Figure 10 shows where the monitoring wells are likely to be within and on the periphery of the plume. Figure 10A shows the boundary of the treatment areas (with the plume concentrations removed) for easier visualization of the proposed groundwater monitoring.

2.5.3 Potential Receptors

Potential receptors include site workers, residents in the area surrounding the KEP, and the general public that may traverse the site. Potential exposure pathways evaluated include direct contact with contaminated soil (ground surface to four feet bgs), direct contact with contaminated soil or groundwater (may extend below four feet bgs) during future excavation activities associated with redevelopment, inhalation of contaminated soil/dust, contact or ingestion of contaminated groundwater, and vapor intrusion. Each of these pathways has been determined to be incomplete, has been mitigated, or is in the process of being mitigated:

- The risk of direct-contact with impacted soil has been mitigated by the targeted soil remediation (excavation), backfilling with soil and/or aggregate approved under the *Soil Management Plan*

(AECOM, 2016) and will be further mitigated when the final grading and temporary cap are installed in the spring of 2019.

- Future redevelopment that requires excavation of impacted soil will be required to comply with the existing *Soil Management Plan* (AECOM, 2016) or will be required to develop and comply with a new soil management plan that includes protective controls regarding soil work, staging, transportation and disposal, run off, and dust.
- The KEP is served by the City of Kenosha municipal water supply and sanitary sewer. The City uses water from Lake Michigan for its potable water supply and groundwater is not permitted for potable or production use within City limits.
- Subsurface utilities, such as storm sewer and sanitary sewer lines, are also potential contaminant migration pathways. The storm sewers on the north half of the KEP drain to Pike Creek at 50th Street. Pike Creek flows to the east-southeast and eventually into Lake Michigan. Storm sewers in the southern half of the KEP drain to the main sewer in 60th Street. Specific potential pathways include migration to the 52nd Street right-of-way to the north near the northwest corner of the KEP and migration down the utility corridors of 54th Street to the east. The storm sewer backfill does not appear to be a preferential pathway based on groundwater monitoring conducted at the site. Sanitary sewers were disconnected at the property boundary when the building were razed in 2011-2012 and sanitary lines present in the subsurface within the property boundaries were removed (in part) during soil remediation completed in 2016 through 2018. Thus, the utility corridors are considered an incomplete pathway.
- The United States Environmental Protection Agency (USEPA) conducted a subsurface vapor migration study (USEPA, September 2011), which was provided to the WDNR. The vapor study collected samples in the areas of specific potential pathways, as well as other areas surrounding the KEP. USEPA concluded that vapor intrusion was not a risk to the surrounding properties. Vapor intrusion risk will be mitigated at the KEP because the City of Kenosha will require a vapor barrier as part of any new construction.

2.6 Remedial Action Selection

A range of alternatives for remediating impacted soil and groundwater at the KEP based on the chemicals present, the nature and extent of the contaminated media, site characteristics, and future redevelopment impacts were evaluated in general accordance with WAC NR 722. The remedial alternatives evaluation process is documented in the RAOR (AECOM, April 2015). The RAOR was approved by the WDNR on June 18, 2015.

Based on the evaluation presented in the RAOR, Alternative 4 (Soil and Groundwater Source Control) was identified to be the most technically and economically feasible alternative for implementation at the KEP. This remedy includes a combination of soil excavation, capping, and in-situ groundwater treatment using in-situ chemical oxidation (ISCO) and/or enhanced reductive dechlorination (ERD). The selected approach addresses the remediation goals and objectives for site-wide management of residual soil and groundwater impacts, focusing on protection of human health and the environment, while considering potential redeveloped site uses and available funding for remediation.

2.7 Treatability and Pilot Studies

Pre-design treatability studies on soil and groundwater samples were conducted in 2015 to evaluate ISCO and ERD as potential remedial options for groundwater.

ISCO treatability studies evaluated various oxidants and oxidant loading rates required to achieve COC reductions. Five oxidants were evaluated including: alkaline persulfate, sodium persulfate with iron activation, alkaline persulfate with calcium peroxide, sodium permanganate, and RegenOx™. Based on the treatability study results, sodium permanganate was the most-effective treatment chemistry of the five oxidants evaluated and a chemical loading rate of three grams treatment chemistry per kilogram of soil (g/kg) was selected for the field pilot test. The remaining four treatment chemistry options evaluated had inconclusive results for success in treating the chlorinated VOCs.

The ERD treatability study evaluated the ability of carbon substrates to stimulate native bacteria capable of biodegrading chlorinated VOCs. The in-situ microcosm study evaluated two carbon substrates: Emulsified Oil Substrate (EOS®), and ABC®+. EOS is a proprietary blend of plant-based fermentable carbon (soybean oil), nutrients, emulsifiers stabilizers. ABC+ contains a mixture of lactate, fatty acids, alcohols, phosphate buffer, and zero-valent iron. The substrates were applied to Bio-Trap® passive samplers and installed in monitoring wells/piezometers within known TCE source areas at the KEP for approximately two months. Based on the treatability study results, both substrates promoted anaerobic conditions; however, populations of specific dechlorinating bacteria known to degrade TCE (*Dehalococcoides spp.* ([DHC]) remained below functional levels. Therefore, bioaugmentation with a DHC culture was recommended for the pilot study.

Two pilot studies were conducted on separate areas of the KEP to evaluate the implementability and effectiveness of two different in-situ treatment techniques. The first pilot test evaluated ISCO treatment in an area of the KEP documented with some of the highest TCE concentrations observed in groundwater. The second pilot test evaluated ERD in an area with moderate TCE concentrations and TCE-degradation products in the groundwater. Competitive bids were solicited from three qualified groundwater remediation contractors and AECOM retained Redox Tech, LLC (Redox Tech) of Chicago, Illinois, to conduct both pilot tests.

Injection permit applications were prepared and submitted to the WDNR. After the permits were granted, the pilot test injections were scheduled. While the permit applications were pending, temporary wells were installed in each pilot test area. The temporary wells and select existing wells in each pilot test areas were sampled for baseline parameters prior to the pilot test injections.

The ISCO pilot test injection activities were initiated on December 5, 2016 and concluded on December 13, 2016. Six temporary monitoring wells were installed at varying distances from proposed injection locations to serve as pilot test monitoring points. Three existing monitoring well/piezometers locations were also used as monitoring points. The sodium permanganate oxidant solution was injected into the subsurface using direct-push technology with injection tooling that consisted of an outer casing with an expendable tip. Based on the treatability study results, the initial design mix included sodium permanganate (40% by weight) mixed with potable water to create a 3% by weight solution. Cold temperatures and the need for reduced injection pressures increased the pilot test injection duration. Monitoring of field parameters, depth to water and vapor monitoring in nearby manholes was conducted during the testing in conformance with permit-required monitoring. Post-treatment samples were collected four weeks after injection and again 14 weeks after injection.

A comparison of TCE concentrations in groundwater prior to and following the pilot injections documented that the selected oxidant chemistry was effective in reducing contaminant mass at most locations within the pilot study area. Significant COC molar mass reductions were documented one month following the pilot injection activities (January 2017). Although rebound occurred in some wells, based on groundwater results approximately three months following injection (March 2017), molar mass at those wells remained significantly below the baseline molar mass. The resulting overall average COC molar mass decrease between the baseline and March 2017 monitoring events was 31 percent (%). The most-significant decreases were in wells screened within the deeper silt portion of the aquifer (averaging 49% molar mass reduction) with lesser reductions in the shallow sand portion of the aquifer (averaging 18%). The report *In-Situ Chemical Oxidation Pilot Test Documentation Report* (AECOM, March 2018) contains a complete discussion of the findings. A copy of the report is attached to the Technical Plans and Specifications for Groundwater Remediation (AECOM, January 2019b). The ISCO pilot test results tables and figures are included in Appendix A.

The ERD pilot test injections were initially planned to be completed immediately following the ISCO injections in December 2016; however, unusually cold weather precluded the injections at that time and the pilot test was postponed until March 2017. Three temporary wells, two monitoring wells and two piezometers were used to monitor the ERD pilot test. The ERD injection points were placed at specific distances from the temporary wells. ABC+ and RTB-1 (bacterial culture) was injected into the subsurface using direct-push technology with injection tooling that consisted of an outer casing with an expendable tip. Based on the treatability study results, a total of 7,692 pounds of ABC$^+$ (5,292 pounds of ABC® and 2,400 pounds of zero-valent iron) was mixed with potable water to form 5,333 gallons of solution (approximately 12 percent by weight). Prior to mixing, sugar and yeast were added for the purpose of deoxygenating the water. The ABC$^+$ solution was augmented with 30 liters of RTB-1 culture. Monitoring of field parameters, depth to water and vapor monitoring in nearby manholes was conducted during the testing in conformance with permit-required monitoring.

Confirmation groundwater sampling events were conducted three months (June 2017), six months (September 2017), and one year (March 2018) after the pilot test injections. In general, VOC molar mass decreased in most wells, with an overall average COC molar mass decrease of 40% between the baseline and March 2018 monitoring events (approximately 12 months), which included TCE reductions of over 99% in all but one of the monitoring points within the injection area. Field parameters, dissolved iron concentrations, and dissolved gas concentrations generally indicated strongly-reducing conditions, conducive to ERD. However, DHC populations did not attain the 1E+04 cells/L population considered the threshold for generally-useful rates of reductive dechlorination. The ERD amendments reduced COC molar mass in the groundwater despite limited DHC population growth and sub-optimal TOC concentrations and/or pH levels in some wells. The report Reductive *Dechlorination Pilot Test Documentation Report* (AECOM, October 2018) contains a complete discussion of findings. A copy of this report is provided in the Technical Plans and Specifications for Groundwater Remediation (AECOM, January 2019b). The ERD pilot test results tables and figures are included in Appendix B.

2.8 Anticipated Post-Remedial Site Conditions

The site is currently zoned M-1 Light Manufacturing and M-2 Heavy Manufacturing. Redevelopment after remediation assumes the following:

- Post-remediation uses are anticipated to be commercial or light manufacturing;
- Residential uses for the site will not be considered;
- The City of Kenosha will require a vapor barrier system for new building construction;
- As redevelopment occurs, the buildings, pavement and landscape will provide the final cap, where necessary;
- Until a final cap is in place (through redevelopment) the site will be capped temporarily by vegetated soil;
- Impacted soil and groundwater encountered during site redevelopment activities will require special handling and disposal; and

- Institutional controls will be utilized to address residual soil and groundwater impacts that remain after completion of the remedial efforts.

3. Groundwater Remedial Design Considerations

3.1 Remedial Objective and Design Approach

The objective for the groundwater remedial action is reduction of groundwater contaminants in source areas of the KEP to establish a stable and shrinking plume, reduce the potential for offsite migration while removing the need for active groundwater recovery, and allow for redevelopment of the site considering potential redeveloped site uses.

The contaminants of concern at the KEP consist of chlorinated VOCs and petroleum VOCs with the highest concentration of a single analyte being TCE at 83,100 micrograms per liter (µg/L). The plume size encompasses approximately 1,500,000 square-foot area with an average 10-foot thickness in one larger area and three smaller areas. Although the groundwater WAC NR 140 Enforcement Standards (ES) were considered for use as the remedial endpoint, active remediation to these standards may not be technically or economically feasible for KEP given the context of the restricted post-development property use and available funding resources. It is anticipated that the post-remediation development plan will incorporate buildings and paved surfaces, which will provide additional protections against potential completion of the direct-contact and groundwater pathways. Thus, a target of 90% reduction in molar mass is selected as a remedial performance standard. The design considerations to achieve this reduction are described below.

Supplementing this Remedial Design Report are the bid documents for the planned performance-based groundwater remediation, in accordance with WAC NR 724. The performance-based specification allows each remedial contractor the freedom to propose their specific or preferred in-situ chemical treatment(s) because the in-situ groundwater treatment universe is continually improving. The selected remedial treatment will be based on approach, cost and timeframe to achieve the desired improvement of groundwater quality.

3.2 Groundwater Corrective Action Design

This design report describes the groundwater conditions at the KEP to support a performance-based groundwater remediation. As part of the public funding process, the groundwater remediation will be publicly-bid in a manner that remedial contractors will be asked to propose their own treatment mix and implement their described method that includes a guarantee for groundwater contamination reduction to achieve a 90% reduction in detected molar mass, rather than an absolute reduction of detected groundwater concentrations below NR 141 Enforcement Standards. Flexibility is planned and adjustments to the remedial design may be made, as necessary, based on work progress, timing, and conditions encountered in the field. Specific details included in the Technical Plans and Specifications for Groundwater Remediation (AECOM, January 2019b) describe how the performance-based remediation will be implemented and how performance will be assessed.

The results of the pilot tests indicate that in-situ remediation is an effective approach to achieve 90% COC molar mass reduction in the groundwater plumes. Due to the variability of VOC concentrations in groundwater and the findings of the ISCO and ERD pilot tests, the site will be spilt in to treatment areas for more-precise targeting of remedial actions (see Figure 10). The precise approach (ISCO, ERD, or some combination) will be proposed by potential remediation contractors to reach the targeted COC reduction. An example of a proposed approach is a combined remedial strategy of ERD and ISCO through a series of treatment grids and reactive zones. This approach may include a phased series of injections and monitoring periods between injection events.

The treatment proposed by bidders will be evaluated using a scoring system for technical approach, past performance and quality and cost. The selected bidder will be determined by the City in consultation with AECOM after the bidders are scored.

3.2.1 Planning and Permits

Following WDNR approval of the groundwater design report (and technical specifications), the planned groundwater remediation will be advertised for public comments to comply with the requirements of the Ready for Reuse Grant that will be used to fund this project. The advertisement for bids for groundwater remediation will be released mid-way through the public comment period. The advertisement for bids requires a minimum of two weeks of publication, and as such, the overlap between receipt of public comments and the receipt of the public bids will permit time to address any public comments that may be received that would necessitate modification(s) incorporation into the technical specifications.

The Technical Plans and Specifications for Groundwater Remediation prepared by AECOM as a companion document to this design report will require that the successful bidder to prepare injection or other permits necessary to implement their specified remediation. AECOM will provide technical support and will review the permit applications before they are submitted. The contractor will be required to include permitting time in the schedule required as part of their bid. AECOM will assist with the preparation of the injection permit applications and upon receipt of the permits, with conducting monitoring required by the permit(s).

A temporary exemption pursuant to WAC NR 140.28(5), approval to inject materials under WAC NR 812.05, and a Wisconsin Pollutant Discharge Elimination System (WPDES) permit are required to complete the groundwater remediation. AECOM will prepare and submit an Injection Request for submittal to the WDNR. As part of the Injection Request, an application for coverage under the WPDES general permit for Discharge of Contaminated Groundwater from Remedial Action Operations (WI-0046566-6) will also be prepared. The selected remedial contractor will be required to provide the documentation needed to support these permit requests.

3.2.2 Health and Safety Plan

Consistent with the requirements of the Occupational Safety and Health Administration (OSHA) Hazardous Waste Operations and Emergency Response Standard (29 CFR 1910.120), a site-specific health and safety plan must be developed and followed during the implementation of the proposed remedial action. The Health and Safety Plan was developed as part of the site investigation activities and will be updated for use by AECOM during the remediation work. All remediation contractors will be responsible for their own site-specific Health and Safety Plans. The contractor will have overall operational authority for health and safety during active site remediation work.

3.2.3 Site Security and Fencing

The existing perimeter chain link fence and gates will remain throughout implementation of the remedial actions. Temporary fencing may be necessary depending upon the treatment contractors plan and/or to meet the requirements of the contractor’s Health and Safety Plan as well as when other contractors may be working on different parts of the KEP site.

3.2.4 Traffic Control Plan

No closures of the public roadways are necessary for this work because the work will be conducted within the property boundaries on private property. Truck traffic will enter/exit the primary work area via the gated entrance at 26th Avenue and 52nd Street.

3.2.5 Utilities

Active utilities that are to remain in operation are identified in Figures 3 and 4 and must be protected by the contractor during performance of the remedial activities. These include:

- ATC-owned overhead power transmission lines (north to south) in a center easement on the KEP,
- We Energies-owned overhead power distribution lines that traverse the site from north to south located in on the eastern property boundary;
- Overhead power lines that run from a pole on the west central property line eastward to power the central groundwater remediation system;
- Site-wide storm sewers, new and existing, as depicted in Figure 4;
- Subsurface piping and electrical power associated with the pumps for the groundwater recovery systems; and
- Three active sanitary discharge lines associated with the groundwater recovery systems.

Abandoned utilities that served the KEP during its active operations that may be encountered include; potable water, fire-suppression water lines, internal sanitary sewers, internal underground electrical, and former subsurface process piping. These utilities were removed from the site as encountered during subsequent soil remedial activities, generally to a depth of four feet bgs. Underground electrical services (except as noted above), sanitary sewers (except as noted above) and potable water were cut and capped at the property boundary in conformance with City of Kenosha ordinances. Most of the abandoned utilities that were found during the remedial soil excavations were capped at the excavation edge. Thus, these utilities are no longer continuous nor connected and are not expected to interfere significantly with the groundwater treatment, as the bulk of the treatment activities will occur below the level that these utilities would normally be encountered (*i.e.*, groundwater treatment zone is 10 to 20 feet bgs and the abandoned utilities are generally 8 feet bgs or less).

3.2.6 Waste Management

Soil cuttings from monitoring well installations will be placed in 55-gallon drums, the soil will be characterized, and properly disposed. Decontamination fluids and monitoring well purge water will be treated in the on-site central remediation groundwater treatment system and discharged to the sanitary sewer under the existing permit.

The remedial contractor will be responsible for wastes generated by their remediation activities and must provide all documentation regarding generation, characterization, and disposal to the City of Kenosha.

3.3 Implementation

It is anticipated that the delivery of aquifer amendments for in-situ remediation will likely be conducted using direct-push technology, similar to the techniques used during the pilot testing. Soil boring spacing and locations will be determined and documented in each individual bid. Once the bids have been received, evaluated and a bidder selected, the name of the selected contractor and their proposed remedial approach will be submitted to the WDNR. The specific amendment(s) and implementation approach will also be incorporated into the injection permit request(s).

4. Groundwater Remediation Monitoring

4.1 KEP Perimeter Groundwater Monitoring

The existing perimeter monitoring well/piezometers will continue to be monitored by AECOM on a semi-annual basis. Seventeen water table monitoring wells and three piezometers are analyzed for volatile organic compounds. Additionally, three water table monitoring wells (MW-69, MW-70, and MW-71) and one piezometer (PZ-69) were also part of the perimeter monitoring program. These four wells were damaged by the soil remediation contractor and are planned to be replaced for monitoring the groundwater downgradient from the plume, but still within the KEP site. These wells have historically been free of contamination and thus, are important to the perimeter monitoring program. The existing and planned replacement perimeter wells are included in Table 1.

4.2 Groundwater Monitoring During Remediation

WAC NR 141-compliant groundwater monitoring wells and/or piezometers will be installed after approval of this remedial design report and prior to implementation of the remedial activities to monitor baseline conditions as well as conditions during and after remediation. Groundwater samples will be collected by AECOM from the planned monitoring wells/piezometer locations before the remedial work is conducted to obtain baseline measurements prior to remediation.

The locations for groundwater monitoring during and after remediation has been planned on a per-treatment area basis and monitoring locations are depicted on Figure 10 and 10A. The list of wells by treatment area is also listed in Table 2.

- Treatment Area 1 is the largest area of groundwater treatment located over the central portion of the site. Thirteen water table monitoring wells and eight piezometers will be installed around the perimeter and through the middle of the treatment area.
- Treatment Area 2 is located along the northern property boundary around MW-31. Three water table monitoring wells and two piezometers will be installed around the southern and eastern boundaries of the treatment area. Additionally, perimeter wells MW-31, MW-113, MW-114 and PZ-118 will be sampled during remediation.
- Treatment Area 3 is a small area located south of the main gate at the end of 26th Avenue. Three water table monitoring wells and three piezometers will be installed north, east and south of the treatment area.
- Treatment Area 4 is the Jockey parking lot. Four existing water table monitoring wells and one new piezometer will be installed for monitoring during remediation.

Some perimeter existing monitoring wells will be used for Treatment Areas 2 and 4 as listed in Table 2. Groundwater monitoring will be conducted on a quarterly basis. The first quarter will occur in conjunction with the schedule of the proposed remedial contractors plan.

If after the selection of the remediation contractor and the remediation plan a change is needed in monitoring well locations or frequency, an update to this plan will be provided.

4.3 Sampling and Collection Methods

Before sampling, depth-to-groundwater measurements will be collected for calculating the groundwater flow direction. Depth to water will be measured using an audible water level indicator and measurements will be referenced to the top of the surveyed well casing at each monitoring point.

Prior to sample collection, monitoring wells will be purged at a low-flow rate using a peristaltic pump. The wells will be purged at a pumping rate of approximately 200 milliliters per minute (mL/min) or less if needed to reduce the turbidity of the groundwater and/or maintain groundwater levels. If the wells purge dry, a bailer will be used to collect the groundwater samples after the well has been purged dry and the water level has recovered to within 90% of its original level.

Groundwater field measurements, including temperature, pH, conductivity, dissolved oxygen, and oxidation-reduction potential will be measured at approximate five-minute intervals using a portable water quality meter (*e.g.,* Aqua Troll or equivalent meter) with a flow through cell. After groundwater field parameters stabilize, groundwater samples will be collected at the low-flow sampling rate of 200 mL/min or less as required maintain the groundwater level without drawdown and low turbidity levels.

Groundwater samples will be collected in laboratory-supplied bottles containing preservatives, as appropriate. Duplicate samples (1 per 10 samples) and a trip blanks (1 per shipment container or one per day) will be submitted for analysis for quality control (QC) purposes. The samples will be placed on ice in an insulated rigid cooler and delivered with completed chain-of-custody forms to Pace Analytical (a Wisconsin certified laboratory). Groundwater samples will be analyzed using SW846 Method 8260 for VOCs.

4.4 Site Restoration

Areas disturbed performing remedial activities will be repaired and seeded following completion of the groundwater remediation activities to repair any damage to the vegetative soil cap in place from previous soil remediation activities. New seeding will be watered, as needed, to maintain soil moisture for a minimum of two weeks after seeding. The water will be applied at a rate that does not result in soil erosion or runoff.

If weather or other unforeseen delays prevent implementation or completion of the site restoration activities based on permanent seeding time periods, then the final site restoration activities (seeding and mulching) will be completed at the beginning of the next growing season.

5. Documentation and Implementation Schedule

5.1 Documentation

Remediation activities will be documented in a field logbook or on designated field sheets that will be maintained in the project file. Included in the daily documentation are:

- Procedures for routine activities associated with the groundwater remedial action activities;
- Personnel working on the KEP;
- Chronological log of site activities;
- Daily tailgate meeting and site safety briefing summaries;
- Site visitors log; and,
- Other pertinent sample collection data and/or field/weather observations.

Upon completion of the groundwater remediation activities, data evaluation, and receipt of the groundwater remediation performance confirmation analytical results, a Groundwater Remedial Action Documentation Report to WDNR in accordance with NR 724.15. The Groundwater Remedial Action Documentation Report will include:

- A summary of the on-site groundwater remediation activities and its conformance to the planned remedial design
- dates of completion (such as injection events) and field observations including measurements taken during injection or treatment,
- results from confirmation samples,
- quantities of materials used or injected, and
- injection well abandonment documentation.

The report may include a revised groundwater monitoring plan and/or schedule for the post-remediation period.

5.2 Implementation Schedule

The planned implementation schedule is:

Activity	Days for Completion
Submit Groundwater Remedial Design Report and Groundwater Technical Specifications	1
WDNR Review and Approval	60
Publish Request for Public Comment	14
Request for Bids	28

Bid Opening and Review	5
Award of Contract, Common Council Approval and Signed Contract from Awarded Contractor	30
Prepare and Submit Injection Permit to WDNR	30
WDNR Permit Review and Issuance	60
Groundwater Remediation	12 to 24 months

6. Implementation Plan

Following is a listing of the primary tasks that will be implemented as part of the groundwater remedial action. The following provides a general implementation plan of groundwater remedial activities:

- Publish public notice for comments on the Groundwater Remediation Design Report (AECOM, January 2019a) and Technical Plans and Specifications for Groundwater Remediation (AECOM, January 2019b)
- Publicly bid groundwater remediation at the KEP
- Receive and evaluate bids
- Select remediation contractor and negotiate contract
- Conduct site preparation, injections, and site restoration activities
- Progress reports will be prepared to document intermediary milestones, such as after the following work phases:
  - Monitoring well/piezometer installation and baseline, pre-remediation groundwater monitoring
  - Injection completion
  - Annual groundwater monitoring (during remediation and post-remedial confirmation)
  - Other phases (*e.g.*, supplemental injections)
- Prepare and submit the Groundwater RADR at the completion of the remedial action for demonstration that the remedial objectives have been achieved.

It is anticipated that each progress report will be submitted to the WDNR approximately 60 days following completion of the work included in the progress report.

7. Reference

AECOM, March 2015, *Site Investigation Report*

AECOM, April 2015, *Remedial Action Options Report*

AECOM, Month, Soil Remediation Design Report

AECOM*, March* 2016, *Soil and Material Management Plan*

AECOM, March 2018, *In-Situ Chemical Oxidation Pilot Test Documentation Report*

AECOM, July 2018, *Remedial Action Documentation Report: Phase I Groups, A, B, C, E, G, H and J* (RADR; AECOM, July 2018)

AECOM, October 2018, *Enhanced Reductive Dechlorination Pilot Test Documentation Report*

AECOM, January 2019a, *Groundwater Remediation Design Report*

AECOM, January 2019b, *Technical Plans and Specifications for Groundwater Remediation*

Weston Solutions, Inc., September 2011, *Preliminary Investigation Report, Revision 3 for Chrysler Kenosha Engine Plant Site, Kenosha, Wisconsin,* prepared for the United States Environmental Protection Agency, Region V.

Tables

Table 1
Proposed Groundwater Monitoring
Monitoring Wells, Piezometers and Proposed Analytes
Former Kenosha Engine Plant

Perimeter Monitoring Wells

Sample Frequency	Semi-annually
Field Measurement	Temperature, pH, conductivity, dissolved oxygen, and oxidation reduction potential
Chemical Analysis	Volatile Organic Compounds (Analyzed by method SW-846 8260)
Existing Monitoring Wells and Piezometers (in order counterclockwise around KEP starting at NW corner)	
MW-101	West
MW-102	West
MW-103	West
MW-105	South (in sidewalk)
MW-107	South (in sidewalk)
MW-108	Southeast
MW-44	Southeast
MW-109	East-southeast
MW-110	East
MW-116	East
PZ-116	East
MW-117	East
PZ-117	East
MW-111	East
MW-112	East
MW-113	North
PZ-118	North
MW-31	North
MW-114	North
MW-115	North
MW-206	Southwest -Water level only
Replacement Wells to be Installed	
MW-69R	East Side of KEP between 55th Street to the north and 56th Street to the south
PZ-69R	
MW-70R	
MW-71R	

Table 2
Proposed Groundwater Monitoring Wells, Piezometers and Analytes
Groundwater Remediation
Former Kenosha Engine Plant

Groundwater Treatment Area 1		
Sample Frequency	Quarterly	
Field Measurement	Temperature, pH, conductivity, dissolved oxygen, and oxidation reduction potential	
Chemical Analysis	Volatile Organic Compounds (Analyzed by method SW-846 8260)	
New Monitoring Wells/Piezometers to be Installed		
MW-2101	MW-2106	MW-2111
PZ-2101	MW-2107	PZ-2111
MW-2102	PZ-2107	MW-2112
MW-2103	MW-2108	PZ-2112
PZ-2103	MW-2109	MW-2113
MW-2104	PZ-2109	PZ-2113
MW-2105	MW-2110	MW-2114
PZ-2105	PZ-2110	PZ-2114
Additional analysis if Chemical Oxidation		
Analyte	*Analytical Method*	
Total Organic Carbon	SM 5310C	
Permanganate	Field Kit	
Chloride	EPA 300.0	
Barium	EPA 6020	
Chromium	EPA 6020	
Lead	EPA 6020	
Nickel	EPA 6020	
Additional analysis if Enhanced Reductive Dechlorination		
Analyte	*Analytical Method*	
TOC	SM 5310C	
Alkalinity	EPA 310.2	
Chloride	EPA 300.0	
Total Iron	EPA 6010	
Dissolved Iron	EPA 6010	
Total Manganese	EPA 6010	
Dissolved Manganese	EPA 6010	
Sulfate	EPA 300.0	
Sulfide		
Methane, ethane, ethene	EPA 8015B	
Barium	EPA 6020	
Chromium	EPA 6020	
Lead	EPA 6020	
Nickel	EPA 6020	

If other treatment alternatives are proposed, the proposed monitoring will be modfied.

Groundwater Treatment Area 2		
Sample Frequency	Quarterly	
Field Measurement	Temperature, pH, conductivity, dissolved oxygen, and oxidation reduction potential	
Chemical Analysis	Volatile Organic Compounds (Analyzed by method SW-846 8260)	
Existing Monitoring Wells and Piezometers		
MW-114	MW-113	
MW-31	PZ-118	
New Monitoring Wells/Piezometers to be Installed		
MW-2201	MW-2202	MW-2203
	PZ-2202	PZ-2203
Additional analysis if Chemical Oxidation		
Analyte	*Analytical Method*	
Total Organic Carbon	SM 5310C	
Permanganate	Field Kit	
Chloride	EPA 300.0	
Barium	EPA 6020	
Chromium	EPA 6020	
Lead	EPA 6020	
Nickel	EPA 6020	
Additional analysis if Enhanced Reductive Dechlorination		
Analyte	*Analytical Method*	
TOC	SM 5310C	
Alkalinity	EPA 310.2	
Chloride	EPA 300.0	
Total Iron	EPA 6010	
Dissolved Iron	EPA 6010	
Total Manganese	EPA 6010	
Dissolved Manganese	EPA 6010	
Sulfate	EPA 300.0	
Sulfide		
Methane, ethane, ethene	EPA 8015B	
Barium	EPA 6020	
Chromium	EPA 6020	
Lead	EPA 6020	
Nickel	EPA 6020	

If other treatment alternatives are proposed, the proposed monitoring will be modfied.

Table 2
Proposed Groundwater Monitoring Wells, Piezometers and Analytes
Groundwater Remediation
Former Kenosha Engine Plant

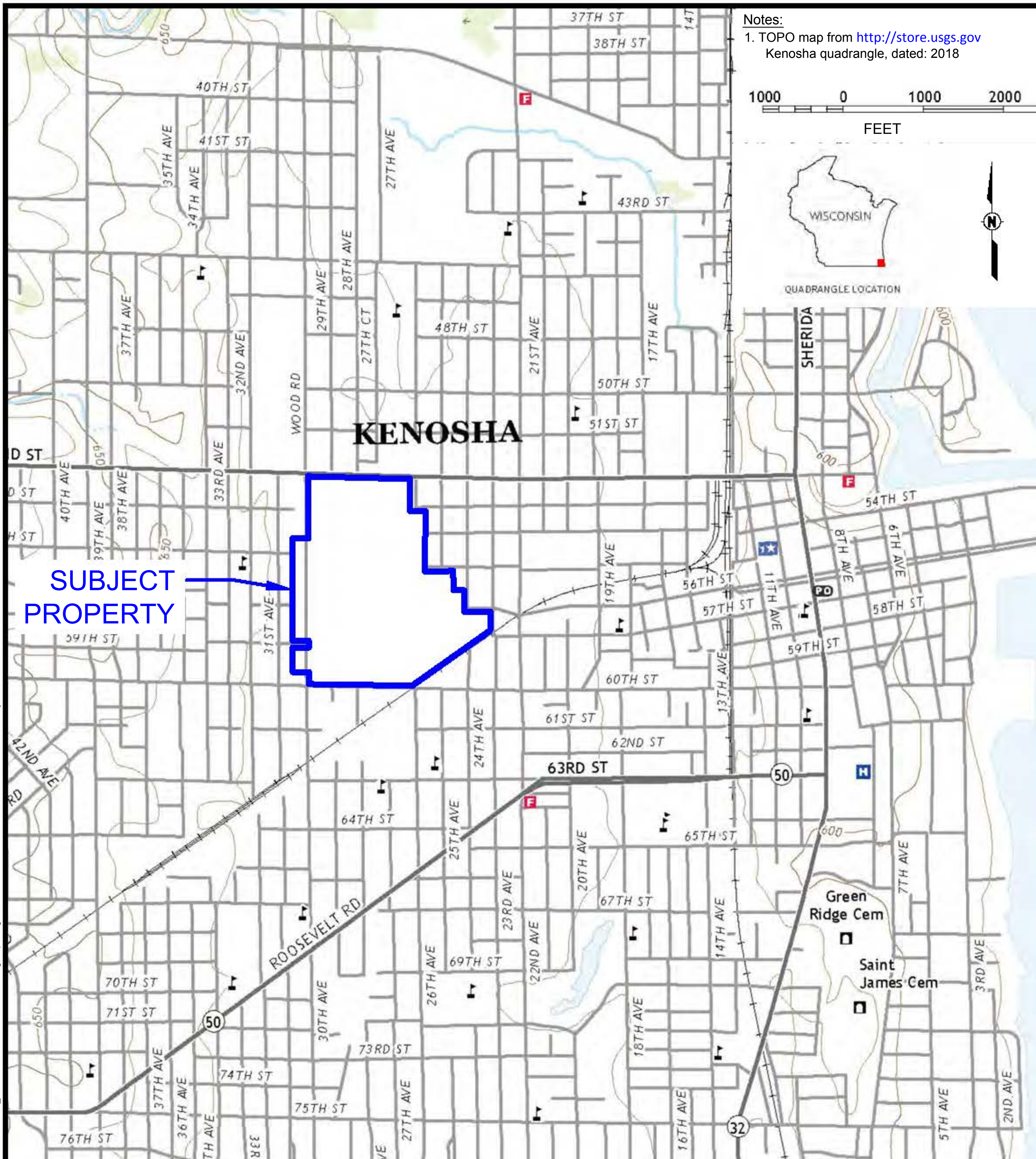
Groundwater Treatment Area 3		
Sample Frequency	Quarterly	
Field Measurement	Temperature, pH, conductivity, dissolved oxygen, and oxidation reduction potential	
Chemical Analysis	Volatile Organic Compounds (Analyzed by method SW-846 8260)	
New Monitoring Wells/Piezometers to be Installed		
MW-2301	MW-2302	MW-2303
PZ-2301	PZ-2302	PZ-2303
Additional analysis if Chemical Oxidation		
Analyte	*Analytical Method*	
Total Organic Carbon	SM 5310C	
Permanganate	Field Kit	
Chloride	EPA 300.0	
Barium	EPA 6020	
Chromium	EPA 6020	
Lead	EPA 6020	
Nickel	EPA 6020	
Additional analysis if Enhanced Reductive Dechlorination		
Analyte	*Analytical Method*	
TOC	SM 5310C	
Alkalinity	EPA 310.2	
Chloride	EPA 300.0	
Total Iron	EPA 6010	
Dissolved Iron	EPA 6010	
Total Manganese	EPA 6010	
Dissolved Manganese	EPA 6010	
Sulfate	EPA 300.0	
Sulfide		
Methane, ethane, ethene	EPA 8015B	
Barium	EPA 6020	
Chromium	EPA 6020	
Lead	EPA 6020	
Nickel	EPA 6020	

If other treatment alternatives are proposed, the proposed monitoring will be modfied.

Groundwater Treatment Area 4		
Sample Frequency	Quarterly	
Field Measurement	Temperature, pH, conductivity, dissolved oxygen, and oxidation reduction potential	
Chemical Analysis	Volatile Organic Compounds (Analyzed by method SW-846 8260)	
Existing Monitoring Wells and Piezometers		
MW-65	MW-108	MW-81
MW-77	MW-79	MW-82
MW-44	MW-80	
New Piezometer to be Installed		
PZ-82		
Additional analysis if Chemical Oxidation		
Analyte	*Analytical Method*	
Total Organic Carbon	SM 5310C	
Permanganate	Field Kit	
Chloride	EPA 300.0	
Barium	EPA 6020	
Chromium	EPA 6020	
Lead	EPA 6020	
Nickel	EPA 6020	
Additional analysis if Enhanced Reductive Dechlorination		
Analyte	*Analytical Method*	
TOC	SM 5310C	
Alkalinity	EPA 310.2	
Chloride	EPA 300.0	
Total Iron	EPA 6010	
Dissolved Iron	EPA 6010	
Total Manganese	EPA 6010	
Dissolved Manganese	EPA 6010	
Sulfate	EPA 300.0	
Sulfide		
Methane, ethane, ethene	EPA 8015B	
Barium	EPA 6020	
Chromium	EPA 6020	
Lead	EPA 6020	
Nickel	EPA 6020	

If other treatment alternatives are proposed, the proposed monitoring will be modfied.

Figures



AECOM

1555 RiverCenter Dr
Milwaukee, WI 53212
414.944.6080
www.aecom.com

SITE LOCATION (USGS TOPOGRAPHIC MAP)
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	12/3/2018
Checked:	KC	12/3/2018
Approved:	LLA	12/3/2018

PROJECT NUMBER 60576836

FIGURE NUMBER 1

File: \\USMWK1FS001\prod\Data\Projects\60576836\900_Work\CAD\KEP - GW Rem Design Rpt.dwg; USER: ENGELHARDT, SARAH; PLOTTED:December 5, 2018 - 9:32 AM

LEGEND

- APPROXIMATE SITE BOUNDARY
- RAILROAD
- EXISTING FENCE
- REMEDIATION BUILDING
- SUMPS AND SANITARY OUTFALLS
- SUMP UTILITY LINES
- MONITORING WELLS AND PIEZOMETERS

NOTES

1. AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO, IMAGE DATED 7/6/2018; DOWNLOADED ON 12/3/2018.
2. BORDER DISCONTINUITIES ARE DUE TO ANGLE OF 2018 AERIAL.

AECOM

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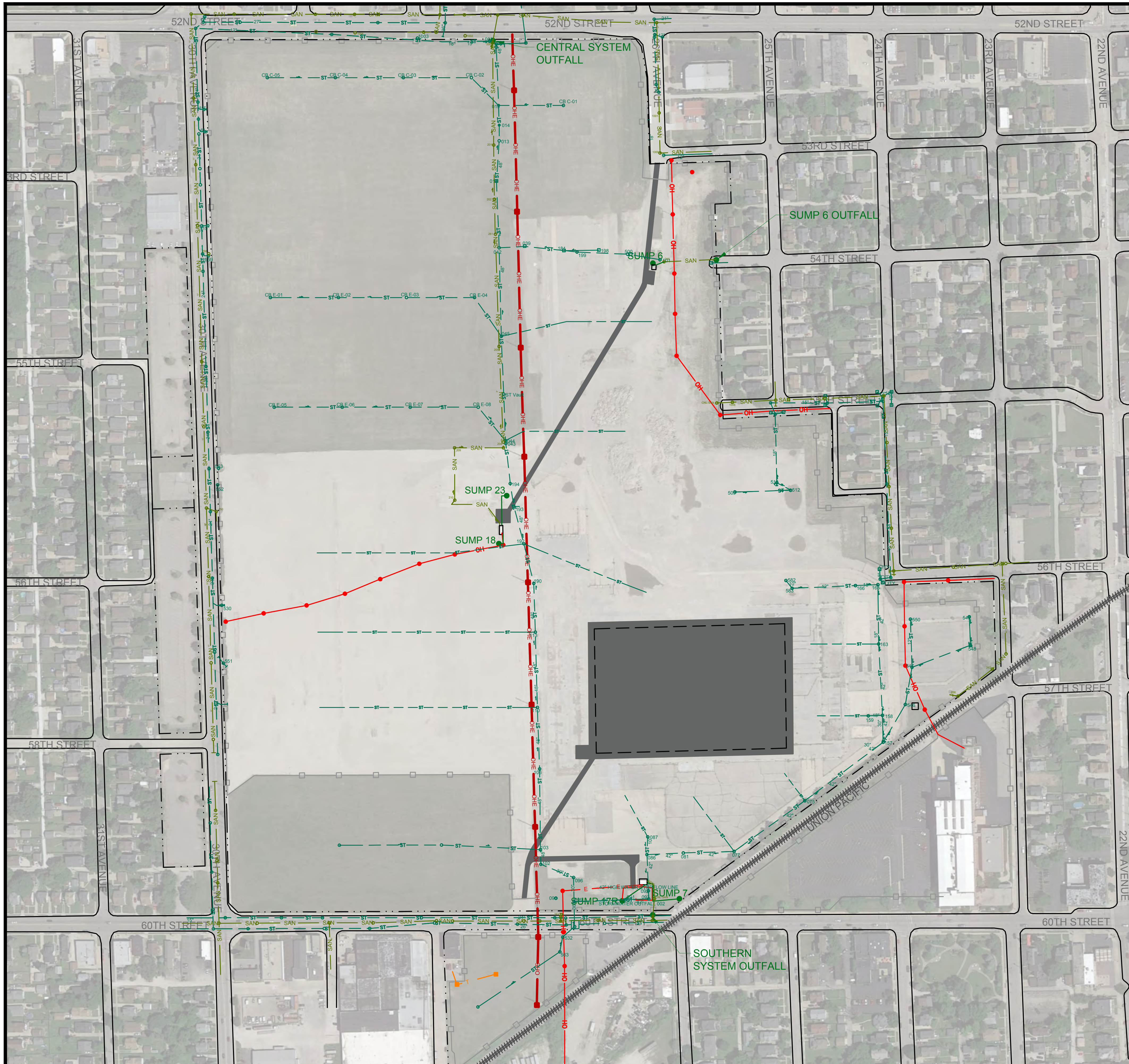
SITE LAYOUT
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	12/4/2018
Checked:	KC	12/4/2018
Approved:	LLA	5/10/2017

PROJECT NUMBER 60576836

FIGURE NUMBER 2



LEGEND

- APPROXIMATE SITE BOUNDARY
- RAILROAD
- EXISTING FENCE
- REMEDIATION BUILDING
- SUMPS AND SANITARY OUTFALLS
- SUMP UTILITY LINES
- SANITARY SEWER
- STORM SEWER
- OVERHEAD ELECTRIC (DISTRIBUTION)
- OVERHEAD ELECTRIC (TRANSMISSION)
- UNDERGROUND ELECTRIC
- TELEPHONE
- ACCESS ROADS AND AGGREGATE STOCKPILE

NOTES

1. AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO, IMAGE DATED 7/6/2018; DOWNLOADED ON 12/3/2018.
2. BORDER DISCONTINUITIES ARE DUE TO ANGLE OF 2018 AERIAL.

0' 150' 300' 600'
SCALE

N

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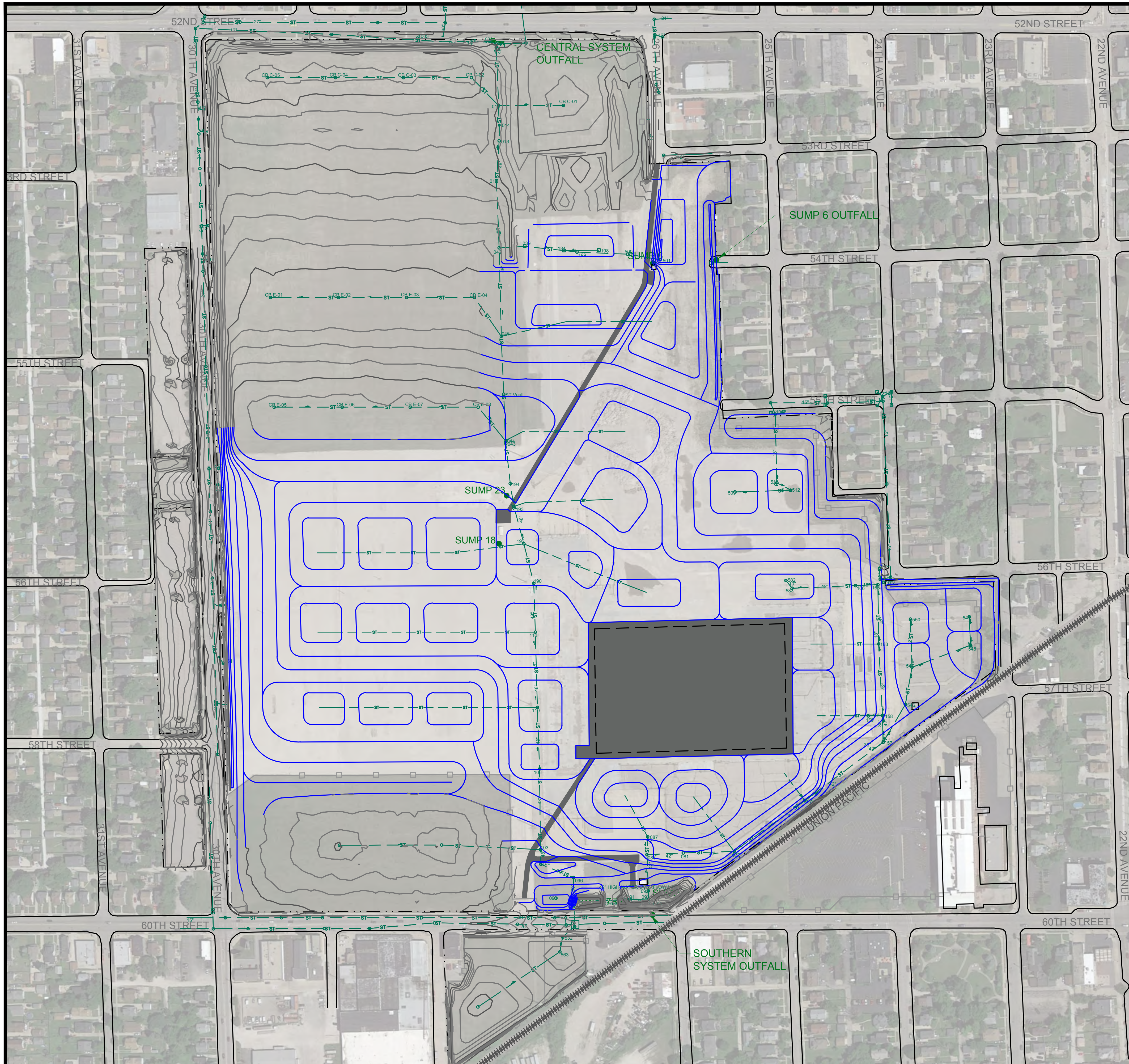
EXISTING UTILITY LOCATIONS AND ACCESS ROADS
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	12/5/2018
Checked:	KC	12/5/2018
Approved:	LLA	12/5/2018

PROJECT NUMBER 60576836

FIGURE NUMBER 3

File: \\USMKE1FS001\prod\Data\Projects\60576836\900_Work\CAD\KEP - GW Rem Design Rpt.dwg; USER: ENGELHARDT, SARAH; PLOTTED:December 10, 2018 - 5:28 PM



LEGEND

- APPROXIMATE SITE BOUNDARY
- RAILROAD
- EXISTING FENCE
- REMEDIATION BUILDING
- STORM SEWER
- ACCESS ROADS AND AGGREGATE STOCKPILE
- EXISTING (2018) TOPOGRAPHY
- PROPOSED TOPOGRAPHY

NOTES

1. AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO, IMAGE DATED 7/6/2018; DOWNLOADED ON 12/3/2018.
2. BORDER DISCONTINUITIES ARE DUE TO ANGLE OF 2018 AERIAL.

0' 150' 300' 600'

SCALE

N

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2018 EXISTING AND PROPOSED SITE GRADES

KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	12/5/2018
Checked:	KC	12/5/2018
Approved:	LLA	12/5/2018
PROJECT NUMBER	60576836	
FIGURE NUMBER	4	

File: \\USMWK1FS001\prod\Data\Projects\60576836\900_Work\CAD\KEP - GW Rem Design Rpt.dwg; USER: ENGELHARDT, SARAH; PLOTTED:January 11, 2019 - 2:49 PM

LEGEND

- APPROXIMATE SITE BOUNDARY
- RAILROAD
- EXISTING FENCE
- REMEDIATION BUILDING
- SUMPS AND SANITARY OUTFALLS
- SUMP UTILITY LINES
- MONITORING WELLS
- 617 WATER TABLE CONTOURS
- GROUNDWATER FLOW DIRECTION

NOTES

1. AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO, IMAGE DATED 7/6/2018; DOWNLOADED ON 12/3/2018.
2. BORDER DISCONTINUITIES ARE DUE TO ANGLE OF 2018 AERIAL.
3. * WELLS LOCATED SOUTHEAST OF THE RAILROAD TRACKS (SOUTHEAST OF KEP) ARE UNDER THE INFLUENCE OF THE SOUTHERN GROUNDWATER RECOVERY SYSTEM AND ARE NOT INCLUDED IN THE CONTOURS.
4. GROUNDWATER ELEVATIONS FROM OCTOBER 2018 SAMPLING EVENT.

0' 150' 300' 600'
SCALE

N

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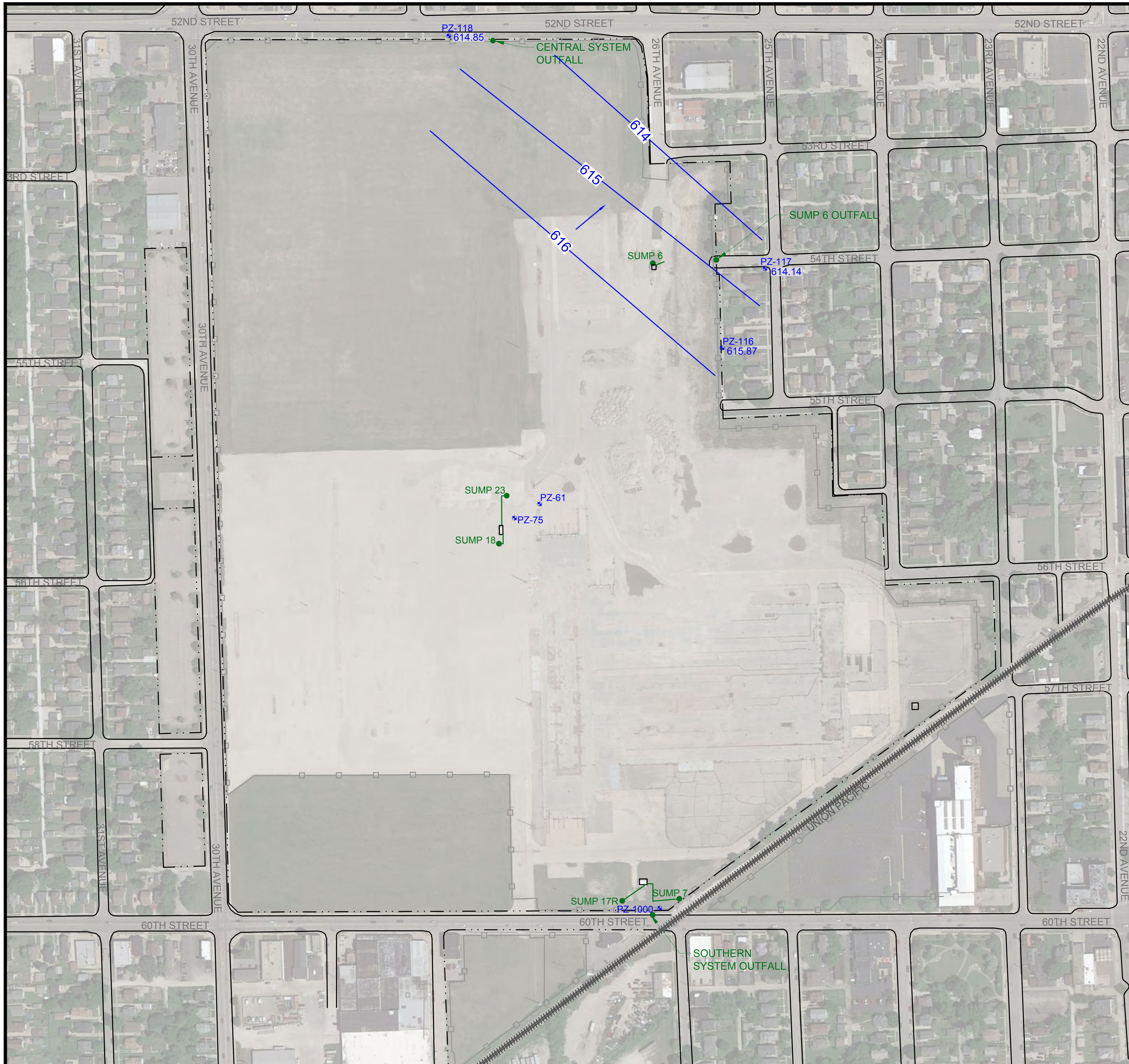
WATER TABLE POTENTIOMETRIC SURFACE MAP
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	12/5/2018
Checked:	KC	12/5/2018
Approved:	LLA	12/5/2018

PROJECT NUMBER 60576836

FIGURE NUMBER 5

File: \\USMWK1FS001\prod\Data\Projects\60576836\900_Work\CAD\KEP - GW Rem Design Rpt.dwg; USER: ENGELHARDT, SARAH; PLOTTED:December 10, 2018 - 5:26 PM



LEGEND

- APPROXIMATE SITE BOUNDARY
- RAILROAD
- EXISTING FENCE
- REMEDIATION BUILDING
- SUMPS AND SANITARY OUTFALLS
- SUMP UTILITY LINES
- MONITORING WELLS
- 617 POTENTIOMETRIC SURFACE CONTOURS
- GROUNDWATER FLOW DIRECTION

NOTES

1. AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO, IMAGE DATED 7/6/2018; DOWNLOADED ON 12/3/2018.
2. BORDER DISCONTINUITIES ARE DUE TO ANGLE OF 2018 AERIAL.
3. GROUNDWATER ELEVATIONS FROM OCTOBER 2018 SAMPLING EVENT.

0' 150' 300' 600'
SCALE

N

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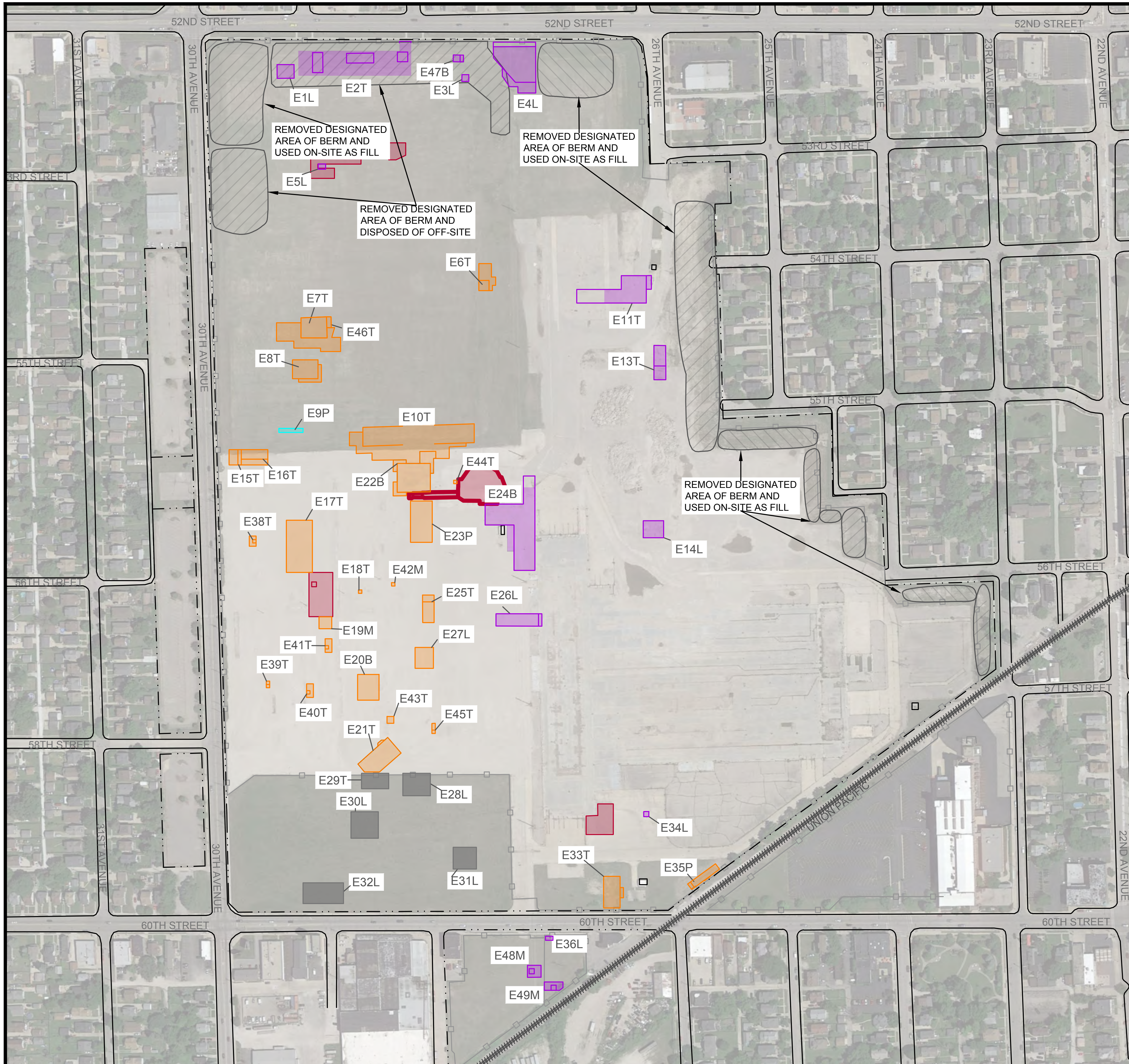
PIEZOMETER POTENTIOMETRIC SURFACE MAP
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	12/5/2018
Checked:	KC	12/5/2018
Approved:	LLA	12/5/2018

PROJECT NUMBER 60576836

FIGURE NUMBER 6

File: \\USMWK1FS001\prod\Data\Projects\60576836\900_Work\CAD\KEP - GW Rem Design Rpt.dwg; USER: ENGELHARDT, SARAH; PLOTTED:December 10, 2018 - 5:25 PM



LEGEND

- APPROXIMATE SITE BOUNDARY
- RAILROAD
- EXISTING FENCE
- REMEDIATION BUILDING
- GROUP A EXCAVATIONS
- GROUP B EXCAVATIONS
- GROUP K EXCAVATIONS
- PRIOR EXCAVATIONS

NOTES

1. AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO, IMAGE DATED 7/6/2018; DOWNLOADED ON 12/3/2018.
2. BORDER DISCONTINUITIES ARE DUE TO ANGLE OF 2018 AERIAL.
3. UNFILLED AREAS ARE NOT EXCAVATED.
4. IRREGULAR SHAPES SHOW WHERE EXCAVATIONS WERE EXTENDED.

0' 150' 300' 600'
SCALE

N

AECOM
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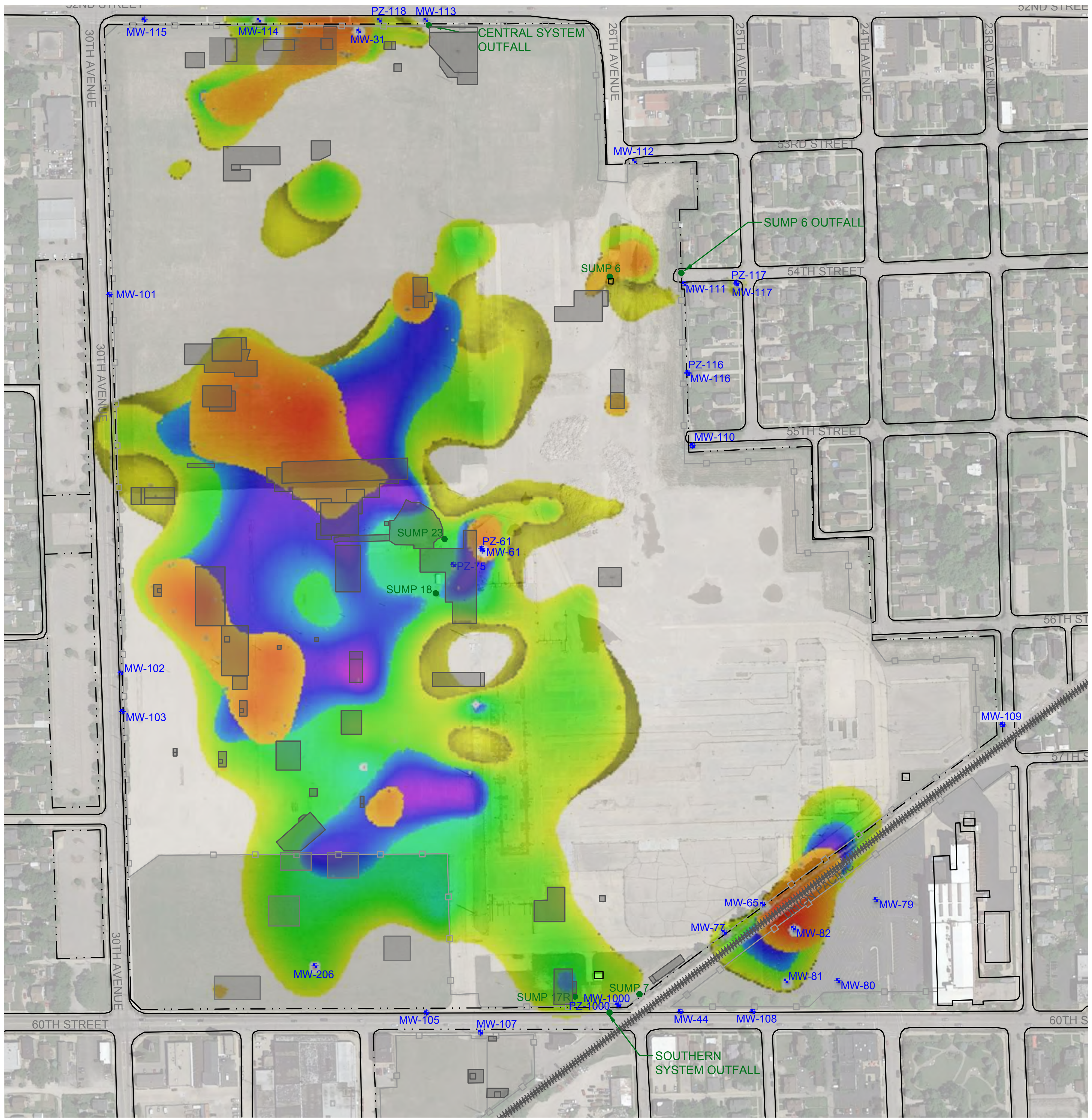
REMEDIAL SOIL EXCAVATION LOCATIONS
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	12/4/2018
Checked:	KC	12/4/2018
Approved:	LLA	12/4/2018

PROJECT NUMBER 60576836

FIGURE NUMBER 7

File: C:\Users\engelhardts\Desktop\KEP\KEP - base map - 2019.dwg; USER: ENGELHARDT, SARAH; PLOTTED:December 5, 2018 - 12:56 AM



LEGEND

- APPROXIMATE SITE BOUNDARY
- RAILROAD
- EXISTING FENCE
- REMEDIATION BUILDING
- SUMPS AND SANITARY OUTFALLS
- MONITORING WELLS AND PIEZOMETERS - EXISTING PERIMETER MONITORING LOCATIONS
- EXCAVATION AREAS - MOST EXTEND TO ~12' BELOW GROUND SURFACE

NOTES

1. AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO, IMAGE DATED 7/6/2018; DOWNLOADED ON 12/3/2018.
2. BORDER DISCONTINUITIES ARE DUE TO ANGLE OF 2018 AERIAL.
3. PLUME IMAGE FROM EARTH VOLUMETRIC STUDIO; VERSION 2018.12

Geology	Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
Fill	69,900 ug/l 30,000 ug/l	15,700 ug/l 10,000 ug/l	10,200 ug/l
Clay	10,000 ug/l	3,000 ug/l	3,000 ug/l
Sand	3,000 ug/l	1,000 ug/l	1,000 ug/l
Silt	1,000 ug/l	300 ug/l	300 ug/l
Till	300 ug/l	100 ug/l 70 ug/l	100 ug/l
	100 ug/l		30 ug/l
	30 ug/l		10 ug/l
	10 ug/l 5 ug/l		3 ug/l
			1 ug/l
			0.3 ug/l 0.2 ug/l

0' 175' 350' 700'
SCALE

N

AECOM

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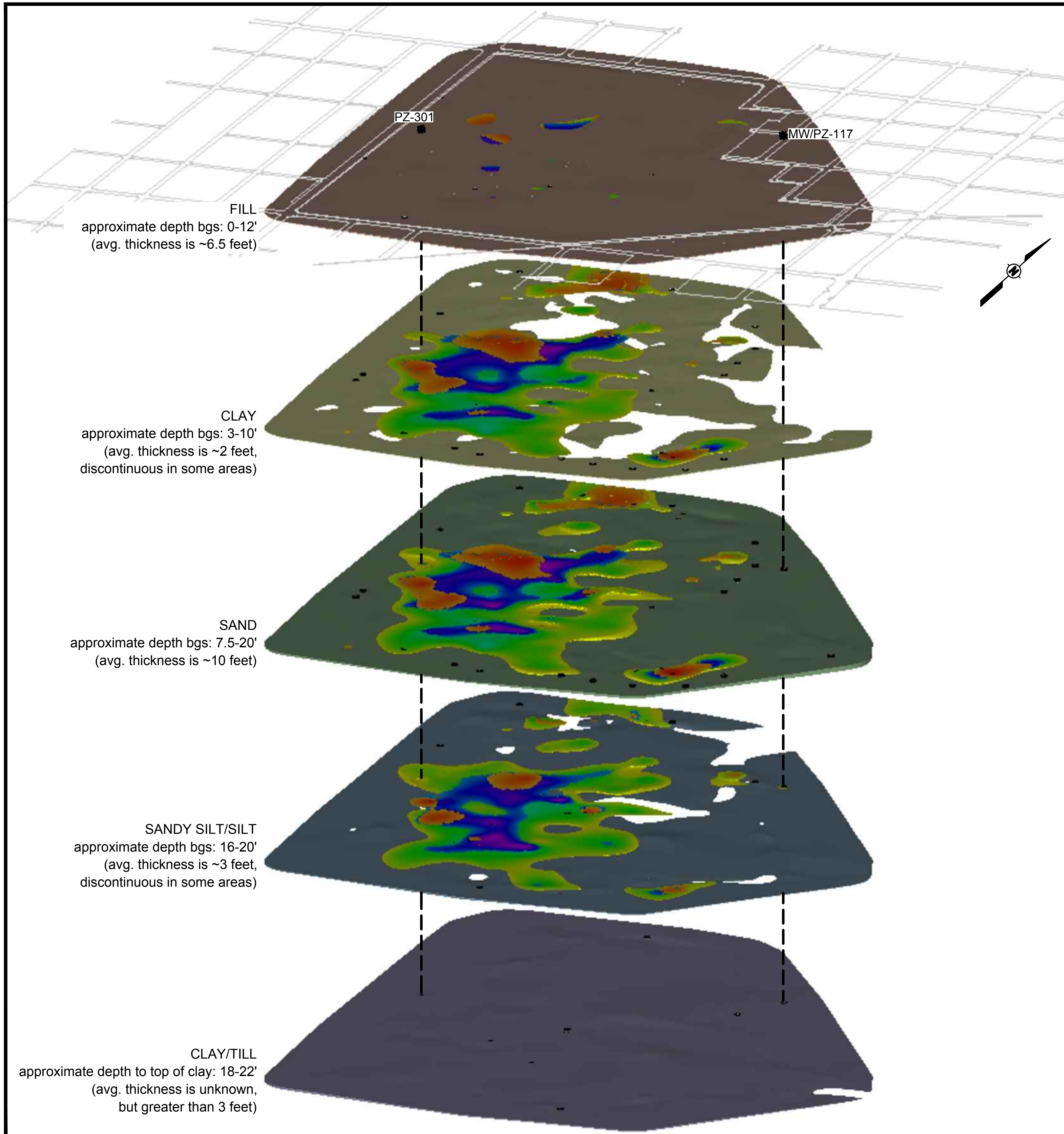
PLAN VIEW - GROUNDWATER QUALITY EXCEEDANCES
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	12/26/2018
Checked:	KC	12/26/2018
Approved:	LLA	12/26/2018

PROJECT NUMBER 60576836

FIGURE NUMBER 8



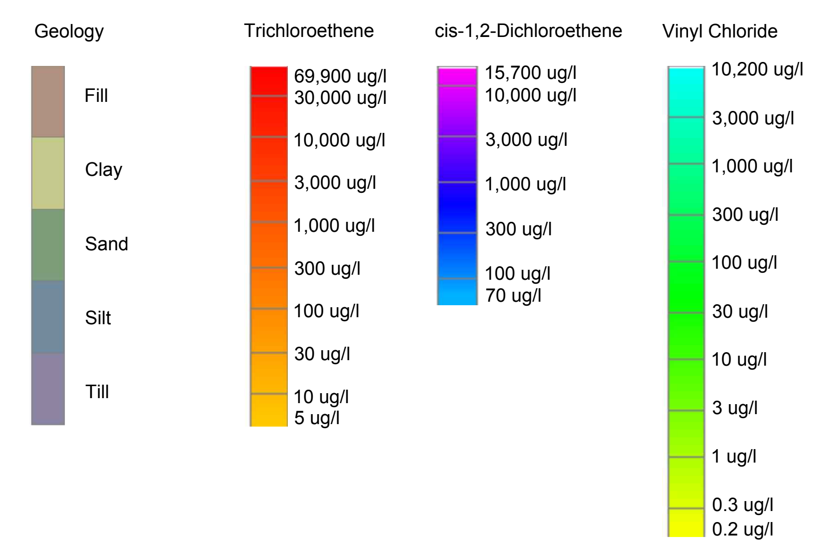
LEGEND

ROADS

RAILROAD

NOTES

1. IMAGE FROM EARTH VOLUMETRIC STUDIO; VERSION 2018.12
2. PLUMES ONLY DEPICT CONCENTRATIONS ABOVE THEIR WDNR ENFOURCEMENT STANDARD
   - Trichloroethene > 5 ug/l
   - cis-1,2-Dichloroethene > 70 ug/l
   - Vinyl Chloride > 0.2 ug/l



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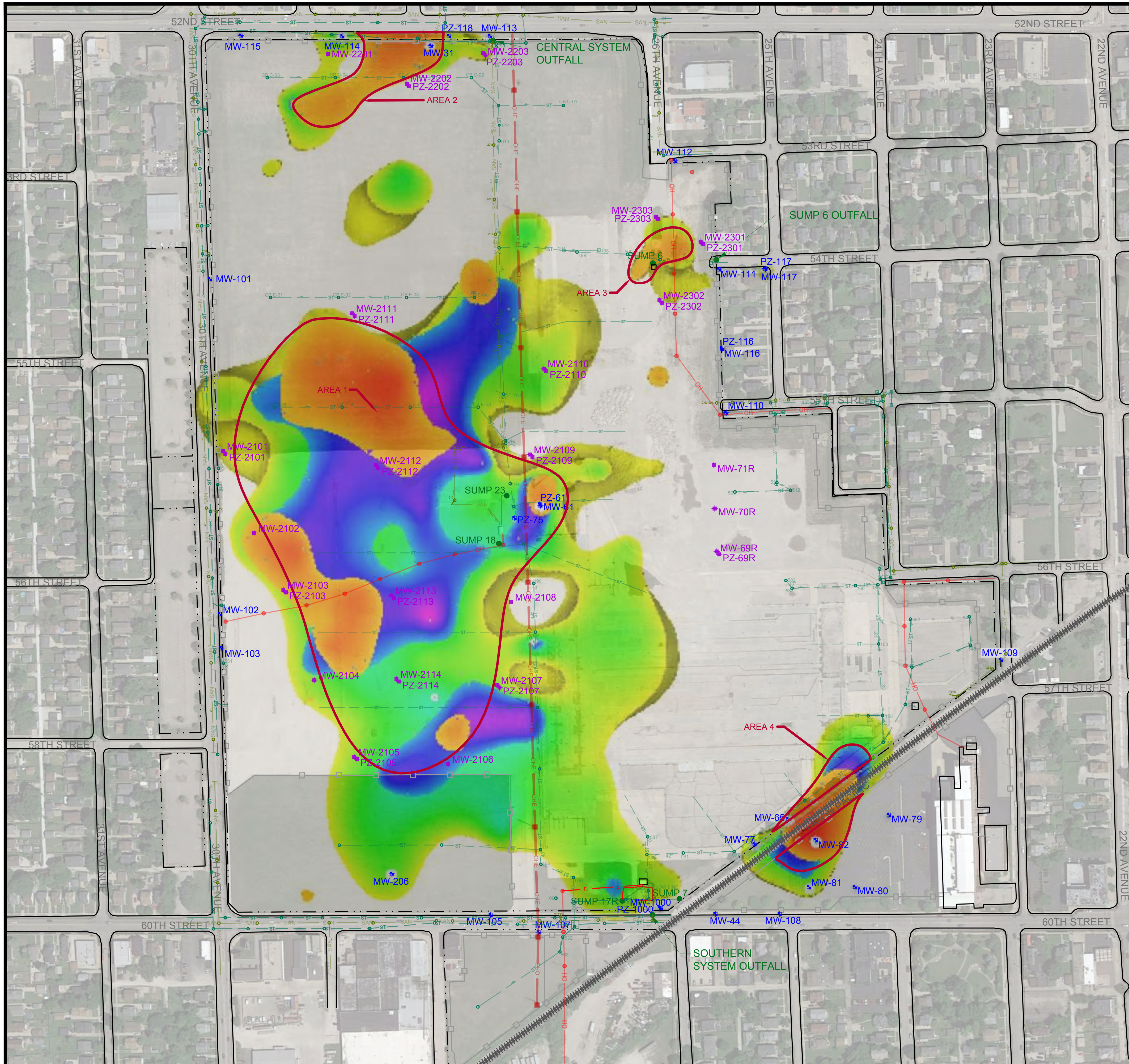
CROSS SECTIONAL VIEW - GROUNDWATER QUALITY EXCEEDANCES
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	12/26/2018
Checked:	KC	12/26/2018
Approved:	LLA	12/26/2018

PROJECT NUMBER 60576836

FIGURE NUMBER 9



LEGEND

	APPROXIMATE SITE BOUNDARY
	RAILROAD
	EXISTING FENCE
	REMEDIATION BUILDING
	SUMPS AND SANITARY OUTFALLS
	SUMP UTILITY LINES
SAN	SANITARY SEWER
ST	STORM SEWER
OH	OVERHEAD ELECTRIC (DISTRIBUTION)
OHE	OVERHEAD ELECTRIC (TRANSMISSION)
E	UNDERGROUND ELECTRIC
T	TELEPHONE
	MONITORING WELLS AND PIEZOMETERS - EXISTING PERIMETER MONITORING LOCATIONS
	MONITORING WELLS AND PIEZOMETERS - PROPOSED REMEDIAL MONITORING LOCATIONS
	PLANNED REMEDIAL TREATMENT AREAS

NOTES

1. AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO, IMAGE DATED 7/6/2018; DOWNLOADED ON 12/3/2018.
2. BORDER DISCONTINUITIES ARE DUE TO ANGLE OF 2018 AERIAL.

Trichloroethene	cis-1,2-Dichloroethene	Vinyl Chloride
69,900 ug/l	15,700 ug/l	10,200 ug/l
30,000 ug/l	10,000 ug/l	3,000 ug/l
10,000 ug/l	3,000 ug/l	1,000 ug/l
3,000 ug/l	1,000 ug/l	300 ug/l
1,000 ug/l	300 ug/l	100 ug/l
300 ug/l	100 ug/l	30 ug/l
100 ug/l	70 ug/l	10 ug/l
30 ug/l		3 ug/l
10 ug/l		1 ug/l
5 ug/l		0.3 ug/l
		0.2 ug/l

0' 150' 300' 600'
SCALE

N

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PROPOSED TREATMENT AREAS
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	12/5/2018
Checked:	KC	12/5/2018
Approved:	LLA	12/5/2018

PROJECT NUMBER 60576836

FIGURE NUMBER 10

LEGEND

- APPROXIMATE SITE BOUNDARY
- RAILROAD
- EXISTING FENCE
- REMEDIATION BUILDING
- SUMPS AND SANITARY OUTFALLS
- SUMP UTILITY LINES
- SANITARY SEWER
- STORM SEWER
- OVERHEAD ELECTRIC (DISTRIBUTION)
- OVERHEAD ELECTRIC (TRANSMISSION)
- UNDERGROUND ELECTRIC
- TELEPHONE
- MONITORING WELLS AND PIEZOMETERS - EXISTING PERIMETER MONITORING LOCATIONS
- MONITORING WELLS AND PIEZOMETERS - PROPOSED REMEDIAL MONITORING LOCATIONS
- PLANNED REMEDIAL TREATMENT AREAS

NOTES

1. AERIAL PHOTOGRAPH FROM GOOGLE EARTH PRO, IMAGE DATED 7/6/2018; DOWNLOADED ON 12/3/2018.
2. BORDER DISCONTINUITIES ARE DUE TO ANGLE OF 2018 AERIAL.

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PROPOSED TREATMENT AREAS WITHOUT WATER QUALITY GRAPHICS
KENOSHA ENGINE PLANT CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	12/5/2018
Checked:	KC	12/5/2018
Approved:	LLA	12/5/2018

PROJECT NUMBER 60576836

FIGURE NUMBER 10A

File: \\USMWK1FS001\prod\DataProjects\60576836\900_Work\CAD\KEP - GW Rem Design Rpt.dwg; USER: ENGELHARDT, SARAH; PLOTTED:February 7, 2019 - 12:37 PM

Appendix A ISCO Pilot Test Results

7.1 Tables and Figures

Table 1
Groundwater Measurements and Elevations
Former Kenosha Engine Plant ISCO Pilot Test

Well Name	**MW-302**		**PZ-302**		**PZ-316**		**MW-317**		**PZ-317**		**MW-354**		**PZ-354**	
Ground Elevation (ft)	625.89		625.91		626.00		625.87		625.86		626.04		626.06	
Top of Casing Elevation (ft)	625.41		625.56		628.72		628.00		628.44		628.04		628.06	
Top of Screen Elevation (ft)	622.22		608.18		604.21		621.15		604.70		621.56		605.97	
Screen Length (ft)	10		2.5		2.5		10		2.5		10		2.5	
Well Bottom (ft)	13.19		19.88		27.01		16.85		26.24		16.48		24.59	
Relative Location to ISCO Test Area	Injection Area		Injection Area		Side-Gradient		Down-Gradient		Down-Gradient		Up-Gradient		Up-Gradient	
Date	Depth to GW from TOC (ft)	Groundwater Elevation (ft)	Depth to GW from TOC (ft)	Groundwater Elevation (ft)	Depth to GW from TOC (ft)	Groundwater Elevation (ft)	Depth to GW from TOC (ft)	Groundwater Elevation (ft)	Depth to GW from TOC (ft)	Groundwater Elevation (ft)	Depth to GW from TOC (ft)	Groundwater Elevation (ft)	Depth to GW from TOC (ft)	Groundwater Elevation (ft)
5/07 - 5/20/2014	7.45	617.78	6.61	618.95	10.80	617.92	9.95	618.05	10.42	618.02	10.36	617.68	10.32	617.74
9/22/2014	8.09	617.14	8.14	617.42	11.22	617.50	10.66	617.34	10.98	617.46	10.30	617.74	10.30	617.76
12/1/2014	8.10	617.13	8.30	617.26	11.34	617.38	11.62	616.38	10.98	617.46	10.38	617.66	10.39	617.67
3/20/2015	8.32	616.91	8.47	617.09	11.48	617.24	10.81	617.19	11.22	617.22	10.59	617.45	10.55	617.51
9/21/2015	7.74	617.49	8.07	617.49	10.94	617.78	10.31	617.69	10.66	617.78	9.91	618.13	9.91	618.15
4/13/2016	7.20	618.03	7.71	617.85	10.44	618.28	9.74	618.26	10.18	618.26	9.65	618.39	9.62	618.44
9/23/2016	8.09	617.32	8.22	617.34	11.24	617.48	10.55	617.45	10.98	617.46	10.35	617.69	10.34	617.72
12/6/2016 (Pilot Test)	7.43	617.98	7.51	618.05	10.64	618.08	NM	NM	NM	NM	Abandoned November 10, 2016 as part of other site remedial activities			
1/11/2017	7.64	617.77	7.84	617.72	10.83	617.89	10.29	617.71	10.64	617.80				
3/17/2017	7.20	618.21	7.45	618.11	NM	NM	9.97	618.03	10.33	618.11				
4/4/2017	Monitoring wells abandoned during excavation of contaminated source soil													

Well Name	**ICO-1-TW-SE5**		**ICO-1-TW-SE7.5**		**ICO-6-TW-NE5**		**ICO-6-TW-NE7.5**		**ICO-7-TW-NE10**		**ICO-7-TW-SE10**	
Ground Elevation (ft)	625.89		625.91		626.04		626.06		626.04		626.06	
Top of Casing Elevation (ft)	--		--		--		--		--		--	
Top of Screen Elevation (ft)	--		--		--		--		--		--	
Screen Length (ft)	15		15		15		15		15		15	
Well Bottom (ft)	19		19		19		20		19		19	
Relative Location to ISCO Test Area	Injection Area		Injection Area		Injection Area		Injection Area		Injection Area		Injection Area	
Date	Depth to GW from TOC (ft)	Groundwater Elevation (ft)	Depth to GW from TOC (ft)	Groundwater Elevation (ft)	Depth to GW from TOC (ft)	Groundwater Elevation (ft)	Depth to GW from TOC (ft)	Groundwater Elevation (ft)	Depth to GW from TOC (ft)	Groundwater Elevation (ft)	Depth to GW from TOC (ft)	Groundwater Elevation (ft)
9/23/2016	8.20	617.69	8.15	617.76	8.31	617.73	8.25	617.81	8.17	617.87	8.23	617.83
12/6/2017 (Pilot Test)	7.63	618.26	7.62	618.29	7.63	618.41	7.57	618.49	7.54	618.50	7.63	618.43
1/1/2017	7.81	618.08	7.78	618.13	7.81	618.23	7.79	618.27	7.72	618.32	7.78	618.28
3/17/2017	7.41	618.48	7.32	618.59	7.46	618.58	7.45	618.61	7.28	618.76	7.37	618.69

Notes:
-- Temporary wells not surveyed; adjacent ground elevation used to estimate groundwater elevation.
ft = feet
NM = not measured

Table 2
Field Paramater Measurements
Former Kenosha Engine Plant ISCO Pilot Test

Well Name/Sample Location	Relative Location to ISCO Test Area	Sample Date	pH (standard units)	DO (mg/L)	ORP (mV)	Conductivity (µS/cm)	Temperature (°C)	Depth to Groundwater (ft below TOC)
ISCO Pilot Test Area Permanent Wells								
MW-302	Injection Area	9/23/2016	6.89	0.83	-68.6	2.244	19.53	8.09
		1/11/2017	7.69	0.71	-30.3	4.810	12.50	10.00
		3/17/2017	7.55	0.87	66.4	3.695	8.68	9.14
PZ-302	Injection Area	9/23/2016	7.05	0.31	-106.6	2.233	17.99	8.62
		1/12/2017	8.17	0.75	496.4	7.805	13.90	10.08
		3/17/2017	9.35	0.11	29.8	5.980	11.16	8.63
PZ-316	Side-Gradient	9/23/2016	7.29	0.32	-42.8	1.335	18.39	14.29
		1/11/2017	7.62	5.46	55.3	1.389	12.71	13.92
		3/17/2017	--	--	--	--	--	--
MW-317	Down-Gradient	9/26/2016	6.76	0.51	-94.7	1.630	18.23	10.69
		1/11/2017	6.94	0.29	52.8	1.853	12.28	10.38
		3/16/2017	7.08	0.22	82.5	1.423	9.81	10.03
PZ-317	Down-Gradient	9/23/2016	7.33	0.34	13.3	1.345	17.94	16.28
		1/11/2017	7.28	5.99	173.7	1.212	12.30	15.73
		3/16/2017	7.81	2.23	48.3	1.640	10.72	14.45
MW-354*	Up-Gradient	9/26/2016	6.89	0.33	-48.1	0.657	18.81	10.35
PZ-354*	Up-Gradient	9/26/2016	7.33	0.76	35.2	0.694	17.48	15.71
ISCO Pilot Test Area Temporary Wells								
IC01-TW-SE5 TOS	Injection Area	9/23/2016	6.91	0.43	-89.4	1.436	19.11	8.30
		1/11/2017	7.01	0.52	-52.8	1.512	11.02	7.85
		3/16/2017	7.25	0.40	-38.8	1.909	10.93	7.42
IC01-TW-SE5 BOS	Injection Area	9/23/2016	6.88	0.29	-103.5	2.309	18.35	8.30
		1/11/2017	7.04	0.25	-68.2	2.104	12.97	7.90
		3/16/2017	7.28	0.45	-47.0	2.299	11.24	7.46
IC01-TW-SE7.5 TOS	Injection Area	9/23/2016	6.86	0.36	-81.6	1.478	19.00	8.26
		1/11/2017	7.01	0.85	-73.7	2.013	12.86	7.81
		3/16/2017	6.99	0.12	-74.9	1.702	11.51	7.36
IC01-TW-SE7.5 BOS	Injection Area	9/23/2016	6.82	0.44	-72.6	2.386	18.08	8.26
		1/11/2017	7.09	0.65	-72.3	2.206	13.71	7.79
		3/16/2017	7.02	0.11	-96.9	1.962	11.79	7.41
IC06-TW-NE5 TOS	Injection Area	9/23/2016	6.84	0.33	-76.6	1.931	19.35	8.34
		1/11/2017	7.80	0.36	-75.7	2.856	14.16	7.93
		3/16/2017	8.40	0.71	-42.3	2.080	10.69	7.43
IC06-TW-NE5 BOS	Injection Area	9/23/2016	6.90	0.38	-85.3	1.951	18.35	8.34
		1/11/2017	8.69	0.10	-53.1	5.426	13.92	7.91
		3/16/2017	8.63	0.83	-49.1	2.154	10.79	7.44
IC06-TW-NE7.5 TOS	Injection Area	9/23/2016	6.92	0.45	-80.1	1.943	19.75	8.31
		1/12/2017	7.59	0.57	73.2	3.108	13.39	7.97
		3/16/2017	7.05	0.32	84.0	1.566	11.99	7.51
IC06-TW-NE7.5 BOS	Injection Area	9/23/2016	6.94	0.33	-83.3	1.987	18.95	8.31
		1/12/2017	8.57	0.39	236.9	4.068	11.96	7.96
		3/16/2017	8.29	0.09	-0.4	2.087	11.94	7.41
IC07-TW-NE10 TOS	Injection Area	9/26/2016	6.93	0.60	-21.2	2.133	19.83	9.29
		1/12/2017	7.65	0.15	149.9	5.640	10.20	8.53
		3/17/2017	7.61	0.24	524.6	4.798	9.24	7.78
IC07-TW-NE10 BOS	Injection Area	9/26/2016	6.95	0.32	-54.9	2.181	18.48	9.29
		1/12/2017	7.71	0.20	112.5	6.948	12.19	8.58
		3/17/2017	7.56	0.57	532.2	5.049	9.40	7.78
IC07-TW-SE10 TOS	Injection Area	9/26/2016	6.91	0.49	-64.9	2.057	19.70	8.33
		1/12/2017	7.10	0.20	104.2	1.580	9.80	7.90
		3/17/2017	7.49	0.50	45.0	2.095	9.18	7.40
IC07-TW-SE10 BOS	Injection Area	9/26/2016	6.95	0.50	-79.8	2.260	18.53	8.33
		1/12/2017	7.14	0.18	94.1	1.777	12.10	7.90
		3/17/2017	7.51	0.56	94.2	2.181	9.99	7.40

Notes:
mg/L = milligrams per liter
mV = millivolts
µS/cm = microSiemens per centimeter
ºC = degrees Celsius
ft = feet
TOC = top of casing
TOS = Top of Screen
BOS = Bottom of Screen
* Wells abandoned during other site remedial activities
-- = not measured

Table 3
Baseline and Post-Injection VOCs Results Summary
Former Kenosha Engine Plant ISCO Pilot Test

Well Name/Sample Location	Relative Location to ISCO Test Area	Field ID	Sample Date	Chloroform	DCA	c-DCE	t-DCE	Methylene Chloride	TCA	TCE	VC
			PAL:	0.6	85	7	20	0.5	40	0.5	0.02
			ES:	6	850	70	100	5	200	5	0.2
ISCO Pilot Test Area Permanent Wells											
MW-302	Injection Area	CS3-MW-302	9/23/2016	< 25	< 2.4	**850**	70.0	< 2.3	< 5	**342**	**173**
			1/11/2017	< 12.5	< 1.2	**166**	17.9	< 1.2	< 2.5	**216**	**3.8** J
			3/17/2017	< 25	< 2.4	**548**	64.4	< 2.3	< 5	**130**	**19.1**
PZ-302	Injection Area	CS3-PZ-302	9/23/2016	< 500	< 48.3	**9,470**	**376**	**132** J	< 100	**45,700**	**203**
			1/12/2017	**12.8** J	< 1.2	< 1.3	< 1.3	3.6 J	< 2.5	< 1.7	< 0.88
			3/17/2017	< 312	< 30.2	**8,500**	**199**	< 29.1	< 62.5	**5,110**	< 21.9
MW-317	Down-Gradient	CS3-MW-317	9/26/2016	< 25	< 2.4	**753**	64.6	3.3 J	< 5	< 3.3	**324**
			1/11/2017	< 10	< 0.97	**1,040**	80.1	< 0.93	< 2	< 1.3	**402**
			3/16/2017	< 10	< 0.97	**708**	44.7	< 0.93	< 2	< 1.3	**291**
		CS3-MW-317-DUP	1/11/2017	< 10	< 0.97	**1,070**	84.6	< 0.93	< 2	< 1.3	**418**
PZ-317	Down-Gradient	CS3-PZ-317	9/23/2016	< 2.5	< 0.24	1.1	< 0.26	< 0.23	< 0.5	0.53 J	< 0.18
			1/11/2017	< 2.5	< 0.24	0.40 J	< 0.26	< 0.23	< 0.5	< 0.33	< 0.18
			3/16/2017	< 2.5	< 0.24	0.31 J	< 0.26	< 0.23	< 0.5	< 0.33	< 0.18
MW-354*	Up-Gradient	CS3-MW-354	9/26/2016	< 10	< 0.97	**248**	12.5	1.1 J	< 2	**43.2**	**101**
		CS3-MW-354-FDUP	9/26/2016	< 12.5	< 1.2	**205**	10.1	< 1.2	< 2.5	**41.9**	**85.6**
PZ-354*	Up-Gradient	CS3-PZ-354	9/26/2016	< 2.5	< 0.24	0.65 J	< 0.26	< 0.23	< 0.5	0.45 J	< 0.18
ISCO Pilot Test Area Temporary Wells											
ICO1-TW-SE5	Injection Area	ICO1-TW-SE5-TOS	9/23/2016	< 12.5	< 1.2	**346**	26.0	2.1 J	< 2.5	< 1.7	**145**
			1/11/2017	< 10	< 0.97	**838**	**138**	< 0.93	< 2	< 1.3	**178**
			3/16/2017	< 10	< 0.97	**736**	**113**	< 0.93	< 2	< 1.3	**165**
		ICO1-TW-SE5-BOS	9/23/2016	< 25	< 2.4	**945**	**142**	3.7 J	< 5	< 3.3	**155**
			1/11/2017	< 10	< 0.97	**925**	**128**	< 0.93	< 2	< 1.3	**186**
			3/16/2017	< 10	< 0.97	**759**	**127**	< 0.93	< 2	< 1.3	**157**
ICO1-TW-SE7.5	Injection Area	ICO1-TW-SE7.5-TOS	9/23/2016	< 6.2	< 0.6	**393**	34.2	< 0.58	< 1.2	0.88 J	**171**
			1/11/2017	< 10	< 0.97	**733**	**104**	< 0.93	< 2	< 1.3	**191**
			3/16/2017	< 10	< 0.97	**653**	**101**	< 0.93	< 2	< 1.3	**176**
		ICO1-TW-SE7.5-BOS	9/23/2016	< 25	< 2.4	**693**	**122**	4.0 J	< 5	< 3.3	**129**
			1/11/2017	< 10	< 0.97	**813**	**116**	< 0.93	< 2	< 1.3	**206**
			3/16/2017	< 10	< 0.97	**762**	**120**	< 0.93	< 2	< 1.3	**180**
ICO6-TW-NE5	Injection Area	ICO6-TW-NE5-TOS	9/23/2016	< 12.5	< 1.2	**512**	43.2	1.3 J	< 2.5	**308**	**69.6**
			1/11/2017	< 6.2	2.0 J	**209**	20.9	0.77 J	< 1.2	**230**	**3.2**
			3/16/2017	< 12.5	< 1.2	**347**	27.5	< 1.2	< 2.5	**90.3**	**68.3**
		ICO6-TW-NE5-BOS	9/23/2016	< 25	< 2.4	**1,060**	92.6	2.7 J	< 5	**621**	**77.4**
			1/11/2017	< 10	1.4 J	**197**	16.4	1.2 J	< 2	**687**	**2.7** J
			3/16/2017	< 12.5	< 1.2	**360**	27.7	< 1.2	< 2.5	**84.6**	**69.2**

Table 3
Baseline and Post-Injection VOCs Results Summary
Former Kenosha Engine Plant ISCO Pilot Test

Well Name/Sample Location	Relative Location to ISCO Test Area	Field ID	Sample Date	Chloroform	DCA	c-DCE	t-DCE	Methylene Chloride	TCA	TCE	VC
ICO6-TW-NE7.5	Injection Area	ICO6-TW-NE7.5-TOS	9/23/2016	< 12.5	< 1.2	**984**	93.6	1.9 J	< 2.5	**376**	**99.6**
			1/12/2017	< 10	< 0.97	**132**	8.6	1.3 J	< 2	**450**	**2.0** J
			3/16/2017	< 2.5	0.51 J	**189**	17.5	< 0.23	< 0.5	**126**	**54.8**
		ICO6-TW-NE7.5-BOS	9/23/2016	< 50	< 4.8	**1,360**	**117**	**8.6** J	< 10	**639**	**75.0**
			1/12/2017	< 10	< 0.97	**134**	9.6	1.3 J	< 2	**624**	**1.8** J
ICO7-TW-NE10	Injection Area	ICO7-TW-NE10-TOS	9/26/2016	< 125	< 12.1	**3,600**	**236**	**15.8** J	< 25	**9,660**	**46.7** J
			1/12/2017	< 10	< 0.97	**191**	14.9	< 0.93	< 2	**491**	**1.8** J
			3/17/2017	< 2.5	< 0.24	37.2	< 0.26	< 0.23	0.60	**177**	< 0.18
		ICO7-TW-NE10-BOS	9/26/2016	< 500	< 48.3	**7,970**	**436**	< 46.5	< 100	**24,800**	< 35.1
			1/12/2017	< 10	< 0.97	**125**	9.6	1.1 J	< 2	**892**	**1.3** J
			3/17/2017	< 2.5	< 0.24	< 0.26	< 0.26	< 0.23	0.84	< 0.33	< 0.18
ICO7-TW-SE10	Injection Area	ICO7-TW-SE10-TOS	9/26/2016	< 125	< 12.1	**1,670**	**144**	< 11.6	< 25	**14,900**	**83.4**
			1/12/2017	< 250	< 24.2	**2,840**	**190**	< 23.3	< 50	**20,300**	**69.1** J
			3/17/2017	< 125	< 12.1	**1,560**	**145**	< 11.6	< 25	**9,470**	**56.1**
		ICO7-TW-SE10-TOS DUP	9/26/2016	< 250	< 24.2	**1,740**	**161**	**31.0** J	< 50	**15,800**	**81.2** J
			1/12/2017	< 250	< 24.2	**3,340**	**214**	< 23.3	< 50	**26,600**	**71.1** J
			3/17/2017	< 100	< 9.7	**1,470**	**141**	< 9.3	< 20	**8,960**	**51.7**
		ICO7-TW-SE10-BOS	9/26/2016	< 2500	< 242	**6,100**	**476** J	< 233	< 500	**66,600**	< 176
			1/12/2017	< 250	< 24.2	**3,160**	**209**	< 23.3	< 50	**22,700**	**64.1** J
			3/17/2017	< 250	< 24.2	**2,370**	**162**	< 23.3	< 50	**20,000**	**46.9** J

Notes:
All results in micrograms per liter (µg/L)
Only compounds detected at least once are reported
PAL - Preventive Action Limit, Wisconsin Administrative Code NR 140.10 Table 1, February 2017; concentrations above PAL are underlined
ES - Enforcement Standard, Wisconsin Administrative Code NR 140.10 Table 1, February 2017; **concentrations above ES are bold-underlined**
* Wells were abandoned during other site remedial activities
J = Estimated value
c-DCE = cis-1,2-dichloroethene
TCE = trichloroethene
VC = vinyl chloride
DCA = 1,1-dichloroethane
t-DCE = trans-1,2-dichloroethene
TCA = 1,1,1-trichloroethane

Table 4
Baseline and Post-Injection Metals Results Summary
Former Kenosha Engine Plant ISCO Pilot Test

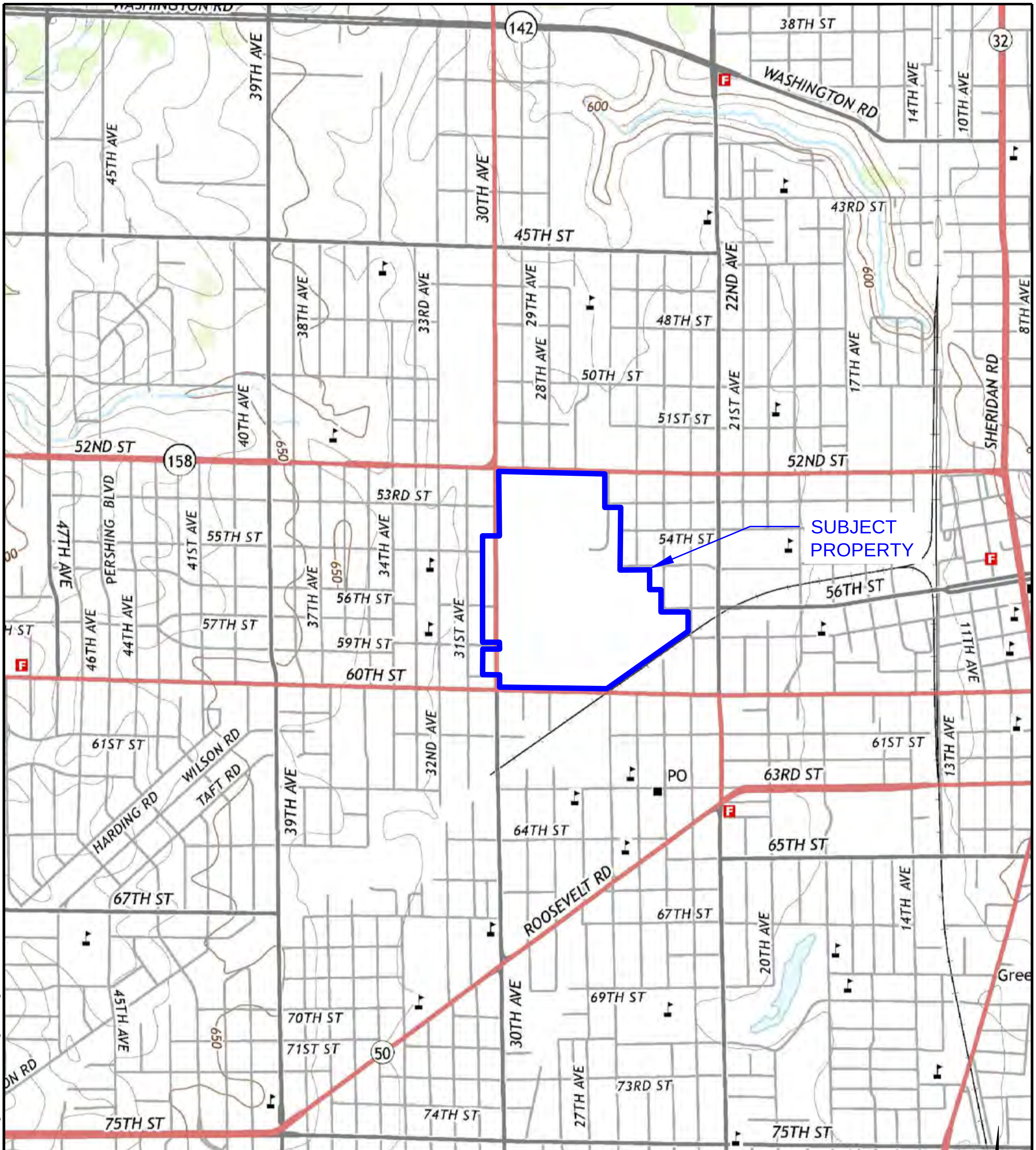
Location	Relative Location to ISCO Test Area	Field ID	Sample Date	Barium	Chromium	Iron (dissolved)	Lead	Manganese (dissolved)	Nickel
			PAL:	400	10	150	1.5	60	20
			ES:	2000	100	300	15	300	100
ISCO Pilot Test Area Permanent Wells									
MW-302	Injection Area	CS3-MW-302	9/23/2016	129	< 0.39	**3,200**	0.37 [J]	256	6.0
			1/11/2017	20.0	26.4	< 15.5	3.4 [J]	**1,320**	12.4
PZ-302	Injection Area	CS3-PZ-302	9/23/2016	107	0.76 [J]	**3,330**	0.17 [J]	113	3.0
			1/12/2017	10.2 [J]	**367**	< 34	< 2.0	**204,000**	< 5.6
MW-317	Down-Gradient	CS3-MW-317	9/26/2016	95.0	< 0.39	**4,030**	0.12 [J]	190	9.5
			1/11/2017	77.0	0.57 [J]	**3,160**	0.24 [J]	214	8.6
		CS-3-MW-317 DUP	1/11/2017	76.1	< 0.39	**2,980**	0.07 [J]	213	8.4
PZ-317	Down-Gradient	CS3-PZ-317	9/23/2016	162	< 0.39	83.6 [J]	< 0.04	59.8	1.0 [J]
			1/11/2017	155	< 0.39	< 15.5	< 0.04	13.8	0.91 [J]
MW-354*	Up-Gradient	CS3-MW-354	9/26/2016	67.1	< 0.39	**416**	< 0.04	274	2.7
		CS3-MW-354 DUP	9/26/2016	67.6	< 0.39	**407**	< 0.04	273	2.6
PZ-354*	Up-Gradient	CS3-PZ-354	9/26/2016	131	0.56 [J]	48.6 [J]	0.08 [J]	14.9	1.2
ISCO Pilot Test Area Temporary Wells									
ICO1-TW-SE5	Injection Area	ICO1-TW-SE5-TOS	9/23/2016	125	< 0.39	**2,280**	0.08 [J]	279	6.6
			1/11/2017	98.7	0.59 [J]	**4,550**	< 0.04	214	4.9
		ICO1-TW-SE5-BOS	9/23/2016	122	< 0.39	**4,720**	0.10 [J]	246	4.9
			1/11/2017	97.9	< 0.39	**4,800**	0.12 [J]	216	4.7
ICO1-TW-SE7.5	Injection Area	ICO1-TW-SE7.5-TOS	9/23/2016	121	< 0.39	**2,470**	0.07	298	13.3
			1/11/2017	99.2	0.44 [J]	**3,850**	0.09 [J]	**366**	7.2
		ICO1-TW-SE7.5-BOS	9/23/2016	119	< 0.39	**1,420**	0.09 [J]	**308**	6.6
			1/11/2017	89.7	< 0.39	**4,310**	0.04 [J]	**302**	6.6
ICO6-TW-NE5	Injection Area	ICO6-TW-NE5-TOS	9/23/2016	102	< 0.39	**3,190**	< 0.04	**354**	6.5
			1/11/2017	228	18.2	**1,380**	1.1	**3,920**	18.6
		ICO6-TW-NE5-BOS	9/23/2016	95.8	< 0.39	**2,770**	0.16 [J]	**305**	6.6
			1/11/2017	189	30.9	**317**	1.5 [J]	**3,220**	30.9
ICO6-TW-NE7.5	Injection Area	ICO6-TW-NE7.5-TOS	9/23/2016	94.2	0.84 [J]	**2,370**	1.0	**341**	8.2
			1/12/2017	16.5	24.1	120	< 0.04	**5,050**	25.8
		ICO6-TW-NE7.5-BOS	9/23/2016	94.0	< 0.39	**2,620**	0.05 [J]	286	6.7
			1/12/2017	15.0	24.2	< 15.5	0.37 [J]	**3,280**	34.2
ICO7-TW-NE10	Injection Area	ICO7-TW-NE10-TOS	9/26/2016	107	< 0.39	**868**	0.04 [J]	**306**	8.1
			1/12/2017	7.0	**122**	**355**	< 0.2	**7,240**	24.9
		ICO7-TW-NE10-BOS	9/26/2016	104	0.98 [J]	**1,060**	0.52 [J]	240	7.9
			1/12/2017	9.4	**189**	**436**	< 0.2	**4,000**	23.7
ICO7-TW-SE10	Injection Area	ICO7-TW-SE10-TOS	9/26/2016	135	< 0.39	**1,530**	< 0.04	294	6.0
			1/12/2017	51.2	< 0.39	< 15.5	< 0.04	**4,220**	8.0
		ICO7-TW-SE10-TOS -DUP	9/26/2016	135	< 0.39	**1,560**	< 0.04	294	5.9
			1/12/2017	51.2	0.40 [J]	17.3 [J]	< 0.04	**3,940**	7.8
		ICO7-TW-SE10-BOS	9/26/2016	120	0.69 [J]	**1,780**	0.21 [J]	238	6.6
			1/12/2017	39.9	0.77 [J]	< 15.5	0.06 [J]	**4,770**	9.8

Notes:
All results in micrograms per liter (µg/L)
PAL - Preventive Action Limit, Wisconsin Administrative Code NR 140.10 Table 1, February 2017; concentrations above PAL are underlined
ES - Enforcement Standard, Wisconsin Administrative Code NR 140.10 Table 1, February 2017; **concentrations above ES are bold-underlined**
* Wells were abandoned during other site remedial activities
[J] = Estimated value [1]
Samples for iron and manganese were filtered (dissolved metals results)
Samples for barium, chromium, lead, and nickel analysis were not filtered (total metals results)

Table 5
Baseline and Post-Injection Groundwater General Chemistry Parameters
Former Kenosha Engine Plant ISCO Pilot Test

Location	Relative Location to ISCO Test Area	Field ID	Sample Date	Chloride	Sulfate	Total Organic Carbon
			PAL:	125	125	NE
			ES:	250	250	NE
ISCO Pilot Test Area Permanent Wells						
MW-302	Injection Area	CS3-MW-302	9/23/2016	173	**511**	21.2
			1/11/2017	96.6	**854**	236
PZ-302	Injection Area	CS3-PZ-302	9/23/2016	**334**	**283**	4.1 J
			1/12/2017	**310**	**1,590**	499
MW-317	Down-Gradient	CS3-MW-317	9/26/2016	135	**358**	7.8 J
			1/11/2017	115	**474**	9.7
		CS-3-MW-317 DUP	1/11/2017	113	**470**	9.7
PZ-317	Down-Gradient	CS3-PZ-317	9/23/2016	187	123	< 0.25
			1/11/2017	201	122	< 0.25
MW-354*	Up-Gradient	CS3-MW-354	9/26/2016	37.5 J	117	6.1
		CS3-MW-354 DUP	9/26/2016	36.7 J	114	6.3
PZ-354*	Up-Gradient	CS3-PZ-354	9/26/2016	130	141	< 0.25
ISCO Pilot Test Area Temporary Wells						
ICO1-TW-SE5	Injection Area	ICO1-TW-SE5-TOS	9/23/2016	65.2	**304**	12.6
			1/11/2017	222	**346**	15.3
		ICO1-TW-SE5-BOS	9/23/2016	**288**	**496**	4.9 J
			1/11/2017	231	**366**	14.5
ICO1-TW-SE7.5	Injection Area	ICO1-TW-SE7.5-TOS	9/23/2016	102	**303**	14.3
			1/11/2017	184	**414**	16.6
		ICO1-TW-SE7.5-BOS	9/23/2016	**390**	**435**	1.6 J
			1/11/2017	203	**439**	14.8
ICO6-TW-NE5	Injection Area	ICO6-TW-NE5-TOS	9/23/2016	163	**513**	13.8
			1/11/2017	113	**644**	113
		ICO6-TW-NE5-BOS	9/23/2016	221	**471**	11.5
			1/11/2017	127	**864**	306
ICO6-TW-NE7.5	Injection Area	ICO6-TW-NE7.5-TOS	9/23/2016	187	**461**	14.6
			1/12/2017	130	**791**	152
		ICO6-TW-NE7.5-BOS	9/23/2016	231	**435**	11.5
			1/12/2017	134	**860**	244
ICO7-TW-NE10	Injection Area	ICO7-TW-NE10-TOS	9/26/2016	177	**494**	12.6
			1/12/2017	63.5	**915**	417
		ICO7-TW-NE10-BOS	9/26/2016	207	**463**	12.2
			1/12/2017	68.7	**919**	486
ICO7-TW-SE10	Injection Area	ICO7-TW-SE10-TOS	9/26/2016	185	**422**	14.6
			1/12/2017	154	**452**	16.7
		ICO7-TW-SE10-TOS -DUP	9/26/2016	178	**462**	14.9
			1/12/2017	157	**454**	16.0
		ICO7-TW-SE10-BOS	9/26/2016	203	**531**	12.4
			1/12/2017	164	**451**	17.6

Notes:
All results in milligrams per liter (mg/L)
PAL - Preventive Action Limit, Wisconsin Administrative Code NR 140.10 Table 2, February 2017;
concentrations above PAL are underlined
ES - Enforcement Standard, Wisconsin Administrative Code NR 140.10 Table 2, February 2017;
concentrations above ES are bold-underlined
NE - PAL and ES are not established for this analyte
* Wells were abandoned during other site remedial activities
J = Estimated value



NOTES

1. TOPOGRAPHIC MAP FROM USGS:
http://store.usgs.gov/b2c_usgs/usgs/maplocator/
DATED 2013

1000 0 1000 2000

FEET

N

AECOM

1555 RiverCenter Dr
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www.aecom.com

SITE LOCATION
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	7/3/2017
Checked:	LLA	7/3/2017
Approved:	SP	7/7/2017
PROJECT NUMBER	60518412	
FIGURE NUMBER	1	

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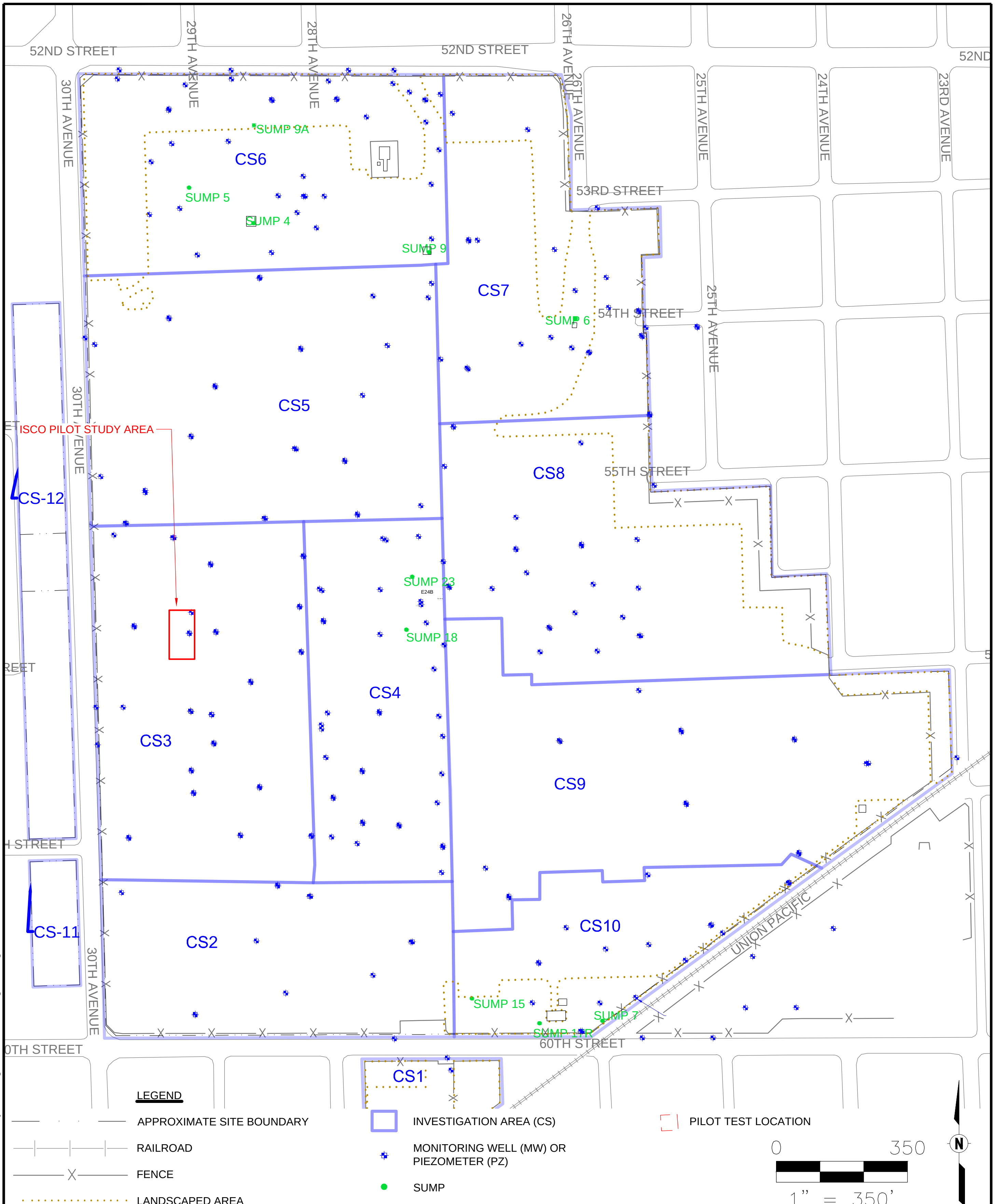

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SITE LAYOUT
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	7/3/2017
Checked:	LLA	7/3/2017
Approved:	SP	7/7/2017
PROJECT NUMBER	60518412	
FIGURE NUMBER	2	

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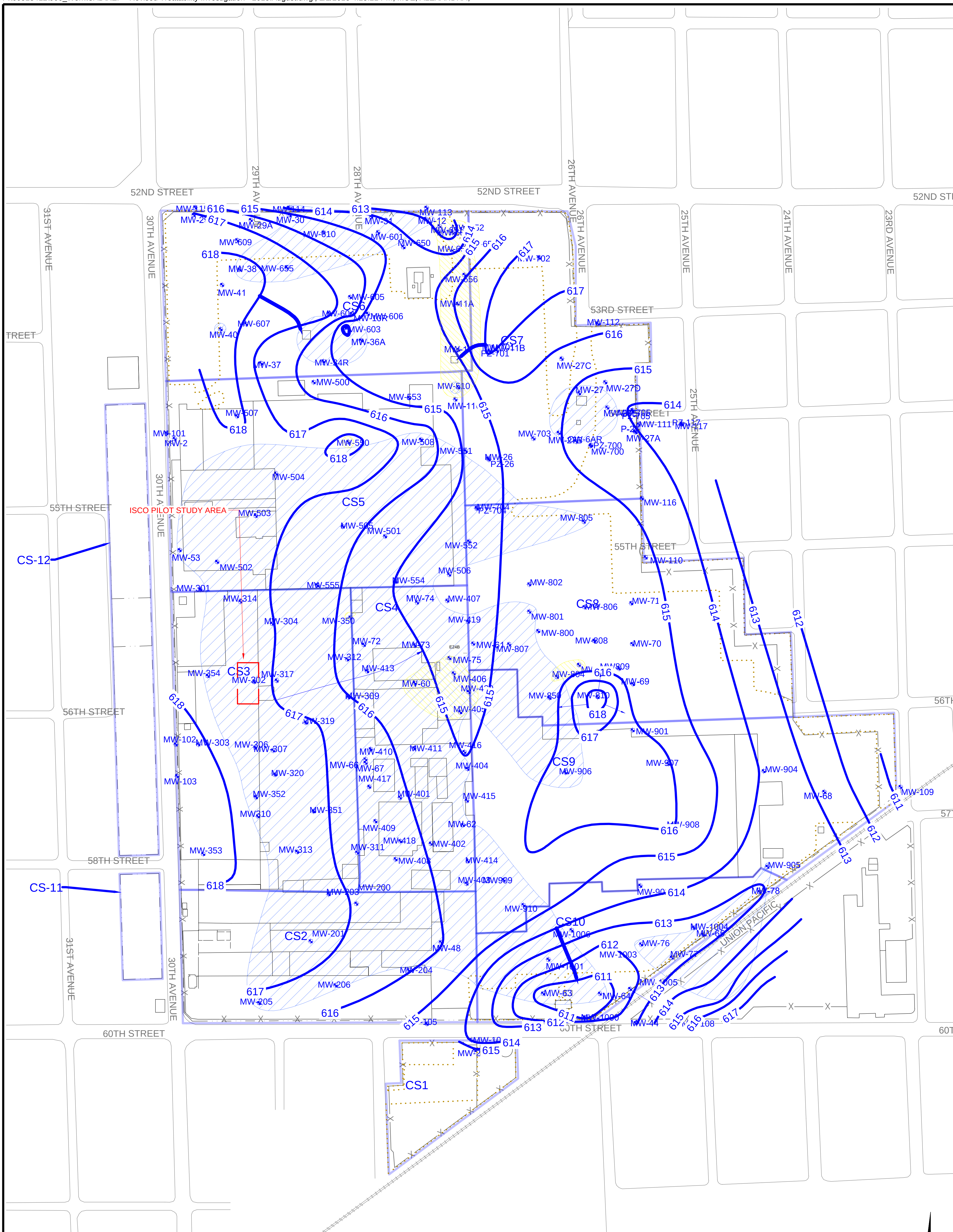

LEGEND

	APPROXIMATE SITE BOUNDARY		MONITORING WELL (MW)		CVOC CONTAMINANT PLUME
	RAILROAD	615.21	GROUNDWATER ELEVATIONS		PVOC AND PAH CONTAMINANT PLUME
	FENCE		GROUNDWATER CONTOURS		
	INVESTIGATION AREA (CS)		FLOW DIRECTION		
	LANDSCAPED AREAS				

0 300
1" = 300'
N

NOTES
1. GROUNDWATER FLOW AND PLUME DATA FROM MONITORING WELLS
2. DATA COLLECTED IN DECEMBER 2014

GROUNDWATER FLOW & EXTENT OF CONTAMINATION AT THE WATER TABLE - DECEMBER 2014
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn: SAE 7/3/2017
Checked: LLA 7/3/2017
Approved: SP 7/7/2017
PROJECT NUMBER 60518412
FIGURE NUMBER 3

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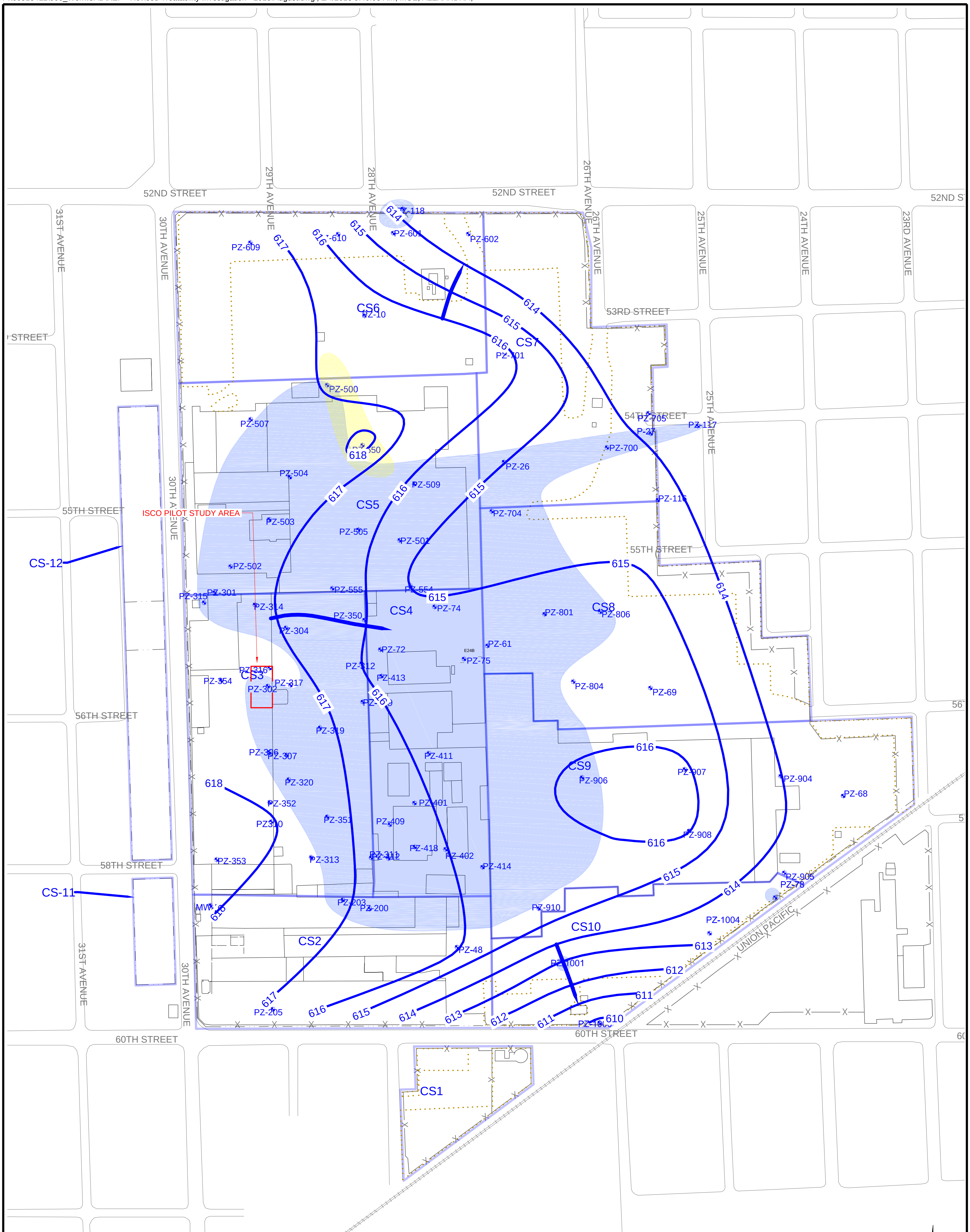

LEGEND

APPROXIMATE SITE BOUNDARY	PIEZOMETER (PZ)	CVOC CONTAMINANT PLUME	
RAILROAD	615.21 GROUNDWATER ELEVATIONS	PVOC AND PAH CONTAMINANT PLUME	
FENCE	GROUNDWATER CONTOURS	NOTES	
INVESTIGATION AREA (CS)	FLOW DIRECTION	1. GROUNDWATER FLOW AND PLUME DATA FROM PIEZOMETERS	
LANDSCAPED AREAS		2. DATA COLLECTED IN DECEMBER 2014	

0 300
1" = 300'
N

GROUNDWATER FLOW & EXTENT OF CONTAMINATION ABOVE CLAY TILL AQUITARD
DECEMBER 2014
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

FIGURE NUMBER 4
PROJECT NUMBER 60518412
Approved: SP 7/7/2017
Checked: LLA 7/3/2017
Drawn: SAE 7/3/2017

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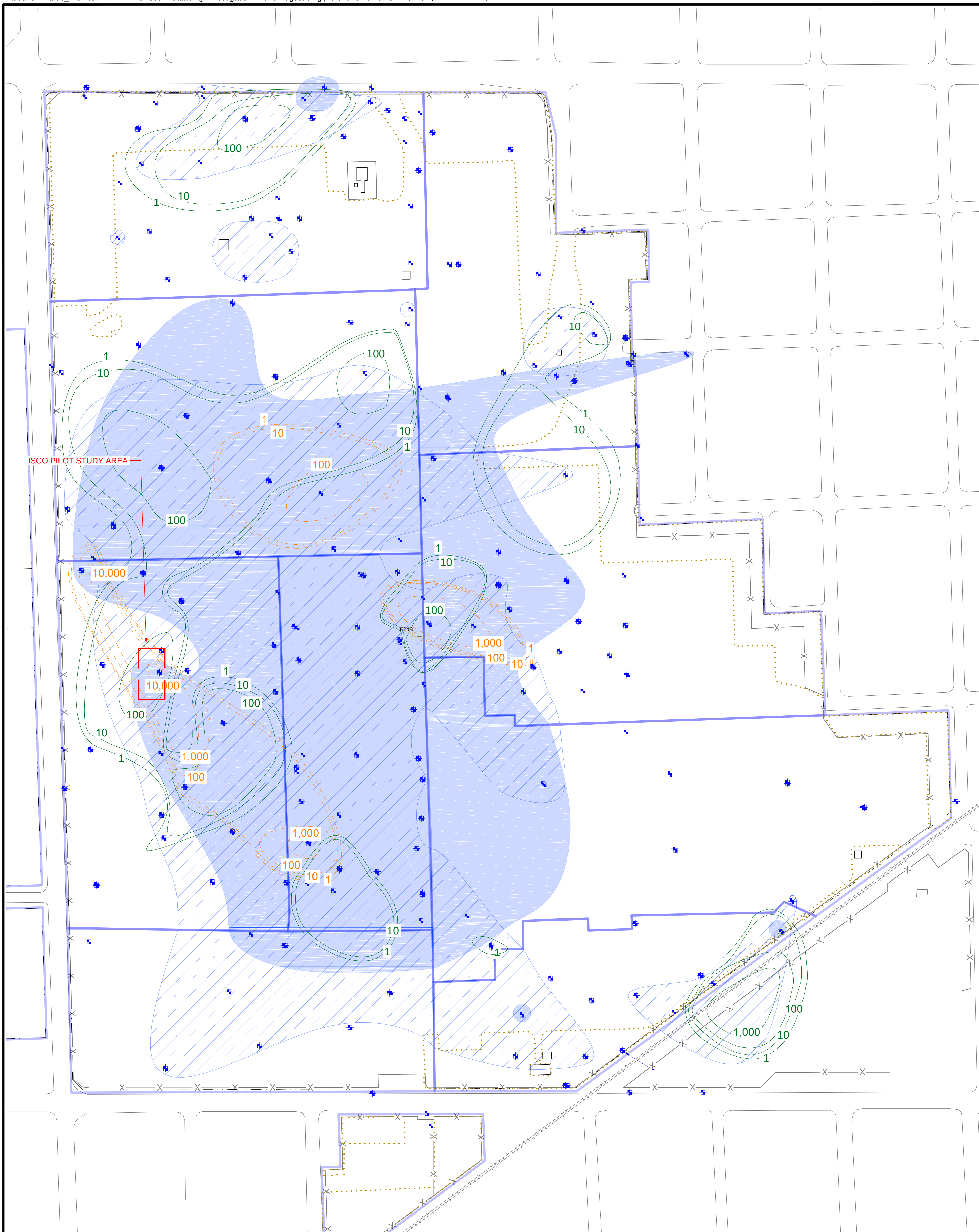

LEGEND

- APPROXIMATE SITE BOUNDARY
- RAILROAD
- FENCE
- INVESTIGATION AREA (CS)
- LANDSCAPED AREAS
- MONITORING WELL (MW) OR PIEZOMETER (PZ)
- FLOW DIRECTION
- SHALLOW CVOC CONTAMINANT PLUME (December 2014)
- DEEP CVOC CONTAMINANT PLUME (December 2014)
- SHALLOW TRICHLOROETHENE (TCE) ISOCONCENTRATION CONTOURS (CONCENTRATIONS IN UG/L) (September 2014)
- DEEP TCE ISOCONCENTRATION CONTOURS (CONCENTRATIONS IN UG/L) (September 2014)

N

0 250

1" = 250'

GROUNDWATER CONTAMINATION PLUME EXTENT & TCE ISOCONCENTRATIONS (DECEMBER & SEPTEMBER 2014)
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn : SAE 7/3/2017
Checked: LLA 7/3/2017
Approved: SP 7/7/2017
PROJECT NUMBER 60518412
FIGURE NUMBER 5

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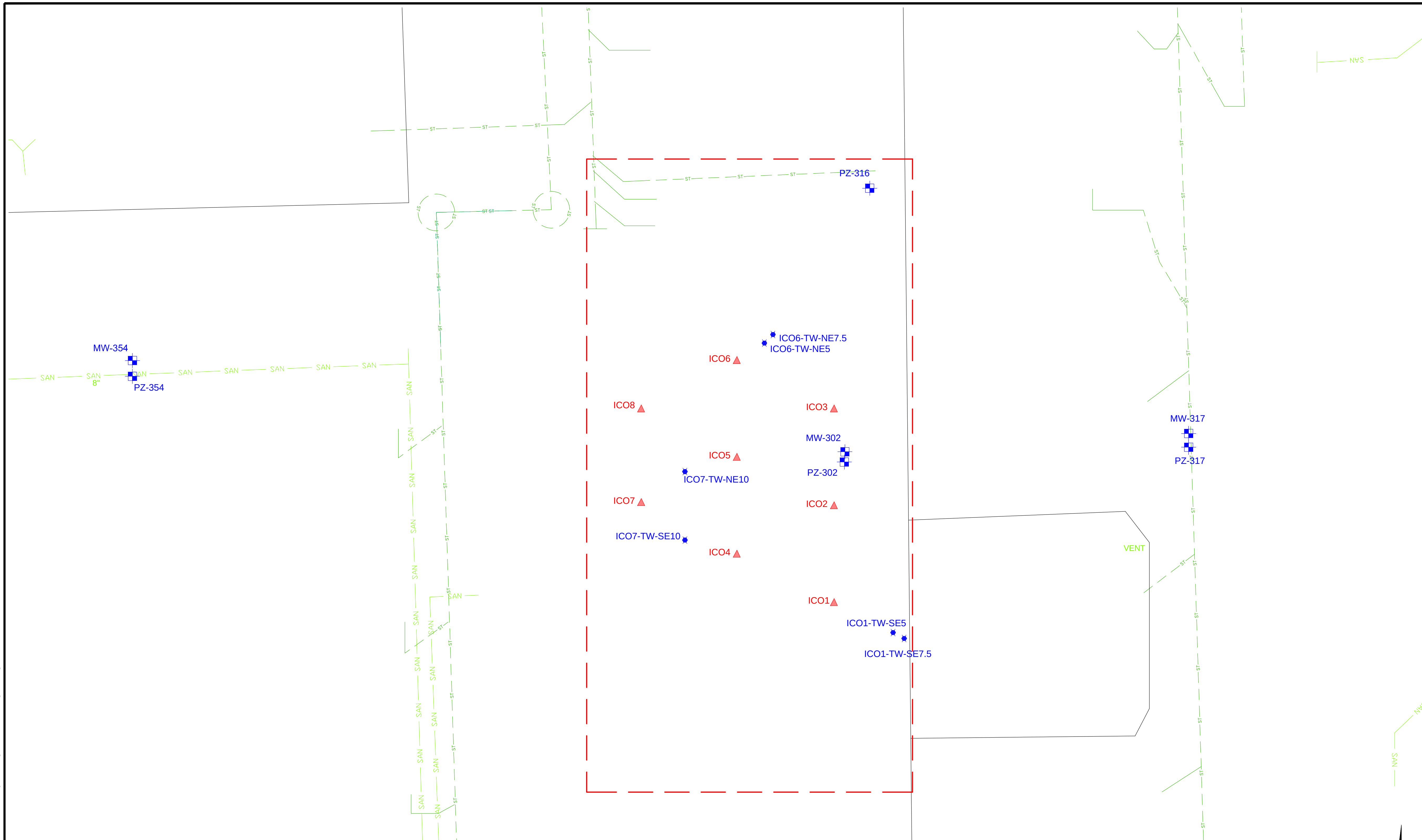

LEGEND

- MONITORING WELL (MW) OR PIEZOMETER (PZ) FOR ISCO PILOT TEST MONITORING
- ISCO PILOT INJECTION LOCATION
- TEMPORARY WELL (TW) FOR ISCO MONITORING
- STORM SEWER (APPROXIMATE LOCATION)
- SANITARY SEWER (APPROXIMATE LOCATION) (8" inch diameter pipe)
- FORMER BUILDING INTERIOR WALL
- ISCO PILOT STUDY AREA

0 20

1" = 20'

N

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ISCO PILOT STUDY LAYOUT
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	ANM	7/3/2017
Checked:	LLA	7/3/2017
Approved:	SP	7/7/2017
PROJECT NUMBER	60518412	
FIGURE NUMBER	6	

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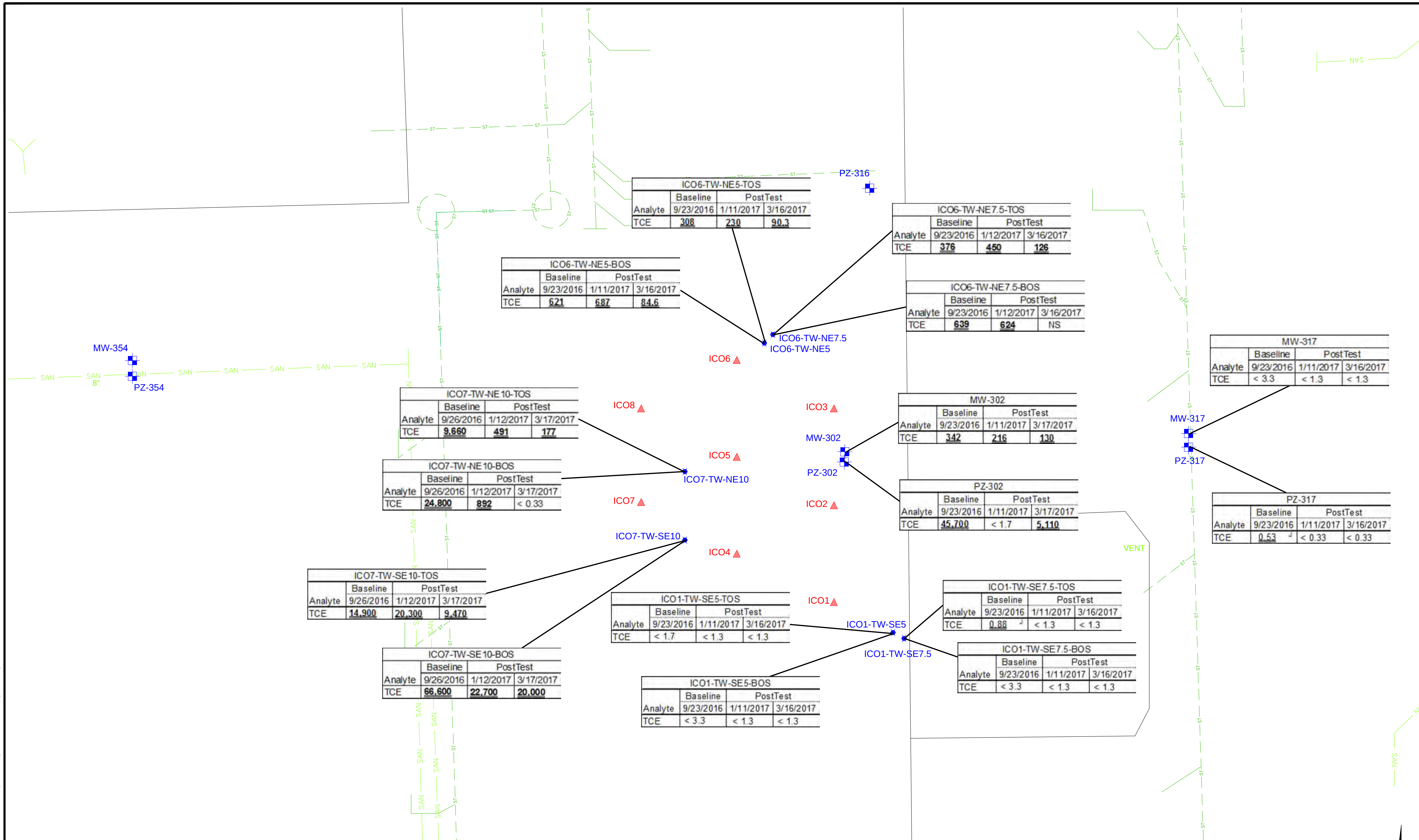

ICO6-TW-NE5-TOS

Analyte	Baseline	PostTest	
	9/23/2016	1/11/2017	3/16/2017
TCE	308	230	90.3

ICO6-TW-NE5-BOS

Analyte	Baseline	PostTest	
	9/23/2016	1/11/2017	3/16/2017
TCE	621	687	84.6

ICO6-TW-NE7.5-TOS

Analyte	Baseline	PostTest	
	9/23/2016	1/12/2017	3/16/2017
TCE	376	450	126

ICO6-TW-NE7.5-BOS

Analyte	Baseline	PostTest	
	9/23/2016	1/12/2017	3/16/2017
TCE	639	624	NS

MW-317

Analyte	Baseline	PostTest	
	9/23/2016	1/11/2017	3/16/2017
TCE	< 3.3	< 1.3	< 1.3

ICO7-TW-NE10-TOS

Analyte	Baseline	PostTest	
	9/26/2016	1/12/2017	3/17/2017
TCE	9,660	491	177

MW-302

Analyte	Baseline	PostTest	
	9/23/2016	1/11/2017	3/17/2017
TCE	342	216	130

ICO7-TW-NE10-BOS

Analyte	Baseline	PostTest	
	9/26/2016	1/12/2017	3/17/2017
TCE	24,800	892	< 0.33

PZ-302

Analyte	Baseline	PostTest	
	9/23/2016	1/11/2017	3/17/2017
TCE	45,700	< 1.7	5,110

PZ-317

Analyte	Baseline	PostTest	
	9/23/2016	1/11/2017	3/16/2017
TCE	0.53 J	< 0.33	< 0.33

ICO7-TW-SE10-TOS

Analyte	Baseline	PostTest	
	9/26/2016	1/12/2017	3/17/2017
TCE	14,900	20,300	9,470

ICO1-TW-SE7.5-TOS

Analyte	Baseline	PostTest	
	9/23/2016	1/11/2017	3/16/2017
TCE	0.88 J	< 1.3	< 1.3

ICO1-TW-SE5-TOS

Analyte	Baseline	PostTest	
	9/23/2016	1/11/2017	3/16/2017
TCE	< 1.7	< 1.3	< 1.3

ICO1-TW-SE7.5-BOS

Analyte	Baseline	PostTest	
	9/23/2016	1/11/2017	3/16/2017
TCE	< 3.3	< 1.3	< 1.3

ICO7-TW-SE10-BOS

Analyte	Baseline	PostTest	
	9/26/2016	1/12/2017	3/17/2017
TCE	66,600	22,700	20,000

ICO1-TW-SE5-BOS

Analyte	Baseline	PostTest	
	9/23/2016	1/11/2017	3/16/2017
TCE	< 3.3	< 1.3	< 1.3

LEGEND

- MONITORING WELL (MW) OR PIEZOMETER (PZ) FOR ISCO PILOT TEST MONITORING
- ISCO PILOT INJECTION LOCATION
- TEMPORARY WELL (TW) FOR ISCO MONITORING
- STORM SEWER (APPROXIMATE LOCATION)
- SANITARY SEWER (APPROXIMATE LOCATION) (8" inch diameter pipe)
- FORMER BUILDING INTERIOR WALL
- ISCO PILOT STUDY AREA

Notes:

1. All results in micrograms per liter (µg/L)
2. TCE = trichloroethene
3. PAL - Preventive Action Limit, Wisconsin Administrative Code NR 140.10 Table 1, February 2017; concentrations above PAL are underlined
4. ES - Enforcement Standard, Wisconsin Administrative Code NR 140.10 Table 1, February 2017; **concentrations above ES are bold-underlined**
5. J = Estimated value

0 20
1" = 20'

N

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TCE CONCENTRATIONS IN GROUNDWATER BASELINE AND POST-INJECTION MONITORING RESULTS KENOSHA ENGINE PLANT CITY OF KENOSHA KENOSHA, WISCONSIN

Drawn :	ANM	7/3/2017
Checked:	LLA	7/3/2017
Approved:	SP	7/7/2017
PROJECT NUMBER	60518412	
FIGURE NUMBER	7	

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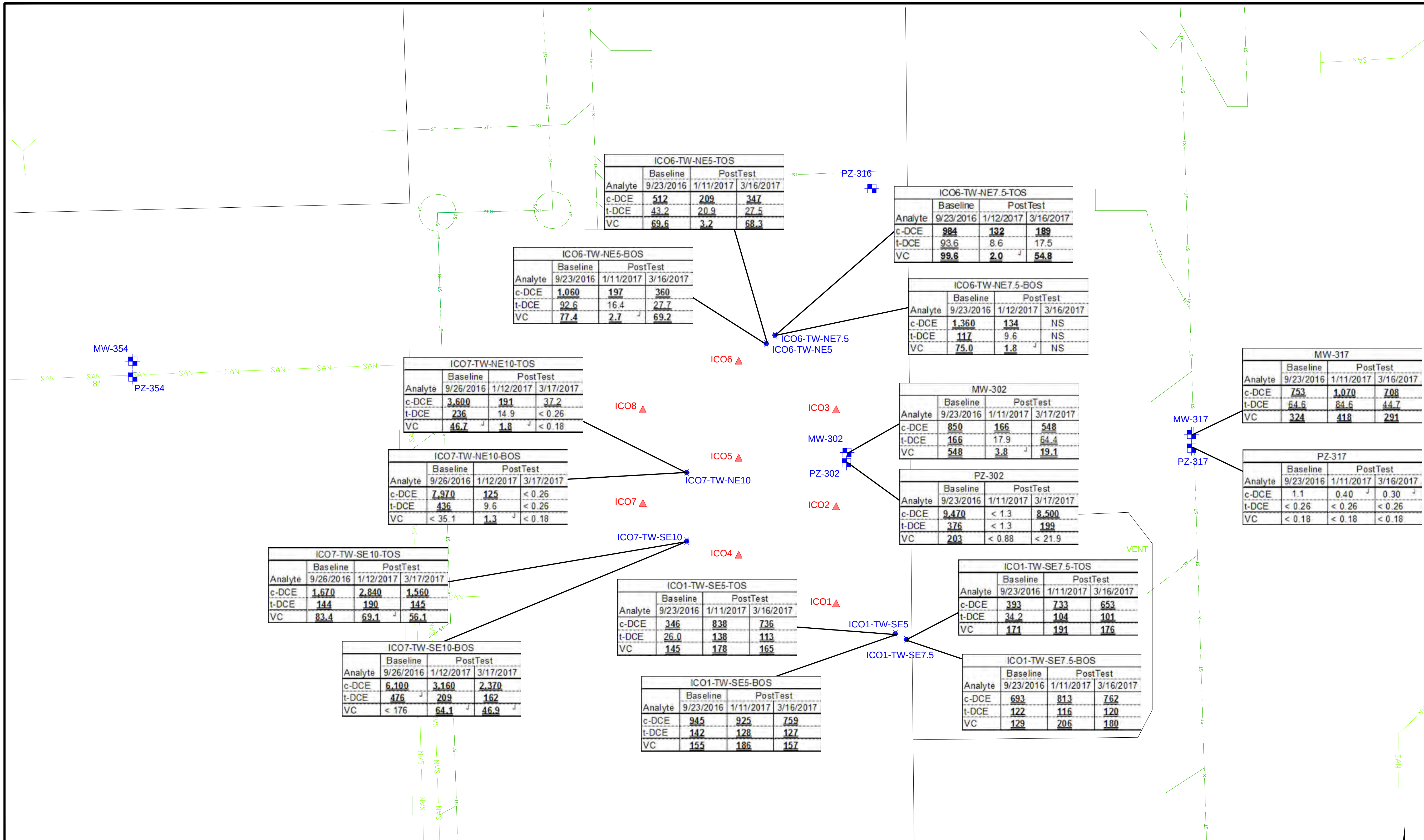

ICO6-TW-NE5-TOS

Analyte	Baseline 9/23/2016	PostTest 1/11/2017	PostTest 3/16/2017
c-DCE	512	209	347
t-DCE	43.2	20.9	27.5
VC	69.6	3.2	68.3

ICO6-TW-NE5-BOS

Analyte	Baseline 9/23/2016	PostTest 1/11/2017	PostTest 3/16/2017
c-DCE	1,060	197	360
t-DCE	92.6	16.4	27.7
VC	77.4	2.7 J	69.2

ICO6-TW-NE7.5-TOS

Analyte	Baseline 9/23/2016	PostTest 1/12/2017	PostTest 3/16/2017
c-DCE	984	132	189
t-DCE	93.6	8.6	17.5
VC	99.6	2.0 J	54.8

ICO6-TW-NE7.5-BOS

Analyte	Baseline 9/23/2016	PostTest 1/12/2017	PostTest 3/16/2017
c-DCE	1,360	134	NS
t-DCE	117	9.6	NS
VC	75.0	1.8 J	NS

ICO7-TW-NE10-TOS

Analyte	Baseline 9/26/2016	PostTest 1/12/2017	PostTest 3/17/2017
c-DCE	3,600	191	37.2
t-DCE	236	14.9	< 0.26
VC	46.7 J	1.8 J	< 0.18

ICO7-TW-NE10-BOS

Analyte	Baseline 9/26/2016	PostTest 1/12/2017	PostTest 3/17/2017
c-DCE	7,970	125	< 0.26
t-DCE	436	9.6	< 0.26
VC	< 35.1	1.3 J	< 0.18

MW-302

Analyte	Baseline 9/23/2016	PostTest 1/11/2017	PostTest 3/17/2017
c-DCE	850	166	548
t-DCE	166	17.9	64.4
VC	548	3.8 J	19.1

PZ-302

Analyte	Baseline 9/23/2016	PostTest 1/11/2017	PostTest 3/17/2017
c-DCE	9,470	< 1.3	8,500
t-DCE	376	< 1.3	199
VC	203	< 0.88	< 21.9

MW-317

Analyte	Baseline 9/23/2016	PostTest 1/11/2017	PostTest 3/16/2017
c-DCE	753	1,070	708
t-DCE	64.6	84.6	44.7
VC	324	418	291

PZ-317

Analyte	Baseline 9/23/2016	PostTest 1/11/2017	PostTest 3/16/2017
c-DCE	1.1	0.40 J	0.30 J
t-DCE	< 0.26	< 0.26	< 0.26
VC	< 0.18	< 0.18	< 0.18

ICO7-TW-SE10-TOS

Analyte	Baseline 9/26/2016	PostTest 1/12/2017	PostTest 3/17/2017
c-DCE	1,670	2,840	1,560
t-DCE	144	190	145
VC	83.4	69.1 J	56.1

ICO7-TW-SE10-BOS

Analyte	Baseline 9/26/2016	PostTest 1/12/2017	PostTest 3/17/2017
c-DCE	6,100	3,160	2,370
t-DCE	476 J	209	162
VC	< 176	64.1 J	46.9 J

ICO1-TW-SE5-TOS

Analyte	Baseline 9/23/2016	PostTest 1/11/2017	PostTest 3/16/2017
c-DCE	346	838	736
t-DCE	26.0	138	113
VC	145	178	165

ICO1-TW-SE5-BOS

Analyte	Baseline 9/23/2016	PostTest 1/11/2017	PostTest 3/16/2017
c-DCE	945	925	759
t-DCE	142	128	127
VC	155	186	157

ICO1-TW-SE7.5-TOS

Analyte	Baseline 9/23/2016	PostTest 1/11/2017	PostTest 3/16/2017
c-DCE	393	733	653
t-DCE	34.2	104	101
VC	171	191	176

ICO1-TW-SE7.5-BOS

Analyte	Baseline 9/23/2016	PostTest 1/11/2017	PostTest 3/16/2017
c-DCE	693	813	762
t-DCE	122	116	120
VC	129	206	180

LEGEND

- MONITORING WELL (MW) OR PIEZOMETER (PZ) FOR ISCO PILOT TEST MONITORING
- ISCO PILOT INJECTION LOCATION
- TEMPORARY WELL (TW) FOR ISCO MONITORING
- STORM SEWER (APPROXIMATE LOCATION)
- SANITARY SEWER (APPROXIMATE LOCATION) (8" inch diameter pipe)
- FORMER BUILDING INTERIOR WALL
- ISCO PILOT STUDY AREA

Notes:
1. All results in micrograms per liter (µg/L)
2. c-DCE = cis-1,2-dichloroethene
3. t-DCE = trans-1,2-dichloroethene
4. VC = vinyl chloride
5. PAL - Preventive Action Limit, Wisconsin Administrative Code NR 140.10 Table 1, February 2017; concentrations above PAL are underlined
6. ES - Enforcement Standard, Wisconsin Administrative Code NR 140.10 Table 1, February 2017; **concentrations above ES are bold-underlined**
7. J = Estimated value

0 20
1" = 20'

N

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DCE & VC CONCENTRATIONS IN GROUNDWATER
BASELINE AND POST-INJECTION MONITORING RESULTS
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	ANM 7/3/2017
Checked:	LLA 7/3/2017
Approved:	SP 7/7/2017
PROJECT NUMBER	60518412
FIGURE NUMBER	8

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Appendix B ERD Pilot Test Results

7.2 Tables and Figures

Tables

Table 1
Groundwater Depth Measurements and Elevations
Kenosha Engine Plant ERD Pilot Test

Well Name	MW-61		PZ-61		PZ-75		MW-807		ERD1-TW-NW10		ERD6-TW-NW10		ERD6-TW-NW15	
Ground Elevation (ft)	624.08		624.08		623.97		623.91		624.00		624.00		624.00	
Top of Casing Elevation (ft)	623.78		623.87		623.83		626.23		--		--		--	
Top of Screen Elevation (ft)	616.48		603.57		604.83		618.28		--		--		--	
Screen Length (ft)	10		2.5		5		10		15		15		15	
Well Bottom (ft)	17.30		22.80		24.00		17.95		22.00		22.00		22.00	
Relative Location to ISCO Test Area	Injection Area		Injection Area		Up-Gradient		Down-Gradient (far)		Side-Gradient		Up-/Side-Gradient		Up-/Side-Gradient	
Date	Groundwater Depth	Groundwater Elevation	Groundwater Depth	Groundwater Elevation	Groundwater Depth	Groundwater Elevation	Groundwater Depth	Groundwater Elevation	Groundwater Depth	Groundwater Elevation	Groundwater Depth	Groundwater Elevation	Groundwater Depth	Groundwater Elevation
9/6-8/2011	9.53	614.25	NI	NI	9.60	614.23	NI	NI	NI	NI	NI	NI	NI	NI
11/2/2011	9.48	614.30	9.65	614.22	9.41	614.42	NI	NI	NI	NI	NI	NI	NI	NI
1/23/2012	9.60	614.18	9.77	614.10	9.89	613.94	NI	NI	NI	NI	NI	NI	NI	NI
4/12/2012	9.60	614.18	9.78	614.09	9.93	613.90	NI	NI	NI	NI	NI	NI	NI	NI
6/11/2012	9.69	614.09	9.84	614.03	9.94	613.89	NI	NI	NI	NI	NI	NI	NI	NI
5/07-20/2014	9.01	614.77	9.12	614.75	9.42	614.41	10.82	615.41	NI	NI	NI	NI	NI	NI
9/22/2014	9.19	614.59	9.33	614.54	9.22	614.61	10.85	615.38	NI	NI	NI	NI	NI	NI
12/1/2014	9.20	614.58	9.24	614.63	9.20	614.63	11.00	615.23	NI	NI	NI	NI	NI	NI
3/20/2015	9.23	614.55	9.43	614.44	9.44	614.39	11.30	614.93	NI	NI	NI	NI	NI	NI
6/23/2015	8.91	614.87	9.17	614.70	9.36	614.47	10.48	615.75	NI	NI	NI	NI	NI	NI
9/21/2015	8.91	614.87	9.06	614.81	9.36	614.47	10.06	616.17	NI	NI	NI	NI	NI	NI
4/13/2016	8.62	615.16	8.86	615.01	9.18	614.65	10.10	616.13	NI	NI	NI	NI	NI	NI
9/26-27/2016	9.73	614.05	9.56	614.31	9.48	614.35	10.89	615.34	9.35	614.65	10.10	613.90	10.16	613.84
12/13/2016	9.30	614.48	9.53	614.34	9.61	614.22	11.31	614.92	9.38	614.62	10.18	613.82	10.21	613.79
12/14/2016	9.32	614.46	9.53	614.34	9.62	614.21	10.33	615.90	9.10	614.90	10.19	613.81	10.23	613.77
3/7/2017	9.02	614.76	9.24	614.63	9.40	614.43	10.85	615.38	9.05	614.95	9.84	614.16	9.91	614.09
3/17/2017	9.04	614.74	4.55	619.32	9.43	614.40	10.05	616.18	9.09	614.91	9.30	614.70	9.61	614.39
6/14-15/2017	9.06	614.72	9.30	614.57	9.40	614.43	11.17	615.06	9.14	614.86	9.90	614.10	9.97	614.03
9/14/2017	9.27	614.51	9.48	614.39	9.24	614.59	11.53	614.70	9.34	614.66	10.08	613.92	10.11	613.89
3/21/2018	9.18	614.60	9.38	614.49	9.24	614.59	11.21	615.02	9.30	614.70	10.08	613.92	10.11	613.89
	0.71		0.32		0.08		0.04		0.30		0.26		0.25	

Notes:

Groundwater depth measured in feet below measure point (top of casing for MWs and PZs, ground elevation for TWs)

-- = temporary wells not surveyed; adjacent ground elevation used to estimate groundwater elevation

NI = well not installed at time of measurement

Table 2
Baseline and Post-Injection Field Paramaters Results Summary
Kenosha Engine Plant ERD Pilot Test

Well Name	Location Relative to ERD Test Area	Field ID	Sample Date	pH (std. units)	DO (mg/L)	ORP (mV)	Conductivity (µS/cm)	Temperature (°C)
ERD Pilot Test Area Permanent Wells								
MW-61	Injection Area	CS8-MW-61	9/26/2016	7.10	0.31	-119.9	2.368	18.66
			3/6/2017	6.98	0.78	20.4[1]	1.492	11.57
			3/17/2017	7.02	1.17[1]	-190.1	1.298	9.11
			6/15/2017	7.03	0.23	-133.3	1.554	17.62
			9/13/2017	7.00	0.48	-199.1	1.367	18.11
			3/21/2018	9.28[1]	0.94	-115.8	1.753	9.43
PZ-61	Injection Area	CS8-PZ-61	9/26/2016	6.96	0.43	-91.0	2.970	15.97
			3/6/2017	7.23[1]	3.08[1]	31.0[1]	1.617	12.81
			6/15/2017	5.87	0.19	-149.2	6.045	14.58
			9/13/2017	5.64	0.78	-69.6	4.247	16.39
			3/21/2018	6.51	0.29	-59.0	1.725	11.14
MW-75*	Up-Gradient	CS4-MW-75	9/26/2016	7.08	0.53	-102.0	0.954	17.90
PZ-75	Up-Gradient	CS4-PZ-75	9/26/2016	7.06	0.31	-107.3	2.103	16.91
			3/6/2017	6.86	5.48[1]	194.7[1]	0.902	12.06
			6/14/2017	7.06	0.41	-87.5	1.826	17.15
			9/14/2017	7.22	0.61	-103.4	1.762	16.83
			3/22/2018	7.02	0.53	44.3[1]	2.147	11.46
MW-807	Down-Gradient (far)	CS8-MW-807	9/26/2016	8.24	6.58	42.7	0.393	20.14
			3/6/2017	6.96	6.97	194.8	0.330	11.43
			6/14/2017	7.57	4.90	76.0	0.365	22.34
			9/14/2017	7.66	2.32	8.4	0.958	19.46
			3/22/2018	7.75	6.89	50.3	0.526	8.32
ERD Pilot Test Area Temporary Wells								
ERD1-TW-NW10	Side-Gradient	ERD1-TW-NW10-TOS	9/27/2016	7.12	0.86	-108.9	2.278	17.24
			3/6/2017	7.09	--	-43.2	1.553	10.97
			3/17/2017	7.52	0.60	-44.0	2.303	9.68
			6/15/2017	7.18	0.74	-142.3	1.742	15.28
			9/14/2017	7.17	0.66	-109.2	1.643	18.08
			3/22/2018	9.41[1]	2.24[1]	-222.8	1.953	9.15
		ERD1-TW-NW10-BOS	9/27/2016	6.90	0.88	-109.8	4.972	16.49
			3/6/2017	6.89	--	-78.5	5.022	12.61
			3/17/2017	7.46	0.44	-79.0	4.009	10.20
			6/15/2017	6.99	0.78	-139.2	2.611	16.65
			9/14/2017	6.75	0.83	-196.5	5.047	18.46
			3/22/2018	12.16[1]	0.82	-240.9	4.887	11.16
ERD6-TW-NW10	Up-/Side Gradient	ERD6-TW-NW10-TOS	9/27/2016	6.99	0.64	-119.1	2.314	17.54
			3/6/2017	6.98	2.37[1]	-51.8	1.507	11.33
			6/14/2017	6.57	0.31	-117.2	1.927	16.51
			9/13/2017	7.00	1.59[1]	-115.0	1.788	19.47
			3/21/2018	4.82[1]	1.02[1]	-152.4	1.647	9.42
		ERD6-TW-NW10-BOS	9/27/2016	7.01	0.33	-124.5	3.202	16.50
			3/6/2017	7.08	2.09[1]	-44.0[1]	3.099	12.30
			6/14/2017	5.84	0.18	-119.0	2.191	16.16
			9/13/2017	6.03	0.45	-70.3	3.528	18.99
			3/21/2018	7.11	0.87	-171.1	1.908	10.40
ERD6-TW-NW15	Up-/Side Gradient	ERD6-TW-NW15-TOS	9/27/2016	7.17	0.36	-101.4	2.727	17.72
			3/6/2017	7.03	0.42	-79.7	2.093	11.10
			6/14/2017	5.92	1.40[1]	-95.6	1.820	13.69
			9/13/2017	6.67	1.03[1]	-126.3	1.821	17.36
			3/21/2018	7.17	0.50	-89.8	1.596	8.99
		ERD6-TW-NW15-BOS	9/27/2016	7.12	0.48	-104.4	4.577	16.29
			3/6/2017	6.95	0.37	-81.8	3.494	12.37
			6/14/2017	5.96	1.11[1]	-119.6	3.261	14.58
			9/13/2017	6.14	1.36[1]	-120.2	2.870	16.83
			3/21/2018	6.83	0.49	-68.6	2.401	10.76
ERD8-TW-SW15*	Injection Area	ERD8-TW-SW15 TOS	9/27/2016	7.19	0.33	-105.6	2.389	17.41
		ERD8-TW-SW15 BOS	9/27/2016	7.15	0.53	-113.2	6.271	17.07

Notes:
DO = disolved oxygen
ORP = oxidation-reduction potential
-- = not measured
* wells abandoned during other site remedial activities

mg/L = milligrams per liter
mV = millivolts
µS/cm = microSiemens per centimeter
ºC = degrees Celsius

TOS = top of screen
BOS = bottom of screen
[1] measurement is suspect, due to possible instrument error.

Table 3
Baseline and Post-Injection Alkalinity, Anions, Total Organic Carbon, and Dissolved Gases Results Summary
Kenosha Engine Plant ERD Pilot Test

Well Name	Location Relative to ERD Test Area	Field ID	Sample Date	Alkalinity (mg/L)	Anions Chloride (mg/L)	Anions Sulfate (mg/L)	Anions Sulfide (mg/L)	Total Organic Carbon (mg/L)	Dissolved Gases Ethene (ug/L)	Dissolved Gases Ethane (ug/L)	Dissolved Gases Methane (ug/L)
ERD Pilot Test Area Permanent Wells											
MW-61	Injection Area	CS8-MW-61	3/23/2015	NA	1,010	17.5	< 2	NA	191	95.4	2,030
			9/24/2015	511	874	< 100	< 2	0.56	192	100	942
			12/15/2015	NA	847	65.1	< 2	0.47 J	122	73.7	917
			9/26/2016	519	431	67.0	NA	1.9 J	98.8	27.1	705
			3/17/2017	NA	NA	NA	NA	4.1	NA	NA	NA
			6/15/2017	397	431	5.7 J	NA	1.9 J	244	30.9	2,720
			9/13/2017	428	350	25.8	< 1.2	2.5	195	23.6	1,870
			3/21/2018	389	551	29.4 J	NA	0.94	74.1	70.0	1,390
			DUP	418	599	32.5 J	NA	0.98	87.2	82.3	1,240
PZ-61	Injection Area	CS8-PZ-61	9/24/2015	282	1,190	59.9	< 2	< 0.17	6.4	10.7	283
			12/15/2015	NA	1,600	70.7	< 2	0.2 J	3.9 J	6.1	273
			9/26/2016	342	1,710	64.6	NA	< 1.5	4.3 J	6.6	271
			6/15/2017	1,660	1,750	< 100	NA	4,840	27.1	8.3	279
			9/13/2017	1,320	1,020	13.4 J	< 1.2	5,680	54.0	34.8	403
			3/21/2018	1,460	360	< 20.0	NA	2,050	68.9	9.2	4,460
MW-75*	Up-Gradient	CS4-MW-75	9/26/2016	479	138	180	NA	24.0 J	1.2 J	2.9 J	194
PZ-75	Up-Gradient	CS4-PZ-75	9/26/2016	357	488	57.9	NA	3.2 J	< 0.52	11.8	278
			3/17/2017	NA	NA	NA	NA	0.52 J	NA	NA	NA
			6/14/2017	399	539	102	NA	1.1 J	2.4 J	15.5	436
			9/14/2017	397	506	118	< 1.2	10.3	23.3	12.1	542
			3/22/2018	417	542	103	NA	3.1	52.1	11.7	716
MW-807	Down-Gradient (far)	CS8-MW-807	9/26/2016	121	47.4 J	40.3 J	NA	2.0 J	4.9 J	< 0.58	< 1.4
			3/17/2017	NA	NA	NA	NA	1.8	NA	NA	NA
			6/14/2017	< 176	35.0	33.9	NA	1.0	< 0.52	< 0.58	< 1.4
			9/14/2017	287	169	45.2	< 1.2	0.54 J	10.6	5.0 J	218
			3/22/2018	221	29.1	48.4	NA	1.5	< 0.52	< 0.58	< 1.4
ERD Pilot Test Area Temporary Wells											
ERD1-TW-NW10	Side-Gradient	ERD1-TW-NW10-TOS	9/27/2016	NA	NA	NA	NA	1.6 J	NA	NA	NA
			3/17/2017	NA	NA	NA	NA	0.5 J	NA	NA	NA
			6/15/2017	511	741	9.5	NA	9.5	4.0 J	63.0	1,770
			9/14/2017	473	462	< 20.0	< 1.2	1.5 J	5.8	105	2,650
			3/22/2018	520	533	32.7 J	NA	3.4	177	85.1	1,880
		ERD1-TW-NW10-BOS	9/27/2016	NA	NA	NA	NA	< 2.5	NA	NA	NA
			DUP	NA	NA	NA	NA	< 2.5	NA	NA	NA
			3/17/2017	NA	NA	NA	NA	0.4 J	NA	NA	NA
			6/15/2017	504	944	13.7 J	NA	10.1	13.5	64.5	1,790
			9/14/2017	553	1,200	34.1 J	< 1.2	21.5	95.8	39.3	770
			3/22/2018	590	1,170	15.4 J	NA	7.3	1,190	54.0	7,890

Table 3
Baseline and Post-Injection Alkalinity, Anions, Total Organic Carbon, and Dissolved Gases Results Summary
Kenosha Engine Plant ERD Pilot Test

Well Name	Location Relative to ERD Test Area	Field ID	Sample Date	Alkalinity (mg/L)	Anions: Chloride (mg/L)	Anions: Sulfate (mg/L)	Anions: Sulfide (mg/L)	Total Organic Carbon (mg/L)	Dissolved Gases: Ethene (ug/L)	Dissolved Gases: Ethane (ug/L)	Dissolved Gases: Methane (ug/L)
ERD6-TW-NW10	Up-/Side Gradient	ERD6-TW-NW10-TOS	9/27/2016	NA	NA	NA	NA	< 1.5	NA	NA	NA
			6/14/2017	776	278	< 5.0	NA	606	57.0	14.8	1,290
			9/13/2017	569	499	< 10.0	< 1.2	102	128	70.2	1,860
			3/21/2018	473	329	< 20.0	NA	58.7	51.9	86.1	2,660
		ERD6-TW-NW10-BOS	9/27/2016	NA	NA	NA	NA	< 1.5	NA	NA	NA
			6/14/2017	548 [J]	379	< 5.0	NA	1,430	104	21.0	771
			9/13/2017	717	709	< 20.0	< 1.2	1,260	209	28.1	1,450
			3/21/2018	406	408	< 20.0	NA	23.2	28.6	32.0	2,070
ERD6-TW-NW15	Up-/Side Gradient	ERD6-TW-NW15-TOS	9/27/2016	NA	NA	NA	NA	< 1.5	NA	NA	NA
			6/14/2017	419 [J]	684	< 5.0	NA	368	136	22.0	1,720
			9/13/2017	541	558	< 20.0	< 1.2	130	193	55.8	2,930
			3/21/2018	465	349	< 20.0	NA	5.6	189	167	6,860
		ERD6-TW-NW15-BOS	9/27/2016	NA	NA	NA	NA	< 1.5	NA	NA	NA
			6/14/2017	405 [J]	795	< 5.0	NA	887	240	33.7	2,270
			9/13/2017	692	658	< 20.0	< 1.2	448	336	80.4	3,360
			3/21/2018	556	457	< 20.0	NA	206	94.2	62.6	5,790
ERD8-TW-SW15*	Injection Area	ERD8-TW-SW15-TOS	9/27/2016	NA	NA	NA	NA	< 1.5	NA	NA	NA
		ERD8-TW-SW15-BOS	9/27/2016	NA	NA	NA	NA	< 2.5	NA	NA	NA
			ES	--	250 [a]	250 [a]	--	--	--	--	--
			PAL	--	125 [a]	125 [a]	--	--	--	--	--

Notes:
ug/L = micrograms per liter
mg/L = milligrams per liter
[J] = estimated value
PAL = Preventive Action Limit, Wisconsin Administrative Code NR 140.12 (Public Welfare Groundwater Quality Standards) Table 2, February 2017.
ES = Enforcement Standard, Wisconsin Administrative Code NR 140.12 (Public Welfare Groundwater Quality Standards) Table 2, February 2017.
[a] = PAL and ES are Public Welfare Groundwater Quality Standards; concentrations above the ES and PAL are not highlighted.
Alkalinity = total as $CaCO_3$
* wells abandoned during other site remedial activities

Table 4
Baseline and Post-Injection VOCs Results Summary
Kenosha Engine Plant ERD Pilot Test

Well Name	Location Relative to ERD Test Area	Field ID	Sample Date	Benzene (ug/L)	Chloro-ethane (ug/L)	1,1-DCE (ug/L)	c-DCE (ug/L)	t-DCE (ug/L)	Toluene (ug/L)	TCE (ug/L)	Vinyl Chloride (ug/L)	Xylene (Total) (ug/L)
ERD Pilot Test Area Permanent Wells												
MW-61	Injection Area	CS8-MW-61	4/11/2012	**12.1** J	< 24.2	**15.0** J	**6,690**	**294**	< 16.8	**223**	**2,460**	< 65
			5/22/2014	< 25	< 18.7	< 20.5	**4,550**	**191**	< 25	**308**	**1,950**	< 75
			9/24/2014	< 25	< 18.7	< 20.5	**6,470**	**215**	< 25	**485**	**3,430**	< 75
			12/3/2014	< 25	< 18.7	< 20.5	**5,910**	**183**	< 25	**391**	**3,180**	< 75
			3/23/2015	< 10	< 7.5	**13.4** J	**4,750**	**216**	< 10	**389**	**3,290**	< 30
			9/24/2015	< 20	< 15	< 16.4	**4,170**	**159**	< 20	**410**	**2,490**	< 60
			12/15/2015	< 12.5	< 9.4	< 10.3	**3,490**	**135**	< 12.5	**383**	**1,760**	< 37.5
			9/26/2016	**13.0** J	< 9.4	< 10.3	**2,740**	*47.1*	< 12.5	**242**	**1,130**	< 37.5
			6/15/2017	**16.0** J	< 9.4	< 10.3	**1,420**	*42.6*	< 12.5	**61.4**	**760**	< 37.5
			DUP	**19.1** J	< 9.4	< 10.3	**1,280**	*44.7*	< 12.5	**68.6**	**752**	< 37.5
			9/13/2017	**18.8** J	< 7.5	< 8.2	**2,160**	**103**	< 10.0	**111**	**835**	< 30
			3/21/2018	**16.6** J	< 9.4	< 10.3	**2,540**	< 6.4	< 12.5	**104**	**3,280**	< 37.5
			DUP	**16.3** J	< 9.4	< 10.3	**2,560**	< 6.4	< 12.5	**116**	**3,140**	< 37.5
PZ-61	Injection Area	CS8-PZ-61	4/11/2012	< 20.5	< 48.5	< 28.5	**9,180**	**108**	< 33.5	**2,610**	**129**	< 130
			DUP	< 16.4	< 38.8	< 22.8	**8,600**	**137**	< 26.8	**2,480**	**125**	< 104
			5/22/2014	< 50	< 37.5	< 41	**7,660**	**135**	< 50	**2,770**	**124**	< 150
			DUP	< 50	< 37.5	< 41	**7,760**	**129**	< 50	**2,820**	**109**	< 150
			9/24/2014	< 50	< 37.5	< 41	**8,770**	**145**	< 50	**2,950**	**132**	< 150
			DUP	< 50	< 37.5	< 41	**8,450**	**136**	< 50	**2,760**	**130**	< 150
			12/3/2014	< 50	< 37.5	< 41	**7,120**	**290**	< 50	**1,840**	**118**	< 150
			DUP	< 25	< 18.7	**20.8** J	**7,220**	**196**	< 25	**1,770**	**114**	< 75
			3/23/2015	< 50	< 37.5	< 41	**7,560**	**135**	< 50	**2,220**	**108**	< 150
			DUP	< 25	< 18.7	< 20.5	**7,930**	**143**	< 25	**2,670**	**117**	< 75
			9/24/2015	< 50	< 37.5	< 41	**6,760**	**127**	< 50	**1,420**	**130**	< 150
			12/15/2015	< 25	< 18.7	< 20.5	**6,330**	**117**	< 25	**1,490**	**123**	< 75
			9/26/2016	< 25	< 18.7	< 20.5	**6,410**	< 12.8	< 25	**1,430**	**114**	< 75
			6/15/2017	< 25	< 18.7	< 20.5	**5,290**	*78.0*	32.5 J	**251**	**272**	< 75
			9/13/2017	< 25.0	< 18.7	< 20.5	**2,880**	< 12.8	< 25.0	**37.9** J	**203**	< 75
			3/21/2018	< 5.0	< 3.7	< 4.1	**1,210**	< 2.6	< 5.0	*4.2* J	**81.2**	< 15
MW-75*	Up-Gradient	CS4-MW-75	9/26/2016	**87.5**	< 0.37	< 0.41	1.4	< 0.26	3.7	< 0.33	**27.4**	64.4
PZ-75	Up-Gradient	CS4-PZ-75	4/12/2012	< 2.0	< 4.8	< 2.8	< 4.2	< 4.4	< 3.4	< 2.4	**515**	< 13
			5/30/2014	< 0.5	< 0.37	< 0.41	< 0.26	< 0.24	< 0.5	< 0.33	**328** J-	< 1.5
			9/30/2014	< 0.5	< 0.37	< 0.41	0.27 J	< 0.26	< 0.5	< 0.33	**109**	< 1.5
			12/9/2014	< 0.5	< 0.37	< 0.41	< 0.26	< 0.26	< 0.5	< 0.33	**45.8**	< 1.5
			9/26/2016	< 0.5	< 0.37	< 0.41	< 0.26	< 0.26	< 0.5	< 0.33	**9.0**	< 1.5
			6/14/2017	< 0.5	< 0.37	< 0.41	< 0.26	< 0.26	< 0.5	< 0.33	**18.6**	< 1.5
			9/14/2017	< 0.50	< 0.37	< 0.41	< 0.26	< 0.26	< 0.50	< 0.33	**65.1**	< 1.5
			3/22/2018	< 2.5	< 1.9	< 2.1	< 1.3	< 1.3	< 2.5	< 1.7	**673**	< 7.5

Table 4
Baseline and Post-Injection VOCs Results Summary
Kenosha Engine Plant ERD Pilot Test

Well Name	Location Relative to ERD Test Area	Field ID	Sample Date	Benzene (ug/L)	Chloro-ethane (ug/L)	1,1-DCE (ug/L)	c-DCE (ug/L)	t-DCE (ug/L)	Toluene (ug/L)	TCE (ug/L)	Vinyl Chloride (ug/L)	Xylene (Total) (ug/L)
MW-807	Down-Gradient (far)	CS8-MW-807	5/22/2014	*1.2*	< 0.37	< 0.41	0.27 [J]	< 0.24	< 0.5	*0.76* [J]	**8.8**	< 1.5
			9/23/2014	< 0.5	< 0.37	< 0.41	< 0.26	< 0.26	< 0.5	< 0.33	**7.2**	< 1.5
			12/3/2014	< 0.5	< 0.37	< 0.41	< 0.26	< 0.26	< 0.5	< 0.33	< 0.18	< 1.5
			3/23/2015	< 0.5	< 0.37	< 0.41	< 0.26	< 0.26	< 0.5	< 0.33	**80.4**	< 1.5
			9/26/2016	< 0.5	< 0.37	< 0.41	< 0.26	< 0.26	< 0.5	*0.92* [J]	< 0.18	< 1.5
			6/14/2017	< 0.5	< 0.37	< 0.41	< 0.26	< 0.26	< 0.5	*0.64* [J]	< 0.18	< 1.5
			9/14/2017	< 0.50	< 0.37	< 0.41	< 0.26	< 0.26	< 0.50	*0.62* [J]	64.8	< 1.5
			3/22/2018	< 0.50	< 0.37	< 0.41	< 0.26	< 0.26	< 0.50	*0.56* [J]	< 0.18	< 1.5
ERD Pilot Test Area Temporary Wells												
ERD1-TW-NW10	Side-Gradient	ERD1-TW-NW10-TOS	9/27/2016	< 1	*225*	< 0.82	**101**	< 0.51	< 1	**194**	**3.8**	< 3
			6/15/2017	< 2	*119*	< 1.6	**329**	4.2	< 2	**13.0**	**24.0**	< 6
			9/14/2017	< 2.0	*149*	< 1.6	**335**	4.2	< 2.0	*3.5* [J]	**27.2**	< 6
			DUP	< 2.5	*149*	< 2.1	**428**	5.3	< 2.5	*4.8* [J]	**31.2**	< 7.5
			3/22/2018	< 0.50	*134*	< 0.41	**158**	< 0.26	< 0.50	*0.76* [J]	**36.4**	< 1.5
		ERD1-TW-NW10-BOS	9/27/2016	< 5	13.4	< 4.1	**816**	2.9 [J]	< 5	**1,180**	**25.5**	< 15
			DUP	< 5	13.6	< 4.1	**832**	< 2.6	< 5	**1,150**	**25.3**	< 15
			6/15/2017	< 2.5	*97.9*	< 2.1	**628**	11.4	< 2.5	**84.9**	**46.3**	< 7.5
			9/14/2017	< 20.0	< 15.0	< 16.4	**1,710**	79.8	< 20.0	**61**	**105**	< 60
			3/22/2018	< 0.50	15.6	*1.2*	**578**	< 0.26	< 0.50	**5.3**	**138**	< 1.5
ERD6-TW-NW10	Up-/Side Gradient	ERD6-TW-NW10-TOS	9/27/2016	**5.6** [J]	73.3	< 4.1	**747**	< 2.6	< 5	**5.3** [J]	**228**	< 15
			6/14/2017	**5.2**	38.7	< 0.82	**150**	< 0.51	2.9	*0.97* [J]	**133**	< 3
			9/13/2017	**5.2**	54	< 0.41	*30.5*	0.48 [J]	1.5	0.45 [J]	**125**	< 1.5
			3/21/2018	*2.7*	< 0.75	< 0.82	*16.4*	< 0.51	< 1.0	< 0.66	**218**	< 3
		ERD6-TW-NW10-BOS	9/27/2016	**5.8** [J]	21.7	*5.9* [J]	**1,800**	< 2.6	< 5	**10.6**	**305**	< 15
			6/14/2017	**5.3**	8.5	*1.7* [J]	**475**	2.9	4.8	*1.4* [J]	**189**	3.6 [J]
			9/13/2017	**5.1**	26.7	< 2.1	**433**	3.1 [J]	4.0 [J]	< 1.7	**388**	< 7.5
			3/21/2018	*2.5* [J]	< 1.5	< 1.6	*49.3*	< 1.0	< 2.0	< 1.3	**456**	< 6
ERD6-TW-NW15	Up-/Side Gradient	ERD6-TW-NW15-TOS	9/27/2016	**8.9**	53.8	*2.2* [J]	**689**	< 1.3	< 2.5	< 1.7	**259**	< 7.5
			6/14/2017	**6.8**	62.6	< 2.1	**472**	3.4 [J]	2.7 [J]	< 1.7	**710**	< 7.5
			9/13/2017	**8.3**	16.9	< 0.41	2.2	< 0.26	1.1	< 0.33	**24.0**	1.1 [J]
			3/21/2018	**6.7**	< 0.37	< 0.41	*11.6*	< 0.26	0.72 [J]	< 0.33	**60.4**	< 1.5
		ERD6-TW-NW15-BOS	9/27/2016	< 10	11.8 [J]	< 8.2	**1,980**	**120**	< 10	< 6.6	**152**	< 30
			6/14/2017	< 10	*82.8*	< 8.2	**798**	< 5.1	< 10	< 6.6	**995**	< 30
			9/13/2017	**7.0**	19.0	< 0.41	**123**	1.3	1.8	< 0.33	**104**	1.5 [J]
			3/21/2018	**5.8**	< 0.37	< 0.41	*58.6*	< 0.26	0.93 [J]	< 0.33	**115**	< 1.5
ERD8-TW-SW15*	Injection Area	ERD8-TW-SW15-TOS	9/27/2016	**79.1**	< 15	< 16.4	**4,520**	*45.5*	< 20	< 13.2	**2,520**	< 60
		ERD8-TW-SW15-BOS	9/27/2016	**40.0**	< 1.9	< 2.1	**563**	< 1.3	< 2.5	< 1.7	**983**	< 7.5
			PAL	0.5	80	0.7	7	20	160	0.5	0.02	400
			ES	5	400	7	70	100	800	5	0.2	2,000

Notes:
ug/L = micrograms per liter [J] = estimated value [J-] = estimated value, may be biased low
PAL = Preventive Action Limit, Wisconsin Administrative Code NR 140.10 Table 1, February 2017; concentrations above PAL are in *underlined italics*.
ES = Enforcement Standard, Wisconsin Administrative Code NR 140.10 Table 1, February 2017; concentrations above ES are in **bold**.
Only compounds with at least one confirmed detection above the PAL are shown
* wells abandoned during other site remedial activities

Table 5
Baseline and Post-Injection Metals Results Summary
Kenosha Engine Plant ERD Pilot Test

Well Name	Location Relative to ERD Test Area	Field ID	Sample Date	Barium (ug/L)	Chromium (ug/L)	Iron, Total (ug/L)	Iron, Dissolved (ug/L)	Lead (ug/L)	Nickel (ug/L)
ERD Pilot Test Area Permanent Wells									
MW-61	Injection Area	CS8-MW-61	3/23/2015	NA	NA	3,700	3,480	NA	NA
			9/24/2015	NA	NA	3,280	3,060	NA	NA
			12/15/2015	NA	NA	2,960	3,180	NA	NA
			9/26/2016	*432*	< 0.39	2,190	2,320	0.07 J	0.18 J
			6/15/2017	297	< 1	3,010	2,990	< 0.2	< 0.4
			DUP	298	< 1	3,100	2,930	< 0.2	< 0.4
			9/13/2017	294	< 1.0	1,590	1,800	< 0.20	< 0.40
			3/21/2018	322	< 1.0	2,220	2,250	0.46 J	< 0.40
			DUP	339	< 1.0	2,240	2,300	< 0.20	< 0.40
PZ-61	Injection Area	CS8-PZ-61	9/24/2015	NA	NA	3,540	3,420	NA	NA
			12/15/2015	NA	NA	3,660	3,560	NA	NA
			9/26/2016	*404*	< 0.39	3,050	3,390	0.23 J	1.6
			6/15/2017	*549*	*11.6* J	312,000	296,000	0.98 J	7.0
			9/13/2017	*1,670*	< 10.2	968,000	896,000	< 0.98	4.4 J
			3/21/2018	*1,260*	< 10.2	570,000	756,000	*6.5* J	4.8 J
MW-75*	Up-Gradient	CS4-MW-75	9/26/2016	207	0.77 J	1,780	1,880	0.79 J	4.5
PZ-75	Up-Gradient	CS4-PZ-75	9/26/2016	238	0.61 J	2,670	1,810	*1.6*	2.8
			6/14/2017	249	< 1	3,020	< 15.5	0.23 J	2.5
			9/14/2017	236	< 1.0	3,890	4,090	< 0.20	6.3
			3/22/2018	223	< 1.0	614	400	0.75 J	10.2
MW-807	Down-Gradient (far)	CS8-MW-807	9/26/2016	124	*43.9*	31,600	< 12.9	**18.8**	*33.6*
			6/14/2017	48.1	*15.8*	9,680	24.5 J	*5.6*	9.9
			9/14/2017	51.8	< 1.0	419	278	0.23 J	0.77 J
			3/22/2018	39.1	*10.5*	4,100	84.6 J	*2.2*	4.2
ERD Pilot Test Area Temporary Wells									
ERD1-TW-NW10	Side-Gradient	ERD1-TW-NW10-TOS	6/15/2017	339	< 1	4,500	4,580	0.22 J	0.42 J
			9/14/2017	258	< 1.0	2,640	3,090	0.31 J	< 0.40
			DUP	275	< 1.0	2,750	2,970	< 0.39	< 0.40
			3/22/2018	246	< 1.0	2,180	1,850	< 0.20	< 0.40
		ERD1-TW-NW10-BOS	6/15/2017	*523*	< 1	5,650	5,800	< 0.2	< 0.4
			9/14/2017	*919*	< 5.1	10,100	10,500	< 0.98	< 2.0
			3/22/2018	*659*	< 5.1	6,980	6,030	< 0.20	< 2.0
ERD6-TW-NW10	Up-/Side Gradient	ERD6-TW-NW10-TOS	6/14/2017	158	3.4 J	21,100	< 15.5	< 0.2	2.5
			9/13/2017	206	1.1 J	19,500	21,000	< 0.20	1.0 J
			3/21/2018	152	*10.2*	31,000	27,600	0.26 J	6.8
		ERD6-TW-NW10-BOS	6/14/2017	196	3.3 J	55,800	43,900	0.38 J	2.2
			9/13/2017	*710*	< 5.1	138,000	120,000	< 0.98	< 2.0
			3/21/2018	173	4.2	16,200	9,030	< 0.20	3.4

Table 5
Baseline and Post-Injection Metals Results Summary
Kenosha Engine Plant ERD Pilot Test

Well Name	Location Relative to ERD Test Area	Field ID	Sample Date	Barium (ug/L)	Chromium (ug/L)	Iron, Total (ug/L)	Iron, Dissolved (ug/L)	Lead (ug/L)	Nickel (ug/L)
ERD6-TW-NW15	Up-/Side Gradient	ERD6-TW-NW15-TOS	6/14/2017	378	< 1	25,400	1,090	< 0.2	0.5 [J]
			9/13/2017	282	< 1.0	29,400	34,300	< 0.20	< 0.40
			3/21/2018	79.8	< 1.0	6,700	7,140	< 0.20	0.78 [J]
		ERD6-TW-NW15-BOS	6/14/2017	*482*	< 1	34,100	6,770	< 0.2	0.44 [J]
			9/13/2017	*574*	1.4 [J]	44,200	50,100	< 0.39	0.89 [J]
			3/21/2018	283	8.9	33,800	32,000	1.3	5.8
			PAL	400	10	150 [a]	150 [a]	1.5	20
			ES	2,000	100	300 [a]	300 [a]	15	100

Notes:
ug/L = micrograms per liter [J] = estimated value
PAL = Preventive Action Limit, Wisconsin Administrative Code NR 140.10 Table 1, February 2017; concentrations above PAL are in *underlined italics*.
ES = Enforcement Standard, Wisconsin Administrative Code NR 140.10 Table 1, February 2017; concentrations above ES are in **bold**.
[a] = PAL and ES are Public Welfare Groundwater Quality Standards; concentrations above the ES and PAL are not highlighted.
* wells abandoned during other site remedial activities

Table 6
Baseline and Post-Injection Volatile Fatty Acids Results Summary
Kenosha Engine Plant ERD Pilot Test

Well Name	Location Relative to ERD Test Area	Field ID	Sample Date	Acetic Acid (mg/L)	Butyric Acid (mg/L)	Formic Acid (mg/L)	Hexanoic Acid (mg/L)	i-Hexanoic Acid (mg/L)	i-Pentanoic Acid (mg/L)	Lactic Acid (mg/L)	Pentanoic Acid (mg/L)	Propionic Acid (mg/L)	Pyruvic Acid (mg/L)
ERD Pilot Test Area Permanent Wells													
MW-61	Injection Area	CS8-MW-61	9/26/2016	0.33 [Jb]	0.07 [Jb]	0.26 [Jb]	< 0.07	< 0.04	< 0.07	0.09 [Jb]	0.17 [J]	< 0.09	< 0.07
			6/15/2017	7.4	0.37 [J]	< 0.69	< 0.38	< 0.41	< 0.055	< 0.2	< 0.12	0.18 [J]	< 0.16
			9/13/2017	3.0	< 0.055	0.36 [Jb]	< 0.095	< 0.11	< 0.098	0.38 [Jb]	< 0.082	< 0.055	< 0.089
PZ-61	Injection Area	CS8-PZ-61	9/26/2016	0.31 [Jb]	< 0.07	0.27 [Jb]	< 0.07	< 0.04	< 0.07	0.099 [Jb]	0.22 [J]	< 0.09	< 0.07
			6/15/2017	1,300	1,400	63	8.0	5.7	2.5 [J]	140	55	760	6.5 [J]
			9/13/2017	3,200	2,600	96 [Jb]	48	9.6	9.6 [J]	4.5	270	1,900	15 [J]
MW-75*	Up-Gradient	CS4-MW-75	9/26/2016	0.089 [Jb]	0.0074 [Jb]	0.063 [Jb]	< 0.007	< 0.004	< 0.007	0.012 [Jb]	0.031 [J]	< 0.009	< 0.007
PZ-75	Up-Gradient	CS4-PZ-75	9/26/2016	0.3 [Jb]	0.094 [Jb]	0.2 [Jb]	< 0.07	< 0.04	< 0.07	0.076 [Jb]	0.07 [J]	< 0.09	< 0.07
			6/14/2017	0.4 [Jb]	< 0.14	0.76 [J]	< 0.38	< 0.41	< 0.055	< 0.2	< 0.12	< 0.061	< 0.16
			9/14/2017	0.31 [J]	< 0.055	0.72 [Jb]	0.097 [J]	< 0.11	< 0.098	0.18 [Jb]	< 0.082	< 0.055	< 0.089
MW-807	Down-Gradient (far)	CS8-MW-807	9/26/2016	0.039 [Jb]	< 0.007	0.046 [Jb]	0.025 [J]	< 0.004	< 0.007	0.0092 [Jb]	0.034 [J]	< 0.009	< 0.007
			6/14/2017	0.55 [Jb]	0.14 [J]	1.7 [J]	< 0.38	< 0.41	< 0.055	< 0.2	< 0.12	0.1 [J]	< 0.16
			9/14/2017	0.42 [J]	< 0.055	0.9	< 0.095	< 0.11	< 0.098	0.19 [Jb]	< 0.082	< 0.055	< 0.089
ERD Pilot Test Area Temporary Wells													
ERD1-TW-NW10	Side-Gradient	ERD1-TW-NW10-TOS	6/15/2017	21	0.54 [J]	1.1 [J]	< 0.38	< 0.41	< 0.055	< 0.2	< 0.12	11	< 0.16
			9/14/2017	0.26 [J]	< 0.055	0.55 [Jb]	< 0.095	< 0.11	< 0.098	0.2 [Jb]	< 0.082	< 0.055	< 0.089
		ERD1-TW-NW10-BOS	6/15/2017	35	1.3	1.2 [J]	< 0.38	< 0.41	< 0.055	< 0.2	< 0.12	18	< 0.16
			9/14/2017	64	0.28 [J]	0.5 [Jb]	< 0.095	< 0.11	< 0.098	0.15 [Jb]	0.31 [J]	36	0.24 [J]
ERD6-TW-NW10	Up-/Side Gradient	ERD6-TW-NW10-TOS	6/14/2017	600	44	3.3	5.4	0.41 [J]	1.7	8.7	4.9	350	2.3
			9/13/2017	110	13	0.99 [Jb]	1.3 [J]	< 0.11	0.84 [J]	0.17 [Jb]	4.7	54	3.1
		ERD6-TW-NW10-BOS	6/14/2017	660	150	5.7	4.0	0.82 [J]	1.9	8.6	9.1	380	3.0
			9/13/2017	970	480	11	19	2.6	4.0	7.3	65	450	17
ERD6-TW-NW15	Up-/Side Gradient	ERD6-TW-NW15-TOS	6/14/2017	230	82	2.5	0.94 [J]	0.6 [J]	0.79 [J]	0.28 [J]	4.8	96	1.2
			9/13/2017	160	14	0.92 [Jb]	2.1	< 0.11	0.53 [J]	< 0.11	2.3	42	2.4
		ERD6-TW-NW15-BOS	6/14/2017	350	170	10 [J]	1.2 [J]	1.2 [J]	0.8 [J]	7.1 [J]	9.4	150	1.5
			9/13/2017	370	160	1.8 [Jb]	2.9	0.8 [J]	0.69 [J]	< 1.1	13	220	3.5

Notes:
mg/L = milligrams per liter
[J] = estimated value
[b] = analyte present in method blank and considered laboratory contamination (value is within 5 times the blank concentration, taking into consideration sample dilutions)
* wells abandoned during other site remedial activities

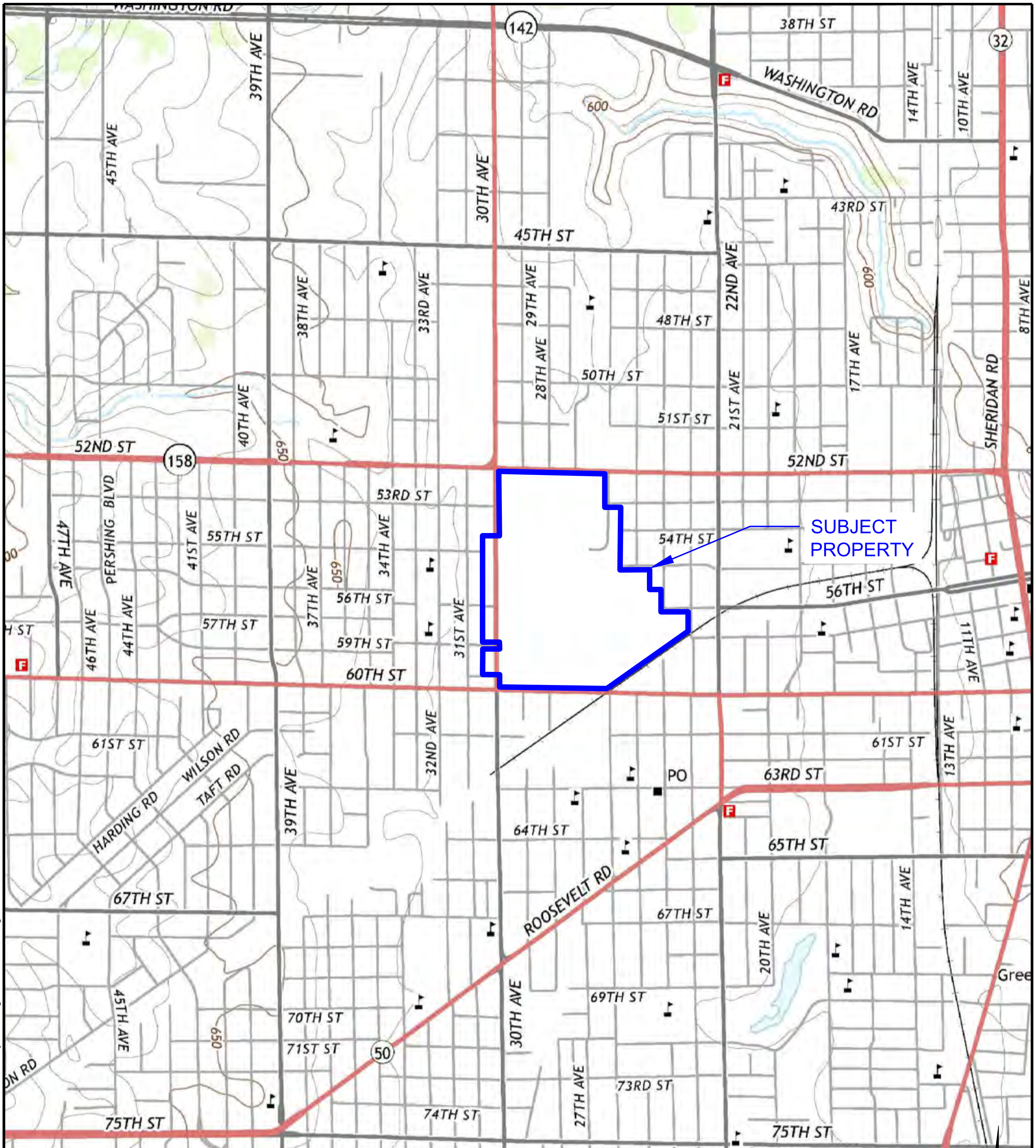
Table 7
Baseline and Post-Injection Microbial Populations Results Summary
Kenosha Engine Plant ERD Pilot Test

Well Name	Location Relative to ERD Test Area	Field ID	Sample Date	*DHC* (cells/mL)	tceA (cells/mL)	bvcA BAV1 (cells/mL)	vcrA (cells/mL)	MGN (cells/mL)	APS (cells/mL)
ERD Pilot Test Area Permanent Wells									
MW-61	Injection Area	CS8-MW-61	9/26/2016	< 5.00E-01	1.28E+02	4.36E+04	3.13E+05	1.79E+04	8.09E+03
			6/15/2017	5.10E+01	5.48E+04	1.04E+05	1.52E+06	9.05E+04	5.69E+04
			9/13/2017	1.79E+01	8.94E+04	9.40E+04	6.09E+05	2.96E+04	5.99E+04
			3/21/2018	3.60E+00	2.77E+03	5.61E+03	5.90E+04	1.85E+03	2.04E+03
PZ-61	Injection Area	CS8-PZ-61	9/26/2016	< 5.00E-01	1.00E+01	3.82E+02	5.61E+04	2.94E+01	2.69E+01
			6/15/2017	4.56E+02	1.16E+03	7.36E+02	1.04E+03	< 2.94E+01	4.42E+02
			9/13/2017	1.64E+02	5.86E+02	1.79E+04	1.96E+04	3.39E+03	8.51E+03
			3/21/2018	2.39E+02	3.46E+04	5.06E+03	1.24E+06	4.79E+03	1.84E+03
MW-75*	Up-Gradient	CS4-MW-75	9/26/2016	8.08E+01	6.76E+02	7.50E+03	1.51E+05	1.29E+03	1.47E+03
PZ-75	Up-Gradient	CS4-PZ-75	9/26/2016	< 5.00E-01	3.83E+02	1.08E+02	4.51E+04	1.21E+01	9.80E+00
			6/14/2017	< 5.00E-01	1.58E+03	1.79E+02	1.56E+05	4.51E+01	2.60E+03
			9/14/2017	< 5.00E-01	3.42E+01	3.45E+02	9.78E+03	2.04E+01	1.78E+03
			3/22/2018	2.00E-01 [J]	1.40E+00 [J]	9.20E+00	2.64E+04	2.70E+00	2.54E+01
MW-807	Down-Gradient (far)	CS8-MW-807	9/26/2016	< 1.10E+00	1.10E+00 [J]	< 1.10E+00	1.39E+02	< 1.10E+00	< 1.10E+00
			6/14/2017	< 4.00E+00	1.87E+01 [J]	< 4.00E+00	< 4.00E+01	< 4.00E+00	< 4.00E+00
			9/14/2017	< 1.00E+00	< 1.02E+01	< 1.00E+00	< 1.02E+01	< 1.00E+00	< 1.00E+00
			3/22/2018	< 2.50E+00	< 2.50E+01	< 2.50E+00	< 2.50E+01	< 2.50E+00	< 2.50E+00
ERD Pilot Test Area Temporary Wells									
ERD1-TW-NW10	Side-Gradient	ERD1-TW-NW10-TOS	6/15/2017	3.33E+01	2.22E+04	3.05E+04	1.37E+06	2.64E+04	4.58E+04
			9/14/2017	1.01E+01	1.54E+02	8.04E+03	4.40E+03	1.61E+03	1.73E+04
			3/22/2018	7.39E+03	1.81E+03	2.56E+04	2.57E+04	4.83E+03	1.41E+04
		ERD1-TW-NW10-BOS	6/15/2017	8.26E+01	2.25E+04	4.34E+04	1.98E+06	4.65E+04	8.08E+04
			9/14/2017	2.09E+04	9.32E+03	1.13E+05	2.48E+04	3.09E+04	1.60E+05
			3/22/2018	1.66E+04	2.08E+04	5.08E+04	8.89E+04	5.25E+03	1.97E+04
ERD6-TW-NW10	Up-/Side Gradient	ERD6-TW-NW10-TOS	6/14/2017	7.60E+01	2.10E+04	1.41E+04	5.08E+02	3.14E+03	5.20E+03
			9/13/2017	1.23E+02	3.51E+04	1.55E+05	1.22E+04	2.05E+04	6.44E+04
			3/21/2018	9.86E+02	7.74E+05	4.00E+04	2.37E+05	2.99E+04	2.85E+04
		ERD6-TW-NW10-BOS	6/14/2017	2.72E+02	3.61E+04	5.97E+03	7.35E+02	6.82E+02	9.16E+02
			9/13/2017	1.95E+01	3.09E+03	1.86E+04	1.27E+03	3.15E+03	4.24E+03
			3/21/2018	4.60E+02	6.92E+05	3.94E+04	3.30E+05	1.80E+04	2.07E+04
ERD6-TW-NW15	Up-/Side Gradient	ERD6-TW-NW15-TOS	6/14/2017	4.49E+01	8.31E+04	1.14E+04	9.32E+03	2.59E+03	3.98E+03
			9/13/2017	3.68E+01	2.55E+04	2.09E+04	2.46E+03	2.66E+03	1.32E+04
			3/21/2018	4.92E+02	5.65E+05	1.81E+04	5.16E+05	4.83E+03	7.58E+03
		ERD6-TW-NW15-BOS	6/14/2017	4.52E+01	7.89E+03	3.39E+03	4.33E+02	6.86E+02	1.51E+03
			9/13/2017	3.81E+01	2.64E+04	3.24E+04	4.00E+03	5.43E+03	1.70E+04
			3/21/2018	5.68E+02	4.54E+05	1.68E+04	3.56E+05	3.54E+03	5.74E+03

Notes:
cells/mL = cells per milliliter
[J] = estimated value
* wells abandoned during other site remedial activities

DHC = *Dehalococcoides spp.*
tceA = tce Reductase functional gene encoding reductive dehalogenases, TCE to DCE and vinyl chloride
bvcA (BAV1) = BAV1 vinyl chloride Reductase functional gene encoding reductive dehalogenases, vinyl chloride to ethene
vcrA = vinyl chloride Reductase functional gene encoding reductive dehalogenases, vinyl chloride to ethene
APS = Sulphur-Reducing Bacteria MGN = Methanogens

Figures



NOTES

1. TOPOGRAPHIC MAP FROM USGS: http://store.usgs.gov/b2c_usgs/usgs/maplocator/ DATED 2013

1000 0 1000 2000

FEET

N

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SITE LOCATION
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	7/3/2017
Checked:	LLA	7/3/2017
Approved:	SP	7/7/2017
PROJECT NUMBER	60518412	
FIGURE NUMBER	1	

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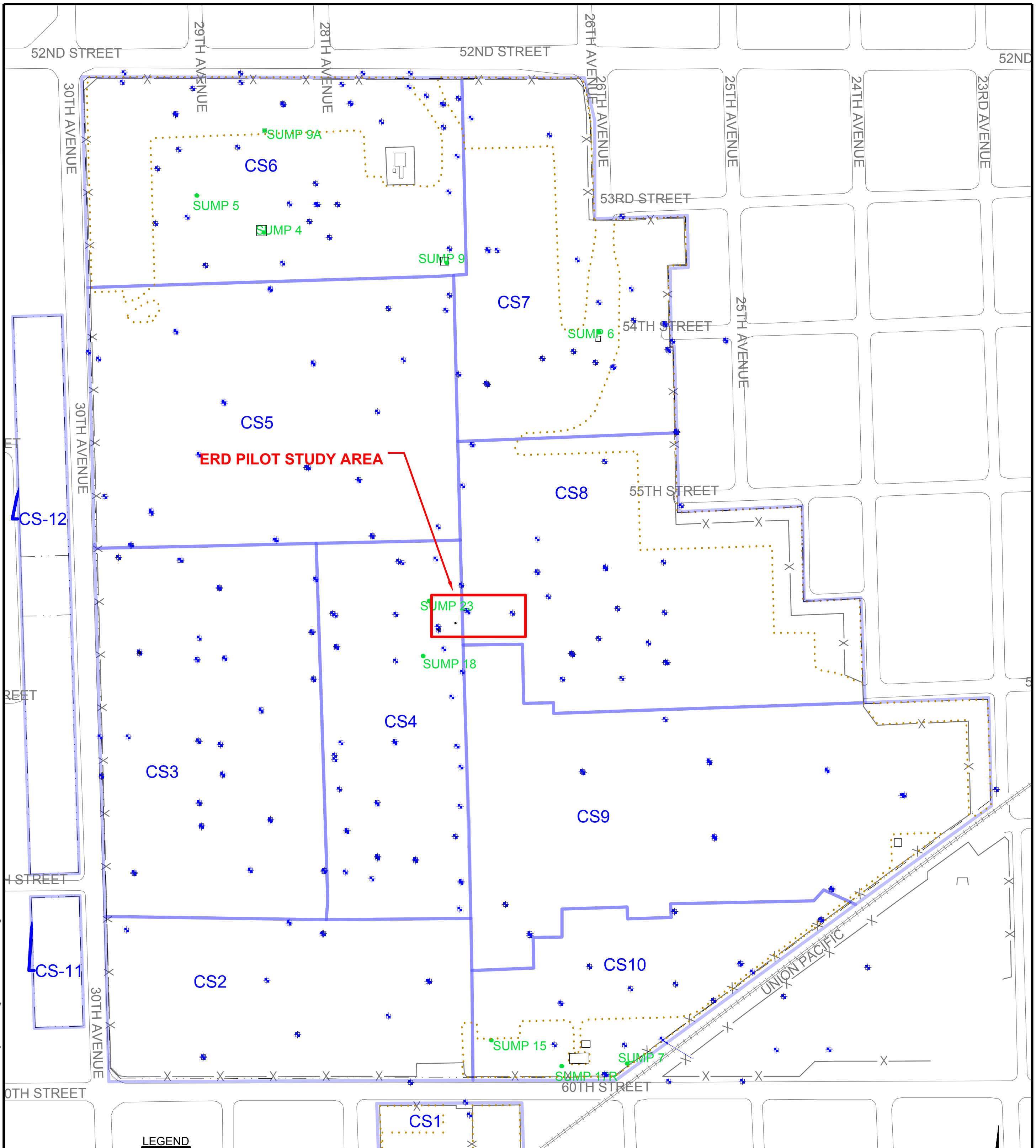

LEGEND

APPROXIMATE SITE BOUNDARY

RAILROAD

FENCE

LANDSCAPED AREA

INVESTIGATION AREA (CS)

MONITORING WELL (MW) OR PIEZOMETER (PZ)

GROUNDWATER RECOVERY SUMP

PILOT TEST LOCATION

0 350

1" = 350'

N

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SITE LAYOUT
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	7/3/2017
Checked:	LLA	7/3/2017
Approved:	SP	7/7/2017
PROJECT NUMBER	60518412	
FIGURE NUMBER	2	

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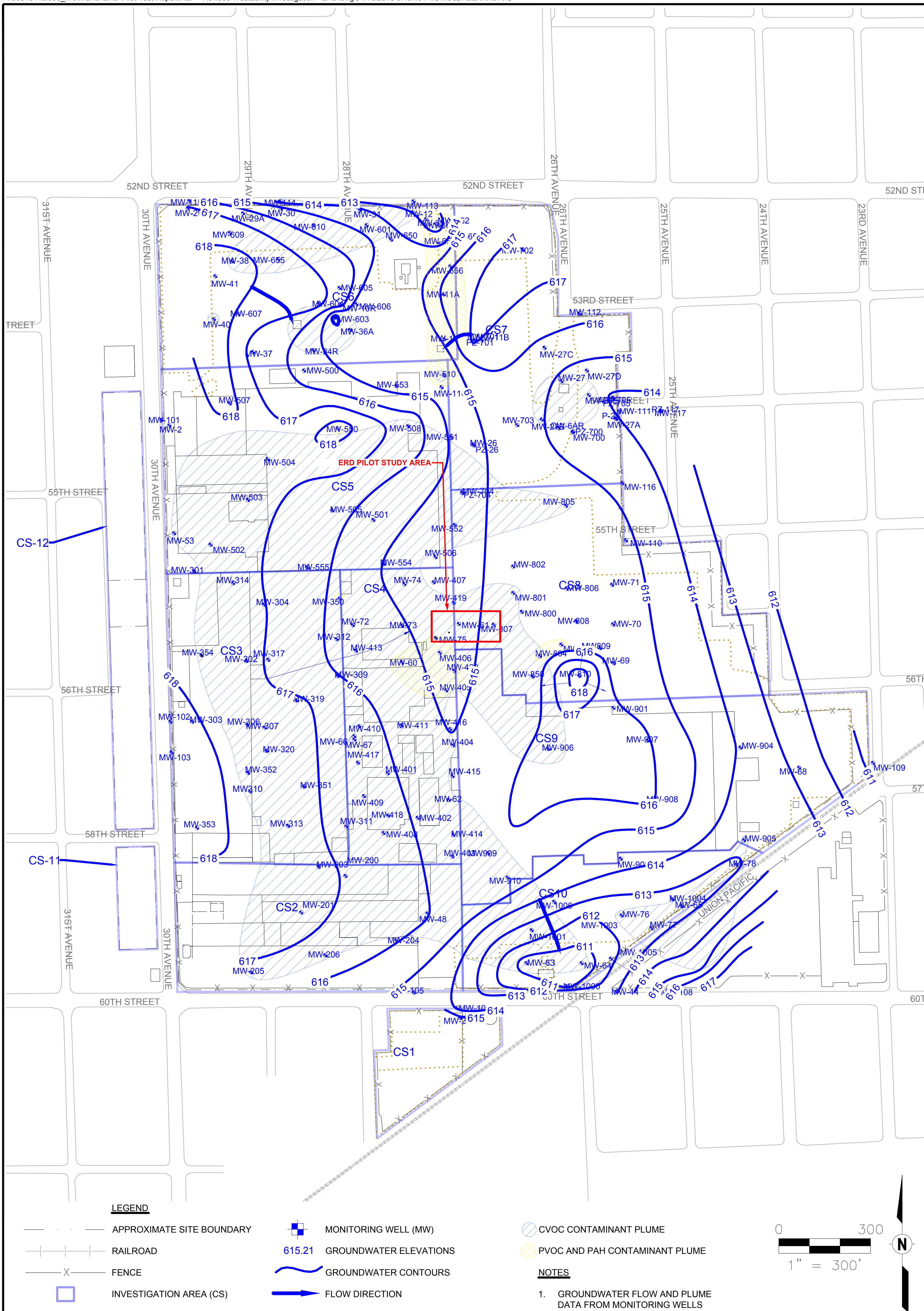

GROUNDWATER FLOW & EXTENT OF CONTAMINATION AT THE WATER TABLE - DECEMBER 2014
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn: SAE 7/3/2017
Checked: LLA 7/3/2017
Approved: SP 7/7/2017
PROJECT NUMBER: 60518412
FIGURE NUMBER: 3

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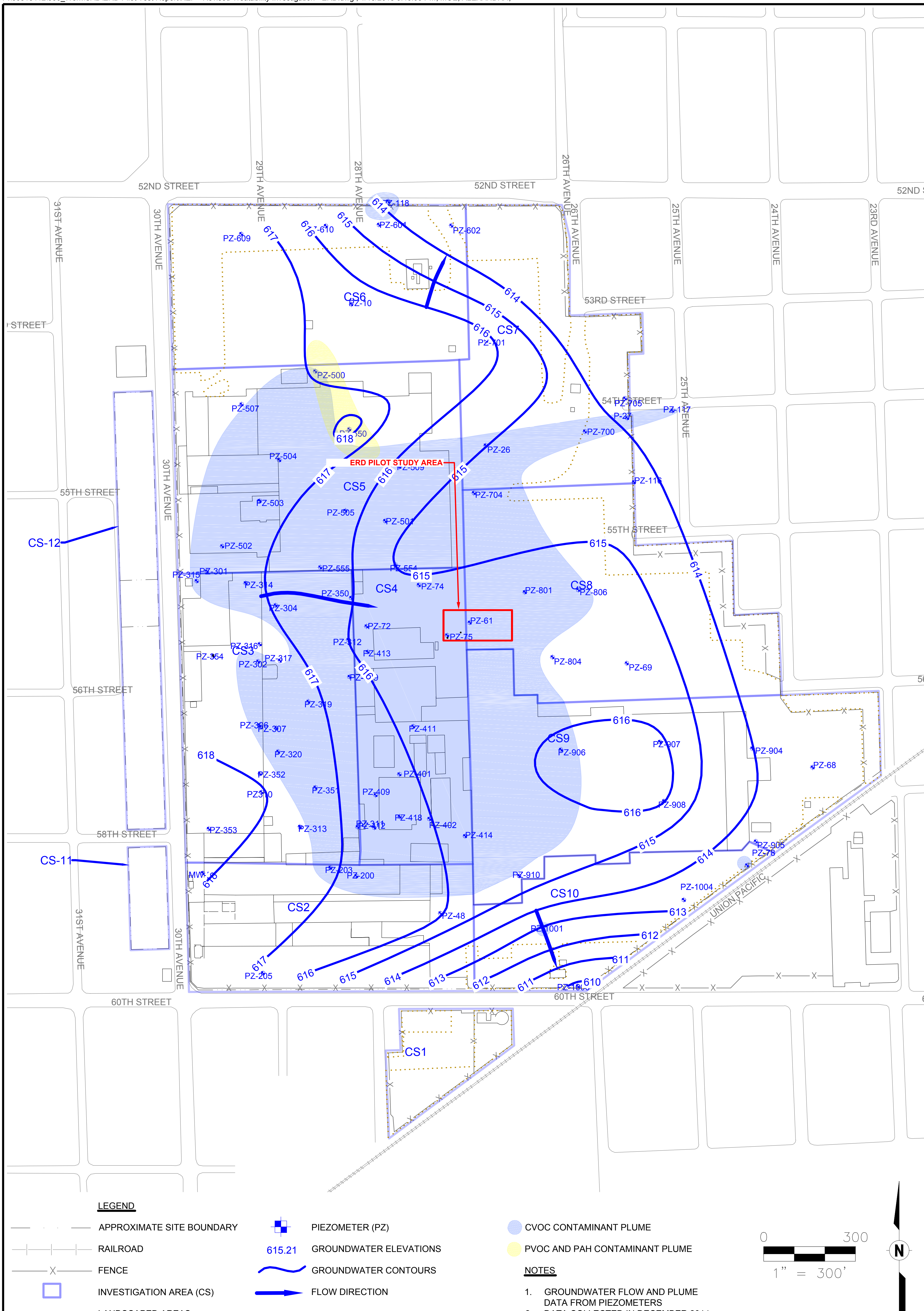

FIGURE NUMBER	4
PROJECT NUMBER	60518412
Approved:	SP 7/7/2017
Checked:	LLA 7/3/2017
Drawn:	SAE 7/3/2017

GROUNDWATER FLOW & EXTENT OF CONTAMINATION ABOVE CLAY TILL AQUITARD
DECEMBER 2014
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

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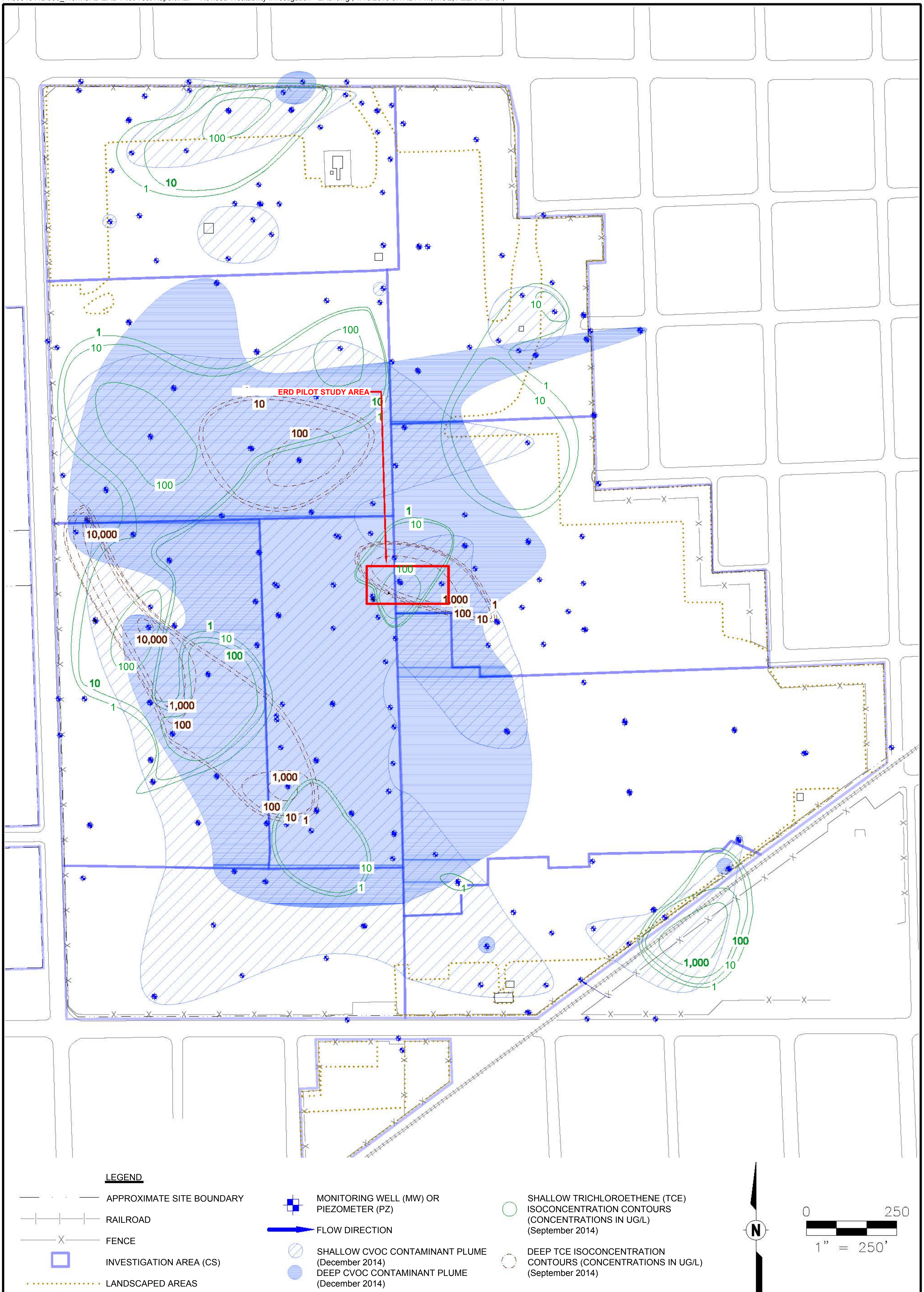

GROUNDWATER CONTAMINATION PLUME EXTENT & TCE ISOCONCENTRATIONS
DECEMBER & SEPTEMBER 2014
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	7/3/2017
Checked:	LLA	7/3/2017
Approved:	SP	7/7/2017
PROJECT NUMBER	60518412	
FIGURE NUMBER	5	

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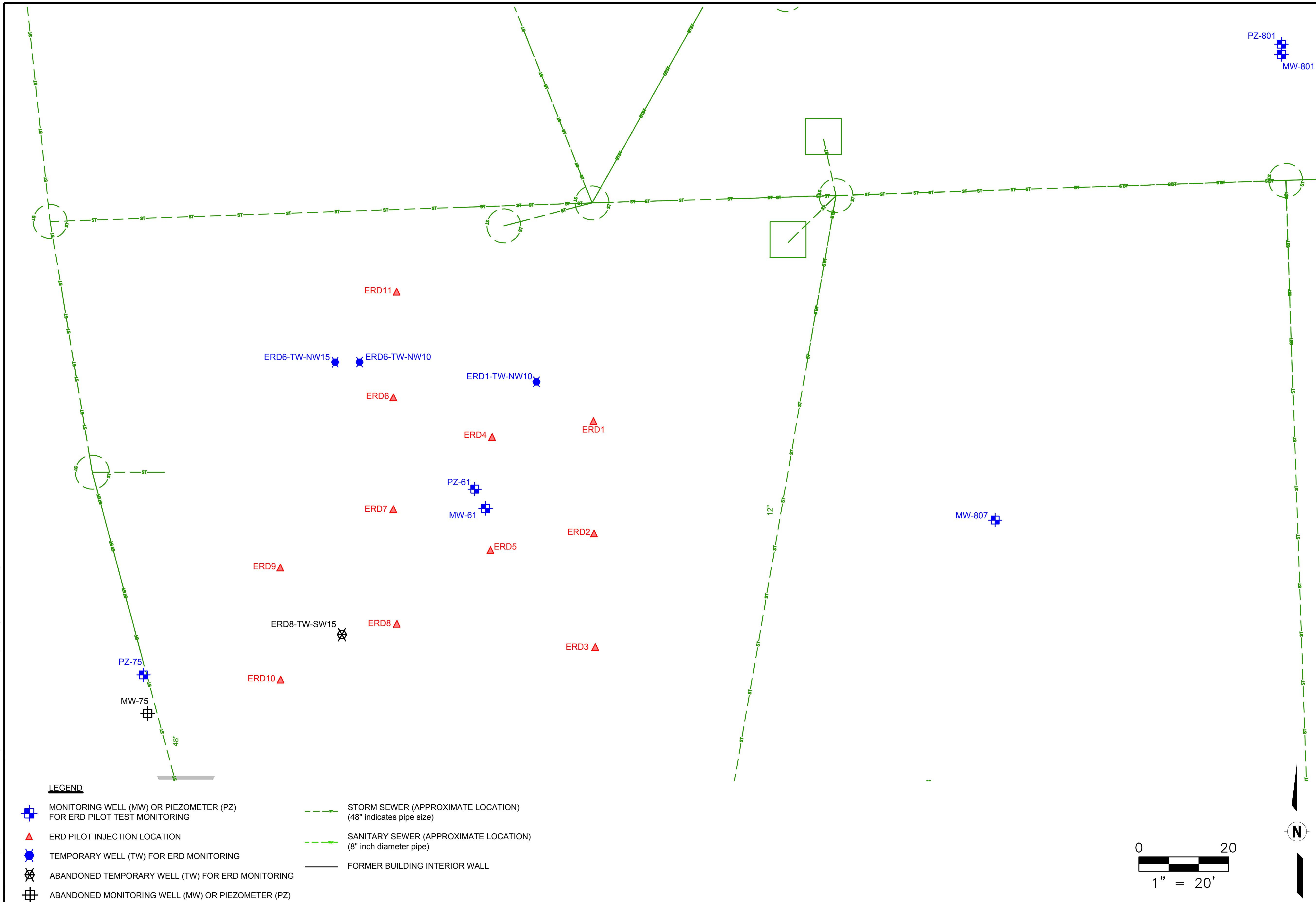

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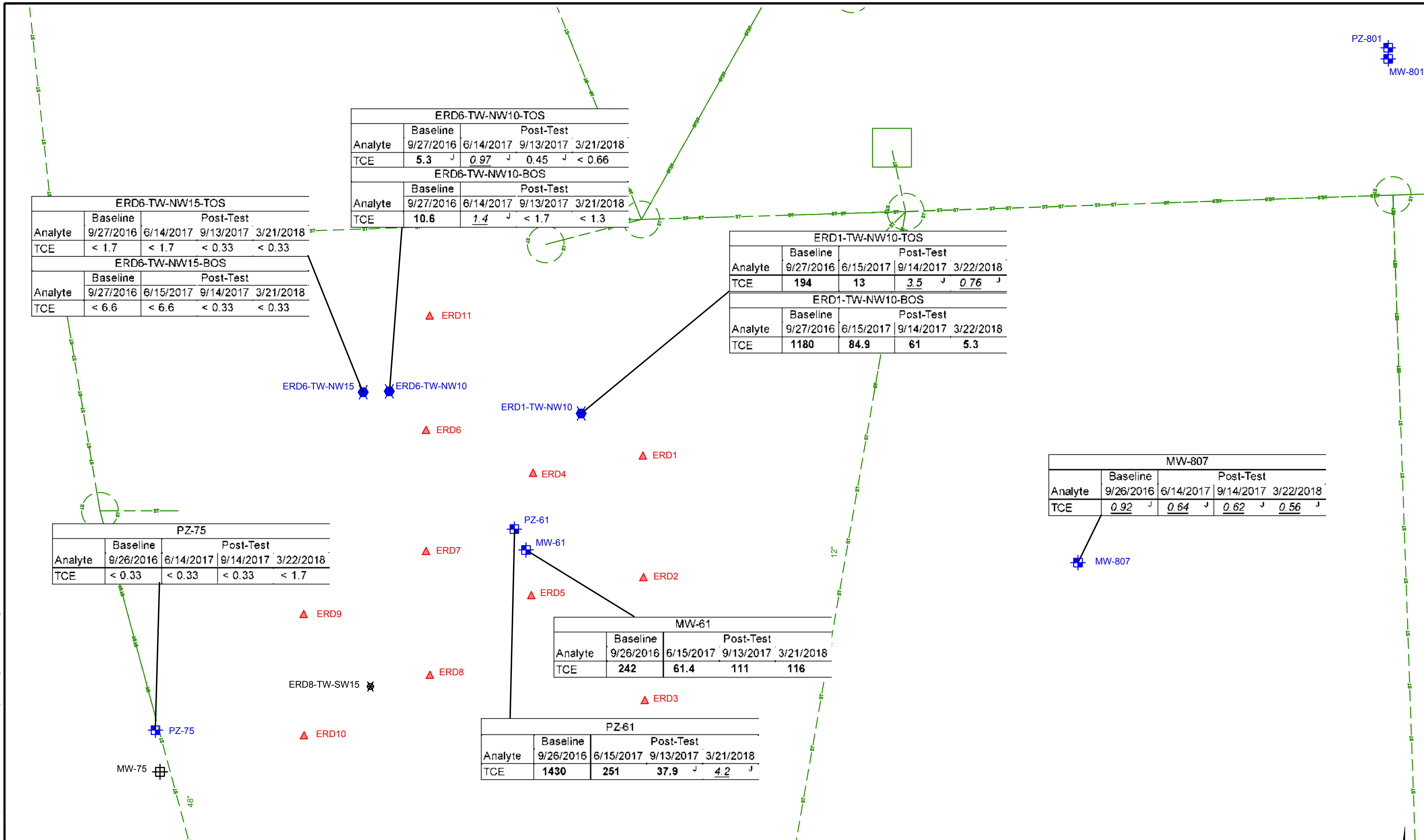
ERD PILOT STUDY LAYOUT
KENOSHA ENGINE PLANT
CITY OF KENOSHA
KENOSHA, WISCONSIN

Drawn :	SAE	7/3/2017
Checked:	LLA	7/3/2017
Approved:	KWB	7/7/2017
PROJECT NUMBER	60518412	
FIGURE NUMBER	6	



ERD6-TW-NW10-TOS

Analyte	Baseline 9/27/2016	Post-Test 6/14/2017	Post-Test 9/13/2017	Post-Test 3/21/2018
TCE	**5.3** ^J	*<u>0.97</u>* ^J	0.45 ^J	< 0.66

ERD6-TW-NW10-BOS

Analyte	Baseline 9/27/2016	Post-Test 6/14/2017	Post-Test 9/13/2017	Post-Test 3/21/2018
TCE	**10.6**	*<u>1.4</u>* ^J	< 1.7	< 1.3

ERD6-TW-NW15-TOS

Analyte	Baseline 9/27/2016	Post-Test 6/14/2017	Post-Test 9/13/2017	Post-Test 3/21/2018
TCE	< 1.7	< 1.7	< 0.33	< 0.33

ERD6-TW-NW15-BOS

Analyte	Baseline 9/27/2016	Post-Test 6/15/2017	Post-Test 9/14/2017	Post-Test 3/21/2018
TCE	< 6.6	< 6.6	< 0.33	< 0.33

ERD1-TW-NW10-TOS

Analyte	Baseline 9/27/2016	Post-Test 6/15/2017	Post-Test 9/14/2017	Post-Test 3/22/2018
TCE	**194**	**13**	*<u>3.5</u>* ^J	*<u>0.76</u>* ^J

ERD1-TW-NW10-BOS

Analyte	Baseline 9/27/2016	Post-Test 6/15/2017	Post-Test 9/14/2017	Post-Test 3/22/2018
TCE	**1180**	**84.9**	**61**	**5.3**

MW-807

Analyte	Baseline 9/26/2016	Post-Test 6/14/2017	Post-Test 9/14/2017	Post-Test 3/22/2018
TCE	*<u>0.92</u>* ^J	*<u>0.64</u>* ^J	*<u>0.62</u>* ^J	*<u>0.56</u>* ^J

PZ-75

Analyte	Baseline 9/26/2016	Post-Test 6/14/2017	Post-Test 9/14/2017	Post-Test 3/22/2018
TCE	< 0.33	< 0.33	< 0.33	< 1.7

MW-61

Analyte	Baseline 9/26/2016	Post-Test 6/15/2017	Post-Test 9/13/2017	Post-Test 3/21/2018
TCE	**242**	**61.4**	**111**	**116**

PZ-61

Analyte	Baseline 9/26/2016	Post-Test 6/15/2017	Post-Test 9/13/2017	Post-Test 3/21/2018
TCE	**1430**	**251**	**37.9** ^J	*<u>4.2</u>* ^J

LEGEND

- MONITORING WELL (MW) OR PIEZOMETER (PZ) FOR ERD PILOT TEST MONITORING
- ERD PILOT INJECTION LOCATION
- TEMPORARY WELL (TW) FOR ERD MONITORING
- ABANDONED TEMPORARY WELL (TW) FOR ERD MONITORING
- ABANDONED MONITORING WELL (MW) OR PIEZOMETER (PZ)
- STORM SEWER (APPROXIMATE LOCATION) (48" indicates pipe size)
- SANITARY SEWER (APPROXIMATE LOCATION) (8" inch diameter pipe)
- FORMER BUILDING INTERIOR WALL

Notes:
1. All results in micrograms per liter (µg/L)
2. TCE = trichloroethene
3. PAL - Preventive Action Limit, Wisconsin Administrative Code NR 140.10 Table 1, February 2017 exceedances are *<u>underlined italics</u>*.
4. ES - Enforcement Standard, Wisconsin Administrative Code NR 140.10 Table 1, February 2017, exceedances are **bold**.
5. ^J = Estimated value
6. TOS = Top of Screen
7. BOS = Bottom of Screen

0 20
1" = 20'

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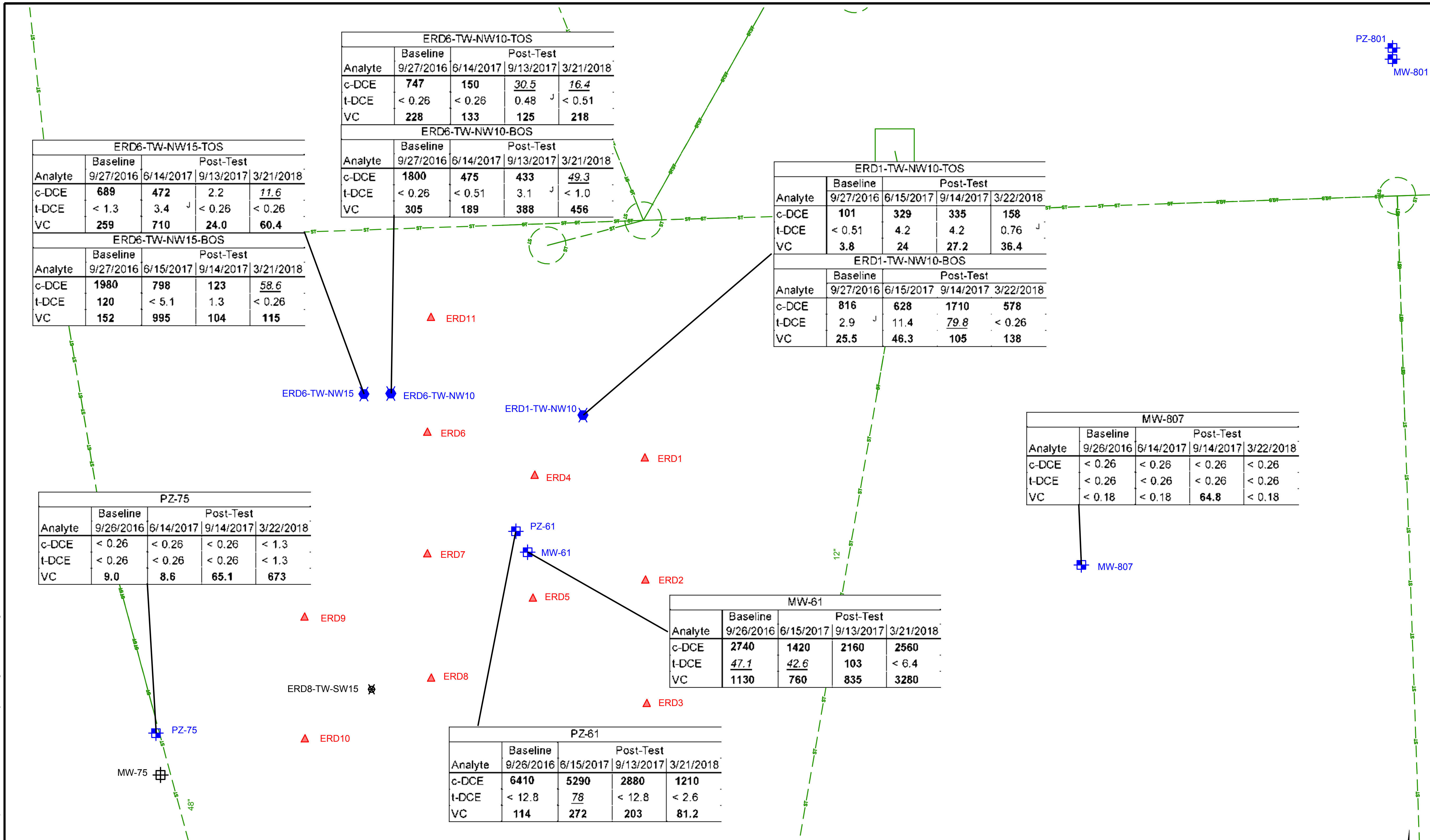
TCE CONCENTRATIONS IN GROUNDWATER BASELINE & POST-INJECTION MONITORING RESULTS KENOSHA ENGINE PLANT ERD PILOT TEST CITY OF KENOSHA KENOSHA, WISCONSIN

Drawn :	SAE	7/3/2017
Checked:	LLA	7/3/2017
Approved:	KWB	7/7/2017
PROJECT NUMBER	60518412	
FIGURE NUMBER	7	



ERD6-TW-NW10-TOS	Baseline	Post-Test		
Analyte	9/27/2016	6/14/2017	9/13/2017	3/21/2018
c-DCE	**747**	**150**	*30.5*	*16.4*
t-DCE	< 0.26	< 0.26	0.48 J	< 0.51
VC	**228**	**133**	**125**	**218**

ERD6-TW-NW10-BOS	Baseline	Post-Test		
Analyte	9/27/2016	6/14/2017	9/13/2017	3/21/2018
c-DCE	**1800**	**475**	**433**	*49.3*
t-DCE	< 0.26	< 0.51	3.1 J	< 1.0
VC	**305**	**189**	**388**	**456**

ERD6-TW-NW15-TOS	Baseline	Post-Test		
Analyte	9/27/2016	6/14/2017	9/13/2017	3/21/2018
c-DCE	**689**	**472**	2.2	*11.6*
t-DCE	< 1.3	3.4 J	< 0.26	< 0.26
VC	**259**	**710**	**24.0**	**60.4**

ERD6-TW-NW15-BOS	Baseline	Post-Test		
Analyte	9/27/2016	6/15/2017	9/14/2017	3/21/2018
c-DCE	**1980**	**798**	**123**	*58.6*
t-DCE	**120**	< 5.1	1.3	< 0.26
VC	**152**	**995**	**104**	**115**

ERD1-TW-NW10-TOS	Baseline	Post-Test		
Analyte	9/27/2016	6/15/2017	9/14/2017	3/22/2018
c-DCE	**101**	**329**	**335**	**158**
t-DCE	< 0.51	4.2	4.2	0.76 J
VC	**3.8**	**24**	**27.2**	**36.4**

ERD1-TW-NW10-BOS	Baseline	Post-Test		
Analyte	9/27/2016	6/15/2017	9/14/2017	3/22/2018
c-DCE	**816**	**628**	**1710**	**578**
t-DCE	2.9 J	11.4	*79.8*	< 0.26
VC	**25.5**	**46.3**	**105**	**138**

MW-807	Baseline	Post-Test		
Analyte	9/26/2016	6/14/2017	9/14/2017	3/22/2018
c-DCE	< 0.26	< 0.26	< 0.26	< 0.26
t-DCE	< 0.26	< 0.26	< 0.26	< 0.26
VC	< 0.18	< 0.18	**64.8**	< 0.18

PZ-75	Baseline	Post-Test		
Analyte	9/26/2016	6/14/2017	9/14/2017	3/22/2018
c-DCE	< 0.26	< 0.26	< 0.26	< 1.3
t-DCE	< 0.26	< 0.26	< 0.26	< 1.3
VC	**9.0**	**8.6**	**65.1**	**673**

MW-61	Baseline	Post-Test		
Analyte	9/26/2016	6/15/2017	9/13/2017	3/21/2018
c-DCE	**2740**	**1420**	**2160**	**2560**
t-DCE	*47.1*	*42.6*	**103**	< 6.4
VC	**1130**	**760**	**835**	**3280**

PZ-61	Baseline	Post-Test		
Analyte	9/26/2016	6/15/2017	9/13/2017	3/21/2018
c-DCE	**6410**	**5290**	**2880**	**1210**
t-DCE	< 12.8	*78*	< 12.8	< 2.6
VC	**114**	**272**	**203**	**81.2**

LEGEND

- MONITORING WELL (MW) OR PIEZOMETER (PZ) FOR ERD PILOT TEST MONITORING
- ERD PILOT INJECTION LOCATION
- TEMPORARY WELL (TW) FOR ERD MONITORING
- ABANDONED TEMPORARY WELL (TW) FOR ERD MONITORING
- ABANDONED MONITORING WELL (MW) OR PIEZOMETER (PZ)
- STORM SEWER (APPROXIMATE LOCATION) (48" indicates pipe size)
- SANITARY SEWER (APPROXIMATE LOCATION) (8" inch diameter pipe)
- FORMER BUILDING INTERIOR WALL

Notes:
1. All results in micrograms per liter (µg/L)
2. c-DCE = cis-1,2-dichloroethene
3. t-DCE = trans-1,2-dichloroethene
4. VC = vinyl chloride
5. PAL - Preventive Action Limit, Wisconsin Administrative Code NR 140.10 Table 1, February 2017 exceedances are *underlined italics*.
6. ES - Enforcement Standard, Wisconsin Administrative Code NR 140.10 Table 1, February 2017, exceedances are **bold**.
7. J = Estimated value
8. TOS = Top of Screen
9. BOS = Bottom of Screen

0 20
1" = 20'

N

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DCE & VC CONCENTRATIONS IN GROUNDWATER BASELINE & POST-INJECTION MONITORING RESULTS KENOSHA ENGINE PLANT ERD PILOT TEST CITY OF KENOSHA KENOSHA, WISCONSIN

Drawn :	SAE	7/3/2017
Checked:	LLA	7/3/2017
Approved:	KWB	7/7/2017
PROJECT NUMBER	60518412	
FIGURE NUMBER	8	

P:\60518412\900_Work\CAD\ERD Pilot Test Report\KEP - Revised Treatability Investigation - ERD.dwg; 5/11/2018 10:45:51 AM; MOE, ALEXANDRA; ----

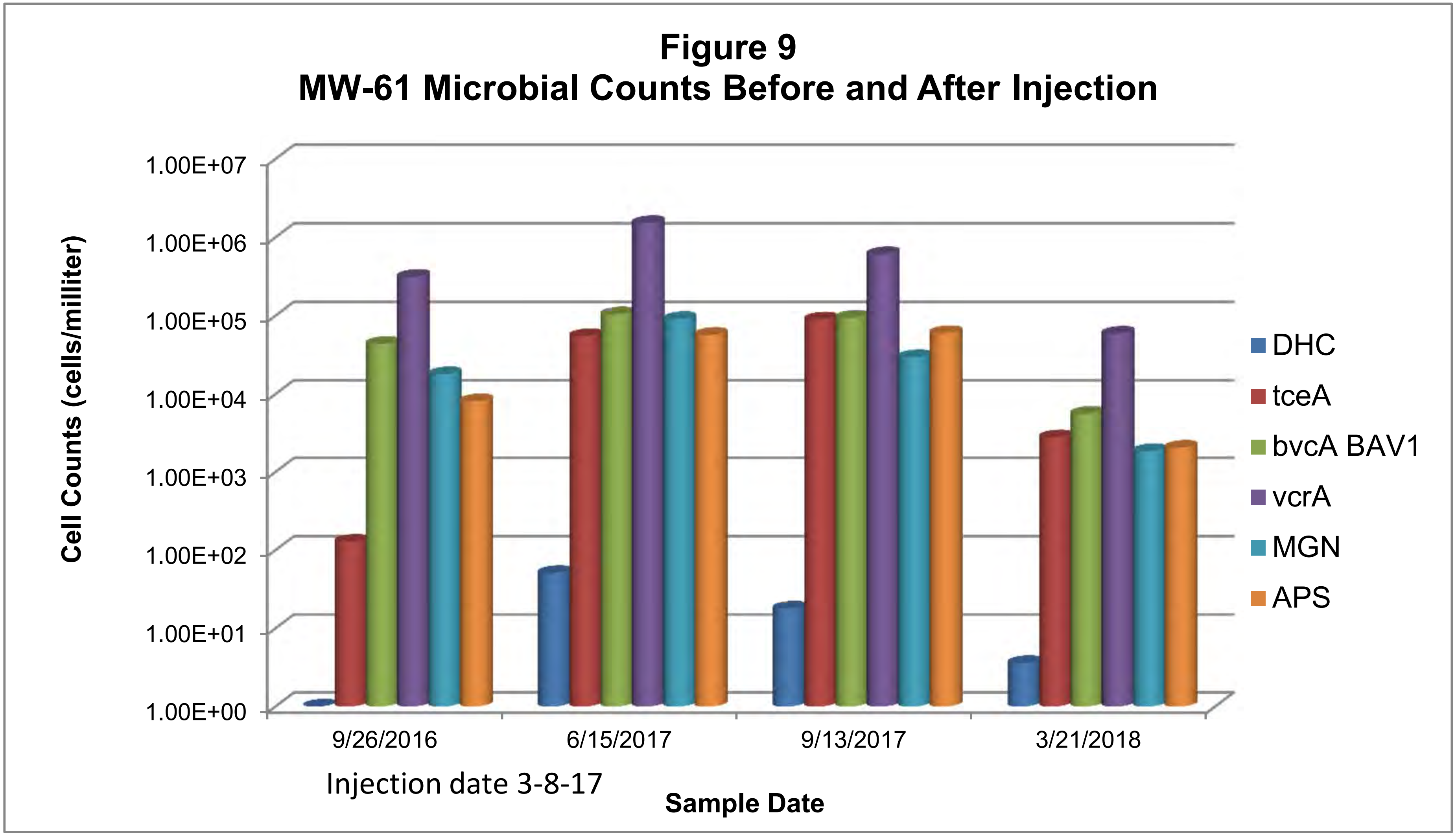
Figure 9
MW-61 Microbial Counts Before and After Injection
Cell Counts (cells/milliter)
1.00E+07
1.00E+06
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
9/26/2016
6/15/2017
9/13/2017
3/21/2018
Injection date 3-8-17
Sample Date
DHC
tceA
bvcA BAV1
vcrA
MGN
APS

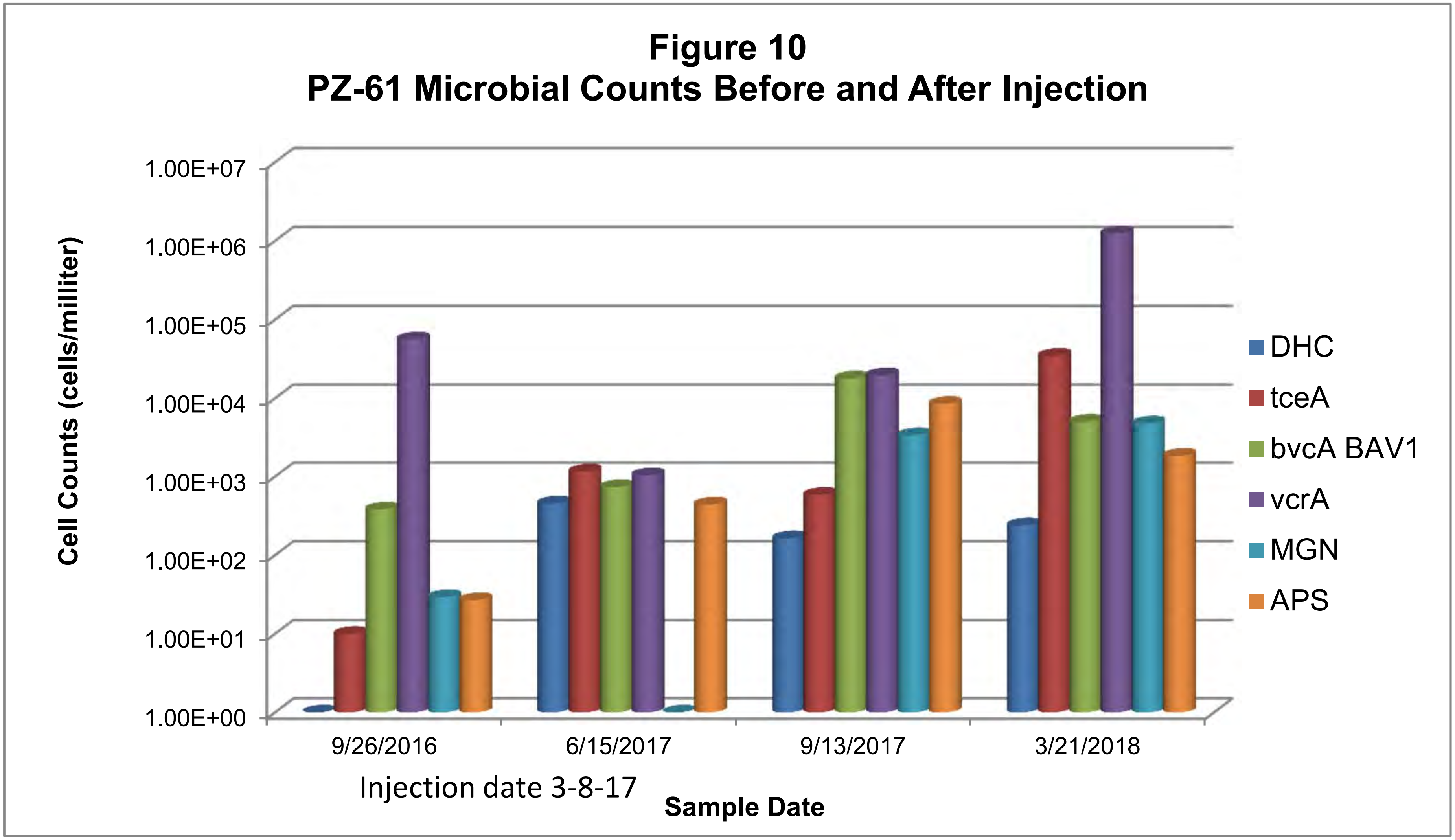
Figure 10
PZ-61 Microbial Counts Before and After Injection
Cell Counts (cells/milliter)
1.00E+07
1.00E+06
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
9/26/2016
6/15/2017
9/13/2017
3/21/2018
Injection date 3-8-17
Sample Date
DHC
tceA
bvcA BAV1
vcrA
MGN
APS

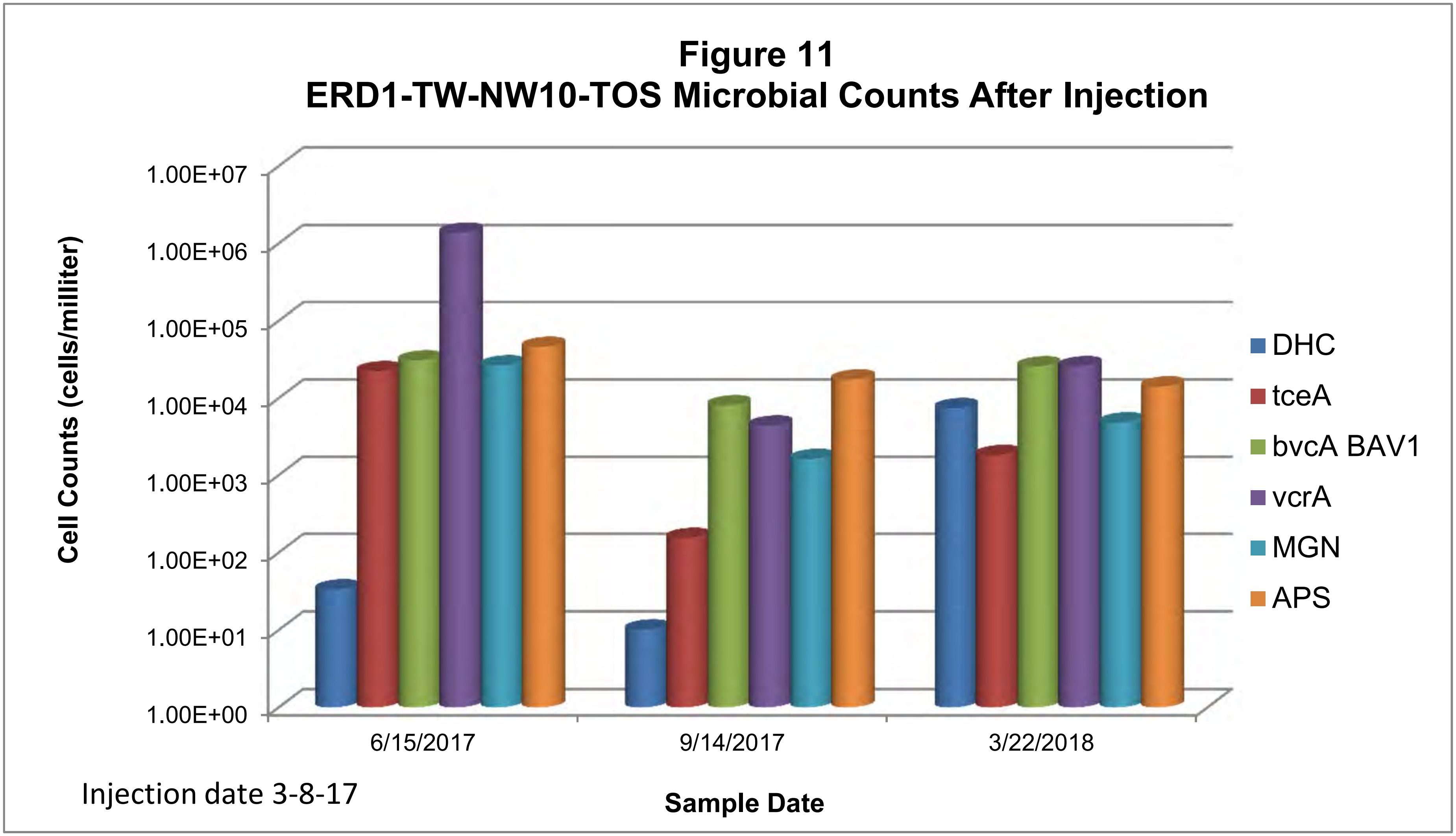

Figure 11
ERD1-TW-NW10-TOS Microbial Counts After Injection
Cell Counts (cells/milliter)
1.00E+07
1.00E+06
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
6/15/2017
9/14/2017
3/22/2018
Sample Date
DHC
tceA
bvcA BAV1
vcrA
MGN
APS
Injection date 3-8-17

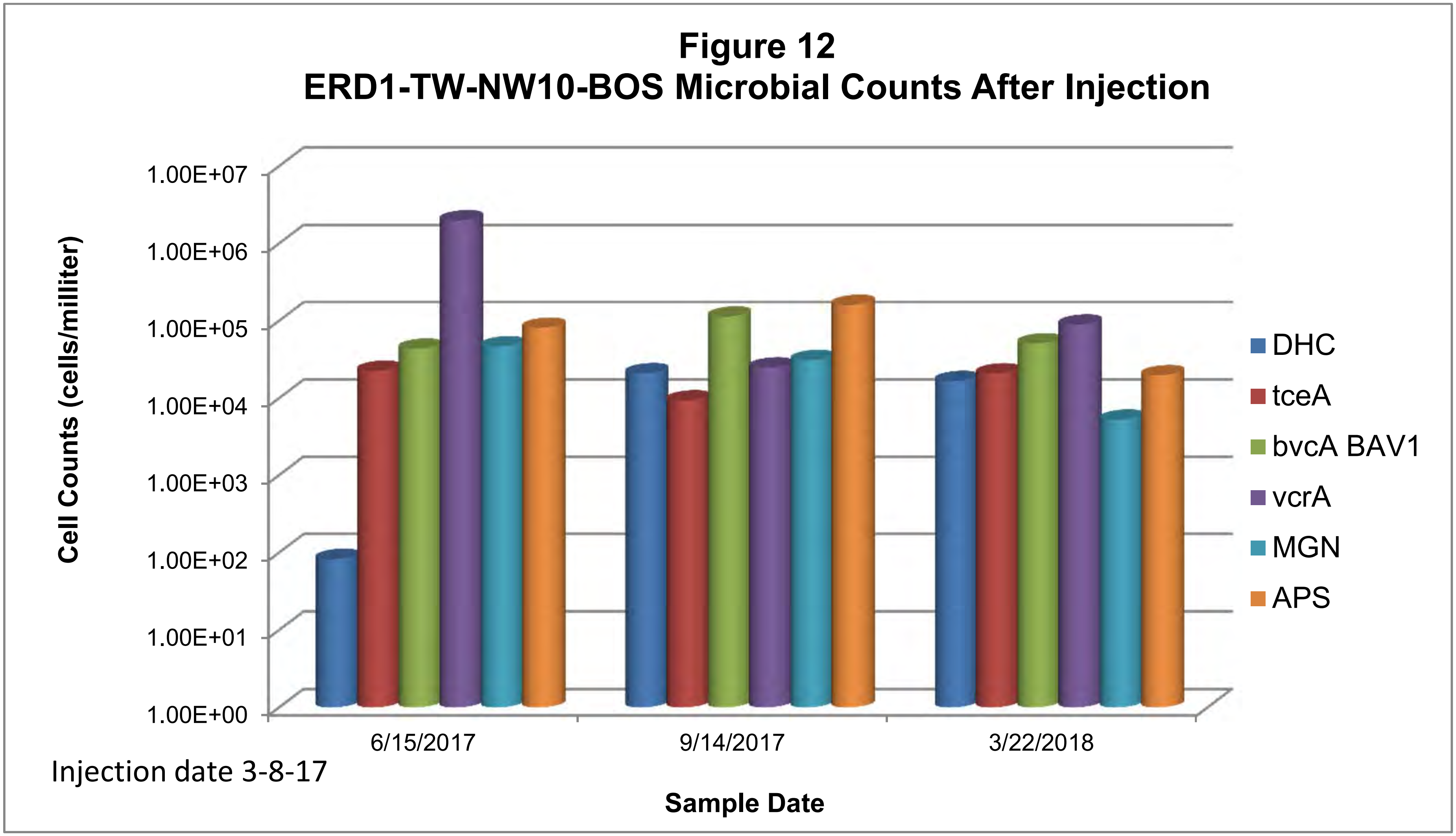

Figure 12
ERD1-TW-NW10-BOS Microbial Counts After Injection
Cell Counts (cells/milliter)
1.00E+07
1.00E+06
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
6/15/2017
9/14/2017
3/22/2018
Injection date 3-8-17
Sample Date
DHC
tceA
bvcA BAV1
vcrA
MGN
APS

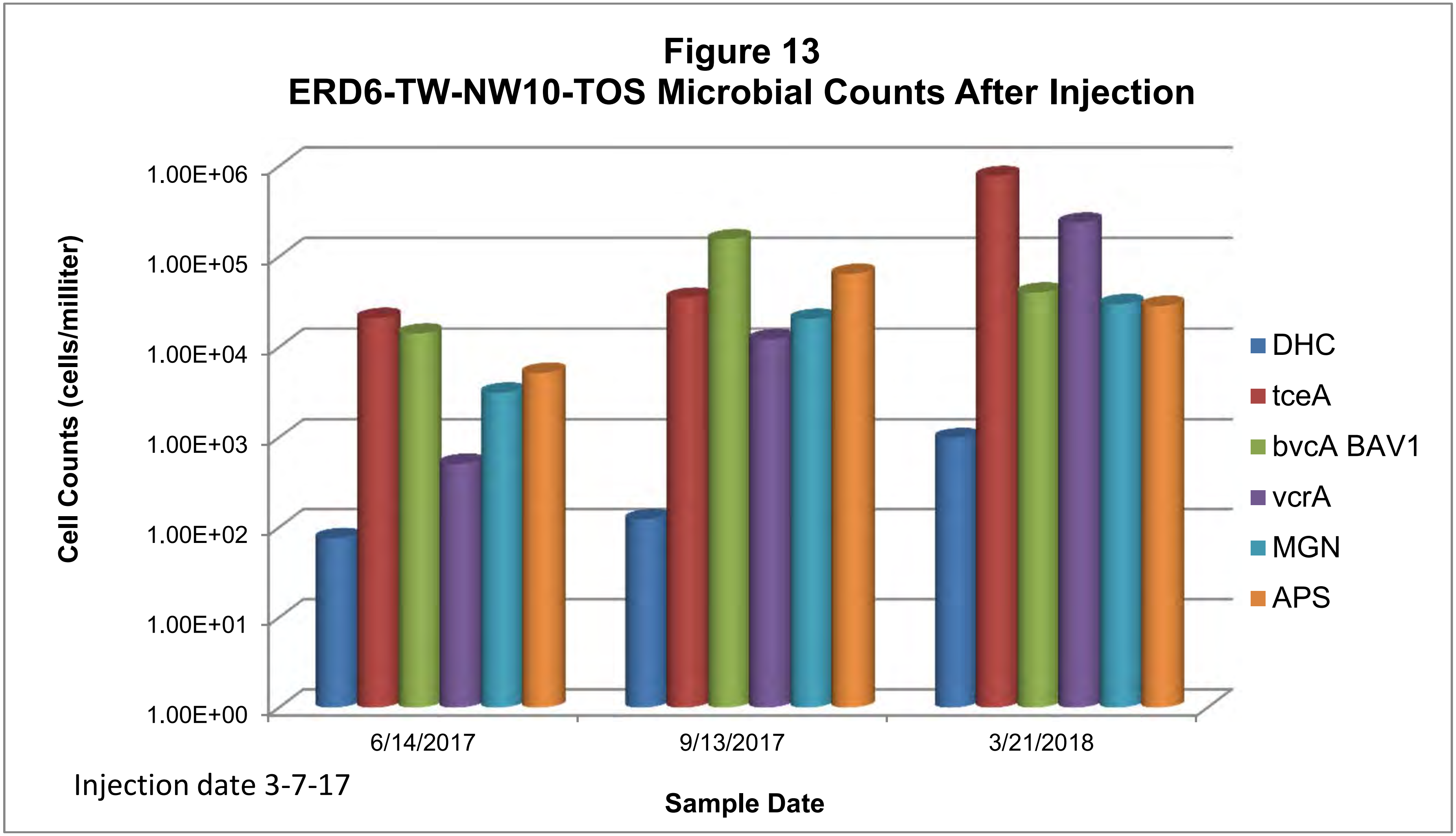
Figure 13
ERD6-TW-NW10-TOS Microbial Counts After Injection
Cell Counts (cells/milliter)
1.00E+06
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
6/14/2017
9/13/2017
3/21/2018
Injection date 3-7-17
Sample Date
DHC
tceA
bvcA BAV1
vcrA
MGN
APS

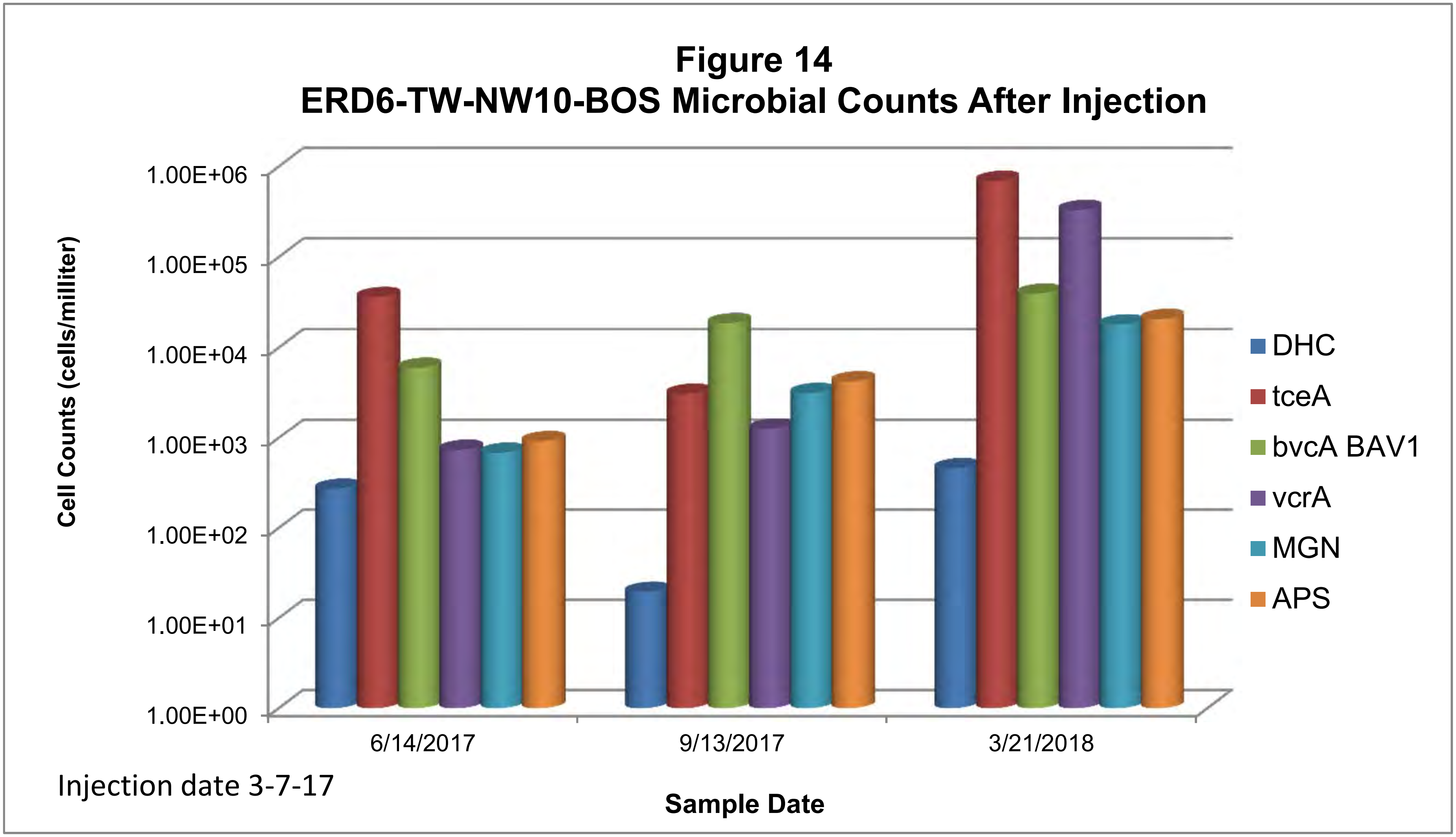
Figure 14
ERD6-TW-NW10-BOS Microbial Counts After Injection
Cell Counts (cells/milliter)
1.00E+06
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
6/14/2017
9/13/2017
3/21/2018
Sample Date
DHC
tceA
bvcA BAV1
vcrA
MGN
APS
Injection date 3-7-17

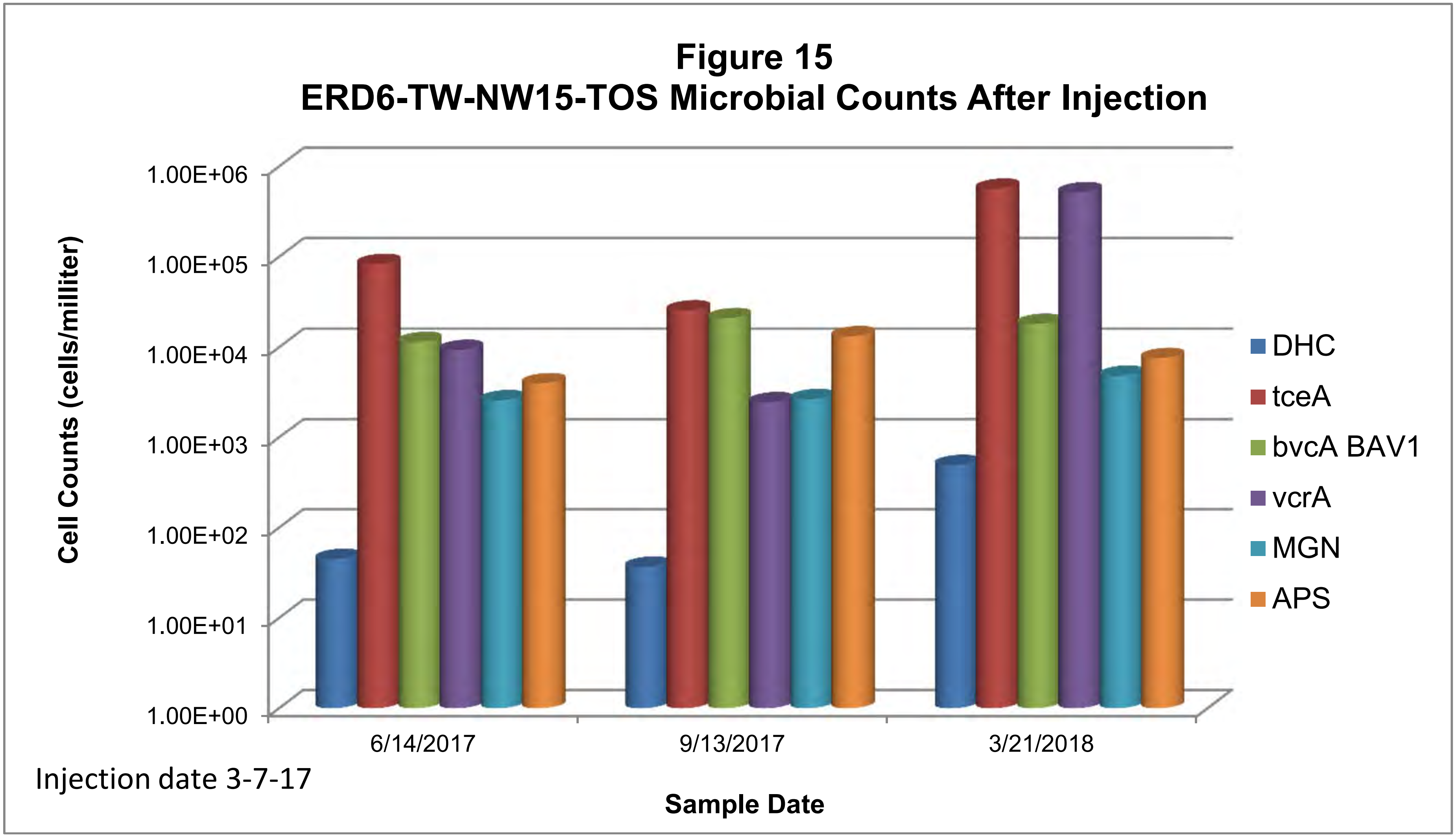
Figure 15
ERD6-TW-NW15-TOS Microbial Counts After Injection
Cell Counts (cells/milliter)
1.00E+06
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
6/14/2017
9/13/2017
3/21/2018
Injection date 3-7-17
Sample Date
DHC
tceA
bvcA BAV1
vcrA
MGN
APS

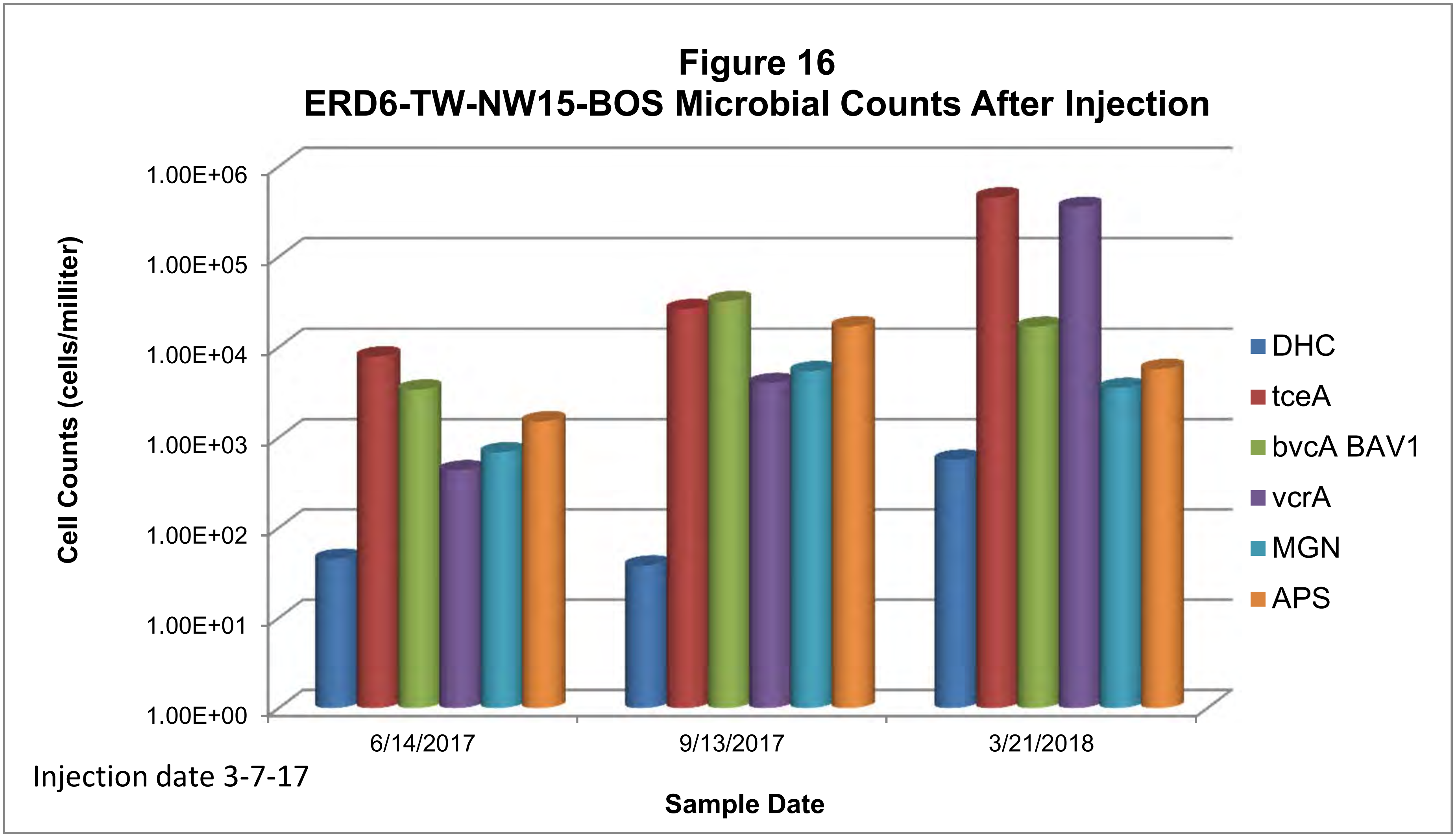

Figure 16
ERD6-TW-NW15-BOS Microbial Counts After Injection
Cell Counts (cells/milliter)
1.00E+06
1.00E+05
1.00E+04
1.00E+03
1.00E+02
1.00E+01
1.00E+00
6/14/2017
9/13/2017
3/21/2018
Injection date 3-7-17
Sample Date
DHC
tceA
bvcA BAV1
vcrA
MGN
APS

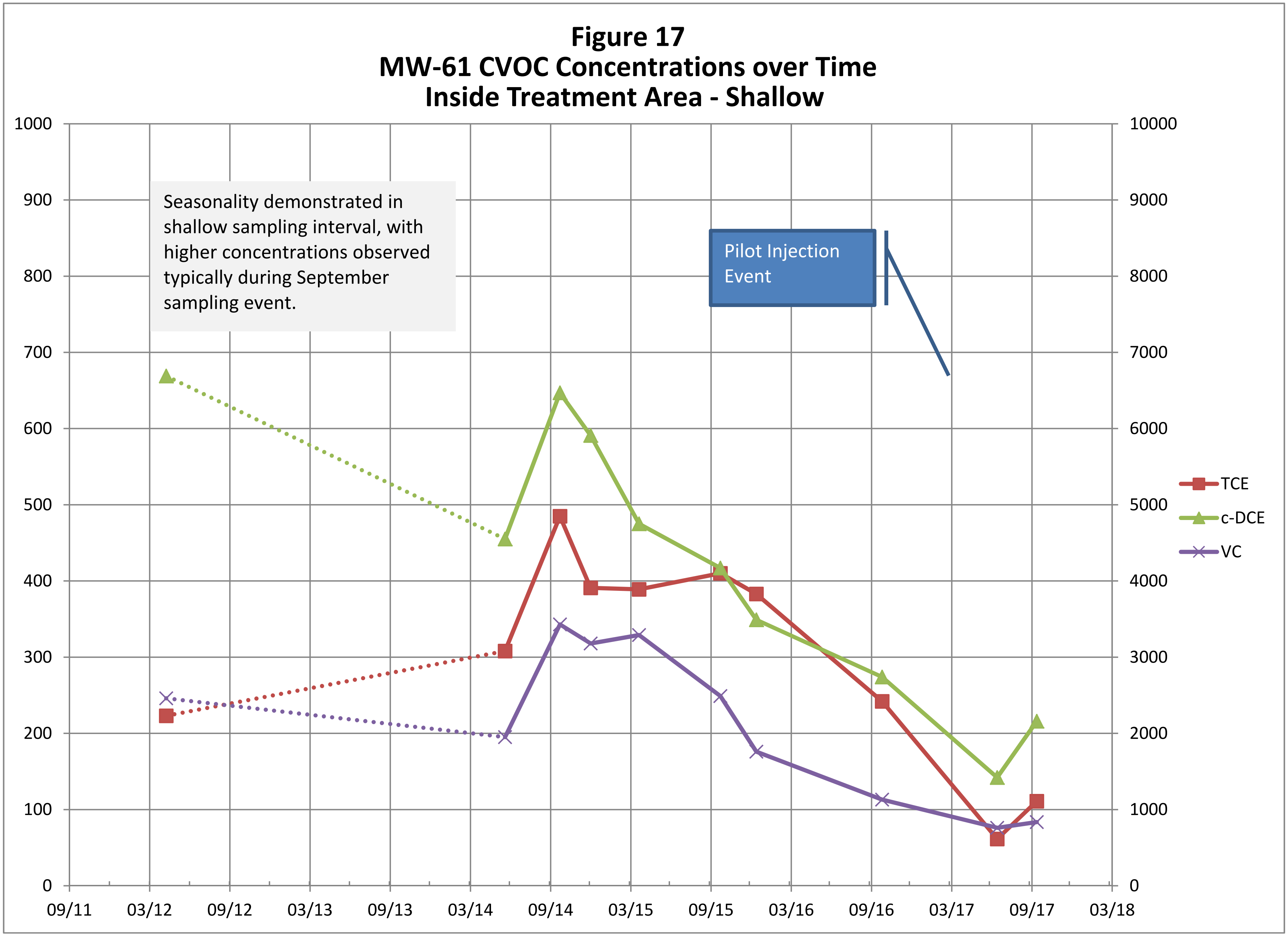
Figure 17
MW-61 CVOC Concentrations over Time
Inside Treatment Area - Shallow
Seasonality demonstrated in shallow sampling interval, with higher concentrations observed typically during September sampling event.
Pilot Injection Event
TCE
c-DCE
VC
1000
900
800
700
600
500
400
300
200
100
0
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
09/11
03/12
09/12
03/13
09/13
03/14
09/14
03/15
09/15
03/16
09/16
03/17
09/17
03/18

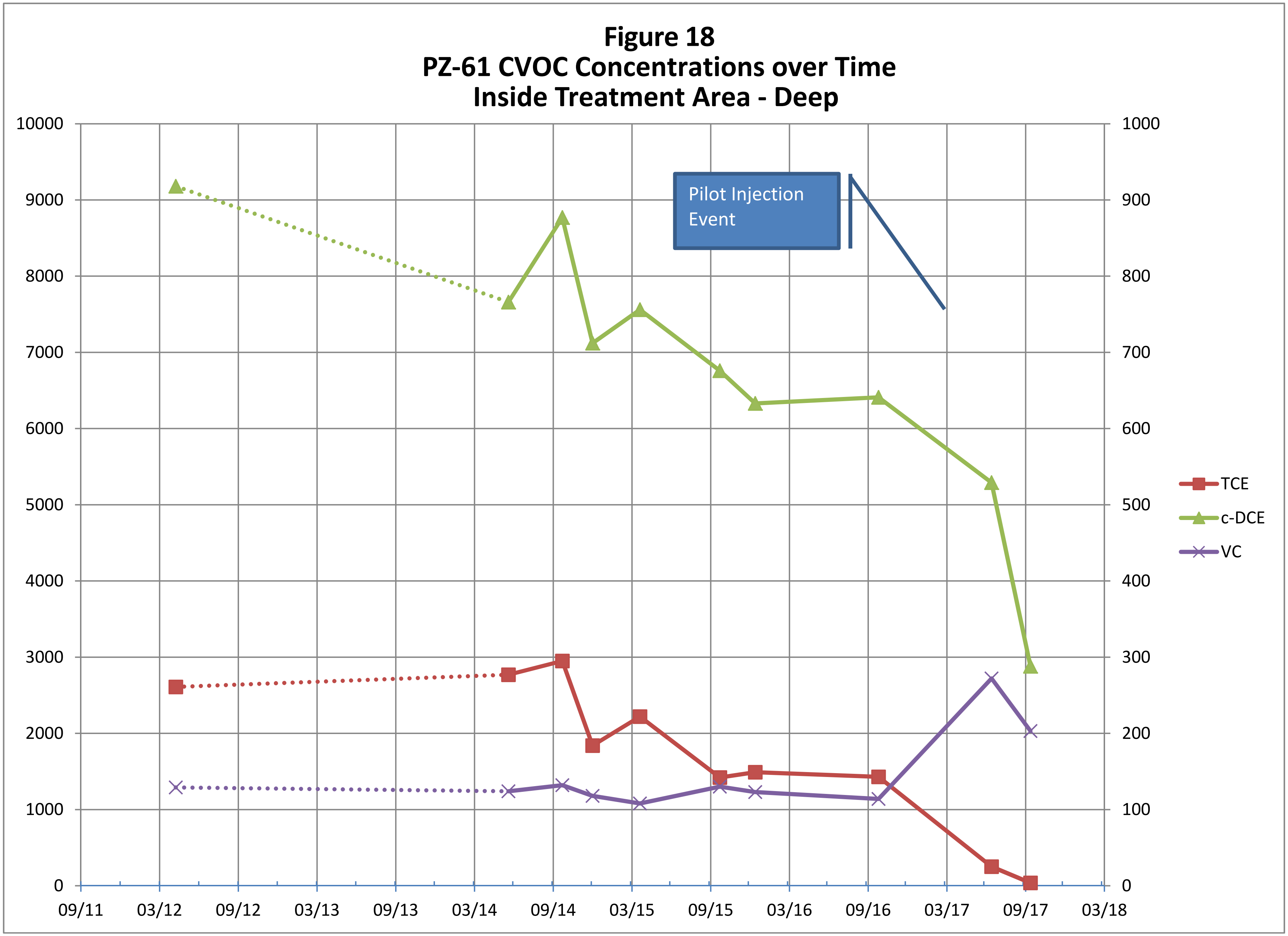
Figure 18
PZ-61 CVOC Concentrations over Time
Inside Treatment Area - Deep
Pilot Injection Event
TCE
c-DCE
VC
10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
1000
900
800
700
600
500
400
300
200
100
0
09/11
03/12
09/12
03/13
09/13
03/14
09/14
03/15
09/15
03/16
09/16
03/17
09/17
03/18